

Project Manual For

COMMUNITY HIGH SCHOOL DISTRICT 99

Project No. 07-5274-36B

Downers Grove North AHU Replacement Project

Prepared For

COMMUNITY HIGH SCHOOL DISTRICT 99

1436 Norfolk Street

DOWNERS GROVE, IL 60516

BID PACKAGES-GROUP 1

Bid Package # 01.....Demolition
Bid Package # 02.....HVAC
Bid Package #3.....Electrical

January 25, 2017



DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS
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Project: Community High School District 99
Downers Grove South- Electrical Work
Project No. 07-5274-36A

Owner: Community High School District 99
4436 Main St.
Downers Grove, IL 60515

Architect: Wight & Company
2500 North Frontage Road
Darien, Illinois 60561

Date: *January 25, 2017*

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NOTICE TO BIDDERS:

Notice is hereby given that *Community High School District 99* is accepting sealed bids for *the Downers North High School AHU Replacement Projects*. Such proposals as herein concerned shall be for the following as described:

BID GROUP NO. 1 BID PACKAGE #01:

Bid Package #01 – Demolition
Bid Package #02- HVAC
Bid Package #03 - Electrical

SEALED BIDS will be received by *Community High School District 99* at the place, date and time stated below and publicly opened and read there:

PLACE:
Administrative Center
6301 Springside Avenue
Downers Grove, IL 60516

DUE DATE:
Wednesday, February 8, 2017

TIME:
1:00 PM (CST)
(as Date/Time stamped by
District 99's Receptionist)

A non-mandatory pre-bid walk thru will take place at the site on Tuesday January 31st, at 7:30 a.m. Location is 4436 Main Street, Downers Grove, IL. meet at the loading dock.

All bids must be sealed and marked on the envelope with the bid package title and bid package number.

Pre-qualification of all bidders in this bid group is required prior to the bid due date. Submit one fully executed copy of AIA Document A305 "Contractor's Qualification Statement" prior to submitting this bid form. In addition to supplying this form, each trade Contractor is also required to answer the following questions and provide these answers with your AIA Document A305.

The Construction Manager for this project is Wight Construction, Inc. All questions concerning this project or those concerning bidding requirements should be directed to Craig Polte at 630-918-8120. Questions must be received in writing, or via email (cpolte@wightco.com), until 12:00 PM, Tuesday January 31st.

The competency, experience and responsibility of the bidders will be considered in making awards. Bid security in the form of a Bid Bond, certified or Bank Draft in the amount equal to not less than 10% of the bid and made payable to Community High School District 99.

All Contracts for the Construction of Public Works are subject to the Illinois Prevailing Wage Act (820 ILCS 130/1-12).

Bidders can make arrangements to visit the site by contacting Craig Polte at 630-918-8120.

DIVISION 0 – BIDDING AND CONTRACT REQUIREMENTS
SECTION 00200 –NOTICE TO BIDDERS

The Board of Education of District #99 reserves the right to accept or reject any or all bids.

Pool Projects

- 1) Plans and Specifications can be viewed or downloaded electronically via ISQFT.com Please send email to cpolte@wightco.com to receive electronic invitation after 2:00 PM on Wednesday, January 25, 2017.

This invitation is issued in the name of *Community High School District 99*

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1.0 In General

This section contains provisions governing the rights and responsibilities of the Construction Manager and each of its Subcontractors. Each Subcontractor shall be bound by the provisions of this section as if the provisions were contained in the subcontract between the Construction Manager and the individual Subcontractor.

1.1 Execution, Correlation and Intent

- 1.1.1 Execution of the Contract by the Subcontractor is a representation that the Subcontractor has visited the site, become familiar with the local conditions under which the Work is to be performed and correlated personal observations with the requirements of the Contract Documents.
- 1.1.2 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Subcontractor. The Contract Documents are complementary and what is required by one shall be as binding as if required by all; performance by the Subcontractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.
- 1.1.3 Organization of the Specifications into divisions, sections and articles and the arrangement of Drawings shall not control the Subcontractor in dividing the work among Subcontractors or in establishing the extent of Work to be performed by any trade.
- 1.1.4 Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.
- 1.1.5 Should discrepancies appear among the Contract Documents or between the Contract Documents and existing conditions, the Subcontractor shall request an interpretation from the Construction Manager before bidding. If the Subcontractor fails to make such request, it is presumed that both provisions were included in the bid and the Construction Manager shall determine which of the conflicting requirements shall govern. The Subcontractor shall perform the Work at no additional cost to the Owner in accordance with the Construction Manager's determination. Where conflicts exist between or within the Contract Documents and applicable standards, codes, ordinances or manufacturer's recommendations, and clarification has not been requested from the Construction Manager prior to bidding as provided for above, the more stringent or higher quality standard shall prevail. Large-scale drawings shall take precedence over small-scale drawings, figured dimensions on the drawings over scaled dimensions and noted material over graphic representations.
- 1.1.6 The Subcontractor shall provide all work and materials which any section or part of the Drawings, Specifications or conditions require him to provide regardless of whether such requirement is or is not faithfully repeated in other parts of documents thereof to which the provision might be appropriate

2.0 Subcontractor's Responsibilities

- 2.1 Subcontractor's Work. Subcontractor shall furnish all labor, materials and equipment, provide supervision, and direct the work, inspect, test, and provide tools, construction equipment and specialty items necessary to execute and complete construction of the Subcontract Work. Subcontractor warrants that it has inspected the site and has satisfied itself regarding all conditions affecting the Subcontract Work and the meaning and intention of the Subcontract Documents. Subcontractor is solely responsible for the means, methods, techniques, sequences and coordination of the Subcontract Work.
- 2.2 Review of Contract Documents and Field Conditions by Subcontractor. The Subcontractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner and shall at once report to the Construction Manager errors, inconsistencies or omissions discovered. The Subcontractor shall not be liable to the Owner or Construction Manager for damage resulting from errors, inconsistencies or omissions in the Contract Documents unless the Subcontractor recognized such error, inconsistency or omission and knowingly failed to report it to the Construction Manager. If the Subcontractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Construction Manager, the Subcontractor shall assume responsibility for such performance and shall bear the amount of the attributable costs for correction.
- 2.3 The Subcontractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Subcontractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Construction Manager at once.
- 2.4 The Subcontractor shall perform the Work in accordance with the Contract Documents and submittals approved pursuant to Paragraph 2.14.
- 2.5 Supervision and Construction Procedures. The Subcontractor shall supervise and direct the Work, using the Subcontractor's best skill and attention. The Subcontractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.
- 2.6 The Subcontractor shall be responsible to the Construction Manager for acts and omissions of the Subcontractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under a contract with the Subcontractor.
- 2.7 The Subcontractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Construction Manager in the Construction Manager's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Subcontractor.
- 2.8 The Subcontractor shall be responsible for inspection of portions of Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work.

DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS
SECTION 00201 - GENERAL PROVISIONS

- 2.9 Workmanship and Construction Equipment. The Subcontract Work shall be executed in accordance with the provisions of the Subcontract and in a thorough, first-class, sound, workmanlike, safe, and substantial manner. All construction equipment shall be in first-class operating condition, safe, fit for the uses for which intended, and suitable for the safe and efficient performance of the Subcontract Work. Subcontractor agrees to perform the Subcontract Work and provide construction equipment to the satisfaction and approval of Construction Manager.
- 2.10 Protection of the Work. The Subcontractor shall take necessary precautions to properly protect the Subcontractor's Work and the work of others from damage caused by the Subcontractor's operations. Should the Subcontractor cause damage to the Work or property of the Owner, the Construction Manager or others, the Subcontractor shall promptly remedy such damage to the satisfaction of the Construction Manager, or the Construction Manager may remedy the damage and deduct its cost from any amounts due or to become due the Subcontractor, unless such costs are recovered under applicable property insurance.
- 2.11 Compliance with Law
- 2.11.1 The Subcontractor shall conform to all Illinois statutory requirements, including, but not limited to, the following Acts:
- 2.11.1.1 Equal Employment Opportunity - Applicable Laws. Employment opportunities shall be free from discrimination. The prohibition in employment discrimination contained in 775 ILCS 10/1 is incorporated into the Contract and is intended to insure compliance with the applicable laws and with the Illinois Department of Human Rights Rules and Regulations for Public Contracts (44 Ill. Admin. Code, Ch. X, §750 Appendix A) (to the extent constitutionally required).
 - 2.11.1.2 The Human Rights Act, as amended, Administrative Rules promulgated by the Illinois Human Rights Commission to the extent constitutionally required.
 - 2.11.1.3 An Act to prohibit unjust discrimination in employment because of age and providing penalties, as amended. 775 ILCS 5/1-101.
 - 2.11.1.4 An Act to give preference to veterans of the United States Military and Naval Service in appointments and employment upon public works by, or for the use of the State or its political subdivisions, as amended. 330 ILCS 55/1, et seq.
 - 2.11.1.5 The Service Men's Employment Tenure Act. 330 ILCS 60/1, et seq.
 - 2.11.1.6 In no event shall minors be employed except as authorized under an Act to regulate the employment of children. 820 ILCS 205/1, et seq.
 - 2.11.1.7 An Act requiring employment of Illinois Workers on public works projects, as amended, to the extent constitutionally required. 30 ILCS 570/1, et seq.
 - 2.11.1.8 The Worker's Compensation Act, as amended. 820 ILCS 305/1, et seq.
 - 2.11.1.9 Certification required by the Drug-Free Workplace Act. 30 ILCS 580/1, et seq.

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SECTION 00201 - GENERAL PROVISIONS

- 2.11.1.10 The Subcontractor, by executing this Agreement, certifies that it is not barred from contracting with any unit of state or local government as a result of a violation of §33E-3 or §33E-4 of 720 ILCS 5/33E-1, et seq.
- 2.11.1.11 Where bid specifications do not require a current license and the contract is capable of securing a license before commencement of the project. (The deficiency is waivable).
- 2.11.1.12 Compliance with Illinois Drug-Free Workplace Act (Ill. Rev. Stat., ch 127,par.)
- 2.11.1.13 Employment of Illinois Workers on Public Works Act, 30ILCS 570/0.01 et.al.
- 2.11.2 Prevailing Wage Act
 - 2.11.2.1 Subcontractor shall pay the then prevailing rate of wages for the county where the project is to be located, as established by the Illinois Department of Labor for each craft or type of worker needed to execute the contract in accordance with 820 ILCS 130/0.01, et seq.
 - 2.11.2.2 The Subcontractor shall prominently post the current Schedule of Prevailing Wages at the project site, and shall notify immediately in writing all of its Subcontractors, etc., of all changes in the Schedule of Prevailing Wages.
 - 2.11.2.3 Any increases in costs to the Subcontractor due to changes in the prevailing rate of wages or labor law during the term of any contract shall be at the expense of the Subcontractor and not the expense of Construction Manager or Owner.
 - 2.11.2.4 Change Orders shall be computed using the prevailing wage rates applicable at the time the change order work is scheduled to be performed.
 - 2.11.2.5 Project Expenses. Subcontractor shall maintain, for a minimum of five years after the completion of the contract, adequate books, records, and supporting documents to verify the amounts, receipts, and uses of all disbursements of funds passing in conjunction with the contract. Those records shall be available for review and audit by the Owner. The Subcontractor agrees to cooperate fully with any such audit and shall provide full access to all relevant materials.
 - 2.11.2.6 Subcontractor shall comply with federal, state and local tax laws, social security acts, and unemployment compensation acts insofar as applicable to the performance of the Subcontract.
- 2.11.3 Subcontractor shall secure and pay for permits and governmental fees, license and inspections necessary for the proper execution and completion of the Subcontract Work.
- 2.11.4 Subcontractor represents it has a valid license authorizing it to do business within the political unit or municipality of the Project site if such license is required and agrees to maintain same throughout the duration of the Subcontract Work at its expense.

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- 2.11.5 Subcontractor shall submit to Construction Manager within five days of notification, Subcontractor payroll documentation as proof of prevailing wage compliance.
- 2.12 Accounts and Schedule of Values. Subcontractor shall keep such accounts as may be necessary for financial management under the Subcontract. Subcontractor shall base its Applications for Payment on the Verified Schedule of Values provided to Construction Manager in the bid documents unless Subcontractor and Construction Manager agree to a different Schedule of Values. In the event the Schedule of Values is changed as a result of a Change Order, a new Schedule of Values will be provided to Construction Manager and shall be used for all subsequent Applications for Payment.
- 2.13 Cooperation/Coordination
- 2.13.1 Subcontractor shall cooperate and coordinate work with Construction Manager, Owner and other Subcontractors in scheduling and performing the Subcontract Work to avoid conflict, delay or interference in the Project or in the work of Construction Manager, Owner or other Subcontractors. Subcontractor shall avoid interference with the operation of adjacent facilities, streets, sidewalks, railroad tracks and utilities.
- 2.13.2 If any part of the Subcontract Work depends on timely and proper execution or results of the work of Construction Manager, Owner or other Subcontractors, Subcontractor shall promptly report any delays, discrepancies or defects in such other work to Construction Manager in writing before proceeding with the Subcontract Work. Subcontractor's failure to make such reports shall constitute acceptance of such other work as being fit, proper, and ready to receive the Subcontract Work.
- 2.13.3 If the Subcontract Work takes place in or around an existing facility, Subcontractor shall abide by the Owner's rules for the facility; Subcontractor's access to the facility will be restricted to those areas which are the subject of the Subcontract Work; and there shall be no interruption in Owner's operating systems, equipment or utilities without the written authorization of Construction Manager.
- 2.13.4 Subcontractor shall protect benchmarks and monuments whether of record or by other Subcontractors, and replace same if damaged by Subcontractor.
- 2.13.5 Subcontractor shall use the site entrances and staging and parking areas (if available) designated by Construction Manager.
- 2.14 Submittals
- 2.14.1 Subcontractor shall prepare or cause to be prepared, all shop drawings, samples, and other submittals, which are required by the Subcontract Documents or are necessary to the performance of Subcontractor's obligations hereunder. Such submittals shall bear the Subcontractor's approval stamp and shall be submitted to Construction Manager in accordance with the Subcontract Schedule and in any case in time to permit adequate review by the Construction Manager and in such sequence as to cause no delay in the Project or in the work of Owner, Construction Manager or Construction Manager's other Subcontractors. All required submittals shall be transmitted to the Construction Manager according to the master project schedule or as adjusted upon a mutually agreed schedule revision. This Subcontractor acknowledges and agrees to a \$100.00 per day back-charge for each working day beyond the agreed to date that these documents are not submitted to Construction Manager.

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- 2.14.2 By approving and forwarding submittals, Subcontractor represents that it has determined and verified all materials, field measurements, and field construction criteria related thereto, and that it has checked and coordinated the information contained within such submittals with the requirements of the Subcontract Work and of the Subcontract Documents.
- 2.14.3 Subcontractor shall not be relieved of responsibility for any deviation from the requirements of the Subcontract Documents or for errors or omissions in the approval of submittals by the Architect.
- 2.14.4 Subcontractor shall direct specific attention, in writing or on resubmitted submittals, to revisions other than those requested by the Architect on previous submittals.
- 2.14.5 No portion of the Subcontract Work shall be commenced until the submittals required by the Subcontract Documents have been reviewed and approved by the Architect for conformance with the design concept of the Subcontract Work and information given in the Subcontract Documents. Commencement of the Work prior to review and approval of the submittals by the Architect shall constitute an absolute warranty of sufficiency by Subcontractor. Approval of submittals by the Architect shall in no way relieve Subcontractor of any warranty or responsibility concerning the submittals.
- 2.15 Royalties and License Fees. Subcontractor shall pay royalties and license fees required by the Subcontract Work. Subcontractor shall defend suits or claims for infringement of patent or copyrights and shall defend, indemnify and save Construction Manager and Owner harmless from loss on account thereof.
- 2.16 Clean Up. Subcontractor shall keep the premises in which Subcontract Work is performed, or which is used or affected by the Subcontractor, free from the accumulation of trash and other debris caused by its operations. If Subcontractor fails to comply with this Section within twenty-four (24) hours after receipt of notice of noncompliance from Construction Manager, Construction Manager may perform such necessary clean up and deduct the costs for same from any amounts due or to become due to Subcontractor. Within five (5) days of completion of the Subcontract Work, Subcontractor shall remove its tools, surplus materials, temporary construction, construction equipment and machinery from the Project site and leave the premises "broom clean," or cleaner if so provided in the Subcontract Documents.
- 2.17 Record Drawings. Subcontractor shall maintain one reproducible record copy of the drawings, specifications, product data, samples, shop drawings, Change Orders and other modifications, in good order at the site. They shall be marked currently to record changes made during construction. They shall be delivered to the Construction Manager within ten working days of substantial completion. This Subcontractor acknowledges and agrees to a \$100.00 per day back-charge for each day these documents are not submitted to Construction Manager after the aforementioned to working day period. They shall become the property of Owner upon completion of the Subcontract Work or termination under Article 10 of this Agreement.
- 2.18 Reports and Communication. Subcontractor shall furnish Construction Manager with periodic progress reports on Subcontract Work as requested, including information on the status of materials and equipment which may be in the course of preparation, manufacture or delivery. Subcontractor's communications concerning the Subcontract Work shall be exclusively with Construction Manager.

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- 2.19 Property. Subcontractor shall take necessary precautions to protect Owner's property, its property, the Subcontract Work, and the work and property of other Construction Manager Subcontractors, whether located on or off the Project site from damage or loss caused by operations under the Subcontract. Subcontractor shall also take the necessary precautions to protect property off the Project site from damage or loss caused by its operations including, but not limited to, adjacent facilities, streets, sidewalks, and utilities. Subcontractor shall be responsible for damages or loss caused by its operations.
- 2.20 Representative. Five (5) days prior to commencement of the Subcontract Work, Subcontractor shall furnish to Construction Manager written designation of its representative who shall be at the site to represent Subcontractor, and to receive notices, orders and instructions on Subcontractor's behalf, and to be in charge of and responsible for Subcontract Work. Subcontractor's representative shall be competent, fully acquainted with the Subcontract Work, and have the authority to approve changes in the Subcontract Work. Subcontractor's representative shall render approvals and decisions promptly and furnish information expeditiously and in time to meet the dates set forth in the Subcontract Schedule. Construction Manager reserves the right to reject any Subcontractor representative, at which time Subcontractor shall have five (5) working days to provide adequate representative acceptable to Construction Manager
- 2.21 Labor
- 2.21.1 Subcontractor shall supply a sufficient and adequate number of properly and jurisdictionally skilled workmen and competent supervisors to insure the prompt and efficient performance of the Subcontract Work in accordance with the Subcontract Schedule.
- 2.21.2 Subcontractor shall give proper consideration to any collective bargaining agreements which may affect the Subcontract Work or other work at the site. Subcontractor shall perform the Subcontract Work in compliance with the provisions of any collective bargaining agreements binding upon it, shall not interfere with or cause the breach of any collective bargaining agreements to which Subcontractor is not signatory. Subcontractor shall plan and conduct its operations so that its employees will work in a harmonious relationship with other labor at the site. Subcontractor shall take any action necessary to assure that there will be no delays, work stoppages, excessive labor costs or other labor difficulties of any kind due to, or arising out of, any such agreements or due to, or arising out of any labor disputes.
- 2.21.3 Subcontractor shall defend and indemnify Construction Manager and Owner against all claims resulting from failure by Subcontractor to comply with Section 2.14. Subcontractor assumes all responsibility for any loss or damage attributable to any labor difficulty of any kind caused by or involving Subcontractor or its employees.

- 2.21.4 Kotecki Waiver: Subcontractor (and any Subcontractor into whose subcontract this clause is incorporated) agrees to assume the entire liability for all personal injury claims suffered by its own employees, including without limitation claims suffered by its own employees asserted by persons allegedly injured on the Project; waives any limitation of liability defense based upon the Worker's Compensation Act, court interpretations of said Act or otherwise; and agrees to indemnify and defend Owner, Design Professional and Construction Manager and their agents, employees and consultants ("the indemnities") from all such loss, expense, damage or injury, including reasonable attorney's fees, that the indemnities may sustain as a result of such claims, except to the extent that Illinois law prohibits indemnity for the indemnities' own negligence.
- 2.22 Safety of Persons and Property
- 2.22.1 The Subcontractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to:
- 2.22.1.1 employees on the Work and other persons who may be affected thereby;
- 2.22.1.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Subcontractor or the Sub-subcontractors; and
- 2.22.1.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.
- 2.22.2 The Subcontractor shall give notices and comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.
- 2.22.3 The Subcontractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.
- 2.22.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Subcontractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.
- 2.22.5 The Subcontractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract documents) to property referred to in Clauses 2.21.1.2 and 2.21.1.3 caused in whole or in part by the Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Subcontractor is responsible under Clauses 2.21.1.2 and 2.21.1.3, except damage or loss attributable to acts or omissions of the Owner or Construction Manager or anyone directly or indirectly employed by either of them, or by anyone for whose acts either or them may be liable, and not attributable to the fault or negligence of the Subcontractor.

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- 2.22.6 The Subcontractor shall designate a responsible member of the Subcontractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Subcontractor's superintendent unless otherwise designated by the Subcontractor in writing to the Owner and Construction Manager.
- 2.23 Emergencies
- 2.22.1 In an emergency affecting safety of persons or property, the Subcontractor shall act, at the Subcontractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Subcontractor on account of an emergency shall be determined per the contract documents.
- 2.24 Safety Precautions and Procedures
- 2.24.1 Subcontractor shall be solely and exclusively responsible for protecting its employees and all other persons from risk of death, injury or bodily harm arising out of or in any way connected with the Subcontract Work. Subcontractor shall furnish a written designation of a representative responsible for implementation and enforcement of Subcontractor's safety program. This representative shall be at the site whenever Subcontract Work is being performed.
- 2.24.2 Subcontractor shall furnish the Construction Manager's Project Safety Manager with the past 3 years OSHA 200 Logs, Incident Rates, and Lost Work Day Rates for review.
- 2.24.3 Subcontractor agrees to comply with all applicable federal, state, city and county laws, ordinances, rules and regulations for the safety of persons or property in the performance of the Subcontract Work including, but not limited to, the requirements of the Occupational Safety and Health Act of 1970, and amendments, and regulations promulgated and issued pursuant thereto. Failure to comply may result in fines to be assessed as back-charges.
- 2.24.4 Subcontractor shall develop and enforce a written safety program to ensure compliance with the obligation under Section 2.23. Contractor shall submit this written safety program to Construction Manager with ten days of award notification. Construction Manager will review the program for the limited purpose of determining that Subcontractor has a legitimate program. Construction Manager will not review the program to determine its adequacy. Construction Manager will monitor Subcontractor's program at the site in connection with Construction Manager's general inspection functions. Construction Manager's review of such program or monitoring of Subcontractor's enforcement efforts does not in any way absolve Subcontractor from its sole responsibility for safety. Subcontractor shall report any injury to an employee, agent, supplier, or material men to Construction Manager within twenty-four (24) hours of its occurrence and provide Construction Manager with a copy of its safety/incident report.
- 2.24.5 Subcontractor shall provide sufficient, safe and proper facilities, labor and material needed for the access and inspection of Subcontractor's Work by Construction Manager, Owner and other Subcontractors.

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- 2.24.6 Subcontractor agrees to comply with the "Hazard Communication Standard" of the Occupational Safety and Health Administration. To the extent required by such standard, Subcontractor will adopt and implement a written hazard communication program to protect its employees from potential exposure of hazardous chemicals at the job site and will provide lists or inventories of hazardous chemicals in its possession at the job site, warning and handling labels for such chemicals, and material safety data sheets for such chemicals to Construction Manager.
 - 2.24.7 When the use or storage of explosives or other hazardous materials or equipment is necessary for execution of the Subcontract Work, Subcontractor shall carry on such activities with properly qualified personnel under properly qualified supervision.
 - 2.24.8 Subcontractor shall abide by its safety program and procedures, or those of the Construction Manager, whichever is most stringent. A copy of the Construction Managers Safety Program will be provided to the Subcontractor.
 - 2.24.9 Subcontractor shall provide for protection of persons and for vehicle passing around or through the work area of this Subcontractor.
 - 2.24.10 Subcontractor shall adopt the Construction Manager's Drug and Alcohol Program to include pre-employment, post accident, random and suspicion drug testing. All non-negative testing results will disqualify a contractor's employee from working on the project. The Construction Manager's Drug and Alcohol Program is included in the Project Safety Manual. All expenses associated with the Drug and Alcohol Program are the requirement of the subcontractor. Subcontractor shall provide sufficient evidence of negative drug testing results to the Project Safety Manager prior to a contractor's employee being admitted to the project site.
- 2.25 Warranties
- 2.25.1 Subcontractor warrants to Construction Manager and Owner that all materials and equipment furnished under its contract will be new, unless otherwise specified, and that all construction work will be of first-class quality, free from improper workmanship and defective materials, and fit for the purpose intended. Subcontractor agrees to correct all Contract Work performed and material supplied by it under its contract which proves to be defective in material or workmanship within a period of one (1) year from the date of Substantial Completion as defined in Paragraph 5.3 or for such longer period of time as may be provided in the Contract Documents. Any warranty or guarantee obtained by Subcontractor from any manufacturer shall be deemed to have been obtained for the benefit of Construction Manager and Owner. This warranty shall be in addition to all other warranties and remedies, expressed or implied, under the law.
 - 2.25.2 Subcontractor shall collect all equipment manuals and deliver them to Construction Manager upon completion, together with all written warranties or guarantees from equipment manufacturers.

- 2.26 Field Office. Subcontractor shall provide any office or storage trailer complete with all necessary utilities, gas, telephone and water needed for its own use. Location of such facilities shall be subject to approval by Construction Manager and shall be subject to relocation at Subcontractor's expense. Any temporary installation required for these facilities shall be paid for by Subcontractor. Subcontractor shall be responsible for the security and protection of its materials, equipment and tools.
- 2.27 Equipment and Materials
- 2.27.1 Subcontractor shall be responsible for arranging for the shipment of materials and equipment which it is to provide to the Project site and shall consign all such shipments to itself as consignee at the Project shipping address, freight fully prepaid. Subcontractor shall make all delivery payments promptly, including any demurrage charges.
- 2.27.2 Subcontractor shall advise Construction Manager in advance of all major shipments of equipment and materials, and shall coordinate the arrival and unloading of same with Construction Manager.
- 2.27.3 Subcontractor shall promptly unload its shipments and promptly release its carrier's equipment. In the event Subcontractor is unable to promptly unload a shipment, Subcontractor shall notify Construction Manager of such inability not less than five (5) working days in advance of the shipment's arrival. Construction Manager, at its sole option, may unload or make arrangements for others to unload such shipments and Subcontractor will be responsible for the cost thereof.
- 2.27.4 If Construction Manager or Owner is to furnish materials or equipment to Subcontractor for the Subcontract Work, Subcontractor shall notify Construction Manager sufficiently in advance of the date they are needed to permit Construction Manager or Owner to accomplish their delivery by the date needed. Such materials and equipment shall be unloaded and received by Subcontractor in the presence of Construction Manager's authorized representative and the quantities thereof shall be checked jointly by Subcontractor and Construction Manager. The delivery and acceptance of all such materials and equipment shall be recorded in writing and Subcontractor shall sign forms satisfactory to Construction Manager to acknowledge receipt and acceptance of such materials and equipment. Subcontractor shall note any damage to Construction Manager or Owner furnished materials and equipment prior to Subcontractor's acceptance of delivery. Subcontractor shall notify Construction Manager of any materials and equipment supplied to Subcontractor by Construction Manager or Owner which are surplus and shall cooperate with Construction Manager and Owner in the disposition of such surplus as directed by Construction Manager. In the event of misfit of Construction Manager or Owner furnished materials or equipment, Subcontractor shall promptly notify Construction Manager, take steps to avoid standby time due to such misfit, and continue to progress with other portions of the Subcontract Work pending correction of such misfit.
- 2.27.5 Subcontractor shall store and install all materials and equipment necessary for the Subcontract Work in such a way as to preserve their quality and fitness which includes, but is not limited to, actions required to protect same from damage due to weather, fire, theft, and construction operations. This responsibility begins when Subcontractor accepts delivery of the materials and equipment procured by it or Construction Manager and continues until Substantial Completion.

- 2.28 Layout. Subcontractor shall provide such layout as is necessary for completion of the Subcontract Work from basic control points and benchmarks provided by Construction Manager.

3.0 Construction Manager's Responsibilities and Rights

- 3.1 Construction Manager shall sequence, and coordinate activities of the Subcontractors in accordance with the latest approved construction schedule.
- 3.2 Information. Construction Manager will make information which affects the Subcontract Work and which becomes available to Construction Manager promptly available to Subcontractor.
- 3.3 Instructions. Construction Manager shall give instructions or orders only to persons designated as authorized representatives of the Subcontractor.
- 3.4 Contractor shall accept instructions or orders only from persons designated as authorized representatives of Construction Manager.
- 3.5 Stop Work Orders. Construction Manager may order the Subcontract Work or any portion thereof stopped when Subcontractor fails to correct work not in conformance with the Subcontract Documents or fails to supply adequate labor, materials or construction equipment until the cause for such order has been eliminated. Construction Manager's failure to exercise this right does not absolve Subcontractor of its responsibilities.
- 3.6 Completing and Correcting Work. After giving twenty-four (24) hours' notice to Subcontractor, Construction Manager may complete or correct any part of the Subcontract Work which Subcontractor has neglected to show itself otherwise unable to expeditiously complete or correct and deduct the cost of doing so from Subcontractor's payments. If the work not accomplished involves more than one Subcontractor, the cost will be divided in accordance with Construction Manager's determination. Construction Manager may avail itself of the above procedure and of such other rights and remedies which are available under its subcontract, applicable law, or both.

4.0 Subcontracts

- 4.1 Selection of Subcontractors. Subcontractor shall submit to Construction Manager a list of its Subcontractors and material men with a description of the corresponding items of work within ten (10) days of execution of this Agreement and in any event prior to commencing the Subcontract Work if it has not previously submitted same with its bid submittal. Construction Manager reserves the right to approve or disapprove any organization listed thereon for any reason. The list shall be updated as necessary by Subcontractor. Subcontractor shall select competent Subcontractors and shall be responsible for the management of its Subcontractors' performance of their work.

- 4.2 Sub-Subcontractor's Contract. No contractual relationship shall exist between Owner or Construction Manager and any of Subcontractor's Subcontractors. Subcontractor shall use an appropriate written subcontract for its Subcontractors under which its Subcontractors assume all obligations and responsibilities Subcontractor has assumed toward Construction Manager and Owner under the Subcontract Documents including, but not limited to, naming Construction Manager and Owner as additional insured's as required at Paragraph 8.2.1.4.6 and satisfying all other requirements of Section 8.2.

5.0 Subcontractors Construction Scheduling

5.1 Schedule

- 5.1.1 Subcontractor shall accomplish the Subcontract Work within the period of time set forth in the Subcontract Documents (Project Manual Section 01010) and as indicated in the Subcontractor's Schedule prepared pursuant to this Section. Within ten (10) days after execution of this Agreement or prior to commencing the Subcontract Work, whichever occurs first, Subcontractor shall propose a schedule in a form and content acceptable to which minimally includes durations, planned crew sizes, planned procurement dates, and planned submission dates of required submittals.
- 5.1.2 Subcontractor's proposed Schedule shall anticipate the usual amount of delay from all causes encountered in the locale of the site and for the type of work involved. Construction Manager shall review the proposed Schedule and make such revisions as are necessary to make it consistent with the Schedule for the Project. Subcontractor will perform in accordance with the Subcontract Schedule which is approved by Construction Manager.
- 5.1.3 Construction Manager reserves the right to modify the construction schedule. The subcontractor shall adjust their material procurement and on-site activities in accordance with the Construction Managers revised schedule.

5.2 Subcontract Time

- 5.2.1 The Subcontract Work to be performed under the Subcontract shall commence, progress, and be completed in accordance with the Subcontract Schedule provided pursuant to Paragraph 5.1.2. Time is of the essence.
- 5.2.2 The term day, as used in the Subcontract Documents, shall mean calendar day, unless otherwise specifically designated.

5.3 Substantial Completion and Commencement of Warranties

- 5.3.1 The date of Substantial Completion of the Project, or a designated portion thereof, is the date when construction is sufficiently complete in accordance with the drawings and specifications so Owner can occupy or utilize, or in fact does occupy or utilize this Project, or designated portion thereof, for the use for which it is intended.
- 5.3.2 The date of Substantial Completion shall be established by a Certificate of Substantial Completion signed by the Owner and Construction Manager.
- 5.3.3 Owner shall have the right to occupy or use that portion of the Project which has been found to be substantially complete and Subcontractor shall not be entitled to any extra compensation on account of Owner's occupancy or use, nor shall Subcontractor be relieved of any of its responsibilities, including the required times of completion.

5.3.4 Warranties or guarantees called for by the Subcontract, or by the drawings and specifications and addenda attached as Exhibit 1, shall commence on the date of Substantial Completion of the Project, or designated portion thereof, as reflected by the Certificate of Substantial Completion.

5.4 Delays

5.4.1 If Subcontractor is delayed in the commencement, prosecution or completion of the Subcontract Work by causes inherent in the Subcontract Work's scope and complexity and in the locale of the Project site, Subcontractor shall overcome such delays, using premium time if necessary at no additional cost to Construction Manager. Subcontractor agrees it will make no claim for damages of any sort or schedule extensions for delays of this nature. Subcontractor acknowledges the Subcontract Price and Subcontract Schedule are based on the fact it shall not recover such damages or costs and shall not be given extensions for such delays.

5.4.2 If Subcontractor is delayed in the commencement, prosecution or completion of the Subcontract Work by Construction Manager, Owner, or any separate Subcontractor employed by either of them, or by the action of any governmental or regulatory body, or by changes ordered in the Subcontract Work or by labor disputes not directly involving Subcontractor's employees, fire, unusual delay in transportation, adverse weather conditions not reasonably anticipatable, unavoidable casualties, acts of God or any causes beyond the control of Subcontractor, then the Subcontract Schedule may be extended by Change Order for the period of such delay. The time extensions shall be solely determined and fixed by Construction Manager and contingent on Owner's approval, but no such extension shall be made unless a written claim with detailed substantiation therefore is presented to Construction Manager within five (5) days of occurrence causing the delay. Except as provided in Paragraph 5.4.3. Subcontractor shall have no claim against Construction Manager or Owner for damages or additional costs for its direct material and labor costs, its indirect job site costs, extended overhead, disruption and financing costs, lost profits, consequential damages, or other compensation for such delays. Subcontractor acknowledges that the Subcontract Price is based on the fact it shall not recover such damages or costs.

5.4.3 If Subcontractor is delayed in the commencement, prosecution or completion of the Subcontract Work by the bad faith or active interference of Construction Manager, Owner or any separate Subcontractor employed by Owner, the Subcontract Price may be adjusted by Change Order. The price adjustment, if any, shall be limited to Subcontractor's direct material and labor costs and its indirect job site costs, including field supervision, field office costs and rental equipment, incurred during the period of the delay. No claim shall be made by Subcontractor for any other compensation, including, but not limited to, the recovery of extended overhead, financing costs, lost profits or consequential damages. The time extension and/or price adjustment shall be solely determined and fixed by Construction Manager and contingent upon Owner's approval, but no such extension or adjustment shall be made unless a written claim with detailed substantiation therefore is presented to Construction Manager within five (5) days of the occurrence of the wrongful event causing the delay. Subcontractor acknowledges that the Subcontract Price is based on the fact it may not recover such costs or damages due to such delay.

- 5.4.4 If Subcontractor is delayed by the acts or failures to act of other Construction Manager Subcontractors, its sole remedy for delay damages resulting therefrom shall be against such other Subcontractor. Subcontractor shall be responsible to other Construction Manager Subcontractors for delay damages which arise from Subcontractor's acts or failures to act. Subcontractor shall defend, indemnify and hold harmless Owner and Construction Manager from claims against them by other Construction Manager Subcontractors for delays which result from Subcontractor's acts or failures to act.
- 5.4.5 Construction Manager may direct Subcontractor to complete the Subcontract Work ahead of the Subcontract Schedule or to maintain the Subcontract Schedule when delays are caused by the circumstances described at Paragraphs 5.4.3, 5.4.2, and 5.4.4. Upon written Change Order to this effect, Subcontractor shall accelerate the Subcontract Work and the Subcontract Price will be adjusted by Change Order. The price adjustment shall be limited to the premium time necessary to accomplish the accelerated Subcontract Schedule and the fringe benefits and social security tax on same less any reduction in indirect job site costs, including field supervision, field office costs and rental equipment, which occur as a consequence of the acceleration. Subcontractor will make no claim for any other compensation and acknowledges that the Subcontract Price is based on the fact it may not recover any other costs.

6.0 Changes in the Subcontract Work

- 6.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 6 and elsewhere in the Contract Documents.
- 6.2 A Change Order shall be based upon agreement among Subcontractor and Construction Manager; a Construction Change Directive may or may not be agreed to by the Subcontractor; an order for a minor change in the Work may be issued by the Construction Manager alone.
- 6.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Subcontractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.
- 6.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner Construction Manager or Subcontractor, the applicable unit prices shall be equitably adjusted.
- 6.5 Change Orders
 - 6.5.1 Construction Manager may, at any time and without invalidating its Subcontract or Subcontractor's bond, make changes in Subcontractor's Work whether it be an addition, deletion or other revision thereof, by written Change Order, provided said changes are within the general scope of the Subcontract.

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- 6.5.2 Subcontractor shall notify Construction Manager in writing if it contests the Change Order's changes in the Subcontract Price and/or Subcontract Schedule no later than ten (10) days after Subcontractor's receipt of the Change Order. Timely contesting of the Change Order is a condition precedent to making a claim related to the Change Order. If no agreement is reached between the parties regarding the adjustment of the Subcontract Price, then Subcontractor shall be reimbursed for the costs of such work, as determined appropriate by Construction Manager, pursuant to Section 7.2, plus 10% of such costs for overhead and profit in the case of work performed with Subcontractor's forces and 10% in the case of work performed by Subcontractor's Subcontractors. In the event the Change Order causes a decrease in the cost of the Subcontract Work, the Subcontract Price shall be decreased by the amount of Construction Manager's determination of the decrease in the costs of labor, materials and equipment no longer required, based upon the most recent Schedule of Values.
- 6.5.3 Subcontractor shall proceed with the changes required in a Change Order upon receipt of the Change Order so as not to delay the progress of the work whether or not the changes in the Subcontract Work or changes in the Subcontract Price or Subcontract Schedule are contested by Subcontractor.
- 6.5.4 If Subcontractor makes changes in the Subcontract Work without a written Change Order, Subcontractor shall not be entitled to adjustments to the Subcontract Price or Subcontract Schedule and shall be responsible for any costs or damages incurred by Construction Manager, Owner and their Subcontractors as a result of the change.
- 6.6 Cost of Work. The Cost of Work in any Change Order shall be limited to the costs of materials and equipment (excluding sales tax where applicable); costs of delivery and unloading; costs of labor (including social security, unemployment insurance and fringe benefits required by Subcontractor's agreement with its employees); rental costs of equipment and machinery not owned by Subcontractor, exclusive of hand tools; and the additional costs of supervision and field office personnel directly attributable to said Change Order.
- 6.7 Concealed, Unknown or Hazardous Conditions
 - 6.7.1 If Subcontractor encounters conditions at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Subcontract Documents or (2) unknown physical conditions of an unknown nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Subcontract Documents, then Subcontractor shall give written notice promptly to Construction Manager but in no event later than ten (10) days after the conditions are encountered and in all cases before the conditions are disturbed. The Subcontract Price and Subcontract Schedule may be adjusted for such concealed or unknown condition by Change Order.
 - 6.7.2 In the event Subcontractor encounters material reasonably believed to be asbestos or a hazardous substance which has not been rendered harmless, Subcontractor shall immediately stop work in the area affected and report the condition to Construction Manager. Work shall be resumed as directed by Construction Manager.

- 6.8 Construction Change Directives
- 6.8.1 A Construction Change Directive is a written order prepared by the Construction Manager, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum of Contract Time, or both. The Construction Manager may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract sum and Contract Time being adjusted accordingly.
- 6.8.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.
- 6.8.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:
- 6.8.3.1 mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- 6.8.3.2 unit prices stated in the Contract Documents or subsequently agreed upon;
- 6.8.3.3 cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- 6.8.3.4 as provided in Subparagraph 6.8.6.
- 6.8.4 Upon receipt of a Construction Change Directive, the Subcontractor shall promptly proceed with the change in the Work involved and advise the Construction Manager of the Subcontractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.
- 6.8.5 A Construction Change Directive signed by the Subcontractor indicates the agreement of the Subcontractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.
- 6.8.6 If the Subcontractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by the Construction Manager on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit. In such case, and also under Clause 6.8.3.3, the Subcontractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 6.8.6 shall be limited to the following:
- 6.8.6.1 costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' or workmen's compensation insurance;
- 6.8.6.2 costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- 6.8.6.3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Subcontractor or others;

- 6.8.6.4 costs of premiums for all bonds and insurance, permit fees, and sales, use of similar taxes related to the Work; and
- 6.8.6.5 additional costs of supervision and field office personnel directly attributable to the change.
- 6.8.7 Pending final determination of cost to the Owner, amounts not in dispute may be included in Applications for Payment. The amount of credit to be allowed by the Subcontractor to the Construction Manager for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Construction Manager. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, in any, with respect to that change.
- 6.8.8 If the Construction Manager and Subcontractor do not agree with the adjustment in Contract Time or the method for determining it, the adjustment or the method shall be referred to the Construction Manager for determination.
- 6.8.9 When the Construction Manager and Subcontractor agree with the determination made by the Construction Manager concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.
- 6.9 Minor changes in the Work. The Construction Manager will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Construction Manager and Subcontractor. The Subcontractor shall carry out such written orders promptly.

7.0 **Payments to Subcontractor**

7.1 Progress Payments

- 7.1.1 On or before the 7th day of each month, after the contract work has commenced, subcontractor shall submit a "pencil draft" application for payout to Construction Manager. Having made such changes as directed by Construction Manager and on or before the 25th day of each month after the Subcontract Work has commenced, Subcontractor shall submit an Application for Payment to Construction Manager for the period ending on the 30th day of the same month which shall indicate the percentage of work completed or material stored at the site for each major segment of the work on the Schedule of Values, and the current amounts due therefore. Subcontractor's verified Application for Payment shall be submitted on forms acceptable to Construction Manager with such additional substantiating information as may be requested by Construction Manager. Construction Manager, Owner, and any other party whose approval is required by the Subcontract Documents shall have the right of inspection and verification of the Application for Payment. Each Application for Payment shall be accompanied by an unconditional partial waiver of lien stating that the subcontractor waives and releases any and all of the undersigned's rights and claims under the Illinois Public Construction Bond Act to the same extent the undersigned waives and releases any and all lien or claim of, or right to lien under the statutes of Illinois relating to mechanics liens. Subcontractor shall also

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- provide partial lien waivers from its Subcontractors and suppliers when required by Construction Manager.
- 7.1.2 Such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives but not yet included in Changed Orders.
- 7.1.3 Such applications may not include requests for payment of amounts the Subcontractor does not intend to pay to a Sub-subcontractor or material supplier because of a dispute or other reason.
- 7.1.4 Construction Manager shall include Subcontractor's Application for Payment in Construction Manager's next Application for Payment to Owner provided Subcontractor's Application is timely received, there has been a reasonable opportunity for inspection and verification, and it has been accompanied by the required lien waivers and submissions required under Paragraph 7.1.7.
- 7.1.5 Construction Manager shall pay Subcontractor within ten (10) days of its receipt of payment by Owner, subject to the conditions of Paragraphs 7.1.6 and 7.1.7, as follows:
- 7.1.5.1 Ninety percent (90%) of currently due amounts shown on the Application for Payment.
- 7.1.5.2 When a major segment of work is one hundred percent (100%) completed, or materials one hundred percent (100%) purchased and accepted by Owner and Construction Manager, Construction Manager may, at its sole discretion, release the proportionate retainage with respect to that segment, and make full payment therefore to Subcontractor.
- 7.1.6 Approval of an Application for Payment for stored items on or off the site shall be conditioned on submission by the Subcontractor of bills of sale and applicable insurance or such other documents satisfactory to the Owner and Construction Manager to establish Owner's title to materials and equipment or otherwise protect Owner's and Construction Manager's interest therein, including transportation to the site. Stored items shall be marked as belonging to Owner upon payment for same. Subcontractor shall submit evidence satisfactory to Construction Manager and Owner that goods are marked belonging to Owner.
- 7.1.7 Subcontractor warrants and guarantees that title to all Subcontract Work, materials and equipment covered by an Application for Payment, whether incorporated in the Project or not, will pass to the Owner upon receipt of such payment by Construction Manager, free and clear of all liens, claims, security interests or encumbrances hereinafter referred to as Liens. Subcontractor shall indemnify, defend and save harmless Construction Manager and Owner against Liens filed on the property of Owner by Subcontractor's Subcontractors, material men or suppliers for amounts they claim are due them from Subcontractor for Subcontract Work. Within ten (10) days of receiving notice from Owner or Construction Manager to do so, Subcontractor shall obtain the release of any such Liens. If Subcontractor fails to do so within the time provided herein, Construction Manager may satisfy such Liens by payment, notwithstanding Subcontractor's defenses thereto and without liability to Subcontractor or its surety therefore and may retain out of any payment due, or to become due to Subcontractor thereafter, an amount sufficient to indemnify Construction Manager and Owner for such payment and any other expenses incurred by either of them as a result of such Lien. Subcontractor shall also be responsible for the

amount of any premium for any bond given by Construction Manager or Owner to obtain the discharge of any Lien, or for the interest on any money deposited for the purpose of discharging any Lien.

7.2 Certificates for Payment

7.2.1 The Construction Manager will, within seven days after receipt of the Subcontractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Subcontractor, for such amount as the Construction Manager determines is properly due, or notify the Subcontractor and Owner in writing of the Construction Manager's reasons for withholding certification in whole or in part as provided in Subparagraph 7.3.1.

7.2.2 The issuance of a Certificate for Payment will constitute a representation by the Construction Manager to the Owner, based on the Construction Manager's observations at the site and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Construction Manager's knowledge, information and belief, quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the Construction Manager. The issuance of a Certificate for Payment will further constitute a representation that the Subcontractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Construction Manager has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Subcontractor's right to payment or (4) made examination to ascertain how or for what purpose the Subcontractor has used money previously paid on account of the Contract Sum.

7.3 Decisions to Withhold Certification

7.3.1 The Construction Manager may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Construction Manager's opinion the representations to the Owner required by Subparagraph 7.2.2 cannot be made. If the Construction Manager is unable to certify payment in the amount of the Application, the Construction Manager will notify the Subcontractor and Owner as provided in Subparagraph 7.2.1. If the Subcontractor and Construction Manager cannot agree on a revised amount, the Construction Manager will promptly issue a Certificate for Payment for the amount for which the Construction Manager is able to make such representations to the Owner. The Construction Manager may also decide not to certify payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Construction Manager's opinion to protect the Owner from loss because of:

7.3.1.1 defective Work not remedied;

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- 7.3.1.2 third party claims filed or reasonable evidence indicating probable filing of such claims;
 - 7.3.1.3 failure of the Subcontractor to make payments properly to Sub-subcontractors or for labor, materials or equipment;
 - 7.3.1.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
 - 7.3.1.5 damage to the Owner or another Subcontractor;
 - 7.3.1.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
 - 7.3.1.7 persistent failure to carry out the Work in accordance with the Contract Documents.
- 7.3.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.
- 7.4 Final Payment
- 7.4.1 Subject to Paragraph 7.4.2, Final Payment shall be made to Subcontractor when Subcontractor has achieved final completion in accordance with the requirements of the Subcontract Documents. Final completion includes, but is not limited to, completion of the Subcontract Work to the satisfaction of Owner and Construction Manager; Subcontractor's payment of all its Subcontractors and material men; settlement of all claims; payment and recorded release of all mechanics' liens; delivery of all guarantees, warranties, equipment operation and maintenance manuals, record documents, appropriate certificates, and all other required approvals and acceptances by city, county, and state governments, or other authorities having jurisdiction; removal of all rubbish tools, scaffolding, and surplus material and equipment from the site; consent to release of Final Payment from Subcontractor's surety; receipt of appropriate certificates of insurance evidencing continuing insurance obligations; and submittal of Subcontractor's Final Application for Payment.
 - 7.4.2 Final payment to Subcontractor will be made upon Application for Payment and paid no later than thirty (30) days after inspection and verification by Construction Manager and Owner, payment by Owner to Construction Manager, and the satisfaction of all other conditions required for payment. The word "FINAL" shall be placed on the last Application for Payment and an unconditional Final Waivers of Lien shall be attached thereto stating that the subcontractor waives and releases any and all of the undersigned's rights and claims under the Illinois Public Construction Bond Act to the same extent the undersigned waives and releases any and all lien or claim of, or right to lien under the statutes of Illinois relating to mechanics liens. Acceptance of Final Payment by Subcontractor shall constitute a release and waiver by Subcontractor of all claims Subcontractor has or may have against Construction Manager, Construction Manager's surety, and Owner.
- 7.5 Effect of Payment and Occupancy. Progress payments, final payment, partial or entire use or occupancy by Owner and/or Construction Manager shall not constitute acceptance of any work not in conformance with the Subcontract Documents.

7.6 Condition Precedent to Payment. Payment by Owner to Construction Manager for the Subcontract Work is a condition precedent to Subcontractor's payment by Construction Manager. Subcontractor is entitled to payment only for that portion of the Subcontract Work for which Construction Manager has been paid by Owner. Subcontractor expressly assumes the risk of nonpayment by Owner.

8.0 Indemnity, Insurance and Bonds

8.1 Indemnity. To the fullest extent permitted by law, Subcontractor shall defend and indemnify and hold harmless Construction Manager, the Architect and the Owner, their subsidiaries and affiliates and officers, directors, shareholders, partners, managers, members, agents and employees of any of them (and the foregoing's respective successors, assigns, heirs, estates and personal representatives), against all claims, damages, losses, and suits for loss or damage to property (other than the Work itself), or personal and bodily injury, including death, to persons, and from all judgments recovered therefore, and from all expenses for defending such claims or suits, including court costs, litigation expenses, and attorney's fees, which result from the performance of the Subcontract by Subcontractor, its Subcontractors, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable to the extent caused, in whole or in part, by negligent acts or omission of Subcontractor or anyone directly or indirectly employed by them or anyone for whose acts they may be liable. All indemnification provisions contained in this Contract shall survive the termination of the Contract.

8.2 Insurance

8.2.1 Without limiting the liability of Subcontractor under its Subcontract, Subcontractor shall purchase and maintain the following insurance to cover its operations under its Subcontract. Said insurance shall be provided by insurance companies acceptable to Construction Manager and licensed to do business in the state where the Project is located and have a policyholder's rating of "A-" and a financial size rating of "VII" or higher in the most current Best's Key Rating Guide.

8.2.1.1 Worker's Compensation Insurance, which affords insurance with statutory limits as required by Illinois (all states endorsement including occupational diseases), together with Employer's Liability Coverage with limits of not less than the following:

\$500,000 each accident Bodily Injury by Accident

\$500,000 policy limit Bodily Injury by Disease

\$500,000 each employee Bodily Injury by Disease.

Such insurance shall include a Waiver of Subrogation endorsement in favor of Construction Manager, Construction Manager, Architect/Engineer and Owner and coverage extensions as required by applicable state or federal jurisdictions i.e. (U. S. Longshoremen's and harbor Worker's Act Coverage, Maritime Coverage (Jones Act) etc.

Evidence of coverage is still required from Employee Leasing Company should employees be leased.

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- 8.2.1.2 Comprehensive Automobile Liability Insurance covering all owned, hired (rented) and non-owned vehicles with the following minimum limit of liability \$1,000,000 bodily injury and property damage each accident.
- 8.2.1.3 Commercial General Liability Insurance which is written on an occurrence basis, with the following minimum limits of liability:
- | | |
|-----------------------------------------|-------------|
| General aggregate per project | \$2,000,000 |
| Products/completed operations aggregate | \$2,000,000 |
| Personal and advertising injury | \$1,000,000 |
| Each occurrence | \$1,000,000 |
- 8.2.1.4 The Commercial General Liability policy shall include bodily injury, property damage, personal injury and broad form contractual liability coverage with the following coverages:
- 8.2.1.4.1 Products and completed operations coverage for at least two years beyond the completion date of the project and the project is put to its intended use.
- 8.2.1.4.2 Blanket contractual liability coverage which sets forth that coverage exists for the indemnification agreement as applicable to the Subcontractor's obligations under Paragraph 8.1.
- 8.2.1.4.3 Exclusions for property in the care, custody and control of the Subcontractor shall be deleted.
- 8.2.1.4.4 Exclusions for explosion, collapse and underground property damage shall be deleted.
- 8.2.1.4.5 **Construction Manager shall be the certificate holder. Wight Construction, Inc., ("Construction Manager"), Architect/Engineer and the Owner shall each be named as additional insured's on the Commercial General Liability Policy per form CG2010 (11/85) or its equivalent language which is CG2010 (10/01) with the CG2037 (10/01), Auto Liability, Pollution Liability and any required Excess policies.** The Commercial General Liability, Auto Liability, Pollution Liability and required Excess policies shall include a severability of interest or cross-liability clause; a waiver of subrogation in favor of the additional insured's and shall be endorsed to apply on a primary and non-contributory basis with respect to any applicable insurance maintained by Construction Manager, Construction Manager, Architect/Engineer or Owner. Such inclusion as an additional insured shall extend to completed operations coverage and shall not be limited by an insured vs. insured exclusion.
- 8.2.1.4.6 Personal injury with the employee and contractual liability exclusions deleted.

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8.2.1.5 Umbrella liability insurance excess of the coverages in provisions 8.2.1.1-8.2.1.4 and with a coverage form at least as broad as underlying insurance including any special coverage extensions for the following limits of liability:

Aggregate	\$5,000,000
Each Occurrence	\$5,000,000

The insurance limits in provisions 8.2.1.1-8.2.1.5 above may be provided by any combination of primary insurance policies and excess liability ("umbrella") insurance policies provided the resulting insurance is equivalent to the insurance stated hereunder.

8.2.1.6 Aircraft or Watercraft Liability Insurance

This section is applicable only if the Work involves the use of an aircraft or watercraft of any type being used by the Subcontractor or any tier of Subcontractor. The Subcontractor shall maintain or require the operator of the aircraft or watercraft public bodily injury and property damage liability insurance. Aircraft liability insurance is to include passenger liability with combined single limits for bodily injury and property damage of \$5,000,000 each occurrence. Watercraft liability is to be provided in an amount not less than \$1,000,000 per vessel including coverage for wages, maintenance and cure for any master(s) or member(s) of the crew. Workers' Compensation coverage is to include applicable coverage extensions for crew and passengers.

8.2.1.7 Physical Damage Insurance

All-risks of direct physical loss insurance on all vehicles, valuable papers, construction equipment, scaffolding, towers, forms, supplies, trailers, mobile office trailers tools including tools owned by mechanics, and any other property of similar nature which are not consumed in forming a part of the completed Work that are owned, borrowed, rented by, or in the care, custody and control of, Subcontractor to their full insurable value. The requirement to secure and maintain such insurance is solely for the benefit of the Subcontractor.

8.2.2 Subcontractor shall furnish certificates for Construction Manager and Owner evidencing satisfaction of the insurance requirements of Section 8.2 before beginning the Subcontract Work and upon renewal of such coverages during the performance of its Subcontract. Additionally, certificates of insurance are to be provided annually as evidence thereof of extended completed operations coverage. The certificates shall provide that thirty (30) days written notice shall be given to Construction Manager before the policies are changed or canceled. Subcontractor shall, itself, give written notification to Construction Manager as soon as it receives notice of change or cancellation from its insurance company. The certificates of insurance shall plainly designate the name of the Project. Failure to furnish such certificates shall not relieve Subcontractor from its obligations under Section 8.2. Certificates of insurance must evidence the

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- inclusion of the Additional Insured's on a primary and non-contributory basis; severability of interest clause; the required General Liability per project aggregate; and waiver of subrogation clauses. Any applicable deductible or self-insured retention shall be stated on such certificate.
- 8.2.3 Failure to carry and keep the insurance coverages required herein in force shall constitute an event of default under this Contract. The Construction Manager reserves the right to withhold the issuance of the Notice to Proceed, to deny access to the Project, or to withhold payments under this Contract until proper evidence of insurance as required herein is received by the Construction Manager.
- 8.2.4 The insurance coverages as required herein are not intended to preclude the Subcontractor from obtaining, at their own expense, other coverages and higher limits where required by law or as required by the Subcontractor's operations. Failure of the Subcontractor to secure insurance or to maintain adequate amounts of insurance shall not obligate the Construction Manager, Construction Manager, Architect/Engineer and Owner for any losses hereunder.
- 8.2.5 Notwithstanding the insurance proceeds available and collectible by the Subcontractor, the limits of liability specified herein do not in any way limit the liability of the Subcontractor. Any applicable deductible or self-insured retention shall be paid by the Subcontractor.
- 8.2.6 The Subcontractor shall require certificates of insurance of their respective vendors, suppliers, material dealers, independent truckers/haulers, and others who merely transport, pick up, deliver or carry materials, personnel, parts equipment or any other items or persons to or from the Project. Such certificates of insurance shall evidence the Workers' Compensation, General Liability, Automobile Liability, and Umbrella Liability coverages carried.
- 8.2.7 Warranty Work: If Subcontractor and all others for whose work the Subcontractor is responsible for is required to return to the Project during a warranty period, insurance shall be proved and maintained as required in Article 8.
- 8.2.8 Subcontractor shall require evidence of insurance substantially the same as required of Subcontractor from each tier of Subcontractor prior to commencement of work by each tier of Subcontractor.
- 8.3 Waiver of Subrogation. Construction Manager and Subcontractor waive all rights against (1) each other and any of their Subcontractors, agents and employees, each of the other, and (2) the Owner and any of its Subcontractors, agents and employees, for damages caused by fire or other perils covered by builder's risk insurance provided under the Prime Contract or other property insurance applicable to the Subcontract Work, except such rights as they may have to proceeds of such insurance held by the Owner as fiduciary. The Subcontractor shall require of its Subcontractors, agents and employees, by appropriate agreements, written where legally required for validity, similar waivers in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

8.4 Bonds

- 8.4.1 Subcontractor shall furnish a Performance and Payment Bond, in an amount at least equal to the Subcontract Price as security for the faithful performance and payment of its obligations under the Subcontract and it shall not be a violation of the terms of the bond to order changes in the Subcontract Work. The penal sum of each bond shall be adjusted to include the amounts of all change orders. This bond shall be provided within ten (10) calendar days of execution of this agreement. This bond shall remain in effect at least until the later of two (2) years after the date when final payment becomes due or Subcontractor completes its warranty obligations. The bond shall be in the form prescribed by law, regulation or by the Subcontract Documents and be executed by such sureties as are acceptable to Construction Manager and Owner and are licensed to do business in Illinois. The bond shall be signed by an agent and must be accompanied by a certified and current copy of the authority to act. The bond shall name Construction Manager and Owner as dual obligees.
- 8.4.2 The Performance, Labor and Material Bond shall be executed in conformity with American Institute of Architects, Doc. A312™-2010 with coverage provided by a Surety having a policyholder's rating of "A" and minimum class of FSC VIII financial rating in the Best's Insurance Guide, latest edition. A certified copy of the power of attorney from the surety company stating that the person executing the bond shall accompany the bond.
- 8.4.3 If at any time the Construction Manager or the Owner shall become dissatisfied with any Surety or Sureties, or for any other reason, such bond shall cease to be adequate security. Subcontractor shall within five (5) days after receipt of notice to do so, substitute an acceptable bond in such form and sum and signed by such other Sureties as may be satisfactory to Construction Manager. No further payment shall be deemed due nor shall be made until the new Sureties shall have qualified.
- 8.4.4 Whenever the Subcontractor shall be and is declared by the Owner or Construction Manager to be in default under the Subcontract, the Surety of the Subcontractor shall be responsible to reimburse the Construction Manager or Owner in a timely manner and at Construction Manager's or Owner's prevailing rates up to the penal sum of the bond for any and all Work and expense incurred time and material billing by the Construction Manager as a result of the Subcontractor's default including but not limited to additional construction management, architectural fees, miscellaneous costs and expenses, testing, consulting fees, engineering fees or accounting fees. The provisions of the clause for charging of costs, fees and extra work against the Subcontractor shall apply to subparagraphs 3.5, 9.1.1, and 9.1.2.
- 8.4.5 It shall be the duty of the Surety to give an unequivocal notice of intent to remedy the default or defaults promptly or to perform the contracts promptly or to pay to the Construction Manager or Owner the completion cost to remedy the default or defaults up to the penal sum of the bond. Surety shall give such notice in writing to the Construction Manager and Owner within ten (10) days after receipt of the Construction Manager's or Owner's declaration of default and notice of termination of the Subcontractor. Time is of the essence in the Surety's election to remedy the default. In said notice of election, the Surety shall indicate the date on which the remedy or performance will commence, and it shall then be the duty of the Surety to give prompt notice in writing to Construction Manager and Owner immediately upon completion of (a) the remedy and/or

correction of each default, (b) the remedy and/or correction of each item of condemned Work, (c) the furnishing of each omitted item of Work, and (d) the performance of the contract. The Surety shall conduct a due diligence investigation before asserting solvency of its Principal or rely solely on its Principal's denial of default as justification for its failure to give notice of election or for its failure to promptly remedy the default or defaults or perform the contract. If in the event Surety requires additional time to investigate the declaration of default, the Construction Manager or Owner may, without prejudice to its rights under the Bond, temporarily continue construction of the Project and charge the costs of such Work, including Work performed on a time and material basis at the firm's prevailing time and material rates.

Upon the Subcontractor's default and the Owner's declaration of Subcontractor's default, Owner shall provide notice, along with a copy of Section 8.4 of the General Conditions of the Subcontract, to Surety of same.

- 8.4.6 In the event the said Surety shall fail to act promptly as provided herein, then Construction Manager or Owner shall cause ten (10) days notice of such failure to be given, both to said Principal and Surety, and at the expiration of said ten (10) days, the Obligee shall have the authority to cause said Work to be done, and when the same is completed and the cost thereof ascertained, the said Principal and Surety shall and hereby agree to pay any completion costs in excess of the remaining contract balance, but not exceeding the penal sum of the bond.

After declaration of default and termination, and as the contract is completed by a completing contractor or by Surety in accordance with the terms of the Contract Documents, to the extent the construction funds remain and are attributable to the defaulted contractor, Construction Manager or Owner shall pay completing contractor or Surety in accordance with the Schedule of Values as certified by the Architect, and upon completion, any funds which remain due on said contract, the same shall be paid to said Surety.

- 8.4.7 Whenever the Subcontractor shall be and is declared by the Owner or Construction Manager to be in default under the Subcontract, the Subcontractor and Surety further agree as part of this obligation to pay all such damages of any kind arising out of incomplete Work or damaged Work, that may result from a failure in any respect to perform and complete said contract, including, but not limited to, all repair and replacement costs necessary to rectify construction error, architectural and engineering costs and fees, all consultant fees, construction management fees and expenses, all testing and laboratory fees, and all legal fees, expenses and litigation expenses and costs incurred by the Construction Manager or Owner as a result of the default.

After the Surety's receipt of the Obligee's declaration of the Subcontractor's default, the Construction Manager and Owner hereby agree to cooperate with the Surety in its independent investigation of the claim on the Performance Bond including but not limited to (a) providing prompt access to the construction site to the Surety or its consultants, (b) provide a detailed description of any alleged default or defaults by the Subcontractor under its contract along with supporting documentation and (c) provide the results of all testing. However, it is and remains exclusively the Surety's obligation to secure and provide necessary resources to satisfy its obligations under the Performance Bond without unduly burdening the Construction Manager or Owner and provided that the Surety's

due diligence does not unreasonably impede project progress or delay the project as time is of the essence.

- 8.4.8 The Surety agrees that other than as is provided in this Bond, it may not demand of Owner that Owner shall (a) perform any thing or act, (b) give any notice, (c) furnish any clerical assistance, (d) render any service, (e) furnishing any papers or documents, or (f) take any other action of any nature or description which is not required of Owner to be done under Contract Documents.
- 8.4.9 In the event the Surety shall make any assignment for the benefit of creditors or commit any act of bankruptcy, or if it shall be declared bankrupt, or if it shall file a voluntary petition in bankruptcy, or shall in the opinion of the Construction Manager or Owner be insolvent, the Construction Manager and Owner shall have the right to access any reinsurer of said Surety. Further, the Subcontractor agrees forthwith upon request of the Construction Manager and Owner to furnish and maintain other corporate surety with respect to said bond satisfactory to Owner.
- 8.4.10 Any dispute shall be resolved as set forth in the mediation paragraph 1.3.4 of the AIA Document B141-1997; provided, however, that the Surety may fully participate in such dispute resolution. Such proceedings shall begin within three calendar days of request.

9.0 Construction Manager's Right to Perform Subcontractor's Responsibilities and Termination of Agreement

9.1 Failure of Performance

- 9.1.1 Notice to Cure. If the Subcontractor refuses or fails to supply enough properly skilled workers, proper materials, or maintain the Schedule of Work, or fails to make prompt payment to its workers, subcontractors or suppliers, or disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, or otherwise is guilty of a material breach of a provision of this Agreement, the Subcontractor shall be deemed in default of this Agreement. If the Subcontractor fails within three (3) working days after written notification to commence and continue satisfactory correction of the default with diligence and promptness, then the Construction Manager without prejudice to any other rights or remedies, shall have the right to any or all of the following remedies:
 - 9.1.1.1 supply workers, materials, equipment and facilities as the Construction Manager deems necessary for the completion of the Subcontractor's Work or any part which the Subcontractor has failed to complete or perform after written notification, and charge the cost, including reasonable overhead, profit, attorney's fees, costs and expenses to the Subcontractor;
 - 9.1.1.2 contract with one or more additional Subcontractors to perform such part of the Subcontractor's Work as the Construction Manager determines will provide the most expeditious completion of the Work, and charge the cost to the Subcontractor as provided under Clauses 9.1.1.1; and/or
 - 9.1.1.3 withhold any payments due the Subcontractor pending corrective action in amounts sufficient to cover losses and compel performance to the extent required by and to the satisfaction of the Construction Manager.

In the event of any emergency affecting the safety of persons or property, the Construction Manager may proceed as above without notice.

- 9.1.2 Termination by Construction Manager. If the Subcontractor fails to commence and satisfactorily continue correction of a default within three (3) working days after written notification issued under Subparagraph 9.1.1, then the Construction Manager may, in lieu of or in addition to Subparagraph 9.1.1, issue a second written notification, to the Subcontractor and its surety, if any. Such notice shall state that if the Subcontractor fails to commence and continue correction of a default within seven (7) working days of the written notification, the Agreement will be deemed terminated. The Construction Manager also may furnish those materials, equipment and/or employ such workers or subcontractors as the Construction Manager deems necessary to maintain the orderly progress of the Work. All costs incurred by the Construction Manager in performing the Subcontractor's Work, including reasonable overhead, profit and attorney's fees, costs and expenses, shall be deducted from any moneys due or to become due the Subcontractor. The Subcontractor shall be liable for the payment of any amount by which such expense may exceed the unpaid balance of the Contract Price.
- 9.1.3 Use of Subcontractor's Equipment. If the Construction Manager performs work under this Article, either directly or through other Subcontractors, the Construction Manager or other Subcontractors shall have the right to take and use any materials, implements, equipment, appliances or tools furnished by, or belonging to the Subcontractor and located at the Project site.

9.2 Bankruptcy

- 9.2.1 Termination Absent Cure. If the Subcontractor files a petition under the Bankruptcy Code, this Agreement shall terminate if the Subcontractor or the Subcontractor's trustee rejects the Agreement or, if there has been a default, the Subcontractor is unable to give adequate assurance that the Subcontractor will perform as required by this Agreement or otherwise is unable to comply with the requirements for assuming this Agreement under the applicable provisions of the Bankruptcy Code.
- 9.2.2 Interim Remedies. If the Subcontractor is not performing in accordance with the Schedule of Work at the time a petition in bankruptcy is filed, or at any subsequent time, the Construction Manager, while awaiting the decision of the Subcontractor or its trustee to reject or to assume this Agreement and provide adequate assurance of its ability to perform, may avail itself of such remedies under this Article as are reasonably necessary to maintain the Schedule of Work. The Construction Manager may offset against any sums due or to become due the Subcontractor all costs incurred in pursuing any of the remedies provided including, but not limited to, reasonable overhead, profit and attorney's fees. The subcontractor shall be liable for the payment of any amount by which costs incurred may exceed the unpaid balance of the Contract Price.
- 9.2.3 Suspension by Owner. Should the Owner suspend its agreement with the Construction Manager or any part which includes the Subcontractor's Work, the Construction Manager shall notify the Subcontractor in writing and upon receiving notification the Subcontractor shall immediately suspend the Subcontractor's Work. In the event of Owner suspension, the Construction Manager's liability to the Subcontractor shall be limited to the extent of the Construction Manager's recovery on the Subcontractor's behalf under the Contract Documents. The Construction Manager agrees to cooperate with the

Subcontractor, at the Subcontractor's expense, in the prosecution of any Subcontractor claim arising out of an Owner suspension and to permit the Subcontractor to prosecute the claim, in the name of the Construction Manager, for the use and benefit of the Subcontractor.

- 9.2.4 Termination by Owner. Should the Owner terminate its contract with the Construction Manager or any part which includes the Subcontractor's Work, the Construction Manager shall notify the Subcontractor in writing and upon written notification, this Agreement shall be terminated and the Subcontractor shall immediately stop the Subcontractor's Work, follow all of Construction Manager's instructions, and mitigate all costs. In the event of Owner termination, the Construction Manager's liability to the Subcontractor shall be limited to the extent of the Construction Manager's recovery on the Subcontractor's behalf under the Contract Documents. The Construction Manager agrees to cooperate with the Subcontractor, at the Subcontractor's expense, in the prosecution of any Subcontractor claim arising out of the Owner termination and to permit the Subcontractor to prosecute the claim, in the name of the Construction Manager, for the use and benefit of the Subcontractor, or assign the claim to the Subcontractor.
- 9.2.5 Contingent Assignment of Subcontract. The Construction Manager's contingent assignment of the Subcontract to the Owner, as provided in the Construction Manager's agreement with the Owner, is effective when the Owner has terminated the Contract for cause and has accepted the assignment by notifying the Subcontractor in writing. This contingent assignment is subject to the prior rights of a surety that may be obligated under the Construction Manager's bond, if any. Subcontractor consents to such assignment and agrees to be bound to the assignee by the terms of this Subcontract.
- 9.2.6 Suspension by Construction Manager. The Construction Manager may order the Subcontractor in writing to suspend all or any part of the Subcontractor's Work for such period of time as may be determined to be appropriate for the convenience of the Construction Manager. Phased Work or interruptions of the Subcontractor's Work for short periods of time shall not be considered a suspension. The Subcontractor shall notify the Construction Manager in writing within ten (10) working days after receipt of the Construction Manager's order of the effect of such order upon the Subcontractor's Work. To the extent allowed the Construction Manager under its agreement with the Owner, the Contract Price or Schedule of Work shall be adjusted by Subcontract Change Order for any increase in the time or cost of performance of this Agreement caused by such suspension. No claim under this Article shall be allowed for any costs incurred more than ten (10) working days prior to the Subcontractor's notice to the Construction Manager. Neither the contract Price nor the Schedule of Work shall be adjusted for any suspension, to the extent that performance would have been suspended, due in whole or in part to the fault or negligence of the Subcontractor or by a cause for which Subcontractor would have been responsible. The Contract Price shall not be adjusted for any suspension to the extent that performance would have been suspended by a cause for which the Subcontract would have been entitled only to a time extension under this Agreement.

9.2.7 Wrongful Exercise. If the Construction Manager wrongfully exercised any option under this Article, the Construction Manager shall be liable to the Subcontractor solely for the reasonable value of Subcontractor's Work performed by the Subcontractor prior to the Construction Manager's wrongful action, including reasonable overhead and profit on the Subcontractor's Work performed, less prior payments made, and attorney's fees, costs and expenses.

10.0 Claims and Disputes

10.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment of interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Subcontractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

10.2 Decision of Construction Manager. Claims, including those alleging an error or omission by the Construction Manager, shall be referred initially to the Construction Manager for action as provided in Paragraph 11.0. A decision by the Construction Manager, as provided in Subparagraph 11.4, shall be required as a condition precedent to arbitration or litigation of a Claim between the Subcontractor and Owner as to all such matters arising prior to the date final payment is due, regardless of (1) whether such matters relate to execution and progress of the Work or (2) the extent to which the Work has been completed. The decision by the Construction Manager in response to a Claim shall not be a condition precedent to arbitration or litigation in the event (1) the position of Construction Manager is vacant, (2) the Construction Manager has not received evidence or has failed to render a decision within agreed time limits, (3) the Construction Manager has failed to take action required under Subparagraph 11.4 within 30 days after the Claim is made, (4) 45 days have passed after the Claim has been referred to the Construction Manager or (5) the Claim relates to a mechanic's lien.

10.3 Time Limits on Claims. Claims by either party must be made within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be made by written notice. An additional Claim made after the initial Claim has been implemented by Change Order will not be considered unless submitted in a timely manner.

10.4 Continuing Contract Performance. Pending final resolution of a Claim including arbitration, unless otherwise agreed in writing the Subcontractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

10.5 Waiver of Claims: Final Payment. The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

10.5.1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

10.5.2 failure of the Work to comply with the requirements of the Contract Documents;
or

10.5.3 terms of special warranties required by the Contract Documents.

- 10.6 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Construction Manager will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Subcontractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Construction Manager determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Construction Manager shall so notify the Owner and Subcontractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the Construction Manager has given notice of the decision. If the Owner and Subcontractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Construction Manager for initial determination, subject to further proceedings pursuant to Paragraph 11.0.
- 10.7 Claims for Additional Cost. If the Subcontractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 2.22. If the Subcontractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Construction Manager, (2) an order by the Owner to stop the Work where the Subcontractor was not at fault, (3) a written order for a minor change in the Work issued by the Construction Manager, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with the procedure established herein.
- 10.8 Claims for Additional Time.
- 10.8.1 If the Subcontractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Subcontractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.
- 10.8.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions had an adverse effect on the scheduled construction.
- 10.9 Injury or Damage to Person or Property. If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a Claim for additional cost or time related to this Claim is to be asserted, it shall be filed as provided in Subparagraphs 10.7 or 10.8.

11.0 Resolution of Claims and Disputes

- 11.1 The Construction Manager will review claims and take on or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Construction Manager expects to take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the claim by the other party or (5) suggest a compromise. The Construction Manager may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.
- 11.2 If a Claim has been resolved, the Construction Manager will prepare or obtain appropriate documentation.
- 11.3 If a claim has not been resolved, the party making the Claim shall, within ten days after the Construction Manager's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Construction Manager, (2) modify the initial Claim or (3) notify the Construction Manager that the initial Claim stands.
- 11.4 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Construction Manager, the Construction Manager will notify the parties in writing that the Construction Manager's decision will be made within seven days, which decision shall be final and binding on the parties but subject to arbitration. Upon expiration of such time period, the Construction Manager will render to the parties the Construction Manager's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be possibility of a Subcontractor's default, the Construction Manager may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

12.0 Arbitration

- 12.1 Controversies and Claims Subject to Arbitration. Any controversy or Claim arising out of or related to the contract, or the breach thereof, shall be settled by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association, and judgment upon the award rendered by the arbitrator or arbitrators may be entered in any court having jurisdiction thereof, except controversies or Claims relating to aesthetic effect and except those waived as provided for in Subparagraph 10.5. Such controversies or Claims upon which the Construction Manager has given notice and rendered a decision as provided in Subparagraph 11.4 shall be subject to arbitration upon written demand of either party. Arbitration may be commenced when 45 days have passed after a Claim has been referred to the Construction Manager as provided in Paragraph 10.0 and no decision has been rendered.
- 12.2 Rules and Notices for Arbitration. Claims between the Owner and Subcontractor not resolved under Paragraph 11.0 shall, if subject to arbitration under Subparagraph 12.1, be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect, unless the parties mutually agree otherwise. Notice of demand for arbitration shall be filed in writing with the other party to the Agreement between the Owner and Subcontractor and with the American Arbitration Association, and a copy shall be filed with the Construction Manager.
- 12.3 Contract Performance During Arbitration. During arbitration proceedings, the Owner and Subcontractor shall comply with Subparagraph 10.4.

DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS
SECTION 00201 - GENERAL PROVISIONS

- 12.4 When Arbitration May Be Demanded. Demand for arbitration of any Claim may not be made until the earlier of (1) the date of which the Construction Manager has rendered a final written decision on the Claim, (2) the tenth day after the parties have presented evidence to the Construction Manager or have been given reasonable opportunity to do so, if the Construction Manager has not rendered a final written decision by that date, or (3) any of the five events described in Subparagraph 10.2.
- 12.5 When a written decision of the Construction Manager states that (1) the decision is final but subject to arbitration and (2) a demand for arbitration of a Claim covered by such decision must be made within 30 days after the date on which the party making the demand receives the final written decision, then failure to demand arbitration within said 30 days' period shall result in the Construction Manager's decision becoming final and binding upon the Owner and Subcontractor. If the Construction Manager renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence, but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.
- 12.6 A demand for arbitration shall be made within the time limits specified in Subparagraphs 12.1 and 12.4 and clause 12.5 as applicable, and in other cases within a reasonable time after the Claim has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Paragraph 15.0.
- 12.7 Limitation on Consolidation or Joinder. No arbitration arising out of or relating to the Contract Documents shall include, but consolidation or joinder or in any other manner, the Construction Manager, the Construction Manager's employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Construction Manager, Owner, Subcontractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Subcontractor, a separate Subcontractor and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Subcontractor or a separate Subcontractor shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a dispute not described therein or with a person or entity not named or described therein. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.
- 12.8 Claims and Timely Assertion of Claims. A party who files a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded. When a party fails to include a Claim through oversight, inadvertence or excusable neglect or when a Claim has matured or been acquired subsequently, the arbitrator or arbitrators may permit amendment.
- 12.9 Judgment on Final Award. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

13.0 Uncovering and Correction of Work

13.1 Uncovering of Work

13.1.1 If a portion of the Work is covered contrary to the Construction Manager's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Construction Manager, be uncovered for the Construction Manager's observation and be replaced at the Subcontractor's expense without change in the Contract Time.

13.1.2 If a portion of the Work has been covered which the Construction Manager has not specifically requested to observe prior to its being covered, the Construction Manager may request to see such Work and it shall be uncovered by the subcontractor. If such Work is in accordance with the Subcontract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Subcontractor shall pay such costs unless the condition was caused by the Owner or separate contractor in which event the Owner shall be responsible for payment of such costs.

13.2 Correction of Work

13.2.1 The Subcontractor shall promptly correct Work rejected by the Construction Manager or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Subcontractor shall bear costs of correcting such rejected Work, including additional testing and inspections and compensation for the Construction Manager's services and expenses made necessary thereby.

13.2.2 If, within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Subcontract Documents, the Subcontractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Subcontractor a written acceptance of such condition. This period of one year shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation under Subparagraph 13.2.2 shall survive acceptance of the Work under the Subcontract and termination of the Subcontract. The Owner shall give such notice promptly after discovery of the condition.

13.2.3 The Subcontractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Subcontract Documents and are neither corrected by the Subcontractor nor accepted by the Owner.

13.2.4 If the Subcontractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Paragraph 3.5. If the Subcontract does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Construction Manager, the Owner may remove it and store the salvable materials or equipment at the Subcontractor's expense. If the Subcontractor does not pay costs of such removal and storage within ten days after written notice, the Owner may upon ten additional days' written notice, sell such materials and equipment at auction or at

private sale and shall account for the proceeds thereof, after deducting costs and damages that should have been borne by the Subcontractor, including compensation for the Construction Manager's services and expenses made necessary thereby. If such proceeds of sale do not cover costs which the Subcontractor should have borne, the Subcontract Sum shall be reduced by the deficiency. If payments then or thereafter due the Subcontractor are not sufficient to cover such amount, the Subcontractor shall pay the difference to the Owner.

13.2.5 The Subcontractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Subcontractor's correction or removal of Work which is not in accordance with the requirements of the Subcontract Documents.

13.2.6 Nothing contained in this paragraph 13.2 shall be construed to establish a period of limitation with respect to other obligations which the Subcontractor might have under the Subcontract Documents. Establishment of the time period of one year as described in Subparagraph 13.2.2 related only the specific obligation of the Subcontractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Subcontract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Subcontractor's liability with respect to the Subcontractor's obligations other than specifically to correct the Work.

13.3 Acceptance of Nonconforming Work

13.3.1 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

14.0 **Miscellaneous**

14.1 Successors and Assigns. The Subcontract shall be binding on the successors, assigns, and legal representatives of Subcontractor and Construction Manager. Subcontractor shall not assign, sublet or transfer an interest in the Subcontract without the written consent of Construction Manager, nor shall Subcontractor assign any moneys due or to become due hereunder without the previous written consent of Construction Manager.

14.2 Severability and Waiver. The partial or complete invalidity of any one or more provisions of the Subcontract shall not affect the validity or continuing force and effect of any other provision. The failure of Construction Manager to insist, in any one or more instances, upon the performance of any of the terms and conditions of the Subcontract, or to exercise any right herein, shall not be construed as a waiver or relinquishment of such terms, conditions or rights.

14.3 Governing Law. The Subcontract shall be governed by the law of Illinois.

14.4 Notice. Any notice required shall be written and sent to each party's local business address. Notice is effective on the date of receipt.

14.5 Independent Subcontractor. Subcontractor is an independent Subcontractor. No contractual relationship shall exist between Owner and Subcontractor.

14.6 Titles. The title given to the Articles, sections, or paragraphs of the Subcontract are for reference only and shall not be relied upon or cited for any other purpose.

15.0 Commencement of Statutory Limitation Period

15.1 As between the Owner and Subcontractor:

15.1.1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

15.1.2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and

15.1.3 After Final Certificate for Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Subcontractor pursuant to any warranty provided under Paragraph 2.24, the date of any correction of the Work or failure to correct the Work by the Subcontractor under Paragraph 13.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Subcontractor or Owner, whichever occurs last.

16.0 Harmony Clause

16.1 All Subcontractors agree that no labor dispute of any kind involving any Subcontractor, or their employees or agents shall be permitted to occur or be manifested on the Project and the Subcontractors agree to that end to only employ persons on the Work who will work at all times in harmony with other persons employed on the Project.

16.2 The Subcontractors agree that their employees shall not participate in or accede to any work stoppage, slow down or any type of interference with the performance of work by other persons on the project which may occur as a result of any labor dispute involving their employees.

16.3 Should there be a work stoppage, slow down or any type of interference with the performance or work on the project involving the Subcontractor or his employees resulting from a labor dispute and which in the judgment of the Construction Manager will cause, or threatens to cause delay in the progress of construction, then upon twenty-four (24) hours written notice the Construction Manager shall have the right to declare the Subcontractor in default under this Contract and take such steps as are necessary to finish the uncompleted portion of the Work. In such event the Construction Manager shall have the right to take possession of and use all of the Subcontractor's materials (exclusive of tools) intended for use on the Work. The cost of completion including all expenses, attorney's fees and costs incurred in resolving the labor dispute shall be charged against the Subcontractor's remaining interest in the Contract amount.

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SECTION 00201 - GENERAL PROVISIONS

- 16.4 Should the Subcontractor(s) become involved in a labor dispute resulting in a work stoppage, slow down or any type of interference with progress of construction and resulting in an increase in interest charges to the Construction Manager, the Subcontractor(s) shall be liable to the Construction Manager for this increased cost. If the Subcontractor's remaining interest in the Contract amount exceeds cost of completion, the Subcontractor(s) agree to pay the Construction Manager such excess within thirty (30) days after written demand for such excess has been made upon him by the Construction Manager.
- 16.5 Harmony clause provisions similar to the provisions of the immediately preceding paragraphs shall be included in any of the Subcontractor's subcontracts relating to the Work.

END SECTION 00201

DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS
SECTION 00280 - PREVAILING WAGE RATES

PREVAILING RATE OF WAGES

- 0.1 Pursuant to Public Act 86-799, these specifications list on the following pages, the Illinois Department of Labor prevailing rate of wages for the county where the contract is being performed and for each craft or type of worker needed to execute the contract.

Attached is a copy of the latest available prevailing wage rates from the State of Illinois web site. Contractor is required to be current with and pay the current prevailing wage rates in effect for this project.

Du Page County Prevailing Wage for July 2015

(See explanation of column headings at bottom of wages)

Trade Name	RG	TYP	C	Base	FRMAN	M-F>8	OSA	OSH	H/W	Pensn	Vac	Trng
ASBESTOS ABT-GEN		ALL		39.400	39.950	1.5	1.5	2.0	13.98	10.72	0.000	0.500
ASBESTOS ABT-MEC		BLD		36.340	38.840	1.5	1.5	2.0	11.47	10.96	0.000	0.720
BOILERMAKER		BLD		47.070	51.300	2.0	2.0	2.0	6.970	18.13	0.000	0.400
BRICK MASON		BLD		43.780	48.160	1.5	1.5	2.0	10.05	14.43	0.000	1.030
CARPENTER		ALL		44.350	46.350	1.5	1.5	2.0	11.79	16.39	0.000	0.630
CEMENT MASON		ALL		43.750	45.750	2.0	1.5	2.0	13.05	14.45	0.000	0.480
CERAMIC TILE FNSHER		BLD		36.810	0.000	1.5	1.5	2.0	10.55	9.230	0.000	0.770
COMMUNICATION TECH		BLD		32.650	34.750	1.5	1.5	2.0	9.550	15.16	1.250	0.610
ELECTRIC PWR EQMT OP		ALL		37.890	51.480	1.5	1.5	2.0	5.000	11.75	0.000	0.380
ELECTRIC PWR EQMT OP		HWY		39.220	53.290	1.5	1.5	2.0	5.000	12.17	0.000	0.390
ELECTRIC PWR GRNDMAN		ALL		29.300	51.480	1.5	1.5	2.0	5.000	9.090	0.000	0.290
ELECTRIC PWR GRNDMAN		HWY		30.330	53.290	1.5	1.5	2.0	5.000	9.400	0.000	0.300
ELECTRIC PWR LINEMAN		ALL		45.360	51.480	1.5	1.5	2.0	5.000	14.06	0.000	0.450
ELECTRIC PWR LINEMAN		HWY		46.950	53.290	1.5	1.5	2.0	5.000	14.56	0.000	0.470
ELECTRIC PWR TRK DRV		ALL		30.340	51.480	1.5	1.5	2.0	5.000	9.400	0.000	0.300
ELECTRIC PWR TRK DRV		HWY		31.400	53.290	1.5	1.5	2.0	5.000	9.730	0.000	0.310
ELECTRICIAN		BLD		38.160	41.980	1.5	1.5	2.0	9.550	18.29	4.680	0.680
ELEVATOR CONSTRUCTOR		BLD		50.800	57.150	2.0	2.0	2.0	13.57	14.21	4.060	0.600
FENCE ERECTOR	NE	ALL		37.340	39.340	1.5	1.5	2.0	13.05	12.06	0.000	0.300
FENCE ERECTOR	W	ALL		45.060	48.660	2.0	2.0	2.0	10.52	20.76	0.000	0.700
GLAZIER		BLD		40.500	42.000	1.5	2.0	2.0	13.14	16.99	0.000	0.940
HT/FROST INSULATOR		BLD		48.450	50.950	1.5	1.5	2.0	11.47	12.16	0.000	0.720
IRON WORKER	E	ALL		44.200	46.200	2.0	2.0	2.0	13.65	21.14	0.000	0.350
IRON WORKER	W	ALL		45.060	48.660	2.0	2.0	2.0	10.52	20.76	0.000	0.700
LABORER		ALL		39.200	39.950	1.5	1.5	2.0	13.98	10.72	0.000	0.500
LATHER		ALL		44.350	46.350	1.5	1.5	2.0	11.79	16.39	0.000	0.630
MACHINIST		BLD		45.350	47.850	1.5	1.5	2.0	7.260	8.950	1.850	0.000
MARBLE FINISHERS		ALL		32.400	34.320	1.5	1.5	2.0	10.05	13.75	0.000	0.620
MARBLE MASON		BLD		43.030	47.330	1.5	1.5	2.0	10.05	14.10	0.000	0.780
MATERIAL TESTER I		ALL		29.200	0.000	1.5	1.5	2.0	13.98	10.72	0.000	0.500
MATERIALS TESTER II		ALL		34.200	0.000	1.5	1.5	2.0	13.98	10.72	0.000	0.500
MILLWRIGHT		ALL		44.350	46.350	1.5	1.5	2.0	11.79	16.39	0.000	0.630
OPERATING ENGINEER		BLD 1		48.100	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		BLD 2		46.800	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		BLD 3		44.250	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		BLD 4		42.500	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		BLD 5		51.850	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		BLD 6		49.100	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		BLD 7		51.100	52.100	2.0	2.0	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		FLT		36.000	36.000	1.5	1.5	2.0	17.10	11.80	1.900	1.250
OPERATING ENGINEER		HWY 1		46.300	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		HWY 2		45.750	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		HWY 3		43.700	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		HWY 4		42.300	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		HWY 5		41.100	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		HWY 6		49.300	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
OPERATING ENGINEER		HWY 7		47.300	50.300	1.5	1.5	2.0	17.55	12.65	1.900	1.250
ORNAMNTL IRON WORKER E		ALL		45.000	47.500	2.0	2.0	2.0	13.55	17.94	0.000	0.650
ORNAMNTL IRON WORKER W		ALL		45.060	48.660	2.0	2.0	2.0	10.52	20.76	0.000	0.700
PAINTER		ALL		41.730	43.730	1.5	1.5	1.5	10.30	8.200	0.000	1.350
PAINTER SIGNS		BLD		33.920	38.090	1.5	1.5	1.5	2.600	2.710	0.000	0.000
PILEDRIVER		ALL		44.350	46.350	1.5	1.5	2.0	11.79	16.39	0.000	0.630
PIPEFITTER		BLD		46.000	49.000	1.5	1.5	2.0	9.000	15.85	0.000	1.780
PLASTERER		BLD		43.430	46.040	1.5	1.5	2.0	10.05	14.43	0.000	1.020
PLUMBER		BLD		46.650	48.650	1.5	1.5	2.0	13.18	11.46	0.000	0.880
ROOFER		BLD		41.000	44.000	1.5	1.5	2.0	8.280	10.54	0.000	0.530
SHEETMETAL WORKER		BLD		44.720	46.720	1.5	1.5	2.0	10.65	13.31	0.000	0.820
SPRINKLER FITTER		BLD		49.200	51.200	1.5	1.5	2.0	11.75	9.650	0.000	0.550
STEEL ERECTOR	E	ALL		42.070	44.070	2.0	2.0	2.0	13.45	19.59	0.000	0.350
STEEL ERECTOR	W	ALL		45.060	48.660	2.0	2.0	2.0	10.52	20.76	0.000	0.700
STONE MASON		BLD		43.780	48.160	1.5	1.5	2.0	10.05	14.43	0.000	1.030
SURVEY WORKER												
SURVEY WORKER												
TERRAZZO FINISHER		BLD		38.040	0.000	1.5	1.5	2.0	10.55	11.22	0.000	0.720
TERRAZZO MASON		BLD		41.880	44.880	1.5	1.5	2.0	10.55	12.51	0.000	0.940

TILE MASON	BLD	43.840	47.840	1.5	1.5	2.0	10.55	11.40	0.000	0.990
TRAFFIC SAFETY WRKR	HWY	32.750	34.350	1.5	1.5	2.0	6.550	6.450	0.000	0.500
TRUCK DRIVER	ALL 1	35.920	36.120	1.5	1.5	2.0	8.280	8.760	0.000	0.150
TRUCK DRIVER	ALL 2	32.700	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.150
TRUCK DRIVER	ALL 3	32.900	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.150
TRUCK DRIVER	ALL 4	33.100	33.100	1.5	1.5	2.0	6.500	4.350	0.000	0.150
TUCKPOINTER	BLD	42.620	43.620	1.5	1.5	2.0	10.05	13.34	0.000	0.670

Legend: RG (Region)
 TYP (Trade Type - All, Highway, Building, Floating, Oil & Chip, Rivers)
 C (Class)
 Base (Base Wage Rate)
 FRMAN (Foreman Rate)
 M->8 (OT required for any hour greater than 8 worked each day, Mon through Fri.)
 OSA (Overtime (OT) is required for every hour worked on Saturday)
 OSH (Overtime is required for every hour worked on Sunday and Holidays)
 H/W (Health & Welfare Insurance)
 Pensn (Pension)
 Vac (Vacation)
 Trng (Training)

Explanations

DUPAGE COUNTY

IRON WORKERS AND FENCE ERECTOR (WEST) - West of Route 53.

The following list is considered as those days for which holiday rates of wages for work performed apply: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day and Veterans Day in some classifications/counties. Generally, any of these holidays which fall on a Sunday is celebrated on the following Monday. This then makes work performed on that Monday payable at the appropriate overtime rate for holiday pay. Common practice in a given local may alter certain days of celebration. If in doubt, please check with IDOL.

EXPLANATION OF CLASSES

ASBESTOS - GENERAL - removal of asbestos material/mold and hazardous materials from any place in a building, including mechanical systems where those mechanical systems are to be removed. This includes the removal of asbestos materials/mold and hazardous materials from ductwork or pipes in a building when the building is to be demolished at the time or at some close future date.

ASBESTOS - MECHANICAL - removal of asbestos material from mechanical systems, such as pipes, ducts, and boilers, where the mechanical systems are to remain.

TRAFFIC SAFETY - work associated with barricades, horses and drums used to reduce lane usage on highway work, the installation and removal of temporary lane markings, and the installation and removal of temporary road signs.

CERAMIC TILE FINISHER

The grouting, cleaning, and polishing of all classes of tile, whether for interior or exterior purposes, all burned, glazed or unglazed products; all composition materials, granite tiles, warning detectable tiles, cement tiles, epoxy composite materials, pavers, glass, mosaics, fiberglass, and all substitute materials, for tile made in tile-like units; all mixtures in tile like form of cement, metals, and other materials that are for and intended for use as a finished floor surface, stair treads, promenade roofs, walks, walls, ceilings, swimming pools, and all other places where tile is to form a finished interior or exterior. The mixing of all setting mortars including but not limited to thin-set mortars, epoxies, wall mud, and any other sand and cement mixtures or adhesives when used in the preparation, installation, repair, or maintenance of tile and/or similar materials. The handling and unloading of all sand, cement, lime, tile, fixtures, equipment, adhesives, or any other materials to be used in the preparation, installation, repair, or maintenance of tile and/or similar materials. Ceramic Tile Finishers shall fill all joints and voids regardless of method on all tile work, particularly and especially after installation of said tile work. Application of any and all protective coverings to all types of tile installations including, but not be limited to, all soap compounds, paper products, tapes, and all polyethylene coverings, plywood, masonite, cardboard, and any new type of products that may be used to protect tile installations, Blastrac equipment, and all floor scarifying equipment used in preparing floors to receive tile. The clean up and removal of all waste and materials. All demolition of existing tile floors and walls to be re-tiled.

COMMUNICATIONS TECHNICIAN

Low voltage installation, maintenance and removal of telecommunication facilities (voice, sound, data and video) including telephone and data inside wire, interconnect, terminal equipment, central offices, PABX, fiber optic cable and equipment, micro waves, V-SAT, bypass, CATV, WAN (wide area networks), LAN (local area networks), and ISDN (integrated system digital network), pulling of wire in raceways, but not the installation of raceways.

MARBLE FINISHER

Loading and unloading trucks, distribution of all materials (all stone, sand, etc.), stocking of floors with material, performing all rigging for heavy work, the handling of all material that may be needed for the installation of such materials, building of scaffolding, polishing if needed, patching, waxing of material if damaged, pointing up, caulking, grouting and cleaning of marble, holding water on diamond or Carborundum blade or saw for setters cutting, use of tub saw or any other saw needed for preparation of material, drilling of holes for wires that anchor material set by setters, mixing up of molding plaster for installation of material, mixing up thin set for the installation of material, mixing up of sand to cement for the installation of material and such other work as may be required in helping a Marble Setter in the handling of all material in the erection or installation of interior marble, slate, travertine, art marble, serpentine, alberene stone, blue stone, granite and other stones (meaning as to stone any foreign or domestic materials as are specified and used in building interiors and exteriors and customarily known as stone in the trade), carrara, sanionyx, vitrolite and similar opaque glass and the laying of all marble tile, terrazzo tile, slate tile and precast tile, steps, risers treads, base, or any other materials that may be used as substitutes for any of the aforementioned materials and which are used on interior and exterior which are installed in a similar manner.

MATERIAL TESTER I: Hand coring and drilling for testing of materials; field inspection of uncured concrete and asphalt.

MATERIAL TESTER II: Field inspection of welds, structural steel, fireproofing, masonry, soil, facade, reinforcing steel, formwork, cured concrete, and concrete and asphalt batch plants; adjusting proportions of bituminous mixtures.

OPERATING ENGINEER - BUILDING

Class 1. Asphalt Plant; Asphalt Spreader; Autograde; Backhoes with Caisson Attachment; Batch Plant; Benoto (requires Two Engineers); Boiler and Throttle Valve; Caisson Rigs; Central Redi-Mix Plant; Combination Back Hoe Front End-loader Machine; Compressor and Throttle Valve; Concrete Breaker (Truck Mounted); Concrete Conveyor; Concrete Conveyor (Truck Mounted); Concrete Paver Over 27E cu. ft.; Concrete Paver 27E cu. ft. and Under; Concrete Placer; Concrete Placing Boom; Concrete Pump (Truck Mounted); Concrete Tower; Cranes, All; Cranes, Hammerhead; Cranes, (GCI and similar Type); Creter Crane; Spider Crane; Crusher, Stone, etc.; Derricks, All; Derricks, Traveling; Formless Curb and Gutter Machine; Grader, Elevating; Grouting Machines; Heavy Duty Self-Propelled Transporter or Prime Mover; Highlift Shovels or Front Endloader 2-1/4 yd. and over; Hoists, Elevators, outside type rack and pinion and similar machines; Hoists, One, Two and Three Drum; Hoists, Two Tugger One Floor; Hydraulic Backhoes; Hydraulic Boom Trucks; Hydro Vac (and similar equipment); Locomotives, All; Motor Patrol; Lubrication Technician; Manipulators; Pile Drivers and Skid Rig; Post Hole Digger; Pre-Stress Machine; Pump Cretes Dual Ram; Pump Cretes: Squeeze Cretes-Screw Type Pumps; Gypsum Bulker and Pump; Raised and Blind Hole Drill; Roto Mill Grinder; Scoops - Tractor Drawn; Slip-Form Paver; Straddle Buggies; Operation of Tie Back Machine; Tournapull; Tractor with Boom and Side Boom; Trenching Machines.

Class 2. Boilers; Broom, All Power Propelled; Bulldozers; Concrete Mixer (Two Bag and Over); Conveyor, Portable; Forklift Trucks; Highlift Shovels or Front Endloaders under 2-1/4 yd.; Hoists, Automatic; Hoists, Inside Elevators; Hoists, Sewer Dragging Machine; Hoists, Tugger Single Drum; Laser Screed; Rock Drill (Self-Propelled); Rock Drill (Truck Mounted); Rollers, All; Steam Generators; Tractors, All; Tractor Drawn Vibratory Roller; Winch Trucks with "A" Frame.

Class 3. Air Compressor; Combination Small Equipment Operator; Generators; Heaters, Mechanical; Hoists, Inside Elevators (remodeling or renovation work); Hydraulic Power Units (Pile Driving, Extracting, and Drilling); Pumps, over 3" (1 to 3 not to exceed a total of 300 ft.); Low Boys; Pumps, Well Points; Welding Machines (2 through 5); Winches, 4 Small Electric Drill Winches.

Class 4. Bobcats and/or other Skid Steer Loaders; Oilers; and Brick Forklift.

Class 5. Assistant Craft Foreman.

Class 6. Gradall.

Class 7. Mechanics; Welders.

OPERATING ENGINEERS - HIGHWAY CONSTRUCTION

Class 1. Asphalt Plant; Asphalt Heater and Planer Combination; Asphalt Heater Scarfire; Asphalt Spreader; Autograder/GOMACO or other similar type machines: ABG Paver; Backhoes with Caisson Attachment; Ballast Regulator; Belt Loader; Caisson Rigs; Car Dumper; Central Redi-Mix Plant; Combination Backhoe Front Endloader Machine, (1 cu. yd. Backhoe Bucket or over or with attachments); Concrete Breaker (Truck Mounted); Concrete Conveyor; Concrete Paver over 27E cu. ft.; Concrete Placer; Concrete Tube Float; Cranes, all attachments; Cranes, Tower Cranes of all types: Creter Crane; Spider Crane; Crusher, Stone, etc.; Derricks, All; Derrick Boats; Derricks, Traveling; Dredges; Elevators, Outside type Rack & Pinion and Similar Machines; Formless Curb and Gutter Machine; Grader, Elevating; Grader, Motor Grader, Motor Patrol, Auto Patrol, Form Grader, Pull Grader, Subgrader; Guard Rail Post Driver Truck Mounted; Hoists, One, Two and Three Drum; Heavy Duty Self-Propelled Transporter or Prime Mover; Hydraulic Backhoes; Backhoes with shear attachments up to 40' of boom reach; Lubrication Technician; Manipulators; Mucking Machine; Pile Drivers and Skid Rig; Pre-Stress Machine; Pump Cretes Dual Ram; Rock Drill - Crawler or Skid Rig; Rock Drill - Truck Mounted; Rock/Track Tamper; Roto Mill Grinder; Slip-Form Paver; Snow Melters; Soil Test Drill Rig (Truck Mounted); Straddle Buggies; Hydraulic Telescoping Form (Tunnel); Operation of Tieback Machine; Tractor Drawn Belt Loader; Tractor Drawn Belt Loader (with attached pusher - two engineers); Tractor with Boom; Tractaire with Attachments; Traffic Barrier Transfer Machine; Trenching; Truck Mounted Concrete Pump with Boom; Raised or Blind Hole Drills (Tunnel Shaft); Underground Boring and/or Mining Machines 5 ft. in diameter and over tunnel, etc; Underground Boring and/or Mining Machines under 5 ft. in diameter; Wheel Excavator; Widener (APSCO).

Class 2. Batch Plant; Bituminous Mixer; Boiler and Throttle Valve; Bulldozers; Car Loader Trailing Conveyors; Combination Backhoe Front Endloader Machine (Less than 1 cu. yd. Backhoe Bucket or over or with attachments); Compressor and Throttle Valve; Compressor, Common Receiver (3); Concrete Breaker or Hydro Hammer; Concrete Grinding Machine; Concrete Mixer or Paver 7S Series to and including 27 cu. ft.; Concrete Spreader; Concrete Curing Machine, Burlap Machine, Belting Machine and Sealing Machine; Concrete Wheel Saw; Conveyor Muck Cars (Haglund or Similar Type); Drills, All; Finishing Machine - Concrete; Highlift Shovels or Front Endloader; Hoist - Sewer Dragging Machine; Hydraulic Boom Trucks (All Attachments); Hydro-Blaster; Hydro Excavating (excluding hose work); Laser Screed; All Locomotives, Dinky; Off-Road Hauling Units (including articulating) Non Self-Loading Ejection Dump; Pump Cretes: Squeeze Cretes - Screw Type Pumps, Gypsum Bulker and Pump; Roller, Asphalt; Rotary Snow Plows; Rototiller, Seaman, etc., self-propelled; Self-Propelled Compactor; Spreader - Chip - Stone, etc.; Scraper - Single/Twin Engine/Push and Pull; Scraper - Prime Mover in Tandem (Regardless of Size); Tractors pulling attachments, Sheeps Foot, Disc, Compactor, etc.; Tug Boats.

Class 3. Boilers; Brooms, All Power Propelled; Cement Supply Tender; Compressor, Common Receiver (2); Concrete Mixer (Two Bag and Over); Conveyor, Portable; Farm-Type Tractors Used for Mowing, Seeding, etc.; Forklift Trucks; Grouting Machine; Hoists, Automatic; Hoists, All Elevators; Hoists, Tugger Single Drum; Jeep Diggers; Low Boys; Pipe Jacking Machines; Post-Hole Digger; Power Saw, Concrete Power Driven; Pug Mills; Rollers, other than Asphalt; Seed and Straw Blower; Steam Generators; Stump Machine; Winch Trucks with "A" Frame; Work Boats; Tamper-Form-Motor Driven.

Class 4. Air Compressor; Combination - Small Equipment Operator; Directional Boring Machine; Generators; Heaters, Mechanical; Hydraulic Power Unit (Pile Driving, Extracting, or Drilling); Light Plants, All (1 through 5); Pumps, over 3" (1 to 3 not to exceed a total of 300 ft.); Pumps, Well Points; Vacuum Trucks (excluding hose work); Welding Machines (2 through 5); Winches, 4 Small Electric Drill Winches.

Class 5. SkidSteer Loader (all); Brick Forklifts; Oilers.

Class 6. Field Mechanics and Field Welders

Class 7. Dowell Machine with Air Compressor; Gradall and machines of like nature.

OPERATING ENGINEER - FLOATING

Diver. Diver Wet Tender, Diver Tender, ROV Pilot, ROV Tender

SURVEY WORKER - Operated survey equipment including data collectors, G.P.S. and robotic instruments, as well as conventional levels and transits.

TRUCK DRIVER - BUILDING, HEAVY AND HIGHWAY CONSTRUCTION

Class 1. Two or three Axle Trucks. A-frame Truck when used for transportation purposes; Air Compressors and Welding Machines, including those pulled by cars, pick-up trucks and tractors; Ambulances; Batch Gate Lockers; Batch Hopperman; Car and Truck Washers; Carry-alls; Fork Lifts and Hoisters; Helpers; Mechanics Helpers and Greasers; Oil Distributors 2-man operation; Pavement Breakers; Pole Trailer, up to 40 feet; Power Mower Tractors; Self-propelled Chip Spreader; Skipman; Slurry Trucks, 2-man operation; Slurry Truck Conveyor Operation, 2 or 3 man; Teamsters; Unskilled Dumpman; and Truck Drivers hauling warning lights, barricades, and portable toilets on the job site.

Class 2. Four axle trucks; Dump Crets and Adgetors under 7 yards; Dumpsters, Track Trucks, Euclids, Hug Bottom Dump Turnapulls or Turntrailers when pulling other than self-loading equipment or similar equipment under 16 cubic yards; Mixer Trucks under 7 yards; Ready-mix Plant Hopper Operator, and Winch Trucks, 2 Axles.

Class 3. Five axle trucks; Dump Crets and Adgetors 7 yards and over; Dumpsters, Track Trucks, Euclids, Hug Bottom Dump Turntrailers or turnapulls when pulling other than self-loading equipment or similar equipment over 16 cubic yards; Explosives and/or Fission Material Trucks; Mixer Trucks 7 yards or over; Mobile Cranes while in transit; Oil Distributors, 1-man operation; Pole Trailer, over 40 feet; Pole and Expandable Trailers hauling material over 50 feet long; Slurry trucks, 1-man operation; Winch trucks, 3 axles or more; Mechanic--Truck Welder and Truck Painter.

Class 4. Six axle trucks; Dual-purpose vehicles, such as mounted crane trucks with hoist and accessories; Foreman; Master Mechanic; Self-loading equipment like P.B. and trucks with scoops on the front.

TERRAZZO FINISHER

The handling of sand, cement, marble chips, and all other materials that may be used by the Mosaic Terrazzo Mechanic, and the mixing, grinding, grouting, cleaning and sealing of all Marble, Mosaic, and Terrazzo work, floors, base, stairs, and wainscoting by hand or machine, and in addition, assisting and aiding Marble, Masonic, and Terrazzo Mechanics.

Other Classifications of Work:

For definitions of classifications not otherwise set out, the Department generally has on file such definitions which are available. If a task to be performed is not subject to one of the classifications of pay set out, the Department will upon being contacted state which neighboring county has such a classification and provide such rate, such rate being deemed to exist by reference in this document. If no neighboring county rate applies to the task, the Department shall undertake a special determination, such special determination being then deemed to have existed under this determination. If a project requires these, or any classification not listed, please contact IDOL at 217-782-1710 for wage rates or clarifications.

LANDSCAPING

Landscaping work falls under the existing classifications for laborer, operating engineer and truck driver. The work performed by landscape plantsman and landscape laborer is covered by the existing classification of laborer. The work performed by landscape operators (regardless of equipment used or its size) is covered by the classifications of operating engineer. The work performed by landscape truck drivers (regardless of size of truck driven) is covered by the classifications of truck driver.

MATERIAL TESTER & MATERIAL TESTER/INSPECTOR I AND II

Notwithstanding the difference in the classification title, the classification entitled "Material Tester I" involves the same job duties as the classification entitled "Material Tester/Inspector I". Likewise, the classification entitled "Material Tester II" involves the same job duties as the classification entitled "Material Tester/Inspector II".

PART 1 GENERAL

1.1 SUMMARY

A. General Notes Pertaining to all and or specific Bid Packages:

Bid Pkg. #	Trade	Scope Item #	Scope – This Trade Contractor’s scope shall include but not be limited to the scope listed below. Please see entirety of bid documents for all scope.
ALL	ALL	0.1	Each Trade Contractor shall submit one fully executed copy of AIA Document A305 “Contractor’s Qualification Statement” prior to the bid due date as identified in the Notice to Bidders. Faxed submittals are acceptable. A305 document copies may be obtained from the Chicago AIA office located at 222 Merchandise Mart Plaza, Suite 1049, Chicago, IL 60654
ALL	ALL	0.2	Each Trade Contractor shall coordinate all on-site activities including but not limited to site access, site parking, deliveries, etc. with Wight Construction Services, Inc. on-site supervision.
ALL	ALL	0.3	ALL TRADE CONTRACTORS shall be responsible for keeping scrap and debris cleared from the construction site on a continuing basis. TRADE CONTRACTORS will be required to list their respective dollar value for clean up on the Schedule of Values Form G703 no later than 5 business days from the issuance of Notice to Proceed. Each TRADE CONTRACTOR providing work during any week period will be required to furnish DAILY cleanup personnel, for the needed time to clean the building as directed by the Construction Manager. If this cleanup is not completed to the satisfaction of the Construction Manager, the Construction Manager will contract clean up to be done, and the TRADE CONTRACTOR will be back-charged accordingly.
ALL	ALL	0.4	This Trade Contractor’s field personnel shall complete a safety orientation (managed by the Construction Manager; approximate duration is 1-hour) prior to any on-site activities. At a minimum, the Trade Contractor’s Project Manager and site foreman will be required to attend. If this Trade Contractor fails to attend this meeting on the specified date and time, the Trade Contractor will be charged for a separate orientation at the hourly billing rates for Wight Construction’s Safety Officer.
ALL	ALL	0.5	All Trade Contractors shall be responsible for safety for this portion of work. Provide all necessary scaffolding, handrails, ladders, equipment, etc. necessary to perform the described work. Comply with all O.S.H.A., local, state, or federal safety authorities having jurisdiction.
ALL	ALL	0.6	Each Trade Contractor shall exclude tax payment of Retailers’ Occupation Tax, the Service Occupation Tax (both state and local), the Use Tax and the Service Use Tax, as required by IL Law. The tax exempt letter for District 99 will be furnished to all of the successful bidders.
ALL	ALL	0.7	Control line surveying will be by others. All Trade Contractors shall protect and maintain all survey work by others. This Trade Contractor shall be responsible for all layout and in field measurements related to this Trade Contractor’s work and shall coordinate this layout work with the layout of adjacent work by others.
ALL	ALL	0.8	Each Trade Contractor shall conduct all contract related activities within the guidelines for phasing and scheduling established on this project. It is the responsibility of each Trade Contractor to review and accept, as part of contract, the regular and ongoing schedule updates on this project.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

ALL	ALL	0.9	<p>The industry rule of thumb term “Use is Acceptance” will be enforced.</p> <ul style="list-style-type: none"> a) When work is performed, it will be assumed this Trade Contractor has inspected and accepted the quality and coordination of the work of other trade contractors that this Trade Contractor is working on or against. b) Start of work by this Trade Contractor on top of or against any other surface means this Trade Contractor has accepted the quality and completeness of that surface. c) This Trade Contractor is responsible for preparing (i.e. cleaning) adjacent surfaces including but not limited to those surfaces completed by others prior to proceeding.
ALL	ALL	0.10	As defined by the American Institute of Architects, “the Contractor is the person or entity identified as such in the agreement and is referred to throughout the Contract as if singular in number. The term “Contractor” means the Contractor or the Contractor’s authorized agent.” Trade Contractor, Subcontractor, Sub-Tier Contractor or any derivative thereof shall are all considered synonymous with Contractor.
ALL	ALL	0.11	Each Trade Contractor shall complete the payment application Schedule of Values sheet including full disclosure and listing of each aspect of Trade Contractor’s work valued in excess of \$5,000, within 5 working days of the issuance of a Letter of Intent from Wight Construction.
ALL	ALL	0.12	ALL TRADE CONTRACTORS furnishing material for delivery and installation at any time on this project shall be responsible for the purchase and storage of that material at no additional cost to the Owner. Payment for off-site stored material will not be considered.
ALL	ALL	0.13	ALL TRADE CONTRACTORS shall promptly notify the Construction Manager of any damage caused to their work by another TRADE CONTRACTOR and shall be responsible to remedy their claim with the party causing the damage. Should the responsible party, within 24 hours’ notice, fail to remedy all damages or loss, the Construction Manager shall have the right to remedy the situation and the cost thereof will be back charged to the TRADE CONTRACTOR responsible for the damage or loss.

DIVISION 1 – GENERAL CONDITIONS
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ALL	ALL	0.14	<p>Performance Clause: All Trade Contractors shall at all times supply a sufficient number of jurisdictionally skilled workers to perform, with promptness and diligence, the work covered by contract. Should any workers performing work covered by contract engage in a strike, work stoppage and/or slowdown of any kind or cease to work because of picketing or a labor dispute of any kind, Construction Manager may, at its option and without prejudice to any other remedies it may have, after twenty-four (24) hours written notice to Contractor, provide any such labor and deduct the cost thereof from any moneys then due or thereafter to become due to Contractor. Further, Construction Manager may at its option, without prejudice to any other remedies it may have, terminate the employment of Contractor for work under this contract. Construction Manager shall have the right to enter upon the premises and take possession, for the purpose of completing the work hereunder, of all Contractors' materials, tools and equipment thereon. Further, Construction Manager may finish the work either with its own employees or those of other contractors. When terminated by Construction Manager, Contractor will not receive any further payments under the contract or otherwise. Contractor shall remain liable for any damages that Construction Manager incurs. If expenses incurred by Construction Manager, in completing the work, exceed the unpaid balance due Contractor, Contractor shall pay difference to Construction Manager. In addition, Construction Manager may collect other damages incurred as a result of Contractor's default. Construction Manager shall have a lien upon all on-site material, tools, equipment or other property of Contractor to secure payment thereof. In the event of any inconsistency between the provisions of the performance clause and any other provisions of the contract or the contract documents, the provisions for the performance clause shall prevail. Any provisions of the contract or the contract documents with respect to arbitration or determination of disputes arbitrator or others shall not apply to this performance clause.</p>
ALL	ALL	0.15	<p>If the work of this Trade Contractor is determined by Construction Manager to be deficient in any way this Trade Contractor understands and accepts that in-progress and/or completed work will be redone at the full expense of this Trade Contractor on a time line as established by Construction Manager.</p>
ALL	ALL	0.16	<p>Warranty will be executed upon substantial completion of the entire project. Based on the sequencing of work this Trade Contractor understands that portions of the work may be completed well in advance of this substantial completion date.</p>
ALL	ALL	0.17	<p>All TRADE CONTRACTORS are required to conduct a preliminary punch list walk through with the Construction Manager. TRADE CONTRACTORS will have an allotted time frame to complete deficiencies. TRADE CONTRACTOR is also required to conduct a final walk through with the Construction Manager and Owner and correct and complete those deficiencies within 2 weeks of final punch list. If the TRADE CONTRACTOR fails to complete punch list within allotted time frame, the Construction Manager reserves the right to hire a separate trade contractor to make the corrections to complete those punch list items not addressed and back charge the TRADE CONTRACTOR at the cost of the work.</p>
ALL	ALL	0.18	<p>It is the responsibility of each TRADE CONTRACTOR to assure that his respective area of construction is watertight and protected from the elements, as necessary and as a result of his work, throughout the construction period.</p>

DIVISION 1 – GENERAL CONDITIONS
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ALL	ALL	0.19	All drawings, specification sections, and scopes of work should be referenced for the extent of the work under all accounts.																	
ALL	ALL	0.20	Although Specifications are allocated to the respective "Scopes of Work", it is the intention of the Construction Manager that each TRADE CONTRACTOR read all Specification Sections, and that the Scopes of Work shall take precedence over any allocation of work made by the Architect.																	
ALL	ALL	0.21	All TRADE CONTRACTORS shall be responsible for repair of ruts and removal of trapped water on a continuous basis caused by the use of their motorized equipment.																	
ALL	ALL	0.22	All TRADE CONTRACTORS shall be responsible for damage caused by the use of their motorized lifts, rolling scaffold or other elevated type equipment used on the project.																	
ALL	ALL	0.23	All TRADE CONTRACTORS shall be responsible for cleaning mud and stone off of the tires and tracks of their vehicles and construction equipment prior to entering public roadways off of the project site.																	
ALL	ALL	0.24	All TRADE CONTRACTORS shall be responsible for submitting a work schedule for all of their work on the site within ten working days from of the issuance of a Letter of Intent from Wight Construction. This is to include all durations for each phase of work to be performed by this TRADE CONTRACTOR.																	
ALL	ALL	0.25	<p>It is hereby acknowledged that TRADE CONTRACTOR will provide the following insurance coverage as noted in the project manual:</p> <p>General Liability – Per Project Aggregate, including CG 2010 (11/85) or its equivalent language which is CG2010 (10/01) the CG2037 (10/01) and Waiver of Subrogation endorsement in favor of Additional Insured's</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">General aggregate per project</td> <td style="text-align: right;">\$2,000,000</td> </tr> <tr> <td style="padding-left: 20px;">Products/completed operations aggregate</td> <td style="text-align: right;">\$2,000,000</td> </tr> <tr> <td style="padding-left: 20px;">Personal and advertising injury</td> <td style="text-align: right;">\$1,000,000</td> </tr> <tr> <td style="padding-left: 20px;">Each occurrence</td> <td style="text-align: right;">\$1,000,000</td> </tr> </table> <p>Automobile Liability Insurance – In favor of additional insured's</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">Bodily Injury and Property Damage Each Accident</td> <td style="text-align: right;">\$1,000,000</td> </tr> </table> <p>Excess/Umbrella Liability Insurance – Per Occurrence, In favor of additional insured's</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">Aggregate</td> <td style="text-align: right;">\$5,000,000</td> </tr> <tr> <td style="padding-left: 20px;">Each occurrence</td> <td style="text-align: right;">\$5,000,000</td> </tr> </table> <p>Workman's Compensation – Including Waiver of Subrogation endorsement in favor of Additional Insured's</p> <table style="width: 100%; border: none;"> <tr> <td style="padding-left: 20px;">\$500,000 each accident Bodily Injury by Accident</td> </tr> <tr> <td style="padding-left: 20px;">\$500,000 policy limit Bodily Injury by Disease</td> </tr> <tr> <td style="padding-left: 20px;">\$500,000 each employee Bodily Injury by Disease</td> </tr> </table>	General aggregate per project	\$2,000,000	Products/completed operations aggregate	\$2,000,000	Personal and advertising injury	\$1,000,000	Each occurrence	\$1,000,000	Bodily Injury and Property Damage Each Accident	\$1,000,000	Aggregate	\$5,000,000	Each occurrence	\$5,000,000	\$500,000 each accident Bodily Injury by Accident	\$500,000 policy limit Bodily Injury by Disease	\$500,000 each employee Bodily Injury by Disease
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\$500,000 each accident Bodily Injury by Accident																				
\$500,000 policy limit Bodily Injury by Disease																				
\$500,000 each employee Bodily Injury by Disease																				
ALL	ALL	0.26	Each Trade Contractor shall be responsible for removal and disposal of their waste. All reporting of disposal shall follow spec. section 017419.																	
ALL	ALL	0.27	Pay Applications AND Waivers are to be submitted in original signature triplicates.																	
ALL	ALL	0.28	Provide sufficient equipment, material, skilled manpower, supervision and/or premium time/shift work (all without additional compensation) as may be required to complete the work of this Trade Contractor in accordance with the overall project substantial completion date. Reference Division 0 – Bidding and Contract Requirements, Section 01250 – Construction Schedule.																	
ALL	ALL	0.29	TRADE CONTRACTOR shall be prepared to meet within one week of bid opening to conduct scope reviews, provide submittal log and discuss award of contract.																	

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

ALL	ALL	0.30	Contact J.U.L.I.E. 72 hours minimum prior to any excavation work. Record and document all contact with J.U.L.I.E. including but not limited to Dig Number; present J.U.L.I.E. dig number and all other J.U.L.I.E. related documentation to the Construction Manager 24-hours minimum prior to any excavation. All these J.U.L.I.E. documentation shall be included as part of the close out documentation.
All	All	0.31	Weekly Certified Payroll Reports are required with monthly pay application. Certified Payroll reports are also required on any sub-tiers performing labor.
All	All	0.32	Contractors to provide all necessary signage to alert traffic or other of the work being performed and to provide all related traffic control items as shown on the drawings and/or contract documents. Any TRADE CONTRACTOR not adhering to the traffic control requirements will result in the Construction Manager bringing a flagger onsite at the cost of the TRADE CONTRACTOR(S).
All	All	0.33	All mobilizations and demobilizations related costs of this TRADE CONTRACTOR are to be included without consideration of additional compensation.
All	All	0.34	Change orders are required to be turned in no later than 15 days after the work has been completed and must be accompanied by a signed T&M ticket from the Superintendent. Change orders turned in later than 15 days and/or not accompanied by signed T&M ticket will be subject to rejection.
All	All	0.35	All TRADE CONTRACTORS shall be responsible for his/her for any temporary power needed by that TRADE CONTRACTOR
All	All	0.36	All TRADE CONTRACTORS shall be responsible for the coordination with all other contractors through the Wight Superintendent to achieve final result
All	All	0.37	IT IS THE RESPONSIBILITY OF EACH TRADE CONTRACTOR TO READ THE SCOPES OF WORK FOR ALL TRADES.
All	All	0.38	All TRADE CONTRACTORS must wear High visibility shirts or a high visibility vest at all times. Hard hats and safety glasses must be worn at all times.
All	All	0.39	Each trade contractor must sign in and sign out on the sign-in sheet located in the jobsite trailer every day.
All	All	0.40	Daily Reports are required by trade contractors each day by 8am to the project superintendent in the jobsite trailer. Weekly Tool Box talks will be provided by Superintendent and are to be returned the following day in the jobsite trailer.
All	All	0.41	All trade contractors are required to submit Job Hazard Analysis and method statements as required by the construction manager.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

01	Demolition	01.01	This TRADE CONTRACTOR shall be responsible for taking appropriate measures to protect existing conditions including but not necessary limited to perimeter landscaping, fencing, curbs, gutters, electrical transformers, parking lot surfaces, drives and walks, roofs, buildings, etc. from damage that may be caused by this work.
01	Demolition	01.02	This TRADE CONTRACTOR shall be responsible for all layout work, measuring and field dimensioning associated with this Trade Contractor's work.
01	Demolition	01.03	This TRADE CONTRACTOR shall be responsible for shop drawing and submittals preparation as specified in the project manual.
01	Demolition	01.04	This TRADE CONTRACTOR shall be responsible for applications, inspection coordination, scheduling, testing and all things required for satisfying the requirements of local code enforcement inspection services. This trade contractor to submit verification of conversations, inspections, and/or approvals to Design/Builder within 72 hours of said occurrence.
01	Demolition	01.05	This TRADE CONTRACTOR is responsible for: <ul style="list-style-type: none"> -Coordinate with Design/Builder as required for the work of other contractors impacted and/or otherwise affected by the work of this TRADE CONTRACTOR. -Attend any and all meetings as directed by Design/Builder including but not necessarily limited to pre-construction, coordination (weekly or otherwise), safety, pay-out application, close-out, etc. -Perform selective demolition using methods, which are least likely to damage work to remain, and which will provide surfaces for patching. -Pollution Control. -Noise Control.
01	Demolition	01.06	Remove and legally dispose of all debris as required and indicated on the drawings including but not limited to buildings and miscellaneous equipment. This is to include all masonry, door frames and walls as shown on the drawings.
01	Demolition	01.07	Remove and legally dispose of all light fixtures, associated flexible conduit , conduits, boxes and electrical equipment as required and as indicated on the drawings. Disconnection and identification of all electrical components will be by others.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

01	Demolition	01.08	This TRADE CONTRACTOR will be responsible for the removal of all HVAC components, equipment and systems to be demolished. Disconnection and identification of systems will be by others. This is to include all piping and hangers.
01	Demolition	01.09	This TRADE CONTRACTOR will be responsible for the protection of the roof areas during their work.
01	Demolition	01.10	This TRADE CONTRACTOR is responsible to verify and determine in advance whether removal or demolition of any element will result in structural deficiency, overloading, failure or unplanned collapse, and to detect hazards resulting from demolition related activities as the work progresses. TRADE CONTRACTOR shall be responsible for all temporary shoring and/or support of building elements as required to properly completing this TRADE CONTRACTORS scope of work and/or that may result in structural deficiency.
01	Demolition	01.11	This TRADE CONTRACTOR shall be responsible for returning to the Owner, all items duly indicated on the drawings and as directed by the Construction Manager.
01	Demolition	01.12	This TRADE CONTRACTOR shall be responsible for furnishing required dumpsters to remove and legally disposal of all existing materials off-site within the defined demolition work area. Reporting of disposal will be reported as required in the specifications
01	Demolition	01.13	All interior and exterior demolition with regards to the building is by this TRADE CONTRACTOR,.
01	Demolition	01.14	Contractors to perform under guidelines of phasing and scheduling. The schedule contained in this Bid Group may be updated by future adjustments that will become part of said contractors' agreement. This TRADE CONTRACTOR'S work will begin by August 1, 2015.
01	Demolition	01.15	This TRADE CONTRACTOR will remove the existing louver and leave louver and all anchors on site for reinstallation by others.
01	Demolition	01.16	This TRADE CONTRACTOR shall remove and dispose of the siding panels at the penthouse as shown on the drawings.
01	Demolition	01.17	This TRADE CONTRACTOR will remove and dispose of the existing ladder.
01	Demolition	01.18	Upon completion of the demolition, this TRADE CONTRACTOR is to leave the site "broom clean".
01	Demolition	01.19	This TRADE CONTRACTOR is to include a \$10,000.00 allowance in the base bid for changes or unforeseen conditions. These funds will only be dispersed upon written approval form the construction manager and the owner.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

Bid Pkg. #	Trade	Scope Item #	Scope – This Trade Contractor’s scope shall include but not be limited to the scope listed below. Please see entirety of bid documents for all scope.
02	HVAC Unit Replacement	02.1	This TRADE CONTRACTOR shall be responsible for coordinating shop drawings, layout, and field layout of piping and ductwork with other trade contractors including but not limited to ceiling heights and locations and all wall locations and penetrations.
02	HVAC Unit Replacement	02.2	This TRADE CONTRACTOR shall include training as required for the District 99 maintenance staff as scheduled by Construction Manager.
02	HVAC Unit Replacement	02.3	This TRADE CONTRACTOR shall be responsible for all terminal units including but not limited to all RTUs, AHUs, condensers, all duct work, sheet metal plenums, exhaust fans, flue piping, grilles, sound traps, diffusers, linear diffusers, registers, acoustical duct work lining and insulation, access doors, dampers (all types), filters, sound insulation, hangers, flexible duct connections, turning vanes, and associated devices and other items of work as required to provide a complete ventilation system including condensate drain piping.
02	HVAC Unit Replacement	02.4	This TRADE CONTRACTOR shall be responsible for providing access requirements for smoke detectors in ductwork. This contractor shall furnish and install smoke detectors where required in ductwork. All wiring will be by electrical contractor. Duct smokes to be tied into the existing fire alarm system.
02	HVAC Unit Replacement	02.5	This TRADE CONTRACTOR shall be responsible for the identification and disconnection of all mechanical systems to be demolished.
02	HVAC Unit Replacement	02.6	This Trade Contractor shall be responsible for all of the work shown in the drawings in order to provide a fully functioning AHU system. Demolition and electrical work is by others.
02	HVAC Unit Replacement	02.7	This TRADE CONTRACTOR shall be responsible for providing temporary protection of all HVAC equipment, ductwork, and piping during construction.
02	HVAC Unit Replacement	02.8	This TRADE CONTRACTOR shall be responsible for all dust control, installing protection of existing finishes and protection of the school property.
02	HVAC Unit Replacement	02.9	This TRADE CONTRACTOR shall be responsible for frames for all registers, diffusers and other work scheduled to be installed in ceilings, to be compatible with ceiling materials as specified, are included.
02	HVAC Unit Replacement	02.10	Control wiring for this work is by others.
02	HVAC Unit Replacement	02.11	This TRADE CONTRACTOR shall be responsible for all pipe and duct insulation, which is required for the work of this Trade Contractor.
02	HVAC Unit Replacement	02.12	Left Blank

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

02	HVAC Unit Replacement	02.13	This TRADE CONTRACTOR shall be responsible for caulking the following: joints between sheet metal and masonry, sheet metal casings, filter frames and all other locations where required to eliminate leakage and or/noise including fire caulking as required by code.
02	HVAC Unit Replacement	02.14	The TRADE CONTRACTOR shall be responsible for all coring or saw-cutting required for any new openings. All roofing work required is by this trade contractor
02	HVAC Unit Replacement	02.15	This TRADE CONTRACTOR shall be responsible for all start-up and testing of all supplied equipment and systems. This TRADE CONTRACTOR shall provide mechanic for additional adjustments to entire system during final test and balance.
02	HVAC Unit Replacement	02.16	This TRADE CONTRACTOR shall be responsible for fire stopping all thru wall penetrations.
02	HVAC Unit Replacement	02.17	This TRADE CONTRACTOR shall be responsible for furnishing and installing all sleeves and/or cored penetrations for passage of piping through masonry and gypsum walls, and concrete floors as required. Sleeves shall be sealed watertight, airtight, and/or fireproofed, as required by the documents of this bid package. This TRADE CONTRACTOR shall protect all openings in floors for passage of piping and other items.
02	HVAC Unit Replacement	02.18	This trade contractor is to furnish and install any new exterior louvers.
02			This TRADE Contractor will reinstall the existing louver upon completion of the project. Louver will be removed by demo contractor and left for reinstallation.
02	HVAC Unit Replacement	02.19	This TRADE CONTRACTOR shall install new air filters in all units after all punch list items are completed.
02	HVAC Unit Replacement	02.20	Exterior siding panels at the penthouse will be removed by demolition contractor for access to the space.
02	HVAC Unit Replacement	02.21	Left Blank
02	HVAC Unit Replacement	02.22	This TRADE CONTRACTOR to include removal and replacement of any ACT tiles as needed to accommodate all above ceiling work.
02	HVAC Unit Replacement	02.23	This TRADE CONTRACTOR shall be responsible for all scaffolding and lifts as needed.
02	HVAC Unit Replacement	02.24	This TRADE CONTRACTOR shall be responsible for protection of all existing finishes throughout duration of their work.
02	HVAC Unit Replacement	02.25	This TRADE CONTRACTOR shall be responsible for all of the work shown on sheets n-ME1.2 and s-ME1.3 as shown including electrical work.
02	HVAC Unit Replacement	02.26	This TRADE CONTRACTOR is to include a \$20,000.00 allowance in the base bid for changes or unforeseen conditions. These funds will only be dispersed upon written approval form the construction manager and the owner.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

Bid Pkg. #	Trade	Scope Item #	Scope – This Trade Contractor’s scope shall include but not be limited to the scope listed below. Please see entirety of bid documents for all scope.
03	Electrical	03.01	Provide a fully functioning electrical system as per drawings.
03	Electrical	03.02	This TRADE CONTRACTOR shall be responsible for furnishing and installing all, but not limited to, conduit; boxes; backboxes, wiring; light fixtures; lamps; sconces; exit signs and protective cages; panels; transformers; switchgear; transfer switches; dimming equipment; etc. and other electrical/lighting requirements as required within the specifications and as indicated on drawings.
03	Electrical	03.03	This TRADE CONTRACTOR shall be responsible for testing of electrical/lighting systems and fire alarm systems as required in obtaining approval of inspection authorities having jurisdiction.
03	Electrical	03.04	Left Blank
03	Electrical	03.05	This TRADE CONTRACTOR shall be responsible for furnishing and installing all exterior lighting per construction documents and specifications.
03	Electrical	03.06	This TRADE CONTRACTOR shall be responsible for all electrical connections, including low-voltage, for all starters, motor control devices, etc. for HVAC, work as required within the specifications and as indicated on drawings. All starters provided by HVAC contractor.
03	Electrical	03.07	This TRADE CONTRACTOR shall be responsible for all providing all items for support of contractor’s work, including all clip hangers, angles, and miscellaneous metal of any nature as required within the specifications and indicated on drawings.
03	Electrical	03.08	This TRADE CONTRACTOR shall be responsible for any out-of-sequence and/or additional wiring and testing of contractor’s work to permit expedited completion of partitions, ceilings, and other work, including the furnishing and installation of equipment.
03	Electrical	03.09	This TRADE CONTRACTOR shall be responsible for all coordinating with all other contractors to obtain wiring diagrams and requirements for equipment furnished by others, prior to wiring same in the field.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

03	Electrical	03.10	This TRADE CONTRACTOR shall be responsible for all directory label charts, identification and tagging requirements of work as required within the specifications and as indicated on the drawings.
03	Electrical	03.11	This TRADE CONTRACTOR shall be responsible for all electrical/lighting related work on drawings and in specifications, as may be noted on architectural, mechanical, and plumbing documents or specification sections.
03	Electrical	03.12	This trade contractor shall disconnect all electrical feeds to existing equipment before demolition by others. This TRADE CONTRACTOR shall identify all materials to be demolished by others.
03	Electrical	03.13	Controls for the new mechanical equipment are by others.
03	Electrical	03.14	This TRADE CONTRACTOR shall be responsible for furnishing, installing and maintaining all temporary service equipment as required until permanent service equipment is installed and live, and switchover of temporary system to permanent service has occurred.
03	Electrical	03.15	<p>This TRADE CONTRACTOR shall be responsible for the following:</p> <p>Furnishing, installing and maintaining temporary feeders to permanent mechanical equipment repairing service if permanent feeders are not ready for same.</p> <p>Furnishing, installing, rerouting, and removal of temporary electrical power and lighting systems in accordance with job progress to allow other contractors to complete work.</p> <p>Providing temporary electrical outlets on circuits separate from temporary lighting.</p>
03	Electrical	03.16	This TRADE CONTRACTOR shall be responsible for all maintenance of all temporary items, including replacement of lamps, breakers, and fuses etc. as required due to attrition, theft, etc.

DIVISION 1 – GENERAL CONDITIONS
SECTION 00300– Bid Package Scope Document

03	Electrical	03.17	This TRADE CONTRACTOR shall provide all sleeves and coring of walls, floors, etc., including caulking, patching of walls and floors, packing and safing of sleeves and openings as indicated on construction documents and/or as specified in the project manual. Contractor to protect all floor openings left in floors for passage of piping and other items.
03	Electrical	03.18	This TRADE CONTRACTOR shall be responsible for fire stopping all thru wall penetrations
03	Electrical	03.19	This TRADE CONTRACTOR shall be responsible for connecting new equipment to the existing fire alarm system. Duct smokes are to furnished and installed by HVAC contractor but wired by electrical contractor
03	Electrical	03.20	All shut downs and/or interruptions in service, if required, shall be coordinated through the Design/ Builder. Such activities will be scheduled to minimize project disruption.
03	Electrical	03.21	This TRADE CONTRACTOR shall be responsible for applications, inspection coordination, scheduling, testing and all things required to satisfy the requirements of local code enforcement inspection services shall be by this trade contractor. This trade contractor to submit verification of conversations, inspections, and/or approvals to Design/ Builder within 72 hours of said occurrence.
03	Electrical	03.22	This TRADE CONTRACTOR shall include training as required for the District 99 staff as scheduled by Construction Manager.
03	Electrical	03.23	This TRADE CONTRACTOR is to include a \$20,000.00 allowance in the base bid for changes or unforeseen conditions. These funds will only be dispersed upon written approval form the construction manager and the owner.

END OF SECTION 00300

BID DATE: February 8, 2017 at 1:00 p.m. (CST)
(as date/time stamped by Community High School District's Receptionist)

BID TO: Community High School District 99
Administrative Center
6301 Springside Avenue
Downers Grove, IL 60516

RECEIVED BY:

BID FROM: _____

BID FOR: ***Bid Group 1 - Bid Package #01 Demolition
North High School
4436 Main Street
Downers Grove, IL 60515***

It is required to have one original bid form and one copy of your bid form.

THE UNDERSIGNED:

Acknowledges receipt of:

Plans and specifications for the work indicated above.

Addenda: No. _____ dated _____
No. _____ dated _____
No. _____ dated _____
No. _____ dated _____

Having examined the site of the work, and having familiarized himself or herself with local conditions affecting the cost of the work and with all requirements of the bidding documents including Instructions to Bidders, drawings, specifications and duly issued addenda as prepared by the architect, Wight & Company, hereby agrees to perform all work and furnish all labor, material and equipment specifically required of him by the bidding documents and such additional work as may be included as related requirements in other divisions or sections of the specifications, exclusive of alternate bids.

Agrees:

To furnish and install the described material and/or services for stated lump sum price.

To hold this bid open until **90** calendar days after bid opening date.

To accept the provisions of the General Provisions (Project Manual Division 0 – Bidding & Contracting

Requirements Section 00201) and disposition of bid security.

To enter into and execute a contract with the Owner, if awarded on the basis of this bid, and in connection therewith to:

1. Furnish all bonds and insurance required by the bidding documents.
2. Accomplish the work in accordance with the contract.
3. Complete the work within the contract time herein specified.

Completion Time:

The undersigned agrees to begin construction immediately, or as directed by the Construction Manager, upon notice of contract award and to perform the following components of the work in accordance with the Construction Manager’s Construction. This schedule is bound in the Project Manual. See attached scope of work in section 0300.

SCOPE OF WORK:

The work in this agreement (without additional compensation) shall include, but shall not necessarily be limited to, all skilled labor, supervision, premium time, materials, tools, equipment, plant, supplies, samples, shop drawings, design/engineering drawings, layout, transportation, supervision, contributions, insurance, taxes (if applicable), compliance with all agencies (City / Village, County, State, Federal and/or any other jurisdictional agency, as may be required) and/or all services and facilities necessary and/or required for the performance of all Work shown, detailed, and/or implied by the following documents and as defined herein.

It is understood that this Trade Contractor shall perform the Work for a complete and operational system as indicated or implied in all Contract Documents. It is recognized and understood that the documents upon which the bid is based are at a conceptual phase and this Contractor who has certain skills and judgments based upon his knowledge of techniques, procedures, systems, general state of the art of his specialty is expected to include in the scope of work, all items required in order to carry out a complete and functional system whether or not shown or described in the contract documents. This contract will be awarded on the basis of such documents with the understanding that this contractor is to furnish and install all items required for the proper completion of this work without adjustment to this contract price. No extra payments shall be made of claims entertained as a result of such items, unless it can be clearly demonstrated to be added scope to the contract and beyond the original intent of the documents.

Contractor to provide all Trade Contract work referenced in:

1. Any sheet of this bid group package including (reference Division 0 – Bidding and Contract Requirements, Section 00200 – Notice to Bidders).
2. Specification 00300 Bid Packages Scope Document.

WORK BASE BID: For providing all work including all allowances as required for the completion of the construction of the base bid project as shown on the drawings and specifications and NOT including alternate bids and/or contractor's proposed alternates and substitutes.

BASE BID

TOTAL BASE BID AMOUNT **North High School AHU Replacement Project**

_____ Dollars (\$ _____)

Award Basis:

The project will be awarded based upon the attached Evaluation Criteria, Section 301a. Owner and Construction Manager alternate's may be considered to find the most qualified bidder if the result of combining the base bid and the selected alternate(s) is the most qualified bid, and is to the benefit of the owner.

Each of the following amounts for alternate construction includes the entire cost of such construction, except as otherwise noted. Acceptance of any or all of the alternates for inclusion in the contract is the sole prerogative of the owner.

All additional costs due to the alternates are included in the amount to be added to the base bid, so that no additional costs will be borne by the owner due to acceptance of alternates. This alternate price is not to be included in the base bid price.

Owner Requested Alternates:

Each of the following amounts for alternate construction includes the entire cost of such construction, except as otherwise noted. Acceptance of any or all of the alternates for inclusion in the contract is the sole prerogative of the owner.

All additional costs due to the alternates are included in the amount to be added to the base bid, so that no additional costs will be borne by the owner due to acceptance of alternates.

Proposed Alternates: (Contractors Proposed Alternates)

Item Specified	Proposed Alternate	Change in Bid Price
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

Owner Requested Scheduling Information:

Note: The work of this Trade Contractor is to be completed in accordance with the overall project schedule as identified elsewhere in this project manual and/or as subsequently directed by Construction Manager. This Trade Contractor shall submit a proposed submittals list/schedule/material log within five (5) calendar days of Notice To Proceed.

1. Shop drawings / Submittal for this trade contractor will be submitted within 10 calendar days of receipt of notice to proceed.

Bid Acceptance:

If written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned within the time noted herein, after the date of opening of bids or at any time thereafter before this bid is withdrawn, the undersigned agrees that he will execute a construction contract in accordance with the bids as accepted.

The Owner reserves the right to award the contract to its best interests, review and accept any and all value engineering alternatives, negotiate with the lowest responsible bidder, to reject any or all bids, to waive any informalities in bidding and to hold all bids for the bid guarantee period. The Owner reserves the right to award separate contracts for any of the items of work bid herein.

Bid Deposit:

The undersigned furnishes herewith, as required in the Instructions to Bidders, a bid deposit in the amount of ten percent (10%) of the amount bid in the form of Cashier's Check, or Certified Check, made payable to the Owner or Bid Bond, naming the Owner as obligee. (Bidder to check form of deposit furnished.)

It is understood and agreed that should the undersigned fail to enter into a contract with the Owner or furnish acceptable contract security within the time and in the manner herein provided, the bid deposit shall be retained by the Owner as liquidated damages and not as a forfeiture. As it is impossible to determine precisely an exact amount of damages the Owner will sustain, it is agreed that the bid deposit is a fair and equitable estimate of such damages.

REPRESENTATIONS AND CERTIFICATIONS:

The bidder makes the following representations and certifications as part of his bid on the project herein identified in the Bid Form. In the case of a joint venture bid, each party represents and certifies as to his own organization.

AVAILABILITY. The number and amount of contracts and awards pending which I am and/or will be obligated to perform, now and during the course of the project, will not interfere with or hinder the timely prosecution of my work.

SURETY. I have notified a Surety Company that I am submitting a bid for work to be performed on the project. The Surety Company has agreed to issue a performance and labor and material payment bond for my work, if my bid is accepted and the contract awarded to me.

INDEPENDENT PRICE DETERMINATION. The contract sum in this bid has been arrived at independently, without consultation, communication or agreement for the purpose of restricting competition.

PREVAILING WAGE. The contractor and each subcontractor shall pay not less than the general prevailing rate of hourly wages for work of a similar character in the locality in which the work is performed and not less than general prevailing rate of hourly wages for legal holidays and overtime work in the performance of work under this contract, as established by the Illinois Department of Labor, pursuant to an act of the General Assembly of the State of Illinois approved June 26, 1941 as amended according to Section 820 ILCS 130/1.

Pursuant to Section 820 ILCS 130/5, the contractor and each subcontractor shall keep an accurate record showing the names and occupation of all laborers, workers and mechanics employed by them, and also showing the actual hourly wages paid to each such individual, which record shall be open at all reasonable hours to inspection by the Owner, its officers and agents, and to agents of the Illinois Department of Labor.

The contractor and each subcontractor hereby agree, jointly and severally, to defend, indemnify and hold harmless the Owner from any and all claims, demands, liens or suits of any kind or nature whatsoever (including suits for injunctive relief) by the Illinois Department of Labor under the Illinois Prevailing Wage Act, Section 820 ILCS 130/1., or by any laborer, worker or mechanic employed by the contractor or the subcontractor who alleges that he has been paid for his services in a sum less than prevailing wage rates required by Illinois law. The Owner agrees to notify the contractor or subcontractor of the pendency of any such claim, demand, lien or suit.

By submitting a bid, each bidder agrees to waive any claim it has or may have against the Owner, the Architect, Engineer, Construction Manager and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any bid; waiver of any requirements under the Bid Documents; or the Contract Document; acceptance or rejection of any bids; and award of the Contract.

Signature:

Respectfully submitted this _____ day _____, 2017

Type of Firm (Bidder to indicate)

_____ Individual

_____ Partnership

_____ Corporation

_____ Joint Venture

_____ Other

(CORPORATE SEAL)

(Firm Name)

(Address)

(Telephone Number) (FAX)

(E-mail Address)

(Bidder's Signature)

(Title)

Subscribed and sworn to me
this _____ day of _____, 2013

NOTE: All pages of this bid form must be returned with your proposal. Failure to do so shall disqualify your bid.

CERTIFICATE OF BIDDER ELIGIBILITY

720 ILCS 5/33E-11 REQUIRES THAT ALL CONTRACTORS BIDDING FOR PUBLIC AGENCIES IN THE State of Illinois certify that they are not barred from bidding on public contracts for bid rigging or bid rotation.

The following certification must be signed and submitted with bidder's bid proposal. FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, DuPage County, Illinois certified that said contractor is not barred from bidding on the aforementioned contract as a result of violation of either 720 ILCS 5/33E-3 or 720 ILCS 5/33-E4.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

**CRIMINAL CODE CERTIFICATION
AS REQUIRED BY:
STATE OF ILLINOIS CRIMINAL CODE OF 2012, 720 ILCS 5/33E-11**

I, _____ the individual whose signature appears below on this bid/contract
for _____ hereby certify that the bidding party/contracting
party is not barred from bidding on the contract as a result of a violation of either Section 33E-3 or Section 33E-4
of 720 ILCS 5/33E-3 or 5/33E-4 of the Illinois Compiled Statutes, as amended.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

EQUAL EMPLOYMENT OPPORTUNITY

Section I. This EQUAL EMPLOYMENT OPPORTUNITY CLAUSE is required by the Illinois Human Rights Act and the Rules and Regulations of the Illinois Department of Human Rights published at 44 Illinois Administrative Code Section 750, *et seq.*

Section II. In the event of the Contractor's noncompliance with any provision of this Equal Employment Opportunity Clause, the Illinois Human Rights Act, or the Rules and Regulations of the Department of Human Rights (hereinafter referred to as the Department) the Contractor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and this Contract may be canceled or voided in whole or in part, and other sanctions or penalties may be imposed or remedies involved as provided by statute or regulation.

During the performance of this Agreement, the Contractor agrees:

A. That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, national origin or ancestry, citizenship status, age, physical or mental disability unrelated to ability, military status or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization.

B. That, if it hires additional employees in order to perform this Contract, or any portion hereof, it will determine the availability (in accordance with the Department's Rules and Regulations) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.

C. That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, sexual orientation, marital status, national origin or ancestry, citizenship status, age, or physical or mental handicap unrelated to ability, military status or an unfavorable discharge from military service.

D. That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the Vendor's obligations under the Illinois Human Rights Act and Department's Rules and Regulations. If any labor organization or representative fails or refuses to cooperate with the Contractor in its efforts to comply with the Act and Rules and Regulations, the Contractor will promptly notify the Department and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations under the Contract.

E. That it will submit reports as required by the Department's Rules and Regulations, furnish all relevant information as may from time to time be requested by the Department or the contracting agency, and in all respects comply with the Illinois Human Rights Act and Department's Rules and Regulations.

F. That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and Department for purposes of investigation to ascertain compliance with the Illinois Human Rights Act and Department's Rules and Regulations.

G. That it will include verbatim or by reference the provisions of this Equal Employment Opportunity Clause in every subcontract it awards under which any portion of this Contract obligations are undertaken or assumed, so that such provisions will be binding upon such subcontractor. In the same manner as the other provisions of this Agreement, the Contractor will be liable for compliance with applicable provisions of this clause by such subcontractors; and further it will promptly notify the contracting agency and the Department in the event any subcontractor fails or refuses to comply therewith. In addition, the Contractor will not utilize any subcontractor declared by the Illinois Human Rights Department to be ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

ACKNOWLEDGED AND AGREED TO:

By: _____
Authorized Agent of Contractor (name and title)

DATE: _____

SEXUAL HARASSMENT POLICY

_____, having submitted a bid for _____ (Name of Contractor)
_____ to Community High School District No. 99, hereby certifies
that said contractor has a written sexual harassment policy in place in full compliance with 775 ILCS 5/2-105 (A) (4).

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

TAX CERTIFICATION

I, _____, having been first duly sworn depose and state as follows:

I, _____, am the duly authorized agent for
to _____, which has submitted a proposal
Community High School District No. 99 for

_____ and I hereby certify that _____ is not delinquent in the payment of any tax administered by the Illinois Department of Revenue, or if it is:

- a. it is contesting its liability for the tax or the amount of tax in accordance with procedures established by the appropriate Revenue Act; or
- b. it has entered into an agreement with the Department of Revenue for payment of all taxes due and is currently in compliance with that agreement.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

SUBSTANCE ABUSE PREVENTION ON PUBLIC WORKS PROJECTS

The Contractor certifies that it has in place a written program that meets or exceeds the program requirements of the Substance Abuse Prevention on Public Works Projects Act (Public Act 95-0635), and will provide a copy thereof to Community High School District No. 99 prior to commencement of work on the Project.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

**CERTIFICATE REGARDING
EMPLOYMENT OF ILLINOIS WORKERS ON PUBLIC WORKS**

_____ agrees if at the time the Agreement is executed, or if during the term of the Agreement, there is excessive unemployment in Illinois as defined in the Employment of Illinois Workers on Public Works Act, 30- ILCS 570/0/01 et seq., as two consecutive months of unemployment exceeding 5%, then _____ agrees to employ Illinois laborers in accordance with the Employment of Illinois Workers on Public Works Act. An "Illinois laborer" is defined as any person who has resided in Illinois for at least thirty (30) days and intends to become or remain an Illinois resident.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

PREVAILING WAGE AFFIDAVIT

AFFIDAVIT: "I (we) hereby certify and affirm that if awarded a contract with Community High School District 99, we will comply fully with the "Illinois Prevailing Wage Act (Ill. Rev. Stat., 1987 Ch. 48, Sections 398 s-1-12 as amended by Public Act 86-693 and 86-799 effected January 1, 1990, and any other amendments effective thereafter)". We further understand that current prevailing wage standards are included in the Supplementary General Conditions.

The following affidavit must be signed and submitted with bidder's bid proposal. FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, certifies that said contractor is not barred from bidding on the aforementioned contract as a result of a violation of the Illinois Prevailing Wage Act (Ill. Rev. Stat., 1987 Ch. 48, Sections 398 s-1-12 as amended by Public Act 86-693 and 86-799 effected January 1, 1990).

Firm: _____

By: _____

(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

NON-COLLUSION AFFIDAVIT

AFFIDAVIT: "I (we) hereby certify and affirm that my (our) proposal was prepared independently for this project and that it contains no fees or amounts other than that for the legitimate execution of this work as specified and that it includes no understanding or agreements in restraint of trade."

The following affidavit must be signed and submitted with bidder's bid proposal.
FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as a part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, certifies that said Contractor is not barred from bidding on the aforementioned contract as a result of a violation of the above Non-Collusion Affidavit.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

Criminal Background Investigations

Contractor hereby represents, warrants and certified that no officer or director thereof has any knowledge that any employee thereof has been convicted of committing or attempting to commit "Criminal Code of 1961," 720 ILCS, Sections 5/11-6 (Indecent solicitation of a child), 5/11-9 (Public indecency), 5/11-14 (Prostitution), 5/11-15 (Soliciting for a prostitute), 5/11-15.1 (Soliciting for a juvenile prostitute), 5/11-19 (Pimping), 5/11-19.1 (Juvenile pimping), 5/11-19.2 (Exploitation of a child), 5/11-20 (Obscenity), 5/11-20.1 (Sexual assault), 5/12-14 (Aggravated criminal sexual assault), 5/12-15 (Criminal sexual abuse), and 5/120-16 (Aggravated criminal sexual abuse), and/or those offenses defined in the "Cannabis Control Act," 720 ILCS, 550/1 et seq. (except the "Illinois Controlled Substances Act," 720 ILCS 570/100 et seq. and/or any offense committed or attempted in any other state or against the laws of the United States, which if committed or attempted in this State, would have been punishable as one or more of the foregoing offenses.

Contractor further agrees that it shall not employ any person who have or may have direct, daily contact with the pupils of any school in the district, and for whom a criminal background investigation has not been conducted pursuant hereto, and further represents and agrees that all applicants for any such employment shall furnish with their applications the attached written "Authorization for Criminal Background Information" form authorizing the Board of Education to request a criminal background investigation of said applicant pursuant to Section 5/10-21.9 of the School Code of Illinois and to receive criminal history record information pursuant thereto to determine if the applicant has been convicted of committing or attempting to commit any of the criminal or drug offenses enumerated above. Contractor further agrees to submit with said authorization payment for any costs and expenses associated with the criminal background investigation.

Contractor further represents, warrants, and certifies that no applicant for employment with respect to whom the criminal investigation reveals any conviction for committing and/or attempting to commit any of the above enumerated offenses shall be employed thereby in any position that involves or may involve contact with the students of the school district.

This certification is executed on the date hereinafter indicated by the designated contractor by its duly authorized officer.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

Date: _____

Criminal Background Investigation

The undersigned hereby authorizes in Board of Education of Community High School District 99, Downers Grove, Illinois, to request a criminal background investigation from the Illinois State Police, pursuant to Section 5/10-21.9 of the School Code of Illinois, 105 ILCS 5/10-21.9 and to receive criminal history record information pursuant thereto.

By: _____
(Signature of Applicant of Employee)

(Printed or Typed Name of Applicant Employee)

Date: _____

BUSINESS CLASSIFICATION

a) Business Entity (check one)

Corporation (Publicly held)* Not-for-Profit* Government Agency/Public Institution*
 Corporation (Privately held) Partnership Sole Proprietor

* If checked, do not complete section III (b) and (c) below.

b) Business Ownership (check one) If minority or woman owned, attach copy of certification evidence.

Large Business: Male Owned Woman Owned
Small Business: Male Owned Woman Owned

BUSINESS DEFINITIONS

Small Business Concern - an independently owned and operated concern certified, or certifiable, as a small business by the Federal Small Business Administration (SBA). Standard Industrial Classification (SIC) codes may be found in the Federal Acquisition Regulations, Section 19.102 or in the Federal Procurement Regulations, Section 1-1.701.

Small Disadvantaged or Minority Business Concern - a small business concern which is at least fifty-one percent (51%) owned by one or more socially and economically disadvantaged individuals or in the case of any publicly owned business, at least fifty-one percent (51%) of the stock of which is owned by such individuals; and whose management and daily business operations are controlled by one or more of such individuals. Business owners who certify that they are members of named groups (Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans) are considered socially and economically disadvantaged.

Woman-Owned Business - a business concern that is at least fifty-one percent (51%) owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

c) Race/Ethnicity of Ownership (check one) based on definitions below.

Black Asian/Pacific or Asian/Indian Caucasian
 Hispanic Native American (American Indians, Eskimos, Aleuts and native Hawaiians)

ETHNIC GROUP DEFINITIONS

Black Americans: United States citizens whose origins are in any of the Black racial groups of Africa.

Hispanic Americans: United States citizens whose origins are in Mexico, Puerto Rico, Cuba, Portugal, Central or Central America.

Native Americans: United States citizens whose origins are in any of the original peoples of North America, i.e., American Indians, Eskimos, Aleuts and native Hawaiians.

Asian Pacific/Asian Indian Americans: United States citizens whose origins are in Japan, China, Korea, Taiwan, Cambodia, Laos, Vietnam, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands, the Northern Mariana Islands, India, Pakistan, or Bangladesh.

I certify that the business classification and ethnicity indicated above reflects the true and correct status of this business in accordance with current Federal Small Business Administration criteria. I agree to inform Community High School District 99 immediately in writing of any changes to the information contained herein, including changes in ownership, controlling interest or operations. I understand that falsely certifying this information may result in suspension from participation in Community High School District 99 - North High School Phase II project.

Name: _____ Title: _____
(Print or Type)

Signature: _____ Date: _____

END OF SECTION 00301

BID DATE: February 8, 2017 at 1:00 p.m. (CST)
(as date/time stamped by Community High School District's Receptionist)

BID TO: Community High School District 99
Administrative Center
6301 Springside Avenue
Downers Grove, IL 60516

RECEIVED BY:

BID FROM: _____

BID FOR: ***Bid Group 1 - Bid Package #02 HVAC***
North High School
4436 Main Street
Downers Grove, IL 60515

It is required to have one original bid form and one copy of your bid form.

THE UNDERSIGNED:

Acknowledges receipt of:

Plans and specifications for the work indicated above.

Addenda: No. _____ dated _____
No. _____ dated _____
No. _____ dated _____
No. _____ dated _____

Having examined the site of the work, and having familiarized himself or herself with local conditions affecting the cost of the work and with all requirements of the bidding documents including Instructions to Bidders, drawings, specifications and duly issued addenda as prepared by the architect, Wight & Company, hereby agrees to perform all work and furnish all labor, material and equipment specifically required of him by the bidding documents and such additional work as may be included as related requirements in other divisions or sections of the specifications, exclusive of alternate bids.

Agrees:

To furnish and install the described material and/or services for stated lump sum price.

To hold this bid open until **90** calendar days after bid opening date.

To accept the provisions of the General Provisions (Project Manual Division 0 – Bidding & Contracting

Requirements Section 00201) and disposition of bid security.

To enter into and execute a contract with the Owner, if awarded on the basis of this bid, and in connection therewith to:

1. Furnish all bonds and insurance required by the bidding documents.
2. Accomplish the work in accordance with the contract.
3. Complete the work within the contract time herein specified.

Completion Time:

The undersigned agrees to begin construction immediately, or as directed by the Construction Manager, upon notice of contract award and to perform the following components of the work in accordance with the Construction Manager’s Construction. This schedule is bound in the Project Manual. See attached scope of work in section 0300.

SCOPE OF WORK:

The work in this agreement (without additional compensation) shall include, but shall not necessarily be limited to, all skilled labor, supervision, premium time, materials, tools, equipment, plant, supplies, samples, shop drawings, design/engineering drawings, layout, transportation, supervision, contributions, insurance, taxes (if applicable), compliance with all agencies (City / Village, County, State, Federal and/or any other jurisdictional agency, as may be required) and/or all services and facilities necessary and/or required for the performance of all Work shown, detailed, and/or implied by the following documents and as defined herein.

It is understood that this Trade Contractor shall perform the Work for a complete and operational system as indicated or implied in all Contract Documents. It is recognized and understood that the documents upon which the bid is based are at a conceptual phase and this Contractor who has certain skills and judgments based upon his knowledge of techniques, procedures, systems, general state of the art of his specialty is expected to include in the scope of work, all items required in order to carry out a complete and functional system whether or not shown or described in the contract documents. This contract will be awarded on the basis of such documents with the understanding that this contractor is to furnish and install all items required for the proper completion of this work without adjustment to this contract price. No extra payments shall be made of claims entertained as a result of such items, unless it can be clearly demonstrated to be added scope to the contract and beyond the original intent of the documents.

Contractor to provide all Trade Contract work referenced in:

1. Any sheet of this bid group package including (reference Division 0 – Bidding and Contract Requirements, Section 00200 – Notice to Bidders).
2. Specification 00300 Bid Packages Scope Document.

WORK BASE BID: For providing all work including all allowances as required for the completion of the construction of the base bid project as shown on the drawings and specifications and NOT including alternate bids and/or contractor's proposed alternates and substitutes.

BASE BID

TOTAL BASE BID AMOUNT **North High School AHU Replacement Project**

_____ Dollars (\$ _____)

Award Basis:

The project will be awarded based upon the attached Evaluation Criteria, Section 301a. Owner and Construction Manager alternate's may be considered to find the most qualified bidder if the result of combining the base bid and the selected alternate(s) is the most qualified bid, and is to the benefit of the owner.

Each of the following amounts for alternate construction includes the entire cost of such construction, except as otherwise noted. Acceptance of any or all of the alternates for inclusion in the contract is the sole prerogative of the owner.

All additional costs due to the alternates are included in the amount to be added to the base bid, so that no additional costs will be borne by the owner due to acceptance of alternates. This alternate price is not to be included in the base bid price.

Owner Requested Alternates:

Each of the following amounts for alternate construction includes the entire cost of such construction, except as otherwise noted. Acceptance of any or all of the alternates for inclusion in the contract is the sole prerogative of the owner.

All additional costs due to the alternates are included in the amount to be added to the base bid, so that no additional costs will be borne by the owner due to acceptance of alternates.

Proposed Alternates: (Contractors Proposed Alternates)

Item Specified	Proposed Alternate	Change in Bid Price
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

Owner Requested Scheduling Information:

Note: The work of this Trade Contractor is to be completed in accordance with the overall project schedule as identified elsewhere in this project manual and/or as subsequently directed by Construction Manager. This Trade Contractor shall submit a proposed submittals list/schedule/material log within five (5) calendar days of Notice To Proceed.

1. Shop drawings / Submittal for this trade contractor will be submitted within 10 calendar days of receipt of notice to proceed.

Bid Acceptance:

If written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned within the time noted herein, after the date of opening of bids or at any time thereafter before this bid is withdrawn, the undersigned agrees that he will execute a construction contract in accordance with the bids as accepted.

The Owner reserves the right to award the contract to its best interests, review and accept any and all value engineering alternatives, negotiate with the lowest responsible bidder, to reject any or all bids, to waive any informalities in bidding and to hold all bids for the bid guarantee period. The Owner reserves the right to award separate contracts for any of the items of work bid herein.

Bid Deposit:

The undersigned furnishes herewith, as required in the Instructions to Bidders, a bid deposit in the amount of ten percent (10%) of the amount bid in the form of Cashier's Check, or Certified Check, made payable to the Owner or Bid Bond, naming the Owner as obligee. (Bidder to check form of deposit furnished.)

It is understood and agreed that should the undersigned fail to enter into a contract with the Owner or furnish acceptable contract security within the time and in the manner herein provided, the bid deposit shall be retained by the Owner as liquidated damages and not as a forfeiture. As it is impossible to determine precisely an exact amount of damages the Owner will sustain, it is agreed that the bid deposit is a fair and equitable estimate of such damages.

REPRESENTATIONS AND CERTIFICATIONS:

The bidder makes the following representations and certifications as part of his bid on the project herein identified in the Bid Form. In the case of a joint venture bid, each party represents and certifies as to his own organization.

AVAILABILITY. The number and amount of contracts and awards pending which I am and/or will be obligated to perform, now and during the course of the project, will not interfere with or hinder the timely prosecution of my work.

SURETY. I have notified a Surety Company that I am submitting a bid for work to be performed on the project. The Surety Company has agreed to issue a performance and labor and material payment bond for my work, if my bid is accepted and the contract awarded to me.

INDEPENDENT PRICE DETERMINATION. The contract sum in this bid has been arrived at independently, without consultation, communication or agreement for the purpose of restricting competition.

PREVAILING WAGE. The contractor and each subcontractor shall pay not less than the general prevailing rate of hourly wages for work of a similar character in the locality in which the work is performed and not less than general prevailing rate of hourly wages for legal holidays and overtime work in the performance of work under this contract, as established by the Illinois Department of Labor, pursuant to an act of the General Assembly of the State of Illinois approved June 26, 1941 as amended according to Section 820 ILCS 130/1.

Pursuant to Section 820 ILCS 130/5, the contractor and each subcontractor shall keep an accurate record showing the names and occupation of all laborers, workers and mechanics employed by them, and also showing the actual hourly wages paid to each such individual, which record shall be open at all reasonable hours to inspection by the Owner, its officers and agents, and to agents of the Illinois Department of Labor.

The contractor and each subcontractor hereby agree, jointly and severally, to defend, indemnify and hold harmless the Owner from any and all claims, demands, liens or suits of any kind or nature whatsoever (including suits for injunctive relief) by the Illinois Department of Labor under the Illinois Prevailing Wage Act, Section 820 ILCS 130/1., or by any laborer, worker or mechanic employed by the contractor or the subcontractor who alleges that he has been paid for his services in a sum less than prevailing wage rates required by Illinois law. The Owner agrees to notify the contractor or subcontractor of the pendency of any such claim, demand, lien or suit.

By submitting a bid, each bidder agrees to waive any claim it has or may have against the Owner, the Architect, Engineer, Construction Manager and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any bid; waiver of any requirements under the Bid Documents; or the Contract Document; acceptance or rejection of any bids; and award of the Contract.

Signature:

Respectfully submitted this _____ day _____, 2017

Type of Firm (Bidder to indicate)

_____ Individual

_____ Partnership

_____ Corporation

_____ Joint Venture

_____ Other

(CORPORATE SEAL)

(Firm Name)

(Address)

(Telephone Number) (FAX)

(E-mail Address)

(Bidder's Signature)

(Title)

Subscribed and sworn to me
this _____ day of _____, 2013

NOTE: All pages of this bid form must be returned with your proposal. Failure to do so shall disqualify your bid.

CERTIFICATE OF BIDDER ELIGIBILITY

720 ILCS 5/33E-11 REQUIRES THAT ALL CONTRACTORS BIDDING FOR PUBLIC AGENCIES IN THE State of Illinois certify that they are not barred from bidding on public contracts for bid rigging or bid rotation.

The following certification must be signed and submitted with bidder's bid proposal. FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, DuPage County, Illinois certified that said contractor is not barred from bidding on the aforementioned contract as a result of violation of either 720 ILCS 5/33E-3 or 720 ILCS 5/33-E4.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

**CRIMINAL CODE CERTIFICATION
AS REQUIRED BY:
STATE OF ILLINOIS CRIMINAL CODE OF 2012, 720 ILCS 5/33E-11**

I, _____ the individual whose signature appears below on this bid/contract
for _____ hereby certify that the bidding party/contracting
party is not barred from bidding on the contract as a result of a violation of either Section 33E-3 or Section 33E-4
of 720 ILCS 5/33E-3 or 5/33E-4 of the Illinois Compiled Statutes, as amended.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

EQUAL EMPLOYMENT OPPORTUNITY

Section I. This EQUAL EMPLOYMENT OPPORTUNITY CLAUSE is required by the Illinois Human Rights Act and the Rules and Regulations of the Illinois Department of Human Rights published at 44 Illinois Administrative Code Section 750, *et seq.*

Section II. In the event of the Contractor's noncompliance with any provision of this Equal Employment Opportunity Clause, the Illinois Human Rights Act, or the Rules and Regulations of the Department of Human Rights (hereinafter referred to as the Department) the Contractor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and this Contract may be canceled or voided in whole or in part, and other sanctions or penalties may be imposed or remedies involved as provided by statute or regulation.

During the performance of this Agreement, the Contractor agrees:

A. That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, national origin or ancestry, citizenship status, age, physical or mental disability unrelated to ability, military status or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization.

B. That, if it hires additional employees in order to perform this Contract, or any portion hereof, it will determine the availability (in accordance with the Department's Rules and Regulations) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.

C. That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, sexual orientation, marital status, national origin or ancestry, citizenship status, age, or physical or mental handicap unrelated to ability, military status or an unfavorable discharge from military service.

D. That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the Vendor's obligations under the Illinois Human Rights Act and Department's Rules and Regulations. If any labor organization or representative fails or refuses to cooperate with the Contractor in its efforts to comply with the Act and Rules and Regulations, the Contractor will promptly notify the Department and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations under the Contract.

E. That it will submit reports as required by the Department's Rules and Regulations, furnish all relevant information as may from time to time be requested by the Department or the contracting agency, and in all respects comply with the Illinois Human Rights Act and Department's Rules and Regulations.

F. That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and Department for purposes of investigation to ascertain compliance with the Illinois Human Rights Act and Department's Rules and Regulations.

G. That it will include verbatim or by reference the provisions of this Equal Employment Opportunity Clause in every subcontract it awards under which any portion of this Contract obligations are undertaken or assumed, so that such provisions will be binding upon such subcontractor. In the same manner as the other provisions of this Agreement, the Contractor will be liable for compliance with applicable provisions of this clause by such subcontractors; and further it will promptly notify the contracting agency and the Department in the event any subcontractor fails or refuses to comply therewith. In addition, the Contractor will not utilize any subcontractor declared by the Illinois Human Rights Department to be ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

ACKNOWLEDGED AND AGREED TO:

By: _____
Authorized Agent of Contractor (name and title)

DATE: _____

SEXUAL HARASSMENT POLICY

_____, having submitted a bid for _____ (Name of Contractor)
_____ to Community High School District No. 99, hereby certifies
that said contractor has a written sexual harassment policy in place in full compliance with 775 ILCS 5/2-105 (A) (4).

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

TAX CERTIFICATION

I, _____, having been first duly sworn depose and state as follows:

I, _____, am the duly authorized agent for
to _____, which has submitted a proposal
Community High School District No. 99 for

_____ and I hereby certify that _____ is not delinquent in the payment of any tax administered by the Illinois Department of Revenue, or if it is:

- a. it is contesting its liability for the tax or the amount of tax in accordance with procedures established by the appropriate Revenue Act; or
- b. it has entered into an agreement with the Department of Revenue for payment of all taxes due and is currently in compliance with that agreement.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

SUBSTANCE ABUSE PREVENTION ON PUBLIC WORKS PROJECTS

The Contractor certifies that it has in place a written program that meets or exceeds the program requirements of the Substance Abuse Prevention on Public Works Projects Act (Public Act 95-0635), and will provide a copy thereof to Community High School District No. 99 prior to commencement of work on the Project.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

**CERTIFICATE REGARDING
EMPLOYMENT OF ILLINOIS WORKERS ON PUBLIC WORKS**

_____ agrees if at the time the Agreement is executed, or if during the term of the Agreement, there is excessive unemployment in Illinois as defined in the Employment of Illinois Workers on Public Works Act, 30- ILCS 570/0/01 et seq., as two consecutive months of unemployment exceeding 5%, then _____ agrees to employ Illinois laborers in accordance with the Employment of Illinois Workers on Public Works Act. An "Illinois laborer" is defined as any person who has resided in Illinois for at least thirty (30) days and intends to become or remain an Illinois resident.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

PREVAILING WAGE AFFIDAVIT

AFFIDAVIT: "I (we) hereby certify and affirm that if awarded a contract with Community High School District 99, we will comply fully with the "Illinois Prevailing Wage Act (Ill. Rev. Stat., 1987 Ch. 48, Sections 398 s-1-12 as amended by Public Act 86-693 and 86-799 effected January 1, 1990, and any other amendments effective thereafter)". We further understand that current prevailing wage standards are included in the Supplementary General Conditions.

The following affidavit must be signed and submitted with bidder's bid proposal. FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, certifies that said contractor is not barred from bidding on the aforementioned contract as a result of a violation of the Illinois Prevailing Wage Act (Ill. Rev. Stat., 1987 Ch. 48, Sections 398 s-1-12 as amended by Public Act 86-693 and 86-799 effected January 1, 1990).

Firm: _____

By: _____

(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

NON-COLLUSION AFFIDAVIT

AFFIDAVIT: "I (we) hereby certify and affirm that my (our) proposal was prepared independently for this project and that it contains no fees or amounts other than that for the legitimate execution of this work as specified and that it includes no understanding or agreements in restraint of trade."

The following affidavit must be signed and submitted with bidder's bid proposal.
FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as a part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, certifies that said Contractor is not barred from bidding on the aforementioned contract as a result of a violation of the above Non-Collusion Affidavit.

Firm: _____

By: _____

(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

Criminal Background Investigations

Contractor hereby represents, warrants and certified that no officer or director thereof has any knowledge that any employee thereof has been convicted of committing or attempting to commit "Criminal Code of 1961," 720 ILCS, Sections 5/11-6 (Indecent solicitation of a child), 5/11-9 (Public indecency), 5/11-14 (Prostitution), 5/11-15 (Soliciting for a prostitute), 5/11-15.1 (Soliciting for a juvenile prostitute), 5/11-19 (Pimping), 5/11-19.1 (Juvenile pimping), 5/11-19.2 (Exploitation of a child), 5/11-20 (Obscenity), 5/11-20.1 (Sexual assault), 5/12-14 (Aggravated criminal sexual assault), 5/12-15 (Criminal sexual abuse), and 5/120-16 (Aggravated criminal sexual abuse), and/or those offenses defined in the "Cannabis Control Act," 720 ILCS, 550/1 et seq. (except the "Illinois Controlled Substances Act," 720 ILCS 570/100 et seq. and/or any offense committed or attempted in any other state or against the laws of the United States, which if committed or attempted in this State, would have been punishable as one or more of the foregoing offenses.

Contractor further agrees that it shall not employ any person who have or may have direct, daily contact with the pupils of any school in the district, and for whom a criminal background investigation has not been conducted pursuant hereto, and further represents and agrees that all applicants for any such employment shall furnish with their applications the attached written "Authorization for Criminal Background Information" form authorizing the Board of Education to request a criminal background investigation of said applicant pursuant to Section 5/10-21.9 of the School Code of Illinois and to receive criminal history record information pursuant thereto to determine if the applicant has been convicted of committing or attempting to commit any of the criminal or drug offenses enumerated above. Contractor further agrees to submit with said authorization payment for any costs and expenses associated with the criminal background investigation.

Contractor further represents, warrants, and certifies that no applicant for employment with respect to whom the criminal investigation reveals any conviction for committing and/or attempting to commit any of the above enumerated offenses shall be employed thereby in any position that involves or may involve contact with the students of the school district.

This certification is executed on the date hereinafter indicated by the designated contractor by its duly authorized officer.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

Date: _____

Criminal Background Investigation

The undersigned hereby authorizes in Board of Education of Community High School District 99, Downers Grove, Illinois, to request a criminal background investigation from the Illinois State Police, pursuant to Section 5/10-21.9 of the School Code of Illinois, 105 ILCS 5/10-21.9 and to receive criminal history record information pursuant thereto.

By: _____
(Signature of Applicant of Employee)

(Printed or Typed Name of Applicant Employee)

Date: _____

BUSINESS CLASSIFICATION

a) **Business Entity (check one)**

Corporation (Publicly held)* Not-for-Profit* Government Agency/Public Institution*
 Corporation (Privately held) Partnership Sole Proprietor

* If checked, do not complete section III (b) and (c) below.

b) **Business Ownership (check one)** If minority or woman owned, attach copy of certification evidence.

Large Business: Male Owned Woman Owned
Small Business: Male Owned Woman Owned

BUSINESS DEFINITIONS

Small Business Concern - an independently owned and operated concern certified, or certifiable, as a small business by the Federal Small Business Administration (SBA). Standard Industrial Classification (SIC) codes may be found in the Federal Acquisition Regulations, Section 19.102 or in the Federal Procurement Regulations, Section 1-1.701.

Small Disadvantaged or Minority Business Concern - a small business concern which is at least fifty-one percent (51%) owned by one or more socially and economically disadvantaged individuals or in the case of any publicly owned business, at least fifty-one percent (51%) of the stock of which is owned by such individuals; and whose management and daily business operations are controlled by one or more of such individuals. Business owners who certify that they are members of named groups (Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans) are considered socially and economically disadvantaged.

Woman-Owned Business - a business concern that is at least fifty-one percent (51%) owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

c) **Race/Ethnicity of Ownership (check one)** based on definitions below.

Black Asian/Pacific or Asian/Indian Caucasian
 Hispanic Native American (American Indians, Eskimos, Aleuts and native Hawaiians)

ETHNIC GROUP DEFINITIONS

Black Americans: United States citizens whose origins are in any of the Black racial groups of Africa.

Hispanic Americans: United States citizens whose origins are in Mexico, Puerto Rico, Cuba, Portugal, Central or Central America.

Native Americans: United States citizens whose origins are in any of the original peoples of North America, i.e., American Indians, Eskimos, Aleuts and native Hawaiians.

Asian Pacific/Asian Indian Americans: United States citizens whose origins are in Japan, China, Korea, Taiwan, Cambodia, Laos, Vietnam, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands, the Northern Mariana Islands, India, Pakistan, or Bangladesh.

I certify that the business classification and ethnicity indicated above reflects the true and correct status of this business in accordance with current Federal Small Business Administration criteria. I agree to inform Community High School District 99 immediately in writing of any changes to the information contained herein, including changes in ownership, controlling interest or operations. I understand that falsely certifying this information may result in suspension from participation in Community High School District 99 - North High School Phase II project.

Name: _____ Title: _____
(Print or Type)

Signature: _____ Date: _____

END OF SECTION 00301

BID DATE: February 8, 2017 at 1:00 p.m. (CST)
(as date/time stamped by Community High School District's Receptionist)

BID TO: Community High School District 99
Administrative Center
6301 Springside Avenue
Downers Grove, IL 60516

RECEIVED BY:

BID FROM: _____

BID FOR: ***Bid Group 1 - Bid Package #03 Electrical
North High School
4436 Main Street
Downers Grove, IL 60515***

It is required to have one original bid form and one copy of your bid form.

THE UNDERSIGNED:

Acknowledges receipt of:

Plans and specifications for the work indicated above.

Addenda: No. _____ dated _____
No. _____ dated _____
No. _____ dated _____
No. _____ dated _____

Having examined the site of the work, and having familiarized himself or herself with local conditions affecting the cost of the work and with all requirements of the bidding documents including Instructions to Bidders, drawings, specifications and duly issued addenda as prepared by the architect, Wight & Company, hereby agrees to perform all work and furnish all labor, material and equipment specifically required of him by the bidding documents and such additional work as may be included as related requirements in other divisions or sections of the specifications, exclusive of alternate bids.

Agrees:

To furnish and install the described material and/or services for stated lump sum price.

To hold this bid open until **90** calendar days after bid opening date.

To accept the provisions of the General Provisions (Project Manual Division 0 – Bidding & Contracting

Requirements Section 00201) and disposition of bid security.

To enter into and execute a contract with the Owner, if awarded on the basis of this bid, and in connection therewith to:

1. Furnish all bonds and insurance required by the bidding documents.
2. Accomplish the work in accordance with the contract.
3. Complete the work within the contract time herein specified.

Completion Time:

The undersigned agrees to begin construction immediately, or as directed by the Construction Manager, upon notice of contract award and to perform the following components of the work in accordance with the Construction Manager’s Construction. This schedule is bound in the Project Manual. See attached scope of work in section 0300.

SCOPE OF WORK:

The work in this agreement (without additional compensation) shall include, but shall not necessarily be limited to, all skilled labor, supervision, premium time, materials, tools, equipment, plant, supplies, samples, shop drawings, design/engineering drawings, layout, transportation, supervision, contributions, insurance, taxes (if applicable), compliance with all agencies (City / Village, County, State, Federal and/or any other jurisdictional agency, as may be required) and/or all services and facilities necessary and/or required for the performance of all Work shown, detailed, and/or implied by the following documents and as defined herein.

It is understood that this Trade Contractor shall perform the Work for a complete and operational system as indicated or implied in all Contract Documents. It is recognized and understood that the documents upon which the bid is based are at a conceptual phase and this Contractor who has certain skills and judgments based upon his knowledge of techniques, procedures, systems, general state of the art of his specialty is expected to include in the scope of work, all items required in order to carry out a complete and functional system whether or not shown or described in the contract documents. This contract will be awarded on the basis of such documents with the understanding that this contractor is to furnish and install all items required for the proper completion of this work without adjustment to this contract price. No extra payments shall be made of claims entertained as a result of such items, unless it can be clearly demonstrated to be added scope to the contract and beyond the original intent of the documents.

Contractor to provide all Trade Contract work referenced in:

1. Any sheet of this bid group package including (reference Division 0 – Bidding and Contract Requirements, Section 00200 – Notice to Bidders).
2. Specification 00300 Bid Packages Scope Document.

WORK BASE BID: For providing all work including all allowances as required for the completion of the construction of the base bid project as shown on the drawings and specifications and NOT including alternate bids and/or contractor's proposed alternates and substitutes.

BASE BID

TOTAL BASE BID AMOUNT **North High School AHU Replacement Project**

_____ Dollars (\$ _____)

Award Basis:

The project will be awarded based upon the attached Evaluation Criteria, Section 301a. Owner and Construction Manager alternate's may be considered to find the most qualified bidder if the result of combining the base bid and the selected alternate(s) is the most qualified bid, and is to the benefit of the owner.

Each of the following amounts for alternate construction includes the entire cost of such construction, except as otherwise noted. Acceptance of any or all of the alternates for inclusion in the contract is the sole prerogative of the owner.

All additional costs due to the alternates are included in the amount to be added to the base bid, so that no additional costs will be borne by the owner due to acceptance of alternates. This alternate price is not to be included in the base bid price.

Owner Requested Alternates:

Each of the following amounts for alternate construction includes the entire cost of such construction, except as otherwise noted. Acceptance of any or all of the alternates for inclusion in the contract is the sole prerogative of the owner.

All additional costs due to the alternates are included in the amount to be added to the base bid, so that no additional costs will be borne by the owner due to acceptance of alternates.

Proposed Alternates: (Contractors Proposed Alternates)

Item Specified	Proposed Alternate	Change in Bid Price
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

Owner Requested Scheduling Information:

Note: The work of this Trade Contractor is to be completed in accordance with the overall project schedule as identified elsewhere in this project manual and/or as subsequently directed by Construction Manager. This Trade Contractor shall submit a proposed submittals list/schedule/material log within five (5) calendar days of Notice To Proceed.

1. Shop drawings / Submittal for this trade contractor will be submitted within 10 calendar days of receipt of notice to proceed.

Bid Acceptance:

If written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned within the time noted herein, after the date of opening of bids or at any time thereafter before this bid is withdrawn, the undersigned agrees that he will execute a construction contract in accordance with the bids as accepted.

The Owner reserves the right to award the contract to its best interests, review and accept any and all value engineering alternatives, negotiate with the lowest responsible bidder, to reject any or all bids, to waive any informalities in bidding and to hold all bids for the bid guarantee period. The Owner reserves the right to award separate contracts for any of the items of work bid herein.

Bid Deposit:

The undersigned furnishes herewith, as required in the Instructions to Bidders, a bid deposit in the amount of ten percent (10%) of the amount bid in the form of Cashier's Check, or Certified Check, made payable to the Owner or Bid Bond, naming the Owner as obligee. (Bidder to check form of deposit furnished.)

It is understood and agreed that should the undersigned fail to enter into a contract with the Owner or furnish acceptable contract security within the time and in the manner herein provided, the bid deposit shall be retained by the Owner as liquidated damages and not as a forfeiture. As it is impossible to determine precisely an exact amount of damages the Owner will sustain, it is agreed that the bid deposit is a fair and equitable estimate of such damages.

REPRESENTATIONS AND CERTIFICATIONS:

The bidder makes the following representations and certifications as part of his bid on the project herein identified in the Bid Form. In the case of a joint venture bid, each party represents and certifies as to his own organization.

AVAILABILITY. The number and amount of contracts and awards pending which I am and/or will be obligated to perform, now and during the course of the project, will not interfere with or hinder the timely prosecution of my work.

SURETY. I have notified a Surety Company that I am submitting a bid for work to be performed on the project. The Surety Company has agreed to issue a performance and labor and material payment bond for my work, if my bid is accepted and the contract awarded to me.

INDEPENDENT PRICE DETERMINATION. The contract sum in this bid has been arrived at independently, without consultation, communication or agreement for the purpose of restricting competition.

PREVAILING WAGE. The contractor and each subcontractor shall pay not less than the general prevailing rate of hourly wages for work of a similar character in the locality in which the work is performed and not less than general prevailing rate of hourly wages for legal holidays and overtime work in the performance of work under this contract, as established by the Illinois Department of Labor, pursuant to an act of the General Assembly of the State of Illinois approved June 26, 1941 as amended according to Section 820 ILCS 130/1.

Pursuant to Section 820 ILCS 130/5, the contractor and each subcontractor shall keep an accurate record showing the names and occupation of all laborers, workers and mechanics employed by them, and also showing the actual hourly wages paid to each such individual, which record shall be open at all reasonable hours to inspection by the Owner, its officers and agents, and to agents of the Illinois Department of Labor.

The contractor and each subcontractor hereby agree, jointly and severally, to defend, indemnify and hold harmless the Owner from any and all claims, demands, liens or suits of any kind or nature whatsoever (including suits for injunctive relief) by the Illinois Department of Labor under the Illinois Prevailing Wage Act, Section 820 ILCS 130/1., or by any laborer, worker or mechanic employed by the contractor or the subcontractor who alleges that he has been paid for his services in a sum less than prevailing wage rates required by Illinois law. The Owner agrees to notify the contractor or subcontractor of the pendency of any such claim, demand, lien or suit.

By submitting a bid, each bidder agrees to waive any claim it has or may have against the Owner, the Architect, Engineer, Construction Manager and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any bid; waiver of any requirements under the Bid Documents; or the Contract Document; acceptance or rejection of any bids; and award of the Contract.

Signature:

Respectfully submitted this _____ day _____, 2017

Type of Firm (Bidder to indicate)

_____ Individual

_____ Partnership

_____ Corporation

_____ Joint Venture

_____ Other

(CORPORATE SEAL)

(Firm Name)

(Address)

(Telephone Number) (FAX)

(E-mail Address)

(Bidder's Signature)

(Title)

Subscribed and sworn to me
this _____ day of _____, 2013

NOTE: All pages of this bid form must be returned with your proposal. Failure to do so shall disqualify your bid.

CERTIFICATE OF BIDDER ELIGIBILITY

720 ILCS 5/33E-11 REQUIRES THAT ALL CONTRACTORS BIDDING FOR PUBLIC AGENCIES IN THE State of Illinois certify that they are not barred from bidding on public contracts for bid rigging or bid rotation.

The following certification must be signed and submitted with bidder's bid proposal. FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, DuPage County, Illinois certified that said contractor is not barred from bidding on the aforementioned contract as a result of violation of either 720 ILCS 5/33E-3 or 720 ILCS 5/33-E4.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

**CRIMINAL CODE CERTIFICATION
AS REQUIRED BY:
STATE OF ILLINOIS CRIMINAL CODE OF 2012, 720 ILCS 5/33E-11**

I, _____ the individual whose signature appears below on this bid/contract
for _____ hereby certify that the bidding party/contracting
party is not barred from bidding on the contract as a result of a violation of either Section 33E-3 or Section 33E-4
of 720 ILCS 5/33E-3 or 5/33E-4 of the Illinois Compiled Statutes, as amended.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

EQUAL EMPLOYMENT OPPORTUNITY

Section I. This EQUAL EMPLOYMENT OPPORTUNITY CLAUSE is required by the Illinois Human Rights Act and the Rules and Regulations of the Illinois Department of Human Rights published at 44 Illinois Administrative Code Section 750, *et seq.*

Section II. In the event of the Contractor's noncompliance with any provision of this Equal Employment Opportunity Clause, the Illinois Human Rights Act, or the Rules and Regulations of the Department of Human Rights (hereinafter referred to as the Department) the Contractor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and this Contract may be canceled or voided in whole or in part, and other sanctions or penalties may be imposed or remedies involved as provided by statute or regulation.

During the performance of this Agreement, the Contractor agrees:

A. That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, national origin or ancestry, citizenship status, age, physical or mental disability unrelated to ability, military status or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization.

B. That, if it hires additional employees in order to perform this Contract, or any portion hereof, it will determine the availability (in accordance with the Department's Rules and Regulations) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.

C. That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, sexual orientation, marital status, national origin or ancestry, citizenship status, age, or physical or mental handicap unrelated to ability, military status or an unfavorable discharge from military service.

D. That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the Vendor's obligations under the Illinois Human Rights Act and Department's Rules and Regulations. If any labor organization or representative fails or refuses to cooperate with the Contractor in its efforts to comply with the Act and Rules and Regulations, the Contractor will promptly notify the Department and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations under the Contract.

E. That it will submit reports as required by the Department's Rules and Regulations, furnish all relevant information as may from time to time be requested by the Department or the contracting agency, and in all respects comply with the Illinois Human Rights Act and Department's Rules and Regulations.

F. That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and Department for purposes of investigation to ascertain compliance with the Illinois Human Rights Act and Department's Rules and Regulations.

G. That it will include verbatim or by reference the provisions of this Equal Employment Opportunity Clause in every subcontract it awards under which any portion of this Contract obligations are undertaken or assumed, so that such provisions will be binding upon such subcontractor. In the same manner as the other provisions of this Agreement, the Contractor will be liable for compliance with applicable provisions of this clause by such subcontractors; and further it will promptly notify the contracting agency and the Department in the event any subcontractor fails or refuses to comply therewith. In addition, the Contractor will not utilize any subcontractor declared by the Illinois Human Rights Department to be ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

ACKNOWLEDGED AND AGREED TO:

By: _____
Authorized Agent of Contractor (name and title)

DATE: _____

SEXUAL HARASSMENT POLICY

_____, having submitted a bid for _____ (Name of Contractor)
_____ to Community High School District No. 99, hereby certifies
that said contractor has a written sexual harassment policy in place in full compliance with 775 ILCS 5/2-105 (A) (4).

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

TAX CERTIFICATION

I, _____, having been first duly sworn depose and state as follows:

I, _____, am the duly authorized agent for
to _____, which has submitted a proposal
Community High School District No. 99 for

_____ and I hereby certify that _____ is not delinquent in the payment of
any tax administered by the Illinois Department of Revenue, or if it is:

- a. it is contesting its liability for the tax or the amount of tax in accordance with procedures established by the appropriate Revenue Act; or
- b. it has entered into an agreement with the Department of Revenue for payment of all taxes due and is currently in compliance with that agreement.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

SUBSTANCE ABUSE PREVENTION ON PUBLIC WORKS PROJECTS

The Contractor certifies that it has in place a written program that meets or exceeds the program requirements of the Substance Abuse Prevention on Public Works Projects Act (Public Act 95-0635), and will provide a copy thereof to Community High School District No. 99 prior to commencement of work on the Project.

By: _____
Authorized Agent of Contractor (name and title)

SUBSCRIBED AND SWORN to before
me this ____ day _____, 20__.

Notary Public

**CERTIFICATE REGARDING
EMPLOYMENT OF ILLINOIS WORKERS ON PUBLIC WORKS**

_____ agrees if at the time the Agreement is executed, or if during the term of the Agreement, there is excessive unemployment in Illinois as defined in the Employment of Illinois Workers on Public Works Act, 30- ILCS 570/0/01 et seq., as two consecutive months of unemployment exceeding 5%, then _____ agrees to employ Illinois laborers in accordance with the Employment of Illinois Workers on Public Works Act. An "Illinois laborer" is defined as any person who has resided in Illinois for at least thirty (30) days and intends to become or remain an Illinois resident.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

PREVAILING WAGE AFFIDAVIT

AFFIDAVIT: "I (we) hereby certify and affirm that if awarded a contract with Community High School District 99, we will comply fully with the "Illinois Prevailing Wage Act (Ill. Rev. Stat., 1987 Ch. 48, Sections 398 s-1-12 as amended by Public Act 86-693 and 86-799 effected January 1, 1990, and any other amendments effective thereafter)". We further understand that current prevailing wage standards are included in the Supplementary General Conditions.

The following affidavit must be signed and submitted with bidder's bid proposal. FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, certifies that said contractor is not barred from bidding on the aforementioned contract as a result of a violation of the Illinois Prevailing Wage Act (Ill. Rev. Stat., 1987 Ch. 48, Sections 398 s-1-12 as amended by Public Act 86-693 and 86-799 effected January 1, 1990).

Firm: _____

By: _____

(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

NON-COLLUSION AFFIDAVIT

AFFIDAVIT: "I (we) hereby certify and affirm that my (our) proposal was prepared independently for this project and that it contains no fees or amounts other than that for the legitimate execution of this work as specified and that it includes no understanding or agreements in restraint of trade."

The following affidavit must be signed and submitted with bidder's bid proposal.
FAILURE TO DO SO MAY RESULT IN DISQUALIFICATION OF THE BIDDER.

_____, as a part of its bid for the _____ work for Community High School District 99, Downers Grove, Illinois, certifies that said Contractor is not barred from bidding on the aforementioned contract as a result of a violation of the above Non-Collusion Affidavit.

Firm: _____

By: _____

(Signature)

(Printed Name & Title)

SUBSCRIBED AND SWORN TO before me

This _____ day of _____, 2017

NOTARY PUBLIC

Criminal Background Investigations

Contractor hereby represents, warrants and certified that no officer or director thereof has any knowledge that any employee thereof has been convicted of committing or attempting to commit "Criminal Code of 1961," 720 ILCS, Sections 5/11-6 (Indecent solicitation of a child), 5/11-9 (Public indecency), 5/11-14 (Prostitution), 5/11-15 (Soliciting for a prostitute), 5/11-15.1 (Soliciting for a juvenile prostitute), 5/11-19 (Pimping), 5/11-19.1 (Juvenile pimping), 5/11-19.2 (Exploitation of a child), 5/11-20 (Obscenity), 5/11-20.1 (Sexual assault), 5/12-14 (Aggravated criminal sexual assault), 5/12-15 (Criminal sexual abuse), and 5/120-16 (Aggravated criminal sexual abuse), and/or those offenses defined in the "Cannabis Control Act," 720 ILCS, 550/1 et seq. (except the "Illinois Controlled Substances Act," 720 ILCS 570/100 et seq. and/or any offense committed or attempted in any other state or against the laws of the United States, which if committed or attempted in this State, would have been punishable as one or more of the foregoing offenses.

Contractor further agrees that it shall not employ any person who have or may have direct, daily contact with the pupils of any school in the district, and for whom a criminal background investigation has not been conducted pursuant hereto, and further represents and agrees that all applicants for any such employment shall furnish with their applications the attached written "Authorization for Criminal Background Information" form authorizing the Board of Education to request a criminal background investigation of said applicant pursuant to Section 5/10-21.9 of the School Code of Illinois and to receive criminal history record information pursuant thereto to determine if the applicant has been convicted of committing or attempting to commit any of the criminal or drug offenses enumerated above. Contractor further agrees to submit with said authorization payment for any costs and expenses associated with the criminal background investigation.

Contractor further represents, warrants, and certifies that no applicant for employment with respect to whom the criminal investigation reveals any conviction for committing and/or attempting to commit any of the above enumerated offenses shall be employed thereby in any position that involves or may involve contact with the students of the school district.

This certification is executed on the date hereinafter indicated by the designated contractor by its duly authorized officer.

Firm: _____

By: _____
(Signature)

(Printed Name & Title)

Date: _____

Criminal Background Investigation

The undersigned hereby authorizes in Board of Education of Community High School District 99, Downers Grove, Illinois, to request a criminal background investigation from the Illinois State Police, pursuant to Section 5/10-21.9 of the School Code of Illinois, 105 ILCS 5/10-21.9 and to receive criminal history record information pursuant thereto.

By: _____
(Signature of Applicant of Employee)

(Printed or Typed Name of Applicant Employee)

Date: _____

BUSINESS CLASSIFICATION

a) Business Entity (check one)

Corporation (Publicly held)* Not-for-Profit* Government Agency/Public Institution*
 Corporation (Privately held) Partnership Sole Proprietor

* If checked, do not complete section III (b) and (c) below.

b) Business Ownership (check one) If minority or woman owned, attach copy of certification evidence.

Large Business: Male Owned Woman Owned
Small Business: Male Owned Woman Owned

BUSINESS DEFINITIONS

Small Business Concern - an independently owned and operated concern certified, or certifiable, as a small business by the Federal Small Business Administration (SBA). Standard Industrial Classification (SIC) codes may be found in the Federal Acquisition Regulations, Section 19.102 or in the Federal Procurement Regulations, Section 1-1.701.

Small Disadvantaged or Minority Business Concern - a small business concern which is at least fifty-one percent (51%) owned by one or more socially and economically disadvantaged individuals or in the case of any publicly owned business, at least fifty-one percent (51%) of the stock of which is owned by such individuals; and whose management and daily business operations are controlled by one or more of such individuals. Business owners who certify that they are members of named groups (Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans) are considered socially and economically disadvantaged.

Woman-Owned Business - a business concern that is at least fifty-one percent (51%) owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

c) Race/Ethnicity of Ownership (check one) based on definitions below.

Black Asian/Pacific or Asian/Indian Caucasian
 Hispanic Native American (American Indians, Eskimos, Aleuts and native Hawaiians)

ETHNIC GROUP DEFINITIONS

Black Americans: United States citizens whose origins are in any of the Black racial groups of Africa.
Hispanic Americans: United States citizens whose origins are in Mexico, Puerto Rico, Cuba, Portugal, Central or Central America.
Native Americans: United States citizens whose origins are in any of the original peoples of North America, i.e., American Indians, Eskimos, Aleuts and native Hawaiians.
Asian Pacific/Asian Indian Americans: United States citizens whose origins are in Japan, China, Korea, Taiwan, Cambodia, Laos, Vietnam, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands, the Northern Mariana Islands, India, Pakistan, or Bangladesh.

I certify that the business classification and ethnicity indicated above reflects the true and correct status of this business in accordance with current Federal Small Business Administration criteria. I agree to inform Community High School District 99 immediately in writing of any changes to the information contained herein, including changes in ownership, controlling interest or operations. I understand that falsely certifying this information may result in suspension from participation in Community High School District 99 - North High School Phase II project.

Name: _____ Title: _____
(Print or Type)

Signature: _____ Date: _____

END OF SECTION 00301

PART 1 - GENERAL

1.1 SUMMARY

- A. The Owner is: Community High School District 99
6301 Springside Avenue
Downers Grove, IL 60516

- B. The Architect is: Wight & Company
2500 North Frontage Road
Darien, Illinois 60561

- C. The Construction Manager is: Wight Construction Services, Inc.
2500 North Frontage Road
Darien, Illinois 60561

- D. Section Includes:
 - 1. Project description.
 - 2. Contracts scope description.
 - 3. Applicable regulatory requirements.
 - 4. Permits and licenses.
 - 5. Access to the site.
 - 6. Contractor's use of the premises.
 - 7. Coordination requirements.
 - 8. Work sequence.

- E. Related Sections:
 - 1. Contract responsibilities and general requirements: Elsewhere in Division 1.
 - 2. Scope of Work for each trade is identified bid package scope document 00300.

1.2 PROJECT DESCRIPTION

- A. The Bid Group consists of completing scope as associated with the project identified as Community High School District 99 Downers Grove North Boiler House Upgrades.

- B. The project location is: North High School
4436 Main Street
Downers Grove, IL 60515

- C. The Group No. 1 Bid Package(s) work consists of:
 - Bid Package #01 – Demolition
 - Bid Package #02- HVAC
 - Bid Package #03 - Electrical

- D. The work consists of:
 - 1. Access to site.
 - 2. Contractor's use of the premises.
 - 3. Coordination requirements.
 - 4. Coordination drawings.

- E. Sequencing:

1. Refer to the attached Construction Schedule for construction sequences for this project.

1.3 PRIME CONTRACTS

- A. Each prime contract shall include the work described in:
 1. The agreement.
 2. The General Provisions.
 3. The Bid Form.
 4. Division 1 specification sections, except as specifically indicated to be the responsibility of a particular Contractor.

- B. Other sections which include descriptions of the scope of work of prime contracts are:
 0. Section 01010 – Summary of Work
 1. Section 01025 – Payment, Modification and Completion Procedures.
 2. Section 01200 – Progress Documentation and Procedures.
 3. Section 01250 – Construction Schedule.
 4. Section 01300 – Submittals.
 5. Section 01400 – Quality Control Procedures.
 6. Section 01510 – Temporary Utilities.
 7. Section 01600 – Product Requirements.
 8. Section 01630 – Product Options & Substitutions
 9. Section 01700 – Construction Procedures.
 10. Section 01800 – Project Record Documents.

- C. All Contractors' Duties:
 1. Owner is exempt from sales tax on products permanently incorporated in work.
 2. Obtain sales tax exemption certificate number from Owner.
 3. Place exemption certificate number on invoices for materials incorporated in work.
 4. All contractors shall provide Performance, Labor and Material Payment Bonds.
 5. Secure and pay for, as necessary for proper execution and completion of work, and as applicable at times of receipt of bids:
 - a. Permits: All permits required (except Building Permit).
 - b. Government fees.
 - c. Licenses.
 6. All contractors working on site must be licensed and bonded according to requirements of Will County.
 7. Contact inspecting agencies associated with contractor specific work to: a) schedule any and all required inspections, b) complete that work required for acceptance of contractor specific work by the jurisdictional inspecting agency, and c) submit all inspecting agency sign-off related documentation to Construction Manager.

1.4 DEFINITIONS

- A. **Furnish:** To supply products to the project site, including delivering ready for unloading and replacing damaged and rejected products.

- B. **Install:** To put products in place in the work ready for the intended use, including unloading, unpacking, handling, storing, assembling, installing, erecting, placing, applying, anchoring, working, finishing, curing, protecting, cleaning, and similar operations.

- C. **Provide:** To furnish and install products.

D. Indicated: Shown, noted, scheduled, specified, or drawn, somewhere in the contract documents.

A. 1.5 AS ADOPTED BY THE ILLINOIS ADMINISTRATIVE CODE, TITLE 23: EDUCATION AND CULTURAL RESOURCES, SUBTITLE a: EDUCATION, CHAPTER 1: STATE BOARD OF EDUCATION, SUBCHAPTER D: CONSTRUCTION AND BUILDING MAINTENANCE, PART 180 HEALTH/LIFE SAFETY CODE FOR PUBLIC SCHOOLS, SECTION 180.60 APPLICABILITY:

ILLINOIS ADMINISTRATIVE CODE, TITLE 23,180

1. 2009 International Building Code
2. 2009 International Energy Conservation (IECC)
3. 2009 International Existing Building Code (IEBC)
4. 2009 International Fire Code (IFC); excluding Chapter 4;
5. 2009 International Fuel Gas Code (IFGC);
6. 2009 International Mechanical Code (IMC);
7. 2009 International Property Maintenance Code (IPMC)

B. AMENDMENTS

1. The provisions of 29 Ill. Adm. Code 1500 (Joint Rules of the Office of the State Fire Marshal and the Illinois State Board of Education: School Emergency and Crisis Response Plans) shall apply instead of Chapter 4 of the International Fire Code.
2. The administrative provisions of this part shall apply instead of the administrative provisions contained in Sections 101.4, 103-108, 110-113, and 115 of Chapter 1 of the International Building Code.
3. The Illinois Accessibility Code (71 Ill. Adm. Code 400) shall apply instead of the accessibility provisions set forth in Chapter 11 of the International Building Code.
4. The requirements set forth in the Illinois Plumbing Code (77 Ill. Adm. Code 890) shall apply instead of those expressed in Section 101.4.4 of Chapter 1 and incorporated in Chapter 35 of the International Building Code.
5. The requirements set forth in the Illinois State Fire Marshal's rules titled Boiler and Pressure Vessel Safety (41 Ill. Adm. Code 120) shall apply instead of those expressed in the Boiler and Pressure Vessel Safety Code (ASME 98) published by the American Society of Mechanical Engineers and incorporated in Chapter 35 of the International Building Code.

C. Authorities

1. Downers Grove Fire Department.
2. City of Downers Grove.

D. Other regulations may also be applicable.

E. Obtain copies of the regulations listed above and keep at the project site for the use of all parties.

F. Submit copies of all permits, licenses, and similar permissions obtained, and receipts for fees paid, to the Construction Manager directly.

1.6 ACCESS TO THE SITE AND USE OF THE PREMISES

A. The space available to the Contractor for the performance of the work, either exclusively or in conjunction with others performing other construction as part of the project, is the areas of construction.

- B. *Other areas are off limits to all construction personnel unless permission is granted by the Owner and Construction Manager.*
- C. Access to site will be restricted as required by the Construction Manager.
- D. The following existing facilities may be used by construction personnel:
 - 1. NONE
- E. The Owner will continue to occupy the existing building adjacent to the areas where construction is to occur.
 - 1. Conduct the work so as to cause the least interference with the Owner's operations.
 - 2. Limited storage areas will be available at the project site.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COORDINATION WITH OCCUPANTS / VILLAGE

- A. Occupied areas include all areas in which the Owner's regular operations will be going on or to which the Owner requires access during the construction period, whether conducted by the Owner or his customers, clientele, or the public.
- B. Perform all work on weekdays, between 7:00 a.m. and 4:00 p.m., except as otherwise indicated on the drawings, elsewhere in the specifications and or as restricted by local ordinance. Activities which will require temporary shut down of necessary utilities must be scheduled for non-operating hours, and must be scheduled to cause no interruption to Park District and/or any village activity.
- C. Separate occupied areas from construction areas with dust-proof partitions.
 - 1. Where it is absolutely necessary to conduct construction operations in occupied areas, obtain the Owner's approval of the time period, the areas to be used, and the means of separating the work from the occupants.
- D. Limit access through occupied areas to those days and times which the Construction Manager and Owner approves.
- E. Provide separate access from the exterior to the construction areas, without passing through occupied areas.
- F. When the following must be modified, provide alternate facilities acceptable to the Construction Manager:
 - 1. Emergency means of egress.
 - 2. Entrances which must remain open.
 - 3. Utilities which must remain in operation.
 - 4. Informational signage.

3.2 SECURITY PROCEDURES

- A. Limit access to the site to persons involved in the work.
- B. Provide secure storage for materials for which the Owner has made payment and which are stored on site.

- C. Secure completed work as required to prevent loss.
- D. Contractor personnel will be required to check in through the Construction Manager's office each day.

3.3 COORDINATION

- A. Each prime Contractor shall coordinate his activities with the activities of other Contractors.
- B. If necessary, inform each party involved, in writing, of procedures required for coordination; include requirements for giving notice, submitting reports, and attending meetings.
 - 1. Inform the Owner when coordination of his work is required.
- C. See other requirements in other portions of the contract documents.

END SECTION 01010

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Schedule of values.
 - 2. Payment procedures.
 - 3. Modification procedures.
 - 4. Completion procedures.
- B. Related Requirements Specified Elsewhere in the Project Manual:
 - 1. Progress payment dates and time limits.

1.2 CONTRACT CONDITIONS

- A. See the General Provisions for additional requirements.
- B. The Owner will retain from each progress payment an amount equal to 10 percent of the value of the work covered by the progress payment.
 - 1. At substantial completion the contractor may apply for release of retainage sufficient to bring the total of payments to 95 percent of the contract sum, less those amounts that are withheld to cover incomplete or incorrect work and unsettled claims, as defined elsewhere.
- C. No payment will be made for materials or equipment stored off site unless specifically approved in advance, in writing by the owner. Submit copy of the owner's agreement to pay for such materials and equipment with the application for payment covering such materials, equipment, receipts and such specific certificates of insurance for such stored material.
- D. Payments may be withheld if the contractor fails to make dated submittals within the time periods specified.

1.3 DEFINITIONS

- A. Change Proposal Request: Any written request from the Construction Manager to the contractor for a quotation, price, or breakdown on a change proposed but not ordered.
- B. Final Completion: The stage at which all incomplete and incorrect work has been completed or corrected in accordance with the contract documents.
- C. List of Incomplete Work: A comprehensive list of items to be completed or corrected, prepared by the contractor for the purpose of obtaining certification of substantial completion. This list is also referred to as a "punchlist."
- D. Modifications: Written amendments to the contract signed by the Construction Manager and the contractor, change orders, construction change directives, and written orders for a minor change in the work issued by the Construction Manager.
- E. Schedule of Values: A detailed breakdown of the contract sum into individual cost items, which will serve as the basis for evaluation of applications for progress payments during construction.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01025 - PAYMENT, MODIFICATION, AND COMPLETION PROCEDURES

- F. Substantial Completion: The time at which the work, or a portion of the work which the Construction Manager agrees to accept separately, is sufficiently complete in accordance with the contract documents so that the owner can occupy or use the work for its intended purpose.
- G. Time and Material Work: Work which will be paid for on the basis of the actual cost of the work, including materials, labor, equipment, and other costs as defined elsewhere, as documented by detailed records. This basis is also referred to using the terms "cost-plus," "cost of the work," "force account," and similar terms.

1.4 SUBMITTALS

- A. Schedule of Values: First application for payment will not be reviewed without schedule of values.
 - 1. Submit in size not larger than 8-1/2 by 11 inches.
 - 2. Submit 3 copies.
 - 3. Identify with:
 - a. Project name.
 - b. Project number.
 - c. Construction Manager's name.
 - d. Owner's name.
 - e. Contractor's name and address.
 - f. All major subcontractors, material suppliers, etc.
 - g. Submittal date.
- B. Applications for Progress Payments: Submit sufficiently in advance of date established for the progress payment to allow for the processing indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Each prime contractor shall prepare a schedule of values for his work.
- B. Schedule of Values: Break costs down into line items which will be comparable with line items in applications for payment.
 - 1. Coordinate line items in the schedule of values with portions of the contract documents which identify units or subdivisions of work; provide cross-referencing if necessary to clarify.
 - a. Specifically, correlate with the project manual table of contents.
 - 2. Divide major subcontracts and material suppliers into individual cost items.
 - 3. Where applications for payment are likely to include products purchased or fabricated but not yet installed, provide individual line items for material cost, installation cost, and other applicable phases of completion.
 - 4. Show overhead and profit as a single line item.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01025 - PAYMENT, MODIFICATION, AND COMPLETION PROCEDURES

5. Include the following information for each line item, using AIA Standard Schedule of Values Form.
 - a. Item name.
 - b. Applicable specification section.
 - c. Dollar value, rounded off to the nearest whole dollar (with the total equal to the contract sum).
 - d. Proportion of the contract sum represented by this item, to the nearest one-hundredth percent (with the total adjusted to 100 percent).
 6. Provide the following supporting data for each line item:
 - a. Subcontractor's name.
 - b. Manufacturer or fabricator's name.
 - c. Supplier's name.
- C. Submit schedule of values within 14 days after execution of the contract.
- D. The Construction Manager will notify the contractor if schedule is not satisfactory; revise and resubmit acceptable schedule.
- E. Submit a revised schedule of values when modifications change the contract sum or change individual line items.
1. Make each modification a new line item.
 2. Show the following information for each line item:
 - a. All information required for original submittal.
 - b. Identification of modifications which have affected its value.
 3. Submit prior to next application for payment.

3.2 APPLICATIONS FOR PAYMENT

- A. Application for Payment Forms: Use AIA original current editions of G702, Application and Certificate for Payment, and AIA G703, Continuation Sheet.
- B. Preparation of Applications for Payment: Complete form entirely.
1. Make current application consistent with previous applications, certificates for payment, and payments made.
 2. Base application on current schedule of values and contractor's construction schedule.
 3. Include amounts of modifications issued before the end of the construction period covered by the application.
 4. Include signature by person authorized by the contractor to sign legal documents.
 5. Notarize each copy.
 6. Submit in 3 copies.
 7. Attach waivers of lien.
 8. Attach revised schedule of values, if changes have occurred, unless application forms already show entire schedule of values.
 9. Attach copy of the owner's agreement to pay for materials and equipment stored off site, and any other supporting documentation required by the Design/Builder or the contract documents.

SECTION 01025 - PAYMENT, MODIFICATION, AND COMPLETION PROCEDURES

- C. Provide the following information with every application for payment which involves work completed on a time and material basis:
 - 1. Detailed records of work done, including:
 - a. Dates and times work was performed, and by whom.
 - b. Time records and wage rates paid.
 - c. Invoices and receipts for products.
 - 2. Provide similar detailed records for subcontracts.
- D. Transmit application for payment with a transmittal form itemizing supporting documents attached.
 - 1. Transmit to the Construction Manager.

3.3 WAIVERS OF LIEN

- A. Submit, with each application for payment, waivers of lien from every entity who performed work during the period covered by the previous application for payment, and who may be legally entitled to file a mechanic's or other lien against the work.
- B. Waiver of Lien Forms: Use forms acceptable to the owner.

3.4 FIRST PAYMENT PROCEDURE

- A. The first application for payment will not be reviewed until the following submittals have been received:
 - 1. Certificates of insurance.
 - 2. Schedule of values.
 - 3. List of subcontractors, principal suppliers, and fabricators.
 - 4. Submittal schedule.
 - 5. Unit price schedule. (If applicable.)
 - 6. Names of the contractor's principal staff assigned to the project.
 - 7. All submittals specified to occur prior to first application for payment or prior to first payment.

3.5 MODIFICATION PROCEDURES

- A. Designate a single individual authorized to receive change documents and who will be responsible for informing others of changes to the work.
- B. Changes in cost resulting from modifications shall include only those costs specified elsewhere in the contract documents.
- C. When requested in writing, the contractor shall provide sufficient information for evaluation of proposed changes within 7 days.
- D. Provide the following information for every change proposal request:
 - 1. The amount of change in the contract sum, if any.
 - 2. The amount of change in the contract time, if any, with explanation.
 - 3. Cost breakdown, using schedule of values line items, separated into material and labor costs, additions and deletions, and with overhead and profit handled in the same manner as specified for the schedule of values.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01025 - PAYMENT, MODIFICATION, AND COMPLETION PROCEDURES

4. The period of time within which the proposed changes in contract sum or time will be valid.
5. A statement describing the effect the change may have on the work of other prime contractors.
6. Upon request, provide the following information:
 - a. Quantities and unit costs of products, labor, and equipment.
 - b. Insurance and bonds.
 - c. Overhead and profit.
- E. When changes are performed on a time and material basis, identify the applicable modification on the application for payment.
- F. Provide the following information with every claim for additional costs:
 1. Origin and date of claim.
 2. Detailed records as specified for time and material work.
- G. The contractor may propose changes.
 1. Do not use change order form.
 2. Provide the information required for change proposal requests.
 3. Describe reasons for change.
 4. Document proposed substitutions as specified elsewhere.

3.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Request for inspection and application for payment may coincide.
- B. The Construction Manager will perform one inspection for substantial completion, upon request of the contractor.
 1. If the Construction Manager is unable to issue the certificate of substantial completion because the work is not considered to be substantially complete, the contractor shall pay all subsequent inspection costs, including compensation for the Construction Manager's services and expenses.
 2. Only one certificate of substantial completion will be issued, for the entire project.
- C. Do not submit request for inspection for substantial completion until the following activities have been completed:
 1. Delivery of maintenance materials and tools.
 2. Demonstration of all equipment and systems.
 3. Instruction of the owner's personnel.
 4. Removal of temporary facilities.
 5. Final cleaning.
 6. All activities specified to occur prior to substantial completion.
- D. Do not submit request for inspection for substantial completion until the following submittals have been completed:
 1. List of incomplete work.
 2. Startup reports.
 3. Final testing, adjusting, and balancing reports.
 4. Demonstration reports.
 5. Instruction reports.
 6. Warranties.
 7. Operation and maintenance data.
 8. Project record documents.

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01025 - PAYMENT, MODIFICATION, AND COMPLETION PROCEDURES

9. All submittals specified to occur prior to substantial completion.

- E. Submit the following with application for payment following substantial completion:
1. Contractor's affidavit of release of liens.
 2. Meter readings of all utilities services for which the contractor has been paying.
 3. Request for reduction or release of retainage.
 4. Final list of incomplete work.
 5. Other data required by the contract documents.

3.7 FINAL COMPLETION PROCEDURES

- A. Request for final inspection and final application for payment may coincide.
- B. The Construction Manager will perform one inspection for final completion, upon request of the contractor.
1. Submit the following with request for inspection:
 - a. Previous inspection lists indicating completion of all items.
 - b. If any items cannot be completed, obtain prior approval of such delay.
 2. If the Construction Manager is unable to issue the certificate for final payment because the work is not complete, the contractor shall pay all subsequent inspection costs, including compensation for the Construction Manager's services and expenses.
- C. Do not submit request for final inspection until the following activities have been completed:
1. Completion of all work, except those items agreed upon by the owner.
 2. All activities specified to occur between substantial completion and final completion.
- D. Do not submit request for final inspection until the following submittals have been completed:
1. Maintenance agreements.
 2. All other outstanding specified submittals.
- E. Submit the following with the final application for payment:
1. Certified copy of the previous list of items to be completed or corrected, stating that each has been completed or otherwise resolved for acceptance.
 2. Updated final statement, accounting for final changes to the contract sum.
 3. Meter readings of all utilities services for which the contractor has been paying after substantial completion.
 4. Certification that financial obligations to governing authorities and public utilities have been fulfilled.
 5. Description of unsettled claims.
 6. Other data required by the contract documents.

END SECTION 01025

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DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01200 - PROGRESS DOCUMENTATION AND PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Progress documentation requirements:
 - a. Contractor's construction schedule.
 - b. Progress reports.
 - 2. Progress procedures:
 - a. Progress meetings.
- B. Contract time is indicated elsewhere.
- C. Related Sections:
 - 1. Applications for payment: Elsewhere in Division 1.
 - 2. Coordination meetings: Elsewhere in Division 1.
 - 3. Preconstruction meeting: Elsewhere in Division 1.
 - 4. Schedule of values: Elsewhere in Division 1.
 - 5. Submittal schedule: Elsewhere in Division 1.
 - 6. Quality control activities schedule: Elsewhere in Division 1.

1.2 SUBMITTALS

- A. Contractor's Construction Schedule.
 - 1. Submit within 5 days after notice of Contract Award.
- B. Daily Construction Reports: Submit every week.
- C. Progress Reports: Submit with each application for payment.

1.3 FORM OF SUBMITTALS

- A. Schedules - General:
 - 1. Provide legend of symbols and abbreviations for each schedule.
 - 2. Use the same terminology as that used in the contract documents.
 - 3. When transparencies are submitted, use only media which will not fade or lose contrast over time.
 - 4. When opaque copies are submitted, submit a minimum of 4 copies.
 - 5. Where percentage of completion information is required within time bars, mark updated schedules to show actual percentage of completion.
- B. Reports - General:
 - 1. Submit a minimum of 4 copies.
- C. Photographs: Not Required

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SECTION 01200 - PROGRESS DOCUMENTATION AND PROCEDURES

INFORMATION REQUIRED OF CONTRACTOR

- A. Submit the following information for preparation of construction schedules, and revise at intervals as directed by the Construction Manager:
 - 1. Description of activity; separate into activities of not more than 15 days' duration.
 - 2. Immediately preceding and succeeding activities.
 - 3. Estimated duration in working days.
 - 4. Earliest and latest start dates.
 - 5. Earliest and latest finish dates.
 - 6. Actual start and finish dates.
 - 7. Float time.
 - 8. Monetary value, keyed to schedule of values.
 - 9. Percentage of activity completed.
 - 10. Size of work force required.
 - 11. Entity responsible.

1.4 QUALITY ASSURANCE

- A. Not Used.

1.5 COORDINATION

- A. The Construction Manager is responsible for coordinating scheduling of all contracts.
- B. Each prime Contractor shall provide scheduling information as specified and as required by the Construction Manager.
- C. Each prime Contractor is responsible for coordinating with other contractors.
- D. In preparation of schedules, take into account the time allowed or required for the Construction Manager's administrative procedures.
- E. Notify entity responsible for coordination of schedules promptly when problems are anticipated in meeting schedule dates.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Prepare and submit preliminary construction schedule.
- B. Provide preliminary construction schedule in the form of bar charts:
 - 1. Show activities for the first 90 days of construction in detail; show remainder in skeletal form.
 - 2. Show completion of the work in advance of the date established for substantial completion.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01200 - PROGRESS DOCUMENTATION AND PROCEDURES

3. Include dates and description of all submittals required during the first the first 90 days of construction.
 - a. Include those required by the construction schedule.
 - b. Submittal dates may be provided in a separate list rather than on the schedule.

3.2 CONSTRUCTION MANAGER'S CONSTRUCTION SCHEDULE

- A. Prepare and submit all information required for preparation of integrated construction schedule by Construction Manager:
 1. Base construction schedule on preliminary construction schedule, with adjustments due to changes since start of work.
 2. Use the same items of work as shown in the schedule of values.
 3. Show projected progress in increments of 10 percentage points for:
 - a. Site Work
 - b. Carpentry
 - c. Gypsum Board Systems/Plaster & Acoustical Ceilings
 - e. Painting
 - f. Casework
 - g. Masonry
 - h. Flooring
 - l. Electrical
 - j. Data & Communications
 - k. Plumbing
 - l. Fire Protection
 - m. HVAC
 4. Where related activities must be performed in sequence, show relationship graphically.
 5. Indicate activities separately for:
 - a. Each separate work area.
 6. Incorporate the submittal schedule specified elsewhere.
 7. Incorporate the quality control activities schedule specified elsewhere.
 8. Show dates of:
 - a. Each activity that influences the construction time.
 - b. Preconstruction meeting.
 - c. Quality control activities which involve long lead time or long elapsed time.
 - d. Ordering dates for products requiring long lead time.
 - e. All submittals required.
 - f. Completion of structure.
 - g. Substantial and final completion, with time frames for the Design/Builder's completion procedures.
 9. In developing the schedule take into account:
 - a. Phased completion.
 - b. Work under other contracts.
 - c. Continued occupancy.
 - d. Interruption of services to occupied facilities.
 - e. Occupancy by Owner prior to substantial completion.
 - f. Site limitations.
 - g. Provisions made for future work.
- B. Update the schedule whenever changes occur or are made, or when new information is received, but not less often than at the same intervals at which applications for payment are made.
 1. Indicate changes made since last issue; show actual dates for activities completed.

3.3 PROGRESS REPORTS

- A. Daily Construction Logs: Every day, record the following information concerning events at the site:
1. Approximate number of persons at the site.
 2. Names of prime Contractors at site.
 3. Visitors to the site.
 4. Modifications to the contract received; modifications implemented.
 5. Delays; reasons for delay.
 6. Emergencies and accidents.
 7. Losses of material and property.
 8. Meetings held and significant decisions made there.
 9. Names of subcontractors at site.
 10. Special reports made.
 11. Orders and requests of representatives of governing authorities.
 12. Unusual events.
 13. Utility service disconnections and connections.
- B. Progress Reports: Prepare a narrative report describing the general state of completion of the work and describing in detail the following:
1. Actual and anticipated delays, their impact on the schedule, and corrective actions taken or proposed.
 2. Actual and potential problems.
 3. Status of change order work.
 4. Effect of delays, problems, and changes on the schedules of other prime Contractors.
 5. Outstanding change proposal requests.
 6. Status of corrective work ordered by the Design/Builder.
- C. Progress Photographs: Not Required

3.4 PROGRESS MEETINGS

- A. The Construction Manager will schedule and conduct weekly progress meetings during the construction period.
1. Meetings will be held once a month in the week just prior to submission of application for payment or once a week; progress meeting schedule will be at the discretion of the Construction Manager.
- B. The following are required to attend:
1. All prime Contractors.
 2. Prime Contractors' superintendents.
 3. Major subcontractors and suppliers.
 4. Others as directed by the Construction Manager.
 5. Others who have an interest in the agenda.
- C. Prepare to cover the following topics when applicable:
1. Review minutes of previous meeting.
 2. Status of submittals and impending submittals.
 3. Actual progress of activities in relation to the schedule.
 4. Actual and anticipated delays, their impact on the schedule, and corrective actions taken or proposed.
 5. Actual and potential problems.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01200 - PROGRESS DOCUMENTATION AND PROCEDURES

6. Effect of delays, problems, and changes on the schedules of all prime Contractors.
7. Status of corrective work ordered by the Construction Manager.
8. Progress expected to be made during the next period.

END OF SECTION 01200

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01250 - CONSTRUCTION SCHEDULE

PART 1 GENERAL

1.1 SUMMARY

The schedule for the scope of work covered under this project is as follows:

Demolition work shall be performed starting June 12, 2017 and must be completed by June 23, 2017.

Installation of new mechanical system and electrical work shall be performed starting June 23, 2017 and must be completed by August 11, 2017.

END OF SECTION 01250

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparing and processing of submittals for review and action.
 - 2. Preparing and processing of informational submittals.

- B. Submit the following for the Design/Builder's review and action:
 - 1. Shop drawings.
 - 2. Product data.
 - 3. Samples.
 - 4. Structural design calculations.
 - 5. Submittals for which procedures are not defined elsewhere.

- C. Submit the following as informational submittals:
 - 1. Structural design information required by the contract documents.
 - 2. Certificates.
 - 3. Coordination drawings.
 - 4. Reports.
 - 5. Qualification statements for manufacturers/installers.
 - 6. Certification of structural design.

- D. Related Sections: The following are specified elsewhere in Division 1:
 - 1. Payment, modification, and completion submittals.
 - a. Applications for payment.
 - b. Schedule of values.
 - c. Change proposals.
 - 2. Progress of work submittals:
 - a. Contractor's construction schedules.
 - b. Progress reports.
 - 3. Quality control submittals:
 - a. Quality control activities schedule.
 - b. Inspection reports.
 - c. Test reports.
 - 4. Product submittals:
 - a. Product option submittals.
 - b. Requests for substitution.
 - c. Operating and maintenance data.
 - d. Warranties.
 - e. Maintenance materials and tools.
 - 5. Contract closeout submittals:
 - a. Equipment and systems demonstration reports.
 - b. Request for determination of substantial completion.
 - c. Project record documents.
 - 6. Other administrative submittals:
 - a. Survey data.
 - b. Layout data.

1.2 DEFINITIONS

- A. Shop Drawings: See General Provisions.
 - 1. Shop drawings also include:
 - a. Product data specifically prepared for this project.
 - b. Shop or plant inspection and test reports, when made on specific materials, products, or systems to be used in the work.
- B. Product Data: See General Provisions.
 - 1. Product data submittals also include:
 - a. Performance curves, when issued by the manufacturer for all products of that type.
 - b. Selection data showing standard colors.
 - c. Wiring diagrams, when standard for all products of that type.
- C. Samples: See General Provisions.
- D. Informational Submittals: Submittals identified in the contract documents as to be submitted for information only.

1.3 FORM OF SUBMITTALS

- A. Sheets Larger Than 8-1/2 by 14 Inches:
 - 1. Maximum sheet size: 30 by 42 inches.
 - a. Exception: Full size pattern or template drawings.
 - 2. Number of copies:
 - a. Submittals for review:
 - 1. One correctable reproducible print, not folded and 3 copies of blue- or black-line print(s).
 - 2. Reproducible will be returned.
 - b. Informational submittals:
 - 1. 5 copies of opaque prints.
 - 2. 3 copies will be returned.
- B. Small Sheets or Pages:
 - 1. Minimum sheet size: 8-1/2 by 11 inches.
 - 2. Maximum sheet size for opaque copies: 8-1/2 by 14 inches.
 - 3. Number of copies:
 - a. Transparencies: Same as for larger sheets.
 - b. Opaque copies:
 - 1. For review: 5 copies.
 - a. 3 copies will be retained.
 - 2. Informational submittals: 5 copies.
- C. Samples: 2 sets of each.
 - 1. 1 set will be returned.
- D. If additional sets are needed by other entities involved in work represented by the samples, submit with original submittal.
- E. Copies in excess of the number requested will not be returned.

- F. Provide additional copies, if required for operating and maintenance data, marked to indicate their purpose.
- G. Provide additional copies for project record documents.

1.4 COORDINATION OF SUBMITTALS

- A. Coordinate submittals and activities that must be performed in sequence, so that the Design/Builder has enough information to properly review the submittals.
- B. Coordinate submittals of different types for the same product or system so that the Construction Manager has enough information to properly review each submittal.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TIMING OF SUBMITTALS

- A. Transmit each submittal at or before the time indicated on the approved schedule of submittals.
 - 1. Prepare and submit for approval a schedule showing the required dates of submittal of principal submittals.
 - 2. Organize the schedule by the applicable specification section number.
 - 3. Incorporate the contractor's construction schedule specified elsewhere.
 - 4. Incorporate the quality control activities schedule specified elsewhere.
 - 5. Submit within 30 days after commencement of the work.
 - 6. Revise and resubmit the schedule for approval when requested.
- B. Deliver each submittal requiring approval in time to allow for adequate review and processing time, including resubmittals if necessary; failure of the Contractor in this respect will not be considered as grounds for an extension of the contract time.
- C. Deliver each informational submittal prior to start of the work involved, unless the submittal is of a type which cannot be prepared until after completion of the work; submit promptly.
- D. If a submittal must be processed within a certain time in order to maintain the progress of the work, state so clearly on the submittal.
- E. If a submittal must be delayed for coordination with other submittals not yet submitted, the Construction Manager may at his option either return the submittal with no action or notify the Contractor of the other submittals which must be received before the submittal can be reviewed.
- F. Allow a minimum of 10 business days for the first processing of each submittal. Allow more time when submittals must be coordinated with later submittals.
- G. Allow a minimum of 6 business days for processing of resubmittals.

3.2 SUBMITTAL PROCEDURES - GENERAL

- A. Contractor Review: Sign transmittal form for each submittal certifying compliance with the requirements of the contract documents.
- B. Notify the Construction Manager, in writing and at time of submittal, of all points upon which the submittal does not conform to the requirements of the contract documents, if any.
- C. Do not commence work which requires review of any submittals until receipt of returned submittals with an acceptable action.
- D. Do not allow submittals without an acceptable action marking to be used for the project.
- E. Submit all submittals to the Construction Manager for review.
- F. Do not submit substitute items that have not been approved by means of the procedure specified elsewhere.
- G. Do not include requests for substitution (either direct or indirect) on submittals; comply with procedures for substitutions specified elsewhere.
- H. Preparation of Submittals:
 - 1. Label each copy of each submittal, with the following information:
 - a. Project name.
 - b. Date of submittal.
 - c. Construction Manager's name and address.
 - d. Subcontractor's name and address.
 - e. Supplier's name and address.
 - f. Manufacturer's name.
 - g. Specification section where the submittal is specified.
 - h. Numbers of applicable drawings and details.
 - i. Other necessary identifying information.
 - j. Indicate whether manufacturer or other source is listed on the Owner's preferred vendor list.
 - 2. Pack submittals suitably for shipment.
 - 3. Submittals to receive Design/Builder's action marking: Provide blank space on the label or on the submittal itself for action marking; minimum 4 inches wide by 5 inches high.
- I. Transmittal of Submittals:
 - 1. Submittals will be accepted from the Construction Manager only. Submittals received from other entities will be returned without review or action.
 - 2. Submittals received without a transmittal form will be returned without review or action.
 - 3. Transmittal form: Use AIA G810.
 - a. The Contractor's certification signature.
 - 4. Fill out a separate transmittal form for each submittal; also include the following:
 - a. Other relevant information.
 - b. Requests for additional information.

3.3 SHOP DRAWINGS

- A. Content: Include the following information:
 - 1. Dimensions, at accurate scale.
 - 2. All field measurements that have been taken, at accurate scale.
 - 3. Names of specific products and materials used.
 - 4. Details, identified by contract document sheet and detail numbers.
 - 5. Show compliance with the specific standards referenced.
 - 6. Coordination requirements; show relationship to adjacent or critical work.
 - 7. Name of preparing firm.

- B. Preparation:
 - 1. Reproductions of contract documents are not acceptable as shop drawings.
 - 2. Copies of standard printed documents are not acceptable as shop drawings.
 - 3. Identify as indicated for all submittals.
 - 4. Space for Construction Manager's action marking shall be adjacent to the title block.

3.4 PRODUCT DATA

- A. Submit all product data submittals for each system or unit of work as one submittal.

- B. When product data submittals are prepared specifically for this project (in the absence of standard printed information) submit such information as shop drawings and not as product data submittals.

- C. Content:
 - 1. Submit manufacturer's standard printed data sheets.
 - 2. Identify the particular product being submitted; submit only pertinent pages.
 - 3. Show compliance with properties specified.
 - 4. Identify which options and accessories are applicable.
 - 5. Include recommendations for application and use.
 - 6. Show compliance with the specific standards referenced.
 - 7. Show compliance with specified testing agency listings; show the limitations of their labels or seals, if any.
 - 8. Identify dimensions which have been verified by field measurement.
 - 9. Show special coordination requirements for the product.

3.5 SAMPLES

- A. Samples:
 - 1. Provide samples that are the same as proposed product.
 - 2. Where unavoidable variations must be expected, submit "range" samples, minimum of 3 units, and describe or identify variations among units of each set.
 - 3. Where selection is required, provide full set of all options.
 - 4. Where products are to match a sample prepared by other entities, prepare sample to match.

- B. Preparation:
 - 1. Attach a description to each sample.
 - 2. Attach name of manufacturer or source to each sample.

3. Where compliance with specified properties is required, attach documentation showing compliance.
 4. Where there are limitations in availability, delivery, or other similar characteristics, attach description of such limitations.
 5. Where samples are specified to be returned for installation in the work, indicate such requirement on transmittal form.
- C. Keep final sample set(s) at the project site, available for use during progress of the work.

3.6 REVIEW OF SUBMITTALS

- A. Submittals for approval will be reviewed, marked with appropriate action, and returned.
- B. Informational submittals: Submittals will be reviewed.
1. "X" action: No action taken.
 2. "Not Approved" action: Revise the submittal or prepare a new submittal complying with the comments made.

3.7 RETURN, RESUBMITTAL, AND DISTRIBUTION

- A. The Construction Manager will mail submittals to contractors, unless contractors arrange for pickup at the Construction Manager's office.
- B. Perform resubmittals in the same manner as original submittals; indicate all changes other than those requested by the Construction Manager.
1. Exception: Transmittal number for resubmittal shall be the number of the original submittal plus a letter suffix (example: 14245-1 would become 14245-1A).
- C. Distribution:
1. Distribute one copy to each prime Contractor.
 2. Record distribution on transmittal form with copy to the Construction Manager.

END OF SECTION 01300

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General quality control activities.
 - 2. Procedures for the following:
 - a. Testing and evaluation of test results.
 - b. Inspections.
 - 3. Procedures for quality control activities performed by:
 - a. Public authorities having jurisdiction.
 - b. Construction Manager.
 - 4. Procedures for submittal of quality control documentation.
- B. Quality control activities required are specified in other sections.
- C. See General Provisions for additional requirements for testing, inspections, and approvals.
- D. Related Sections:
 - 1. Alternates: See Bid Forms

1.2 SUBMITTALS

- A. Reports: Provide certified copies of reports.
 - 1. Unless otherwise indicated, submit for review by the Construction Manager.
 - 2. Submit reports within 2 weeks after execution of quality control activity, but not later than the date of application for payment for the work to which the quality control activity relates.
 - 3. Reports shall be prepared by the entity performing the quality control activity.
 - 4. Submit copies directly to governing authorities when so directed.
 - 5. Include the following information in all types of reports:
 - a. Date of report.
 - b. Project name (and number, if applicable).
 - c. Description of the quality control activity.
 - d. Name, address, and telephone number of entity performing activity.
 - e. Date quality control activity was performed.
 - f. Specification section(s) involved.
 - g. Basis for evaluation (test method, etc.).
 - h. Results or conclusions, including evaluations and interpretations.
 - i. Title, name, and signature of person performing activity.

1.3 QUALITY ASSURANCE

- A. Qualifications of Testing and Inspection Personnel:
 - 1. As indicated in individual sections.
- B. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either the National Bureau of Standards (NBS) standards or to accepted values of natural physical constants.

1.4 COORDINATION WITH OTHER ENTITIES

- A. Cooperate with other entities performing quality control activities.
- B. Provide samples of materials and design criteria as indicated and when requested.
- C. Provide other assistance, equipment, tools, and storage facilities as specified.
- D. If desired, make arrangements with those entities and pay for additional similar or related testing or inspection required for the contractor's use or convenience.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate quality control activities to avoid delay and to make it unnecessary to uncover work for testing or inspection.

PART 2. - PRODUCTS (NOT USED)

PART 3. - EXECUTION

3.1 GENERAL

- A. Provide work of the specified quality; where quality level is not indicated, provide work of quality customary in similar types of work.
 - 1. Where codes, laws, or regulations require work of higher quality or performance, provide work complying with those codes, laws, and regulations.
 - 2. Where two or more quality provisions of the contract documents conflict, comply with the most stringent requirement; where requirements are different but apparently equal, and where it is uncertain which requirement is most stringent, obtain clarification from the Design/Builder before proceeding.
 - 3. Actual quality may exceed the specified quality; verify that such differences are acceptable to the owner (other criteria may make excessive quality undesirable).
- B. Control products, suppliers, manufacturers, site conditions, installers, and workmanship in such a manner as to produce work of the specified quality.
- C. Comply with manufacturers' instructions and recommendations.
 - 1. Keep a record of instructions and recommendations which supplement or conflict with the manufacturer's written instructions.
 - 2. When manufacturers' instructions and recommendations conflict with the contract documents, obtain clarification from the Construction Manager before proceeding.
- D. Use installers who are capable of producing work of the specified quality.
- E. Each prime contractor shall perform all specified quality control activities related to his work unless indicated to be performed by other entities.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01400 - QUALITY CONTROL PROCEDURES

3.2 TESTING

- A. Perform tests specified.
- B. When results of tests are unsatisfactory, make whatever changes or repairs are necessary and retest.
- C. Submit written report of each original test and of each retest.

3.3 INSPECTING

- A. Perform inspections specified.
- B. When inspections reveal unsatisfactory work, make whatever changes or repairs are necessary and re-inspect.
- C. Submit written report of each original inspection and each re-inspection.

3.4 PROTECTION AND REPAIR

- A. When work is uncovered during quality control activities, provide protection from damage.
- B. Correct work damaged by quality control activities; where repair is indicated as an unacceptable method, replace the work.

END OF SECTION 01400

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Temporary utilities.
 - a. Water supply.
 - b. Use of permanent water service.
 - c. Electric power and lighting, except extension cords.
 - d. Use of permanent electrical systems.
- B. Related Sections:
 - 1. Access to site: Elsewhere in Division 1.
 - 2. Regulatory requirements: Elsewhere in Division 1.
 - 3. Storage and protection of materials and equipment: Elsewhere in Division 1.

1.2 DEFINITIONS

- A. Temporary Facilities: Construction, fixtures, fittings, and other built items required to accomplish the work but which are not incorporated into the finished work.
- B. Temporary Utilities: A type of temporary facility; primary sources of electric power, water, natural gas supply, etc., obtained from public utilities, other main distribution systems, or temporary sources constructed for the project, but not including the fixtures and equipment served.

1.3 SUBMITTALS

- A. Reports of inspections, tests, and approvals for the installation and use of construction facilities, which are made or given by public authorities.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of governing authorities, as to type, quantity, location, and use of temporary facilities.

1.5 PROJECT CONDITIONS

- A. Obtain easements where required.
- B. Locate construction facilities as directed by the construction manager.
- C. Use of permanent facilities prior to substantial completion is subject to the owner's approval and conditions.
 - 1. Each permanent facility used for construction purposes shall be operated, maintained, and protected during such use by the original installer.
 - 2. Specified warranties shall not be reduced or voided by temporary use.

1.6 SEQUENCING AND SCHEDULING

- A. Maintain required facilities until not needed or until shortly before substantial completion; remove facilities before substantial completion.
 - 1. Exception: Where use of permanent facilities is allowed.

DIVISION 1 – GENERAL CONDITIONS
SECTION 01510 - TEMPORARY UTILITIES

- B. Change over to use of permanent facilities, when applicable, as soon as possible, except when use of permanent facilities is not allowed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials which are both suitable for the use and durable enough to withstand the use and abuse to be expected.

2.2 TEMPORARY UTILITIES

- A. Temporary Water Service: By Demolition Contractor if required.
 - 1. Provide water adequate for demand of construction operations.
 - 2. Piped water service:
 - a. Do not use permanent piping system to distribute nonpotable water.
 - b. Existing water service in the building may be used.
 - c. Take precautions to prevent damage due to leaks and spills inside building.
- B. Temporary Power: By Demolition Contractor as required.
 - 1. Provide electricity adequate for demand of construction operations.
 - (a) Existing electrical service in the building may be used.
- C. Temporary Lighting : By Demolition Contractor
 - 1. Provide temporary lighting for construction work. A minimum of 15 footcandles.
 - 2. Basic requirements
 - a. Covered lamps with safety guards.
 - 3. Contractors or subcontractors who require lighting in excess of that specified shall make arrangements with the electrical contractor and pay all additional costs.

PART 3 - EXECUTION

3.1 GENERAL

- A. Cooperate with other contractors in location of temporary facilities.

3.2 TERMINATION AND REMOVAL

- A. Remove temporary facilities when no longer needed, or when use of appropriate permanent facility is approved, but not later than substantial completion.
 - 1. Exception: When longer usage is requested by the Construction Manager.
- B. Complete permanent work delayed until removal of temporary facilities.
- C. Permanent Facilities Used during Construction: Clean; replace parts that are worn in excess of that expected during normal usage.

END OF SECTION 01510

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General product requirements, including:
 - a. General specification requirements for all products.
 - b. Product options.
 - c. Procedures for substitution requests.
 - 2. General requirements for product documentation, including:
 - a. Requirements and procedures for schedule of products.
 - b. General requirements for operation and maintenance data.
 - c. General requirements for warranties.
 - 3. General procedures for products including:
 - a. Procedures for transportation and handling.
 - b. Procedures for delivery and receiving.
 - c. Procedures for storage.

1.2 DEFINITIONS

- A. Damage: Any sort of deterioration whether due to weather, normal wear and tear, accident, or abuse, resulting in soiling, marring, breakage, corrosion, rotting, or impairment of function.

1.3 SUBMITTALS

- A. Schedule of Products: Submit for approval.
- B. Final Schedule of Products: Submit for project record.
- C. Operation and Maintenance Data: Submit for project record.
- D. Warranties: Submit for project record.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Components required to be supplied in quantity within a specification section shall be identical, interchangeable, and made by the same manufacturer.
- B. Do not use products removed from existing construction, unless specifically permitted by the contract documents or approved by the owner.

PART 3 - EXECUTION

3.1 PRODUCT OPTIONS

- A. It is the contractor's responsibility to select products which comply with the contract documents and which are compatible with one another, with existing work, and with products selected by other contractors.
 - 1. Verify that electrical characteristics of products are compatible with electrical systems; notify Design/Builder of all discrepancies.
- B. No substitute products will be considered, except in the event of unavailability of the specified product through no fault of the contractor.
- C. Definition of Substitute Product: Any product which does not meet the requirements of the contract documents, whether in product characteristics, performance, quality, or manufacturer or brand names, is considered a substitute.
- D. Product Options: Where products are specified using more than one method, such as description with a manufacturer list, use a product meeting the requirements of both specification methods.
- E. Products Specified by Reference Standard: Use any product meeting the specification. Provisions of reference standards shall not modify the responsibilities of the owner or Construction Manager as defined in the contract documents.
- F. Products Specified by Description: Use any product meeting the specification.
- G. Products Specified by Performance Requirements: Use any product meeting the specification.
- H. Products Covered by an Allowance Included in the Contract Documents: Provide products of types and in quantity as directed by the Construction Manager.
 - 1. At the earliest possible date after execution of the contract, inform the Construction Manager of the latest date by which the final selection of the product is required in order to avoid delay of the work.
 - 2. When requested, provide information for use in making selections.
- I. Products Specified by Listing a Brand Name Product as the "Basis of Design": Provide a product equivalent to the product specified within the limits of variation specified; submit substitution request for all products other than that listed as basis of design.
- J. Products Specified by Listing Brand Names(s): Provide one of the products listed; no substitutions will be allowed.
- K. Products Specified by Listing Manufacturer(s): Provide a product meeting the specification and made by one of the manufacturers listed.

- 3.2 SUBSTITUTION PROCEDURE
- A. Submission of request for substitution shall constitute a representation by the contractor that he:
1. Has investigated the proposed product and determined that it is equal to or better than the specified product. Absence of an explicit comparison of any characteristic of the proposed product to the specified product shall constitute a representation that the proposed product is equal to or better than the specified product with regard to that characteristic.
 2. Will provide the same warranty for the proposed product as for the specified product.
 3. Will coordinate the installation and make other changes which may be required for the work to be complete in all respects, including:
 - a. Redesign.
 - b. Additional components and capacity required by other work affected by the change.
 4. Waives all claims for additional costs and time extensions which subsequently may become apparent and which are caused by the change.
 5. Will reimburse the owner for additional costs for evaluation of the substitution request, redesign if required, and re-approval by authorities having jurisdiction if required.
- B. Substitutions will not be considered when acceptance would require substantial revision of the contract documents.
- C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request.
- D. Substitution requests will not be considered when submitted directly by subcontractor or supplier.
- E. Substitution Request Procedure: Submit written request with complete data substantiating compliance of the proposed product with the requirements of the contract documents.
1. Submit request to the Construction Manager.
 2. Submit 3 copies of each request and accompanying data.
 3. Submit request as specified for change order proposals.
 4. Only one request for substitution will be considered for each product.
- F. Data Required with Substitution Request: Provide at least the following data:
1. Identify product by specification section and paragraph number.
 2. Manufacturer's name and address, trade name and model number of product (if applicable), and name of fabricator or supplier (if applicable).
 3. Complete product data.
 4. A list of other projects on which the proposed product has been used, with project name, the design professional's name, and owner contact.
 5. An itemized comparison of the proposed product to the specified product.
 6. Net amount of change to the contract sum.
 7. List of maintenance services and replacement materials available.
 8. Statement of the effect of the substitution on the construction schedule.
 9. Description of changes that will be required in other work or products if the substitute product is approved.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01600 - PRODUCT REQUIREMENTS

- G. The Construction Manager will determine acceptability of the proposed substitution.
- H. When the proposed substitution is not accepted, provide the product (or one of the products, as the case may be) specified.

3.3 SCHEDULE OF PRODUCTS

- A. Prepare a complete schedule of products used, including the following for each product:
 - 1. Manufacturer's name.
 - 2. Brand or trade name.
 - 3. Model number, if applicable.
 - 4. Reference standard, if more than one is applicable.
 - 5. Arrange products in the schedule by specification sections; indicate paragraph where specified.
- B. Prepare and submit a preliminary schedule within 7 days after award of contract; resubmit when revised; submit final schedule prior to final payment.
- C. Schedule of products shall not be used to obtain approval of substitute products; make separate request for substitution.

3.4 OPERATION AND MAINTENANCE DATA

- A. Provide operation and maintenance data as specified in individual product sections.
 - 1. Provide data sufficient for operation and maintenance by owner without further assistance from the manufacturer.
- B. Data Required For Products - General:
 - 1. Name of manufacturer and product.
 - 2. Name, address, and telephone number of subcontractor or supplier.
 - 3. Local source of replacements.
 - 4. Local source of replaceable parts and supplies.
- C. Product Data: Where product data is specified for inclusion in operation and maintenance data, provide manufacturer's data sheets marked to indicate specific product and product options actually installed; delete inapplicable data.
- D. Custom Manufactured Products: Provide all information needed for reordering.
- E. Finish Materials: Manufacturer's product data, color/texture designations, and manufacturer's instructions for care, cleaning, and maintenance.
- F. Products Exposed to Weather and Products for Moisture Protection: Manufacturer's product data, recommended inspection schedule and procedures, maintenance and repair procedures, and maintenance materials required.
- G. Equipment: Provide at least the following information:
 - 1. Product data giving equipment and function description, with normal operating characteristics and limiting conditions.
 - 2. Starting, operating, and troubleshooting procedures.
 - 3. Cleaning and maintenance requirements and procedures.
 - 4. External finish maintenance requirements.
 - 5. List of maintenance materials required.

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DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01600 - PRODUCT REQUIREMENTS

6. List of special tools required.
 7. Parts list: List all replaceable parts, with ordering data.
 8. Recommended quantity of spare parts to be maintained in storage.
 9. Recommended maintenance schedule.
- H. Systems: Provide overall function description, with diagrams, prepared especially for this project.
- I. Form of Data: Prepare data in the form of an instructional manual.
1. Arrange content logically, using section numbers and sequence of sections indicated on the table of contents of this project manual.
 2. When multiple volumes are used, arrange by related subjects; identify contents in cover title.
 3. Assemble into 3-ring binders with maximum 2-inch ring size.
 - a. Hardback, cleanable plastic covers.
 - b. Identify each book with title "Operation and Maintenance Instructions" and project name.
 - c. Page size 8-1/2 by 11 inches, maximum.
 - d. Prepare special typewritten data on minimum 20-pound paper.
 - e. Provide tabbed divider for each product and system.
 - f. Drawings: Bind in with other data; provide reinforced binding edge; fold larger drawings to size of pages.
 1. Do not use pockets or loose drawings.
 4. Provide table of contents for each volume listing:
 - a. Name of the project.
 - b. Name, address, telephone number, and contact name of:
 - (i) Construction Manager.
 - (ii) Contractor.
 - c. Index of products and systems included in volume.

3.5 WARRANTIES

- A. Provide warranties as specified in individual product sections.
- B. Manufacturer Warranties: Manufacturer's standard product warranty running for the manufacturer's standard term, unless otherwise indicated.
 1. Submit copies of all manufacturer warranties which extend beyond the end of the contract correction period.
- C. Special Project Warranties: Written warranty commencing at date of substantial completion, running for the term indicated, and signed by the entities specified.
 1. Where completion of warranty item is materially delayed beyond the date of substantial completion, provide warranty commencing on date of acceptance.
 2. Submit each special project warranty.
- D. Provide 2 notarized copies of each executed warranty.
- E. Show actual date of commencement on each warranty.

- 3.6 TRANSPORTATION AND HANDLING
- A. Require supplier to package finished products in a manner which will protect from damage during shipping, handling, and storage.
 - B. Transport products by methods which avoid damage.
 - C. Deliver in dry, undamaged condition in manufacturer's unopened packaging.
 - D. Provide equipment and personnel adequate to handle products by methods which prevent damage.
 - E. Provide additional protection during handling where necessary to prevent damage to products and packaging.
 - F. Lift large and heavy components at designated lift points only.
- 3.7 DELIVERY AND RECEIVING
- A. When possible arrange deliveries so that storage is not required.
 - B. Arrange deliveries of products to allow time for inspection prior to installation.
 - C. Coordinate delivery to avoid conflict with the work and to take into account both the conditions at the site and the availability of personnel, handling equipment, and storage space.
 - D. Clearly mark partial deliveries to identify contents, to permit easy accumulation of entire delivery, and to facilitate assembly.
 - E. Promptly inspect shipments and remedy damage, incorrect quantity, incompleteness, improper or illegible labeling, and noncompliance with requirements of contract documents and approved submittals.
- 3.8 STORAGE
- A. No outdoor storage areas are available on site.
 - B. Off-site storage of products for which application for payment will be made: Store only in bonded warehouse.
 - C. General Storage Procedures:
 - 1. Store products immediately on delivery.
 - 2. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.
 - 3. Store in a manner to prevent damage to the stored products and to the work.
 - 4. Store moisture-sensitive products in weather tight enclosures.
 - 5. Store indoors if necessary to keep temperature and humidity within ranges required by manufacturer.
 - 6. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01600 - PRODUCT REQUIREMENTS

7. Arrange storage to provide access for inspection and inventory.
8. Periodically inspect and remedy damage and noncompliance with required conditions.

END OF SECTION 01600

DIVISION 1 – GENERAL REQUIREMENTS
SECTION 01630 - PRODUCT OPTIONS AND SUBSTITUTIONS

Part 1. GENERAL

1. SUMMARY

A. Section Includes:

1. Procedures for substitutions during bidding period.
2. General product requirements, including:
 - a. Product options.
 - b. Procedures for substitution requests.

B. Related Sections:

1. Submittal transmission, handling, and action procedures: Elsewhere in Division 1.
2. General installation procedures: Elsewhere in Division 1.
3. Owner instruction for equipment and systems: Elsewhere in Division 1.
4. Project record documents: Elsewhere in Division 1.

Part 2. PRODUCTS (NOT USED)

Part 3. PART - EXECUTION

1. PRODUCT OPTIONS

A. It is the Contractor's responsibility to select products which comply with the contract documents and which are compatible with one another, with existing work, and with products selected by other contractors.

1. Verify that electrical characteristics of products are compatible with electrical systems; notify Design/Builder of all discrepancies.
2. Where visual matching to an established physical sample is required, the Construction Manager's decision will be final.

B. Do not use any substitute products which have not been approved in accordance with the requirements of the contract documents; formal substitution request is required.

C. Where the specification is silent on whether substitutions will be considered, substitutions will not be considered.

D. Definition of Substitute Product: Any product which does not meet the requirements of the contract documents, whether in product characteristics, performance, quality, or manufacturer or brand names, is considered a substitute.

E. Product Options: Where products are specified using more than one method, such as description with a manufacturer list, use a product meeting the requirements of both specification methods.

F. Products Specified by Reference Standard: Use any product meeting the specification. Provisions of reference standards shall not modify the responsibilities of the Owner or Construction Manager as defined in the contract documents.

G. Products Specified by Description: Use any product meeting the specification.

H. Products Specified by Performance Requirements: Use any product meeting the specification.

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DIVISION 1 – GENERAL REQUIREMENTS
SECTION 01630 - PRODUCT OPTIONS AND SUBSTITUTIONS

- I. Products Specified to Match a Physical Sample: Use any product that matches; obtain the Construction Manager's approval.
 - J. Products Specified by Listing a Brand Name Product as the "Basis of Design": Provide a product equivalent to the product specified within the limits of variation specified. Use of a product other than that specified constitutes a representation by the Contractor that he will comply with all the conditions specified for acceptance of substitutions, although formal submittal of a request for substitution is not required.
 - K. Products Specified by Listing Brand Name(s) Accompanied by Language Indicating that Substitutions Are Not Allowed: Provide one of the products listed.
 - L. Products Specified by Listing Brand Name(s) Accompanied by Language Indicating that Substitutions Are Allowed: Provide a product meeting the specification; submit substitution request for any brand-name product that is not listed.
 - M. Products Specified by Listing Manufacturer(s) Accompanied by Language Indicating that Substitutions Are Not Allowed: Provide a product meeting the specification and made by one of the manufacturers listed.
 - N. Products Specified by Listing Manufacturer(s) Accompanied by Language Specifically Indicating that Substitutions Are Allowed: Provide a product meeting the specification; submit substitution request for any manufacturer not listed.
 - O. Language indicating that substitutions are not allowed includes:
 - 1. "Provide one of the following products."
 - 2. "Provide products made by one of the manufacturers listed."
 - 3. "Provide products complying with the contract documents and made by one of the following."
 - 4. "No substitutions."
 - 5. "Provide products complying with the contract documents and made by one of the following"
 - 6. Other similar language.
 - P. Language indicating that substitutions are allowed includes:
 - 1. Substitutions will be considered.
 - 2. "... will be among those considered acceptable."
 - 3. "Or approved equal."
 - 4. Other similar language.
2. SUBSTITUTIONS DURING THE BIDDING PERIOD
- A. Substitution Requests: Attach to the Bid Form.
 - B. Acceptable substitutions will be added to the contract documents by modification.
3. SUBSTITUTIONS AFTER AWARD OF THE CONTRACT
- A. Substitutions will not be considered between the bid date and the award of the contract.

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DIVISION 1 – GENERAL REQUIREMENTS
SECTION 01630 - PRODUCT OPTIONS AND SUBSTITUTIONS

- B. Substitutions will not be allowed after award of the contract except when, through no fault of the Contractor, none of the specified products is available.
4. SUBSTITUTION PROCEDURE
- A. Submission of request for substitution shall constitute a representation by the Contractor that he:
 - 1. Has investigated the proposed product and determined that it is equal to or better than the specified product. Absence of an explicit comparison of any characteristic of the proposed product to the specified product shall constitute a representation that the proposed product is equal to or better than the specified product with regard to that characteristic.
 - 2. Will provide the same warranty for the proposed product as for the specified product.
 - 3. Will coordinate the installation and make other changes which may be required for the work to be complete in all respects, including:
 - a. Redesign.
 - b. Additional components and capacity required by other work affected by the change.
 - 4. Waives all claims for additional costs and time extensions which subsequently may become apparent and which are caused by the change.
 - 5. Will reimburse the Owner for additional costs for evaluation of the substitution request, redesign if required, and re-approval by authorities having jurisdiction if required.
 - B. Substitutions will not be considered when acceptance would require substantial revision of the contract documents.
 - C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request.
 - D. Substitution requests will not be considered when submitted directly by subcontractor or supplier.
 - E. Substitution Request Procedure: Submit written request with complete data substantiating compliance of the proposed product with the requirements of the contract documents.
 - 1. Submit request to the Construction Manager.
 - 2. Submit 4 copies of each request and accompanying data.
 - 3. Submit request as specified for change order proposals.
 - F. Data Required with Substitution Request: Provide at least the following data:
 - 1. Identify product by specification section and paragraph number.
 - 2. Manufacturer's name and address, trade name and model number of product (if applicable), and name of fabricator or supplier (if applicable).
 - 3. Complete product data.
 - 4. A list of other projects on which the proposed product has been used, with project name, the design professional's name, and owner contact.

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SECTION 01630 - PRODUCT OPTIONS AND SUBSTITUTIONS

5. An itemized comparison of the proposed product to the specified product.
 6. Net amount of change to the contract sum.
 7. List of maintenance services and replacement materials available.
 8. Statement of the effect of the substitution on the construction schedule.
 9. Description of changes that will be required in other work or products if the substitute product is approved.
- G. The Construction Manager will determine acceptability of the proposed substitution.
- H. When the proposed substitution is not accepted, provide the product (or one of the products, as the case may be) specified.

END OF SECTION 01630

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General construction and installation procedures.
 2. Cutting procedures.
 3. Patching procedures.
 4. Existing hazardous material procedures.
 5. Cleaning during construction.
 6. Facility startup.
 7. Project completion procedures.
 8. Final cleaning.

B. Related Sections:

1.2 DEFINITIONS

- A. Concealed Spaces: Spaces which are not accessible after completion of construction.
- B. Cutting: Removal of material by cutting, sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation.
- C. Damage: Any sort of deterioration whether due to weather, normal wear and tear, accident, or abuse, resulting in soiling, marring, breakage, corrosion, rotting, or impairment of function.
- D. Debris: Rubbish, waste materials, litter, volatile wastes, and similar materials, with the exception of surplus materials which are to become the property of the owner.
- E. Fire Barriers: Any wall, floor, ceiling, or roof which is indicated as having a fire resistance rating.
- F. Operational Elements: Equipment, moving parts, electrical conductors, sound and vibration control materials, waterproofing, vapor retarders, piping, ducts, tanks, and other similar materials and components which convey or retard the passage of liquids, gases, heat, light, persons, animals, or insects or which perform a similar function; not including structural elements.
- G. Patching: Restoration to completed condition by patching, repairing, refinishing, finishing, filling, closing up, and similar operations.
- H. Safety-Related Elements: Materials and assemblies whose principal function is the promotion of the safety of the building and its occupants, including fire and smoke barriers, fireproofing, emergency egress doors and windows, guardrails, equipment guards, and other similar construction.
- I. Smoke Barriers: Any wall, floor, ceiling, or roof which is indicated as being designed to prevent passage of smoke and gases; may be indicated as "smoke barrier," "smoke partitions," "smoke wall," or similar designation.

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SECTION 01700 - CONSTRUCTION PROCEDURES

- J. Spaces Not Normally Occupied: Accessible spaces such as roofs, accessible plenums and shafts, accessible spaces above ceilings, trenches, equipment vaults, manholes, accessible attics, and similar spaces, but not including the interior of duct or concealed spaces.

1.3 SUBMITTALS

- A. Proposals for Cutting and Patching: Submit request sufficiently in advance of the time the work is to be performed to obtain approval; include:
1. Description of the nature of the work and how it is to be performed, including reasons why cutting cannot be avoided.
 2. Description of results expected, including impact on safety and on structural, operational, and visual qualities.
 3. Products to be used.
 4. If utilities are affected, describe the changes required and be specific as to how long service will be cut off.
 5. If cutting of structural work results in the need for additional reinforcement, provide details and engineering calculations to show how that reinforcement satisfies the original structural requirements.
- B. Startup Reports:
1. Submit within 5 days after startup of item covered by report.
 2. Include a statement that the item has been installed properly and is functioning correctly.
 3. Include the following information:
 - a. Item started up.
 - b. Date of startup operation.
 - c. Entity performing startup.
 - d. Applicable specification section.
 - e. Results of startup.
 - f. Signature of person performing startup.
- C. Demonstration Reports:
1. Submit within 7 days after each demonstration period.
 2. Include the following information:
 - a. Description of equipment or system demonstrated, cross-referenced to the contract documents.
 - b. Date of demonstration.
 - c. Name and title of person performing demonstration.
 - d. Name, title, and signature of person observing demonstration.

1.4 QUALITY ASSURANCE

- A. Cleaning: Perform cleaning in accordance with the recommendations of the manufacturer or fabricator of the product or system. Use only cleaning materials and tools which are specifically recommended, which are not hazardous to health or property, and which will not damage finishes.

PROJECT CONDITIONS

- 1.5 A. The existing facility will be occupied during the period in which the work will be conducted; avoid interference with use of those areas and interruption of access to them.
1. Do not obstruct required exit ways unless alternative exit ways satisfactory to the authorities having jurisdiction are available.

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- B. Take precautions to prevent fires and to facilitate fire-fighting operations.
 - 1. Keep flammable materials in non-combustible containers; store away from potential fire sources; remove flammable waste regularly.
 - 2. Keep temporary and permanent fire fighting facilities readily accessible; keep fire fighting routes open.
 - 3. Do not allow smoking in areas where highly combustible or explosive materials are present.
 - 4. Carefully supervise the operation of potential fire sources, including heating units.
 - 5. Conduct welding operations in manner to prevent fire; comply with local regulations.

- C. Take precautions to prevent accidents due to physical hazards:
 - 1. Provide barricades, warning lights, or signs as required to inform personnel and the public of the hazard being protected against.
 - 2. Safety barricades: Comply with regulations.
 - 3. Provide temporary walkways where walking surfaces are hazardous.
 - 4. Notify the owner before beginning work that involves hazardous operations, including use of explosives and the like.

- D. Take care to prevent pollution of air, water, and soil.
 - 1. Comply with environmental protection regulations.

- E. Do not use tools or equipment which produce harmful levels of noise.
 - 1. Minimize the use of noise-making tools and equipment during hours that adjacent buildings are occupied.

- F. Keep the site and adjacent public ways free of hazardous and unsanitary conditions and public nuisances.

- G. Provide temporary means of draining roofs where required.

- H. Conduct construction operations so that no part of the work and no part of the existing construction is subjected to damaging operations or influences which are in excess of those to be expected during normal occupancy conditions.

- I. Conduct construction operations so that waste of power, water, and fuel is avoided.

- J. Provide temporary supports as required to prevent movement and structural failure.

- K. Install products only during environmental conditions which will ensure the best possible results.

1.5 SEQUENCING AND SCHEDULING

- A. Install products only at the time and in the sequence which will ensure the best possible results.

- B. Coordinate required administrative activities with related construction activities.

PART 2 - PRODUCTS

2.1 MATERIALS

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SECTION 01700 - CONSTRUCTION PROCEDURES

- A. Patching Materials: Identical to the materials of the work to be cut, unless indicated as specific materials specified in other sections.
 - 1. For exposed materials for closing up openings, use materials identical to those of the adjacent construction; concealed materials are not required to be identical.
 - 2. If identical materials are not available or cannot be used, use materials that provide best visual match; obtain approval of the Construction Manager.
 - 3. Use materials that perform equally as well as, or better than, the material cut.
 - 4. If necessary, determine composition of existing materials to be patched by testing.

PART 3 - EXECUTION

3.1 GENERAL EXAMINATION REQUIREMENTS

- A. Prior to performing work, examine the applicable substrates and the conditions under which the work is to be performed.
- B. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding.
 - 1. If the conditions to be corrected involve the work of another prime contract, notify the Construction Manager promptly.
- C. Conditions which could have been discovered by examination will not be allowed as cause for claims for extra work.
- D. Notify the Construction Manager promptly of any modifications required due to existing conditions or previous work.
- E. Before starting work which might affect existing construction, verify the existence and location of such construction.
 - 1. In particular, verify the following:
 - a. Underground utilities.
 - b. Other underground construction.
 - c. Location and invert elevation of points of connection to piped utilities.
- F. Verify that utility requirements of operating equipment are compatible with building utilities.
- G. Verify space requirements of items which are shown diagrammatically on the drawings.

3.2 GENERAL PREPARATION REQUIREMENTS

- A. Take field measurements as required to fit the work properly.
- B. Recheck measurements prior to installing each product.

3.3 GENERAL INSTALLATION PROCEDURES

- A. Accurately locate the work and components of the work; make vertical work plumb; make horizontal work level.
- B. See sections describing specific parts of the work for additional requirements.
- C. Where space is limited, install components to maximize space available for maintenance and to maximize ease of removal for replacement.

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01700 - CONSTRUCTION PROCEDURES

- D. In finished areas, conceal pipes, ducts, and wiring within the construction, unless otherwise indicated.
- E. In ceiling areas without a finished suspended ceiling, maintain minimum headroom clearance of 8 feet.
- F. Coordinate exact locations of fixtures and outlets with finish elements.
- G. Install work in such manner and sequence as to preclude, if possible, or at least to minimize, cutting and patching.
- H. Existing Construction:
 - 1. Perform work in existing construction in same manner as for new construction unless otherwise specified.
 - 2. Where a new surface exposed to view is an extension of any existing surface, align both surfaces without a change of plane and make a neat transition between finishes.
 - a. If a change of plane is necessary due to the configuration of the existing surface, terminate the existing surface and its finish along a straight line at a natural line of division.
 - 3. Where portions of existing work are removed, patch remaining work with neat transitions between remaining surfaces without evidence of cutting.
 - a. Where neat transitions between remaining surfaces are not possible due to configuration of existing surfaces, obtain instructions from the Design/Builder.
 - 4. Where existing construction is removed, remove existing utility services located within or upon the existing construction.
 - a. Cap cut ends of abandoned piping, conduit, and duct in such a manner that they are concealed in finish work.

3.4 CLEANING AND PROTECTION

- A. Remove debris from concealed spaces prior to enclosing the space.
- B. Keep the site and the work free of waste materials and debris.
 - 1. Remove waste from site periodically.
 - 2. When temperature exceeds or is expected to exceed 80 degrees F, remove waste at frequency necessary to prevent development of health hazards and nuisance odors.
 - 3. Keep hazardous and unsanitary materials in containers separate from other waste.
- C. Clean areas in which work is to be done to level of cleanliness necessary for proper execution of that work.
 - 1. Where dust would impair execution of work, broom- and vacuum-clean the entire interior area and keep clean.
- D. Keep installed work clean, and clean again when soiled by other operations.
 - 1. Provide periodic cleaning as required to prevent damage due to soiling.
 - 2. Remove liquid spills promptly.
- E. Protect installed work from soiling and damage.
 - 1. Provide protective coverings as required.
 - 2. Provide protective coverings for work which may be damaged by subsequent operations.
 - 3. Where heavy abuse is expected, use minimum of plywood for protection.

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SECTION 01700 - CONSTRUCTION PROCEDURES

4. Maintain protective coverings until substantial completion.

3.5 CUTTING AND PATCHING PROCEDURES

- A. Use specified cutting and patching procedures when cutting or patching is required for any of the following activities:
 - 1. Fitting the parts of the work together.
 - 2. Modifying existing construction.
 - 3. Repairing existing work to remain.
 - 4. Installing ill-timed work.
 - 5. Removing and replacing defective and nonconforming work.
 - 6. Removing samples of work for testing.
 - 7. Making openings in elements of work for penetrations, such as for piping, conduit, duct, and the like.
 - 8. Uncovering work for observation.
 - 9. Repairing damage.

- B. Each prime contractor shall be responsible for cutting, fitting, or patching required to complete his work or to make its parts fit together properly.
 - 1. When it is necessary to cut the work of another prime contractor, obtain the written consent of such contractor prior to proceeding.
 - 2. Do not unreasonably withhold the contractor's consent to cutting the contractor's work.

- C. Perform cutting and patching at earliest time feasible, unless otherwise indicated or directed by the Construction Manager.

- D. Use procedures specified in applicable product sections as well as those specified in this section:
 - 1. Use procedures recommended by original installer, when such information is available.
 - 2. Where required, obtain approval of procedures by the Construction Manager.
 - 3. Cut using methods that are least likely to damage adjacent work and work to remain and which will provide proper surfaces for patching.
 - 4. Make cuts neatly with minimum disturbance of adjacent work.
 - a. Use appropriate tools intended for sawing or grinding and not for chopping or hammering.
 - b. Do not use pneumatic tools without prior approval.
 - 5. Where installation of similar new work is included, perform patching in manner specified for installation of new work.
 - 6. Where new work is inserted into or through the work that is cut, fit the patched work tightly to the new work.
 - 7. Patch with seams which are durable and as invisible as possible.
 - 8. Repair substrate prior to patching finish.

- E. Employ skilled workers to perform cutting and patching work.
 - 1. Use the original installer of the work to perform cutting and patching of the following:
 - a. Any products so indicated in the applicable product section.

- F. Work Exposed to View: Do not cut or patch in a manner that would result in a lessening of the building's aesthetic value, as determined by the Construction Manager.
 - 1. Generally, cut from exposed side into concealed spaces to avoid unnecessary

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- damage to finish.
2. Do not cut and patch in a manner that would result in substantial visual evidence of cut and patch work.
 3. Restore exposed patched finishes in a manner which eliminates evidence of patching and refinishing.
 - a. For continuous surfaces, extend refinish to nearest intersection, with a neat transition to adjacent surfaces.
 - b. For assemblies: Refinish entire unit.
 - c. Painted piping, conduit, and duct: Clean and repaint.
 4. Remove and replace work which is patched in a visually unacceptable manner.
- G. Structural Elements: Maintain structural capacity; do not increase deflection under design load; provide reinforcing where required.
1. See structural sections for additional requirements.
 2. Before cutting any structural member, obtain the Design/Builder's approval of the proposed method.
- H. Existing Construction:
1. Patch existing work to match adjacent existing work to remain.
 2. Where specified procedures for similar new work are applicable, use those procedures for cutting and patching existing construction.
 3. Take precautions to avoid damage to unanticipated utilities and structural elements. If such elements are encountered, report nature and extent to the Construction Manager and request instructions as to how to proceed.
 4. Do not cut existing mechanical and electrical services which are to remain in use until provisions have been made to relocate or reconnect them within 4 hours.
 5. Make neat transitions between existing and new surface finishes.
- I. Concealed Work: Uncover the concealed work, cut and patch, and patch the covering work.
- J. Concrete and Masonry: Use saws or drills which produce a neat cut; remove in small sections.
- K. Insulation: Replace insulation whenever it is cut in order to modify the element it is insulating.
- L. Slabs on Grade: Use methods that will not crack or disturb adjacent slabs or partitions.
- M. Operational Elements: Maintain capacity to perform in the manner intended, including energy performance; do not cut or patch in any manner that would increase maintenance requirement, decrease life expectancy, or decrease safety.
1. Before cutting the following, obtain the Construction Manager's approval of proposed method:
 - a. Any product for which approval is required in the applicable product section.
 - b. Roofing.
 - c. Piping, wiring, conduit and duct.
- N. Safety-Related Elements: Do not cut or patch in a manner that would result in decreased safety.
1. Before cutting the following, obtain the Construction Manager's approval of the proposed method:
 - a. Any product for which approval is required in the applicable product section.

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b. Fire/smoke barriers.

- O. Fire/Smoke Barriers: Do not cut more than absolutely necessary.
 - 1. Cut penetration holes to sizes required for penetration seal assemblies required.
 - 2. Patch all oversize holes and cuts made in error.
 - 3. Perform patching in a manner which complies in all respects with the original construction; if not possible, report nature of difficulty to the Construction Manager and request instructions.
- P. Protect that part of the project which is exposed during cutting and patching operations from adverse weather.
- Q. Cover openings made whenever they are not in use.

3.6 INSTALLATION OF COMPONENTS

- A. Install all products in accordance with manufacturer's instructions and recommendations, whether conveyed in writing or not.
- B. Mounting Heights: Where mounting heights are not indicated, install components at mounting normally encountered for similar components.
 - 1. Obtain the Construction Manager's instructions for uncertain mounting heights.
- C. Separate incompatible materials with suitable materials or spacing.
 - 1. Prevent cathodic corrosion.
- D. Provide all anchors and fasteners required and use methods necessary to securely fasten work.
 - 1. Allow for thermal expansion and contraction, and for building movement.
- E. Joints in Exposed Work:
 - 1. Make joints of uniform widths.
 - 2. Where joint locations are not indicated, arrange joints for the best visual effect.
 - a. When in doubt, obtain the Construction Manager's instructions.
- F. After installation, adjust operating components to proper operation.

3.7 FACILITY STARTUP

- A. Put each item of equipment and each system into full, satisfactory operation.
- B. Prior to Startup:
 - 1. Verify that equipment and systems are complete, correctly connected to utilities, and tested.
 - a. Comply with requirements of manufacturer.
 - 2. Inspect and test as required to ensure that work is installed as specified and to determine suitability for energizing.
 - 3. Provide power and fuel for startup and testing.
 - 4. Change over from temporary to permanent utility sources.
 - 5. Re-adjust and lubricate operating components as required to ensure smooth and unhindered operation.
 - a. Check drive rotations, belt tension, control sequences, and other features which might cause damage if not properly adjusted.

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6. When required by manufacturer, have manufacturer's representative prepare for startup or supervise such preparation.
- C. Notify the Construction Manager at least 5 days prior to startup of each item and system.
- D. Execute startup under supervision of responsible personnel in accordance with the manufacturer's instructions.
 1. When required by manufacturer, have manufacturer's representative perform startup.
 2. Submit a written report of startup operation.
- E. After startup, adjust equipment and systems as required for proper operation.
 1. Where specified, perform tests or inspections to determine status of operation.
- F. Demonstrate the operation and maintenance of equipment and systems to personnel designated by the owner, prior to substantial completion.
 1. Have final operating and maintenance data available during demonstration.
- G. For equipment and systems which have different operation at different seasons, demonstrate operation during subsequent seasons until fully demonstrated.

3.8 FINAL CLEANING

- A. Each prime contractor shall perform final cleaning of his own work.
- B. Remove materials and equipment which are not part of the work and all debris from the site prior to substantial completion.
 1. Remove all surplus materials which are to remain property of the contractor; obtain the owner's instructions as to disposition of surplus material remaining on site and deliver, store, or dispose of as directed.
 2. Remove protective coverings.
 3. Remove temporary facilities.
- C. Dispose of debris in a lawful manner.
 1. Do not burn or bury debris on the site.
 2. Do not dispose of volatile wastes in storm or sanitary drains.
- D. Perform final cleaning prior to requesting inspection for substantial completion.
 1. Use only professional cleaners.
 2. Clean to the level of cleanliness that would be expected by a commercial building owner from a janitorial service.
- E. Clean entire project site and grounds.
 1. Clean up landscaped areas.
 2. Broom clean paved areas.
 3. Rake smooth all exposed earth surfaces.
 4. Remove snow and ice from building and site accesses.
- F. In spaces to be occupied, remove dirt, stains, and other foreign substances from all accessible surfaces and remove nonpermanent labels.
- G. Remove debris from roofs, gutters, downspouts, and roof drains.

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- H. In spaces not normally occupied, remove debris and surface dust and wipe equipment clean, removing excess lubrication, paint, and other foreign substances.
- I. Remove paint and other coatings from permanent labels and from mechanical and electrical equipment nameplates.
- J. Leave the project clean and ready for occupancy.

3.10 PROJECT COMPLETION PROCEDURES

- A. Complete the work, prior to substantial completion, as required to obtain consent to occupancy from the governing authorities.
- B. Arrange for final inspections by governing authorities to be accomplished prior to substantial completion.
- C. If temporary locking systems differ from permanent locking systems, change over to permanent systems prior to substantial completion.

END OF SECTION 01700

DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01800 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project record documents consisting of:
 - a. Record drawings.
 - b. Record project manual (specifications).
 - c. Record submittals:
 - 1. Shop drawings.
 - (ii) Product data.
- B. Related Sections:
 - 1. Operation and maintenance data: Elsewhere in Division 1.
 - 2. Warranties: Elsewhere in Division 1.

1.2 SUBMITTALS

- A. Project Record Documents: Submit prior to substantial completion.
 - 1. Record drawings: Submit in form of reverse sepia reproduibles.
 - a. Submit original marked-up print set.
 - b. Submit 3 additional opaque print copy sets.
 - c. Sets shall include all drawings, whether changed or not.
 - 2. Other record documents: Submit 3 originals or good quality photocopies.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MAINTENANCE OF PROJECT RECORD DOCUMENTS

- A. Do not use record documents of any type for construction purposes.
- B. Maintain record documents in a secure location at the site while providing for access by the contractor and the Construction Manager during normal working hours; store in a fire-resistive room or container outside of normal working hours.
- C. Record information as soon as possible after it is obtained.
- D. Assign a person or persons responsible for maintaining record documents.
- E. Record the following types of information on all applicable record documents:
 - 1. Dimensional changes.
 - 2. New and revised details.
 - 3. Depths of foundations.
 - 4. Locations and depths of underground utilities.
 - 5. Actual routings of piping and conduits.
 - 6. Revisions to electrical circuits.
 - 7. Locations of utilities concealed in construction.
 - 8. Particulars on concealed products which will not be easy to identify later.

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DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01800 - PROJECT RECORD DOCUMENTS

9. Changes made by modifications to the contract; note identification numbers if applicable.
10. New information which may be useful to the owner, but which was not shown in either the contract documents or submittals.

3.2 RECORD DRAWINGS

- A. Each contractor shall maintain a complete set of opaque prints of the contract drawings, marked to show changes which occur due to his work.
- B. Where the actual work differs from that shown on the drawings, mark this set to show the actual work.
 1. Mark location of concealed items before they are covered by other work.
 2. Mark either record contract drawings or shop drawings, whichever are best suited to show the change.
 3. Where changes are marked on record shop drawings, mark cross-reference on the applicable contract drawing.
- C. When the contractor is required by a provision of a modification to prepare a new drawing, rather than to revise existing drawings, obtain instructions from the Construction Manager as to the drawing scale and information required.
- D. Keep drawings in labeled, bound sets.
 1. Mark with red pencil.
 2. Mark work of separate contracts with different colors of pencils.
 3. Incorporate new drawings into existing sets, as they are issued.
- E. Review completed record set with the Construction Manager.
- F. Upon authorization by the Construction Manager, each prime contractor shall prepare a full set of transparencies of contract drawings marked with all changes shown on his set of record prints.
- G. The Construction Manager will furnish transparencies of original contract drawings at the cost of \$20.00 (twenty dollars) per sheet.

3.3 RECORD PROJECT MANUAL

- A. Maintain a complete copy of the project manual, marked to show changes.
- B. Where the actual work differs from that shown in the project manual, mark the record copy to show the actual work.
 1. Include a copy of each addendum and modification to the contract.

3.4 RECORD SUBMITTALS

- A. Maintain a complete set of all submittals made during construction, marked to show changes.
- B. Each contractor shall maintain a complete set of all submittals made during construction, marked to show changes which occur due to his work.

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DIVISION 1 - GENERAL REQUIREMENTS
SECTION 01800 - PROJECT RECORD DOCUMENTS

1. Maintain submittals in cardboard file boxes, labeled to show contents.
 2. Sort submittals by applicable specification section and file in order of submittal identification number.
- C. Record Shop Drawings: Record the types of information specified for all record documents.
1. Mark changes on record shop drawings only when contract drawing would not be capable of showing the change clearly or completely.
 2. Mark changes in manner specified for record drawings.
- D. Record Product Data Submittals: Record the types of information specified for all record documents.
1. In addition, record the following types of information:
 - a. Changes in the products as delivered to the site.
 - b. Changes in manufacturer's instructions or recommendations for installation.
- E. Record Coordination Drawings: Record the types of information required for all record documents.
1. Mark up in the manner specified for record drawings.

3.5 TRANSMITTAL TO OWNER

- A. Collect, organize, label, and package ready for reference.
1. Provide cardboard file boxes for submittals.
 2. Provide cardboard drawing tubes with end caps for transparencies.
 3. Bind print sets with durable paper covers.
 4. Label each document (and each sheet of drawings) with "PROJECT RECORD DOCUMENTS - This document has been prepared using information furnished by _____" [insert the contractor's name], and the date of preparation.
- B. Submit to the Construction Manager.

END OF SECTION 01800

DIVISION 01 – GENERAL REQUIREMENTS
SECTION 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.
 - 2. Division 01 Section "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 3. Division 02 Section "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
 - 4. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
 - 5. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

SECTION 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report from responsible waste hauler or use **Form A7 for construction waste**. Include the following information, **Use FORM A8**:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- C. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.

3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. [**Use Form A1 for construction waste.**] Include estimated quantities and assumptions for estimates. Use **Form 2 for Tracking Demo Waste.**
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. [**Use Form A3 for construction waste.**] Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures. **Use FORM A4 for tracking demolition waste.**
 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
 1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Savings in hauling and tipping fees that are avoided.
 5. Handling and transportation costs. Include cost of collection containers for each type of waste.
 6. Net additional cost or net savings from waste management plan.
- E. Forms: Prepare waste management plan on Forms A1, A3, A5 and A7 included at end of Part 3.

DIVISION 01 – GENERAL REQUIREMENTS
SECTION 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return and prior to construction.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

SECTION 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

DIVISION 01 – GENERAL REQUIREMENTS
SECTION 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

3.5 ATTACHMENTS

A. Form A1:

CONSTRUCTION WASTE IDENTIFICATION							
MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pallets							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

* Insert units of measure.

B. Form A3:

CONSTRUCTION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pallets						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

DIVISION 01 – GENERAL REQUIREMENTS
SECTION 017419 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

C. Form A5:

COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pallet								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

D. Form A7:

CONSTRUCTION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pallet								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

END OF SECTION 017419

DIVISION 02 - EXISTING CONDITIONS
SECTION 024111 - SELECTIVE DEMOLITION

- WORK INCLUDES: DEMOLITION WORK INDICATED OR REASONABLY IMPLIED ON THE DRAWINGS. CONTRACTOR SHALL VISIT THE SITE TO ESTABLISH EXTENT OF DEMOLITION WORK REQUIRED TO BE COMPLETED. COORDINATE WITH THE OWNER TO ARRANGE CONVENIENT ACCESS TO THE BUILDING AND MINIMIZE INTERFERENCES WITH OWNER'S BUSINESS.
- SUBMIT ALL PERMITS AND NOTICES AUTHORIZING BUILDING DEMOLITION, IF REQUIRED.
- ERECT TEMPORARY CLOSURES, BARRIERS, FENCES, GUARD RAILS, ENCLOSURES, CHUTES, BRACING AND SHORING TO PROTECT PERSONNEL, STRUCTURES AND UTILITIES WHICH ARE TO REMAIN INTACT. PREVENT ACCESS OF UNAUTHORIZED PERSONS TO DEMOLITION AREAS. ANY DAMAGE TO WORK THAT IS INTENDED TO REMAIN SHALL BE REPAIRED TO MATCH EXISTING WORK.
- ENSURE MINIMUM INTERFERENCE WITH ROADS, STREETS, DRIVEWAYS, SIDEWALKS, AND ADJACENT FACILITIES. DO NOT CLOSE OR OBSTRUCT STREETS OR PASSAGEWAYS WITHOUT PERMISSION FROM AUTHORITIES HAVING JURISDICTION.
- EXISTING STRUCTURAL SYSTEM, I.E. BEAMS, COLUMNS AND LOAD BEARING WALLS, SHALL REMAIN UNDISTURBED, UNLESS INDICATED OTHERWISE.
- REMOVE DEMOLITION DEBRIS FROM THE SITE AS SOON AS POSSIBLE AND DISPOSE OF LEGALLY.

END OF DIVISION 02

DIVISION 04 - MASONRY
SECTION 042000 - UNIT MASONRY

- PROVIDE UNIT MASONRY, INCLUDING CONCRETE MASONRY UNITS, AND RELATED MASONRY TIES, ANCHORS, REINFORCEMENT AND ACCESSORIES.
- SYSTEM PERFORMANCE REQUIREMENTS: PROVIDE UNIT MASONRY THAT DEVELOPS THE FOLLOWING INSTALLED COMPRESSIVE STRENGTHS (F_m):
 - 2.1. FOR CONCRETE UNIT MASONRY: F_m = 2150 PSI
- MASONRY STANDARDS: COMPLY WITH ACI 530.1/ASCE 6/TMS 002 AND TO RECOMMENDATIONS OF "NATIONAL CONCRETE MASONRY ASSOCIATION" CONCRETE MASONRY UNITS: ASTM C 90, MEDIUM WEIGHT, MANUFACTURED TO DIMENSIONS 3/8-INCH LESS THAN NOMINAL DIMENSIONS.
- MORTAR AND GROUT MATERIALS:
 - 5.1. PORTLAND CEMENT-LIME MIX, PACKAGED BLEND OF PORTLAND CEMENT COMPLYING WITH ASTM C 150, TYPE I OR TYPE II, AND HYDRATED LIME COMPLYING WITH ASTM C 207, TYPE S.
 - 5.2. AGGREGATE FOR MORTAR: ASTM C 144.
 - 5.3. WATER: POTABLE.
- ADJUSTABLE WALL TIES: 3/16-INCH DIAMETER GALVANIZED STEEL WIRE, ASTM A 82, 2 PIECE, ZEE OR RECTANGULAR TYPE, LENGTH AS REQUIRED.
- MORTAR MIXES: COMPLY WITH ASTM C 270, PROPORTION SPECIFICATION, FOR TYPE N, MIX MORTAR THOROUGHLY BY MECHANICAL BATCH MIXER. USE MORTAR WITHIN TWO HOURS AFTER MIXING.
- MASONRY WORK SHALL BE PLUMB, TRUE AND ALIGNED. LAY MASONRY UNITS WITH RUNNING STRICHES BOND PATTERN IN STRAIGHT LEVEL COURSES AND VERTICAL JOINTS EVENLY STAGGERED. CROSS BONDED AT CORNERS AND OUTER FACES OF UNITS MADE PERFECTLY EVEN. LAY MASONRY UNITS IN FULL MORTAR BEDS WITH FULL ALIGNMENT OF CONCRETE MASONRY UNIT CROSS WEBS. LAY MASONRY UNITS WITH SOLID MORTAR JOINTS OF UNIFORM 3/8-INCH WIDTH WHILE SETTING MORTAR IS STILL DAMP, FIRMLY COMPACT TO OBTAIN UNIFORM CONCAVE TOOLED JOINTS AT EXPOSED SURFACES. CUT UNITS AS REQUIRED WITH POWER SAW.
- PROVIDE CONTINUOUS HORIZONTAL JOINT REINFORCEMENT SET IN MASONRY BEDS AT 16-INCHES VERTICALLY ON CENTER. INSTALL LONGITUDINAL SIDE RODS IN MORTAR FOR THEIR ENTIRE LENGTH WITH A MINIMUM OF 5/8 INCH ON EXTERIOR SIDE OF WALLS AND 1/2 INCH ELSEWHERE. LAP REINFORCEMENT A MINIMUM OF 6-INCHES. CUT OR INTERRUPT JOINT REINFORCEMENT AT CONTROL AND EXPANSION JOINTS.
- UPON COMPLETION, CLEAN EXPOSED MASONRY WITH WATER AND A STIFF FIBER BRUSH, OR WITH APPROPRIATE CLEANING SOLUTION. PROTECT ADJACENT MATERIALS DURING CLEANING PROCESS. REMOVE EFFLORESCENCE WHICH FORMS WITHIN ONE YEAR AFTER DATE OF ACCEPTANCE.

END OF DIVISION 04

DIVISION 05 - METALS
SECTION 05500 - METAL FABRICATIONS

- WORK INCLUDES: METAL FABRICATION, COMPLETE WITH ANCHORS AND ACCESSORIES, INCLUDING ROUGH HARDWARE, PLATES, AND LINTELS.
- SUBMIT SHOP DRAWINGS INDICATING LAYOUT, MEMBERS, CONNECTIONS, MISCELLANEOUS ITEMS AND SCHEDULES, FABRICATION AND ERECTION REQUIREMENTS.
- MATERIALS FOR METAL FABRICATIONS:
 - 3.1. PLATES, SHAPES, AND BARS: ASTM A 36.
 - 3.2. BOLTS AND OTHER ANCHORS: ASTM A 307, GRADE A, GALVANIZED.
 - 3.3. WELDING ELECTRODES: AWS SPECIFICATION.
 - 3.4. FERROUS METAL PRIMER: SSPC 2 64 T, OR SSPC 3 64 T.
- FURNISH BENT OR OTHERWISE CUSTOM-FABRICATED BOLTS, PLATES, ANCHORS, DOWELS AND OTHER METAL FABRICATIONS AS REQUIRED FOR ANCHORING OR SECURING ITEMS INDICATED TO CONCRETE, MASONRY, OR OTHER STRUCTURES. FABRICATE ITEMS TO SIZES, SHAPES, AND DIMENSIONS REQUIRED. FURNISH MALLEABLE-IRON WASHERS FOR HEADS AND NUTS THAT BEAR ON WOOD STRUCTURAL CONNECTIONS; ELSEWHERE, FURNISH STEEL WASHERS.
- PROVIDE LOOSE BEARING AND LEVELING PLATES FOR STEEL ITEMS BEARING ON MASONRY OR CONCRETE CONSTRUCTION, MADE FLAT, FREE FROM WARPS OR TWISTS, AND OF REQUIRED THICKNESS AND BEARING AREA. DRILL PLATES TO RECEIVE ANCHOR BOLTS AS REQUIRED. GALVANIZE AFTER FABRICATION.
- PROVIDE LOOSE STRUCTURAL STEEL LINTELS FOR OPENINGS AND RECESSES IN MASONRY WALLS AND PARTITIONS AS SHOWN. WELD ADJOINING MEMBERS TOGETHER TO FORM A SINGLE UNIT WHERE INDICATED. PROVIDE NOT LESS THAN 6 INCHES BEARING AT EACH SIDE OF OPENINGS, UNLESS OTHERWISE INDICATED.
- INSTALLATION:
 - 7.1. FASTENING TO IN-PLACE CONSTRUCTION: PROVIDE ANCHORAGE DEVICES AND FASTENERS NECESSARY FOR SECURING METAL FABRICATIONS TO IN-PLACE CONSTRUCTION; AND MASONRY INSERTS, TOGGLE BOLTS, THROUGH BOLTS, LAG BOLTS, WOOD SCREWS AND OTHER CONNECTORS AS REQUIRED.
 - 7.2. CUTTING, FITTING AND PLACEMENT: PERFORM CUTTING, DRILLING AND FITTING REQUIRED FOR INSTALLATION OF METAL FABRICATIONS. SET WORK ACCURATELY IN LOCATION, ALIGNMENT AND ELEVATION, PLUMB, LEVEL, TRUE AND FREE OF RACK, MEASURED FROM ESTABLISHED LINES AND LEVELS.
 - 7.3. PROVIDE TEMPORARY BRACING OR ANCHORS FOR ITEMS THAT ARE TO BE BUILT INTO CONCRETE, MASONRY OR SIMILAR CONSTRUCTION.
 - 7.4. FIT EXPOSED CONNECTIONS ACCURATELY TOGETHER TO FORM TIGHT HAIRLINE JOINTS. WELD CONNECTIONS THAT ARE NOT TO BE LEFT AS EXPOSED JOINTS, BUT CANNOT BE SHOP WELDED BECAUSE OF SHIPPING SIZE LIMITATIONS. GRIND EXPOSED JOINTS SMOOTH AND TOUCH UP SHOP PAINT COAT. DO NOT WELD, CUT OR ABRASIVE THE SURFACES OF UNITS THAT HAVE BEEN HOT DIP GALVANIZED AFTER FABRICATION, AND ARE INTENDED FOR BOLTED OR SCREWED FIELD CONNECTIONS.

END OF DIVISION 05

DIVISION 06 - WOOD, PLASTICS & COMPOSITES
SECTION 061000 - ROUGH CARPENTRY

- WORK INCLUDES: ROUGH CARPENTRY OF EVERY DESCRIPTION, INCLUDING FRAMING WITH DIMENSION LUMBER, BLOCKING AND FURRING, AND WOOD PRESERVATIVE TREATMENT.
- SUBMIT PRODUCT DATA FOR EACH TYPE OF PRODUCT INDICATED.
- LUMBER, GENERAL: 19 PERCENT MAXIMUM MOISTURE CONTENT; LUMBER TO CONFORM TO VOLUNTARY PRODUCT STANDARD PS 20, SURFACE FOUR SIDES; GRADE: NO. 2 AND BETTER, SPRUCE-PINE-FIR (SOUTH), WWPA.
- PRESERVATIVE TREATED WOOD: AWPA C2 FOR LUMBER AND C9 FOR PLYWOOD. PROVIDE PRESSURE-TREATED WOOD FOR FRAMING, BLOCKING, FURRING, NAILING STRIPS BUILT INTO EXTERIOR WALLS, WOOD IN CONTACT WITH CONCRETE AND IN CONJUNCTION WITH ROOFING. PRESERVATIVE CHEMICALS: ACCEPTABLE TO AUTHORITIES HAVING JURISDICTION AND CONTAINING NO ARSENIC OR CHROMIUM.
- CONSTRUCTION PANELS: COMPLY WITH PA 1, FACTORY-MARKED WITH APA TRADE MARK EVIDENCING COMPLIANCE WITH GRADE REQUIREMENTS.
- PROVIDE ROUGH HARDWARE REQUIRED, INCLUDING: STEEL BOLTS, ASTM A 307, GRADE A, WITH ASTM A 563 HEX NUTS AND WHERE INDICATED, FLAT WASHERS; LAG BOLTS, ANSI B18.2.1; WOOD SCREWS, ANSI B18.6.1; AND NAILS AND STAPLES, FS FF-N-105. ROUGH HARDWARE FOR EXTERIOR OR IN CONTACT WITH CONCRETE

- OR MASONRY: GALVANIZED.
- WOOD FRAMING INSTALLATION: COMPLY WITH AF&PA'S WCD 1, "DETAILS FOR CONVENTIONAL WOOD FRAME CONSTRUCTION," UNLESS OTHERWISE INDICATED. FRAME WOOD MEMBERS TO A CLOSE FIT, SET ACCURATELY TO REQUIRED LINES AND LEVELS AND SECURE RIGIDLY IN PLACE, CUT AND FIT FRAMING, BLOCKING, ETC., TO ACCOMMODATE OTHER WORK. BRIDGING FOR FLOOR JOISTS SHALL BE 1 X 3 WOOD OR METAL CROSS BRACING AT CENTER OF SPAN. HEADERS AND LINTELS TO BE (2) 2X12 UNLESS NOTED OTHERWISE. SILL PLATES SHALL BE PRESSURE TREATED LUMBER.
- SECURELY ATTACH CARPENTRY WORK AS INDICATED AND ACCORDING TO APPLICABLE CODE AND RECOGNIZED STANDARDS.
 - 8.1. NBS NER-272 FOR POWER-DRIVEN FASTENERS.
 - 8.2. TABLE 2304.9.1, "FASTENING SCHEDULE," IN ICC'S INTERNATIONAL BUILDING CODE.

END OF DIVISION 06

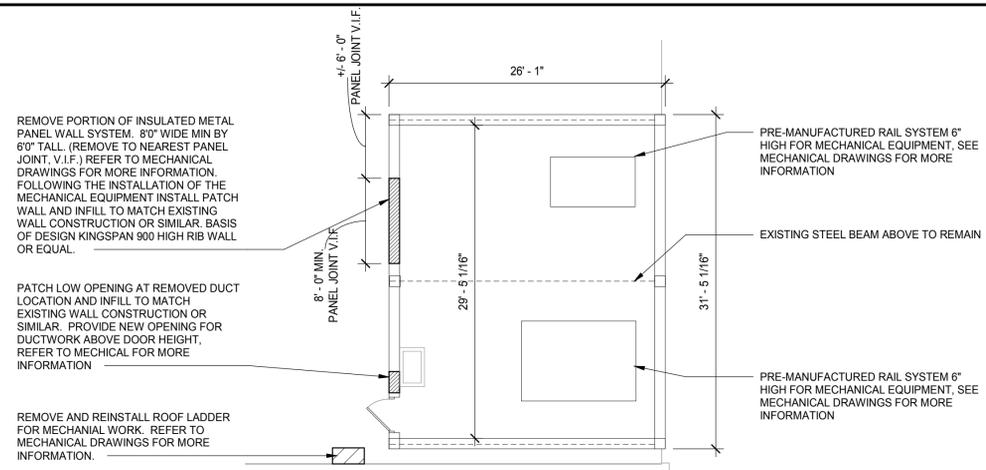
DIVISION 07 - THERMAL & MOISTURE PROTECTION
SECTION 077200 - ROOF ACCESSORIES

- SECTION INCLUDES ROOF CURBS, EQUIPMENT SUPPORTS, AND PREFORMED FLASHINGS.
- SUBMIT PRODUCT DATA FOR EACH PRODUCT INDICATED.
- COMPLY WITH SMARNS' ARCHITECTURAL SHEET "METAL MANUAL" FOR FABRICATION TO COORDINATE WITH ROOFING, AND NRCA'S "ROOFING AND WATERPROOFING MANUAL" DETAILS FOR INSTALLING UNITS. ROOF ACCESSORIES SHALL WITHSTAND EXPOSURE TO WEATHER AND RESIST THERMALLY-INDUCED MOVEMENT WITHOUT FAILURE, RATTLING, LEAKAGE, OR FASTENER DISENGAGEMENT.
- PRODUCTS:
 - 4.1. PREFABRICATED CURB AND EQUIPMENT SUPPORTS: THE PATE CO. OR THYURD DIV./THYBAR CORP.
 - 4.2. PREFABRICATED PIPE HANGER UNITS: PORTABLE PIPE HANGERS, INC. MODEL PS 1-2 OR EQUAL.
 - 4.3. PREFORMED FLASHINGS: PORTALS PLUS, INC.; PIPE PORTAL SYSTEM AND PIPE FLASHING WITH ADAPTERS APPROPRIATE FOR PENETRATION BEING FLASHING.
- INSTALLATION:
 - 5.1. GENERAL: INSTALL ROOF ACCESSORIES ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS. LEVEL, PLUMB, TRUE-TO-LINE AND WITHOUT WARPING OR BUCKLING. PROTECT AGAINST GALVANIC ACTION BY PAINTING CONTACT SURFACES WITH BITUMINOUS COATING.
 - 5.2. ROOF CURBS AND EQUIPMENT SUPPORTS: INSTALL ROOF CURBS AND EQUIPMENT SO TOP SURFACES ARE LEVEL.
 - 5.3. PREFABRICATED PIPE HANGER UNITS: SUPPORT PIPING AND CONDUITS ROUTED ACROSS ROOF ON HANGER UNITS ON ROLLERS. INSTALL HANGER UNITS NO MORE THAN 10 FEET O.C. SET ISOLATION PADS IN ADHESIVE AND BASES ON ISOLATION PADS. SET FRAMING POSTS INTO BASES AND ASSEMBLE FRAME STRUCTURE. ADJUST HEIGHT OF HANGERS TO MAINTAIN ELEVATION AND SLOPE.
 - 5.4. PREFORMED FLASHING: SECURE TO ROOF MEMBRANE ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.
 - 5.5. SEAL JOINTS WITH ELASTOMERIC SEALANT AS REQUIRED BY PREFORMED FLASHING MANUFACTURER.
- CLEAN EXPOSED SURFACES ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS. REPLACE DAMAGED ROOF ACCESSORIES OR THAT CANNOT BE SUCCESSFULLY REPAIRED.

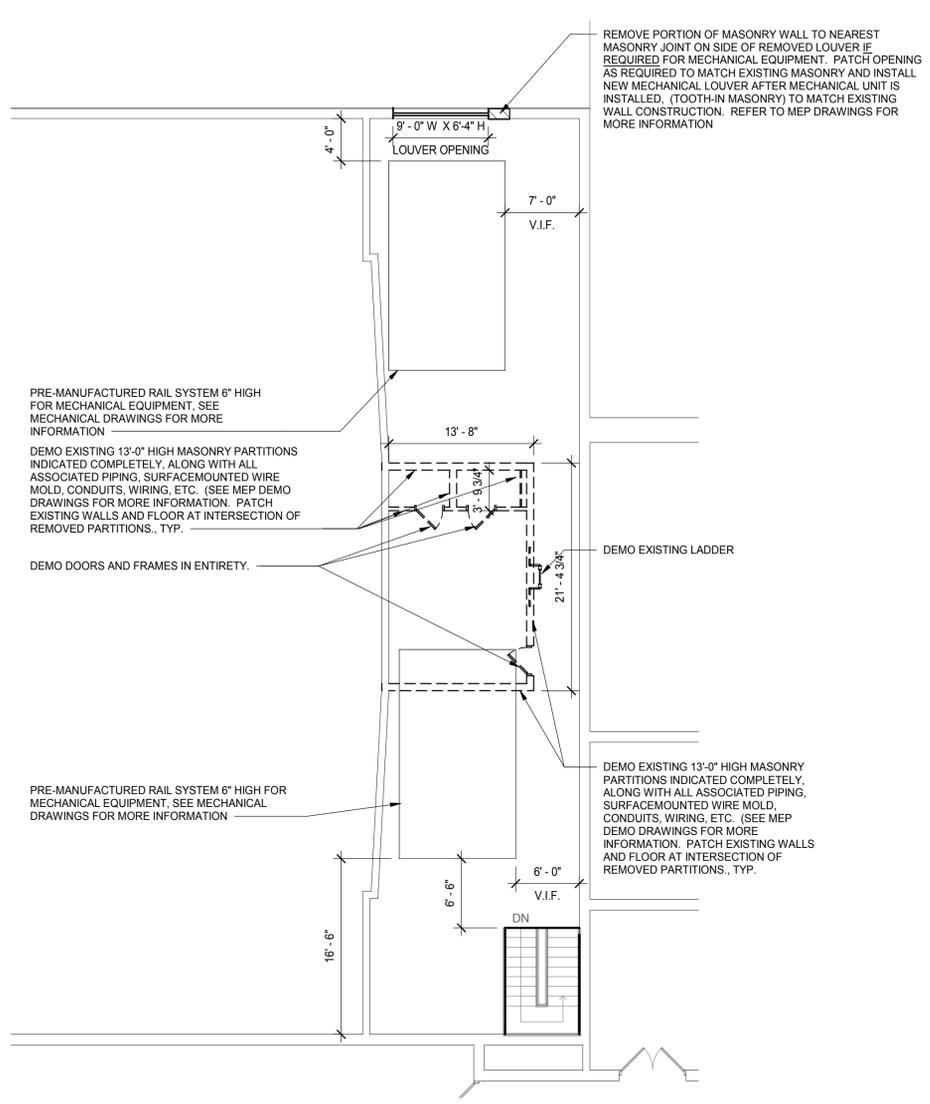
SECTION 079200 - JOINT SEALANTS

- PROVIDE JOINT SEALANTS AND FILLERS OF EVERY TYPE REQUIRED TO CLOSE UP JOINTS BETWEEN SIMILAR AND DISSIMILAR MATERIALS TO MAKE THE STRUCTURE WEATHER TIGHT AND FOR APPEARANCE IMPROVEMENT.
- SUBMIT PRODUCT DATA FOR EACH TYPE OF PRODUCT INDICATED.
- SEALANT PRODUCTS:
 - 3.1. CAULKING: ACRYLIC EMULSION SEALANT, ASTM C 834, MANUFACTURERS: "CHEM CALK 600" (BOSTIK CONSTRUCTION PRODUCTS DIV.); "AC 20"; (PECORA CORP.); "SONOLAC"; (SONNEBORN).
 - 3.2. JOINT FILLER: CLOSED CELL EXPANDED POLYETHYLENE; "ETHAFOAM" (THE DOW CHEMICAL COMPANY); "EXPAND O FOAM" (WILLIAMS PRODUCTS INC.); "FILLER FOAM FF 4" (PROGRESS UNLIMITED INC.).
- PRIME SUBSTRATE AND APPLY CAULKING AND SEALANTS ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.

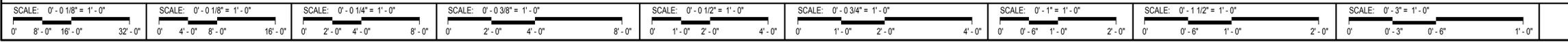
END OF DIVISION 07



1 LIBRARY PENTHOUSE PLAN
 SCALE: 1/8" = 1'-0"
 NORTH



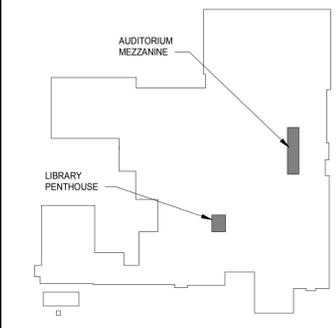
2 THIRD FL MECH MEZZANINE PLAN
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REV	DESCRIPTION	DATE
ISSUED FOR BID		01/18/17

DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

PENTHOUSE PLAN AND MEZZANINE PLAN

Project Number: 02-5274-32
 Drawn By: Author
 Sheet:

A2.3

ELECTRICAL ABBREVIATIONS LIST

1P	1 POLE (2P, 3P, 4P, ETC.)	DCP	DOMESTIC WATER CIRCULATING PUMP	HT	HEIGHT	NEMA	NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION	SWBD	SWITCHBOARD
A	AMPERE	DEPT	DEPARTMENT	HTG	HEATING	NFDS	NON-FUSED SAFETY DISCONNECT SWITCH	SYM	SYMMETRICAL SYSTEM
AC	ABOVE COUNTER OR AIR CONDITIONER	DET	DETAIL	HTR	HEATER	NIC	NOT IN CONTRACT	TEL	TELEPHONE
ACLG	ABOVE CEILING	DIA	DIAMETER	HVAC	HEATING, VENTILATING AND AIR CONDITIONING	NL	NIGHT LIGHT	TEL/DATA	TELEPHONE/DATA
ADO	AUTOMATIC DOOR OPENER	DISC	DISCONNECT	HWP	HYDRONIC WATER PUMP	N.O.	NORMALLY OPEN	TERM	TERMINAL
AF	AMP FRAME	DIST	DISTRIBUTION	IC	INTERRUPTING CAPACITY	NTS	NOT TO SCALE	TL	TWIST LOCK
AFD	ABOVE FINISHED FLOOR	DN	DOWN	IG	ISOLATED GROUND	NTF	NORMAL POWER FACTOR	TR	TAMPER RESISTANT
AFG	ABOVE FINISHED GRADE	DPR	DAMPER	IMC	INTERMEDIATE METAL CONDUIT	OH	OVERHEAD	T-STAT	THERMOSTAT
AFI	ARC FAULT CIRCUIT INTERRUPTER	DS	SAFETY DISCONNECT SWITCH	IR	INFRARED	OL	OVERLOADS	TTC	TELEPHONE TERMINAL
AHU	AIR HANDLING UNIT	DWG	DRAWING	IR	INFRARED	PA	PUBLIC ADDRESS	TV	TELEVISION
AL	ALUMINUM	EC	ELECTRICAL CONTRACTOR	IW	INTERLOCK WITH	PB	PULL BOX OR PUSHBUTTON	TVTC	TELEVISION TERMINAL
ALT	ALTERNATE	ELEC	ELECTRICAL	J-BOX	JUNCTION BOX	PE	PNEUMATIC ELECTRIC	TYP	TYPICAL
AMP	AMPERE	ELEV	ELEVATOR	KV	KILOVOLT	PEDESTAL	UNDERGROUND ELECTRICAL UNDERGROUND	UC	UNDER COUNTER
AMPL	AMPLIFIER	EM	EMERGENCY	KVAR	KILOVOLT-AMPERE REACTIVE	PH	PHASE	UH	UNIT HEATER
ANNUN	ANNUNCIATOR	EMS	ENERGY MANAGEMENT SYSTEM	KWH	KILOWATT HOUR	PIV	POST INDICATING VALVE	UT	UNDERGROUND TELEPHONE
APPROX	APPROXIMATELY	EMT	ELECTRICAL METALLIC TUBING	LOC	LOCATE OR LOCATION	PNL	PANEL	UTIL	UTILITY
AQ-STAT	AQUASTAT	EQIP	EQUIPMENT	LT	LIGHT	PP	POWER POLE	UV	ULTRAVIOLET
ARCH	ARCHITECT, ARCHITECTURAL	EXP	EXPLOSION PROOF	LTG	LIGHTING	PRV	POWER ROOF VENTILATOR	VA	VOLT-AMPERES
AS	AMP SWITCH	EX	EXISTING	LTNG	LIGHTNING	PT	POTENTIAL TRANSFORMER	VDT	VIDEO DISPLAY TERMINAL
AT	AMP TRIP	FA	FIRE ALARM	LV	LOW VOLTAGE	PVC	POLYVINYL CHLORIDE (CONDUIT)	VERT	VERTICAL
ATS	AUTOMATIC TRANSFER SWITCH	FABP	FIRE ALARM BOOSTER POWER SUPPLY PANEL	MAX	MAXIMUM	PWR	POWER	VFD	VARIABLE FREQUENCY DRIVE
AUTO	AUTOMATIC	FACP	FIRE ALARM CONTROL PANEL	MAG.S	MAGNETIC STARTER	QUAN	QUANTITY	VOL	VOLUME
AUX	AUXILIARY	FCU	FAN COIL UNIT	MC	MOMENTARY CONTACT	W	WATT	WG	WIRE GUARD
AV	AUDIO VISUAL	FLR	FLOOR	MCB	MECHANICAL CONTRACTOR	W/G	WATER GUARD	WH	WATER HEATER
AWG	AMERICAN WIRE GAUGE	FLUR	FLUORESCENT	MCC	MOTOR CONTROL CENTER	WO	WITHOUT	WP	WEATHERPROOF
BATT	BATTERY	FU	FUSE	MDC	MAIN DISTRIBUTION CENTER	W/P	WEATHERPROOF	XFMR	TRANSFORMER
BD	BOARD	FUDS	FUSED SAFETY DISCONNECT SWITCH	MDP	MAIN DISTRIBUTION PANEL	W/O	WITHOUT	XFR	TRANSFER
BLDG	BUILDING	GA	GAUGE	MFR	MANUFACTURER	W/	WITH		
BMS	BUILDING MANAGEMENT SYSTEM	GAL	GALLON	MFS	MISUSED DISCONNECT SWITCH	RTU	ROOF TOP UNIT		
C	CONDUIT	GALV	GALVANIZED	MH	MANHOLE	SC	SURFACE CONDUIT		
CAB	CABINET	GC	GENERAL CONTRACTOR	MIC	MICROPHONE	SEC	SECONDARY		
CAT	CATALOG	GEN	GENERATOR	MIN	MINIMUM	SHT	SHEET		
CATV	CABLE TELEVISION	GFI	GROUND FAULT CIRCUIT INTERRUPTER	MISC	MISCELLANEOUS	SM	SMILAR		
CB	CIRCUIT BREAKER	GF	GROUND FAULT PROTECTOR	MLO	MAIN LUGS ONLY	SND	SOLID NEUTRAL		
CCTV	CLOSED CIRCUIT TELEVISION	GND	GROUND	MOA	MULTIOUTLET ASSEMBLY	SPEC	SPECIFICATION		
CKT	CIRCUIT	GRS	GALVANIZED RIGID STEEL (CONDUIT)	MSP	MOTOR STARTER PANELBOARD	SPKR	SPEAKER		
CLG	CEILING	GYP BD	GYPSPUM BOARD	MSB	MAIN SWITCHBOARD	SP	SPARE	△	ANGLE
CLMB	COMBINATION	HOA	HANDS-OFF-AUTOMATIC SWITCH	MT	MOUNT	SR	SURFACE RACEWAY	@	AT
CMFR	COMPRESSOR	CR	CATHODE-RAY TUBE	MTR	MOTOR, MOTORIZED	SS	STAINLESS STEEL	Δ	DELTA
CONN	CONNECTION	CTR	CURRENT TRANSFORMER	N.C.	NORMALLY CLOSED	SSW	SELECTOR SWITCH	'	FEET
CONST	CONSTRUCTION	CU	COPPER	NEC	NATIONAL ELECTRICAL CODE	S/S	STOP/START PUSHBUTTONS	"	INCHES
CONT	CONTINUATION OR CONTINUOUS					STA	STATION	#	NUMBER
CONTR	CONTRACTOR					STD	STANDARD	Ø	PHASE
CONV	CONVECTOR					SURF	SURFACE MOUNTED	C	CENTER LINE
CP	CIRCUITING PUMP					SW	SWITCH	PLATE	PLATE
CRT	CATHODE-RAY TUBE								
CT	CURRENT TRANSFORMER								
CTR	CENTER								
CU	COPPER								

ELECTRICAL NOTES:

- ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE 2014 NEC, 2014 IECC AND ALL LOCAL CODES.
- PROVIDE ALL PERMITS AND INSPECTION FEES.
- ALL MATERIAL AND LABOR SHALL BE GUARANTEED FOR ONE YEAR AFTER FINAL ACCEPTANCE BY THE ENGINEER.
- THIS CONTRACTOR SHALL PROVIDE ALL HIS OWN RIGGING, SCAFFOLDING, RUBBISH REMOVAL, AND LEAVE SPACE BROOM CLEAN.
- MINIMUM SIZE CONDUIT SHALL BE 3/4" E.M.T.
- MINIMUM SIZE WIRE SHALL BE #12 THHN, WITH #14 WAMP FOR CONTROL WIRING.
- WIRE #14 THROUGH #10 SHALL BE COPPER THHN; #8 THROUGH 500 MCM SHALL BE STRANDED COPPER THHN. ALUMINUM WIRE NOT ACCEPTABLE. ALL WIRE SHALL BE COLOR CODED.
- THIS CONTRACTOR SHALL PROVIDE ALL NECESSARY CUTTING AND PATCHING INCLUDING SLEEVES AND INSERTS.
- ALL NEW CIRCUIT BREAKERS SHALL BE "OOB" BOLT-ON BREAKERS (10,000 A.I.C.), OR EQUAL BY G.E. OR ITE. (PROVIDE NEW CIRCUIT BREAKERS COMPATIBLE WITH NEW PANELBOARD). PROVIDE TYPEWRITTEN DIRECTORIES IN ALL PANELS.
- BEFORE SUBMITTING HIS BID, THE ELECTRICAL CONTRACTOR SHALL VISIT THE SITE TO ASCERTAIN ALL WORK INVOLVED IN THE PROJECT.
- THIS CONTRACTOR SHALL COORDINATE HIS WORK WITH OTHER CONTRACTORS ON THE PROJECT.
- THIS CONTRACTOR SHALL MAKE NECESSARY MODIFICATIONS AND ADJUSTMENTS TO ALL ELECTRICAL ITEMS AND EQUIPMENT AS MAY BE REQUIRED BY THIS WORK.
- EQUIPMENT GROUNDING SHALL BE USED TO CONNECT THE GROUNDING TERMINAL OF RECEPTACLES TO THE GROUNDING METALLIC BOX.
- DRAWINGS ARE GENERALLY DIAGRAMMATIC. ROUTING OF CONDUITS, RACEWAYS, ETC., AS SHOWN ON DRAWINGS, DOES NOT INTEND TO SHOW EVERY RISE, DROP, OFFSET, FITTING, NOR EVERY STRUCTURAL ELEMENT THAT MAY BE ENCOUNTERED DURING THE INSTALLATION OF THIS WORK. EACH CONTRACTOR SHALL MAKE ANY REQUIRED CHANGES FROM THE GENERAL ROUTING SHOWN ON THESE DRAWINGS, SUCH AS OFFSETS, BENDS, OR CHANGES IN ELEVATION DUE TO COORDINATION WITH THE WORK OF OTHER TRADES AND BUILDING CONSTRUCTION. ALL CHANGES SHALL BE MADE WITHOUT ADDITIONAL COST TO THE OWNER OR DELAY IN COMPLETION DATE OF THE PROJECT.
- IT IS INTENDED THAT EQUIPMENT SHALL BE LOCATED SYMMETRICALLY WITH THE ARCHITECTURAL ELEMENTS OF THE BUILDING, NOTWITHSTANDING THE FACT THAT LOCATIONS INDICATED BY THESE DRAWINGS MAY BE DISTORTED FOR CLARNESS OF PRESENTATION.
- CONTRACTOR SHALL CHECK DRAWINGS OF OTHER TRADES TO VERIFY THAT SPACES IN WHICH THEIR WORK WILL BE INSTALLED ARE CLEAR OF OBSTRUCTIONS. WORK SHALL BE INSTALLED TO MAINTAIN MAXIMUM HEADROOM AND SPACE CONDITIONS AT ALL POINTS IN THE BUILDING, WHERE HEADROOM OR SPACE CONDITIONS APPEAR INADEQUATE, CONTRACTOR SHALL NOTIFY ARCHITECT/ENGINEER BEFORE PROCEEDING WITH THE INSTALLATION OF THEIR WORK.
- CONTRACTOR SHALL FURNISH OTHER TRADES ADVANCE INFORMATION AND/OR SHOP DRAWINGS ON LOCATIONS AND SIZES OF PIPING, DUCTWORK, CONDUIT, RACEWAYS, EQUIPMENT, FRAMES, BOXES, SLEEVES, AND OPENINGS, ETC. NEEDED FOR THEIR WORK TO PERMIT OTHER TRADES AFFECTED TO INSTALL THEIR WORK PROPERLY AND WITHOUT DELAY.
- WHERE THERE IS EVIDENCE THAT WORK OF ONE TRADE WILL INTERFERE WITH WORK OF OTHER TRADES, ALL TRADES SHALL MEET ON JOB SITE TO WORK OUT SPACE CONDITIONS AND MAKE SATISFACTORY ADJUSTMENTS TO INSTALLATION OF THE NEW WORK. CONTRACTORS SHALL VERIFY EXACT LOCATIONS OF ALL DEVICES AND EQUIPMENT WITH FIELD CONDITIONS, SHOP DRAWINGS, AND WORK OF OTHER TRADES PRIOR TO ROUGH-IN. EACH CONTRACTOR SHALL BE RESPONSIBLE, AT THEIR OWN EXPENSE, FOR THE REMOVAL AND REINSTALLATION OF ANY PART OF THEIR WORK IF SAME WAS INSTALLED WITHOUT CONSULTING WITH OTHER TRADES BEFORE INSTALLING THEIR WORK.
- CONTRACTOR SHALL PROVIDE SLEEVES IN BEAMS, FLOORS, COLUMNS, AND WALLS AS SHOWN ON THE DRAWINGS AS REQUIRED BY JOB SITE CONDITIONS, AND/OR AS SPECIFIED WHEN INSTALLING THEIR WORK. ALL BEAMS AND COLUMNS WHICH ARE REQUIRED TO BE SLEEVED SHALL BE CUT AND REINFORCED AS REQUIRED BY FIELD CONDITIONS, AND LOCATIONS AND SIZES SHALL BE CHECKED AND APPROVED BY ARCHITECT BEFORE CONTRACTOR CUTS AND STRUCTURAL BUILDING MEMBER.
- THE SEQUENCE FOR THE INSTALLATION OF ALL WORK SHALL BE COORDINATED BETWEEN ALL CONTRACTORS ON THE PROJECT AND IN STRICT ACCORDANCE WITH ARCHITECT/ENGINEER AND OWNERS STIPULATION AS DIRECTED.
- CONTRACTOR SHALL REFER TO THE ARCHITECTURAL AND STRUCTURAL CONTRACT DRAWINGS (BEFORE SUBMITTING THEIR BIDS) TO FAMILIARIZE THEMSELVES WITH THE EXTENT OF THE GENERAL CONTRACTORS WORK, CEILING HEIGHTS AND CLEARANCE FOR INSTALLING THEIR WORK.
- CONTRACTOR SHALL BE RESPONSIBLE AND PAY FOR ALL CORING, CUTTING, PATCHING, REPAIRING, REFINISHING, AND REMOVAL/REPLACEMENT OF NEW BUILDING CONSTRUCTION REQUIRED TO ACCOMMODATE THE INSTALLATION, OR REMOVAL OF THEIR WORK. ALL PATCHING, REPAIRING, AND REFINISHING WORK SHALL BE PERFORMED BY THOSE REGULARLY INVOLVED IN THAT TRADE. AND SHALL MATCH THE ADJACENT CONSTRUCTION AS CLOSELY AS POSSIBLE. CARE SHALL BE TAKEN SO AS NOT TO DAMAGE ANY EXISTING BUILDING CONSTRUCTION OR ITEMS THAT ARE TO REMAIN. ANY EXISTING FINISHES THAT ARE DAMAGED DURING THE INSTALLATION OF NEW WORK, OR REMOVAL OF EXISTING WORK, SHALL BE REPAIRED, REPLACED, AND PAID FOR BY THE INSTALLING CONTRACTOR TO THE SATISFACTION OF THE ARCHITECT AND OWNER. REFER TO ARCHITECTURAL DRAWINGS FOR EXISTING BUILDING CONSTRUCTION THAT IS TO REMAIN AND, THEREFORE, SUBJECT TO PATCHING, REPAIRING, REFINISHING, AND REMOVAL/REPLACEMENT.
- CONTRACTOR SHALL INSTALL ALL AUXILIARY SUPPORTING STEEL AS REQUIRED FOR THE SUPPORTING OF THEIR CONDUIT, EQUIPMENT, ETC. ALL SUPPORTING STEEL FOR ITEMS ABOVE A SUSPENDED CEILING SHALL BE FROM BUILDING STRUCTURAL MEMBERS ONLY.
- UNLESS INDICATED OTHERWISE, THE ARCHITECT/ENGINEER MAKES NO REPRESENTATION AS TO WHETHER OR NOT ANY HAZARDOUS OR CONTAMINATED MATERIALS (INCLUDING BUT NOT LIMITED TO ASBESTOS, PCBs, CONTAMINATED SOILS, ETC.) ARE PRESENT WITHIN THE EXISTING BUILDING OR ON THE SITE. WORK SHOWN ON THE DRAWINGS AND/OR INDICATED IN THE SPECIFICATIONS SHALL NOT BE CONSTRUED TO CALL FOR CONTACT WITH ANY OF THESE MATERIALS. IF THESE MATERIALS ARE ENCOUNTERED OR SUSPECTED, THE CONTRACTOR SHALL NOT DISTURB THEM AND SHALL CONTACT THE ARCHITECT/ENGINEER IMMEDIATELY.
- CONTRACTOR SHALL STORE ALL MATERIALS AND EQUIPMENT SHIPPED TO THE SITE IN A PROTECTED AREA. IF MATERIAL IS STORED OUTSIDE OF THE BUILDING, IT MUST BE STORED OFF THE GROUND A MINIMUM OF SIX INCHES (6") SET ON 6X6 PLANKS AND/OR WOOD PALLETS. ALL MATERIAL AND EQUIPMENT MUST BE COMPLETELY COVERED WITH WATERPROOF TARP OR VISQUIN. ALL CONDUIT WILL HAVE THE ENDS CLOSED TO KEEP OUT DIRT AND OTHER DEBRIS. NO EQUIPMENT WILL BE ALLOWED TO BE STORED ON THE SITE UNLESS IT IS SITTING ON WOOD PLANKS AND COMPLETELY PROTECTED WITH WEATHERPROOF COVERS.
- THE DRAWINGS, SCHEDULES, AND SPECIFICATIONS HAVE BEEN PREPARED USING ONE MANUFACTURER FOR EACH PIECE OF EQUIPMENT AS THE BASIS FOR DIMENSIONAL DESIGN. IF THE CONTRACTOR PURCHASES EQUIPMENT FROM A SPECIFIED ACCEPTABLE MANUFACTURER, BUT NOT THE SCHEDULED MANUFACTURER USED FOR THE BASE DESIGN, THE CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING ALL THE DIMENSIONS OF THE EQUIPMENT TO VERIFY THAT IT WILL FIT IN THE SPACE SHOWN ON THE DRAWINGS. MINOR DEVIATIONS IN DIMENSIONS WILL BE PERMITTED, PROVIDED THE RATINGS MEET THOSE SHOWN ON THE DRAWINGS AND EQUIPMENT WILL PHYSICALLY FIT INTO THE SPACE ALLOCATED WITH THE SUITABLE ACCESS AROUND EQUIPMENT FOR OPERATION AND MAINTENANCE OF THE EQUIPMENT. WHEN EQUIPMENT SUBMITTED FOR REVIEW DOES NOT MEET THE PHYSICAL SIZE OR ARRANGEMENT OF THAT SCHEDULED AND SPECIFIED, CONTRACTOR SHALL PAY FOR ALL ALTERATIONS REQUIRED TO ACCOMMODATE SUCH EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER. CONTRACTOR WILL ALSO PAY ALL COSTS FOR ADDITIONAL WORK REQUIRED BY OTHER CONTRACTORS, OWNER, ARCHITECT, OR ENGINEER TO MAKE CHANGES WHICH WOULD ALLOW THE EQUIPMENT TO FIT IN THE SPACE AND FUNCTION AS INTENDED.
- CONTRACTOR AND/OR MANUFACTURER SHALL VERIFY THAT THE CHARACTERISTICS OF THE EQUIPMENT HE SUBMITS FOR REVIEW MEET THE CAPACITY AND DUTY SPECIFIED.
- CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND THEIR ASSOCIATED FEES.
- CONTRACTOR SHALL PROVIDE WARRANTY FOR ALL MATERIAL AND GUARANTEE ALL WORKMANSHIP PROVIDED BY HIM FOR 1 (ONE) YEAR FOR SUBSTANTIAL COMPLETION OF WORK INVOLVED.

ELECTRICAL SYMBOL LIST (ALL LOW VOLTAGE CONDUIT STUBS SHALL HAVE SCREWED/THREADED BUSHING.)

	PREWIRED ADMINISTRATIVE TELEPHONE JACK WALL MOUNTED +16" W" DENOTES WALL MOUNTED AT +48" A.F.F. SINGLE VOICE JACK. PROVIDE JUNCTION BOX AND BLANK FACEPLATE AND CONDUIT STUB. PROVIDE THREADED/SCREWED INSULATED BUSHING.		MAGNETIC DOOR HOLDER
	POWER ASSISTED DOOR ACTUATOR (PADA)		WALL INTERCOM - EXTERIOR MOUNTED
	MAIN INTERCOM SYSTEM AT RECEPTION DESK		MAGNETIC DOOR CONTACT. CONNECT TO SECURITY PANEL. REQUIRES DRILL TO DOOR FRAME. VERIFY. PROVIDE CONDUIT STUBBED INTO ACCESSIBLE CEILING SPACE.
	WALL MOUNTED CARD READER. PROVIDE RECESSED JUNCTION BOX AND CONDUIT STUBBED INTO ACCESSIBLE CEILING SPACE FOR FUTURE CABLING.		ELECTRONIC DOOR (LOCK) STRIKE
	PUSH BUTTON - DOOR RELEASE, (EPO) - EMERGENCY POWER OFF		AREA OF RESCUE - FIRE FIGHTER MAIN STATION - SEE DETAIL
	AREA OF RESCUE STATION - SEE DETAIL		SURFACE MOUNTED BATTERY OPERATED CLOCK, CORRIDOR AND COMMON SPACES SHALL BE DOUBLEFACED
	FLUSH CEILING MOUNTED SPEAKER		WALL MOUNTED SPEAKER - "WP" DENOTES WEATHER PROOF
	VOLUME CONTROL		CEILING MOUNTED OCCUPANCY SENSOR - SEE SCHEDULE FOR MORE DETAIL
	FUSE SIZE (NF FOR NON-FUSED)		NEMA ENCLOSURE RATING (NEMA 1 STANDARD, 3R OUTDOORS AND WET LOCATIONS U.N.O.)
	FUSIBLE SWITCH RATING TAG		NUMBER OF FUSIBLE POLES
	SWITCH FRAME SIZE		CIRCUIT BREAKER PANELBOARD.
	DISTRIBUTION PANEL.		TELEPHONE TERMINAL BOARD (SIZE AS NOTED IN THE PLAN) (3/4" PLYWOOD BACKBOARD COATED WITH FIRE RETARDANT PAINT)
	DRY TYPE TRANSFORMER		CONDUIT WALL SLEEVE FOR ROUTING OF LOW VOLTAGE CABLING. PROVIDE FOR EACH SHOWN, A MINIMUM OF (2) 2" CONDUIT(S) STUBBED INTO CEILING SPACES, UNLESS SPECIFICALLY NOTED OTHERWISE. PROVIDE THREADED/SCREWED INSULATED BUSHINGS AT EACH END.
	CONDUIT ROUTED CONCEALED IN WALLS AND CEILING. HASH MARKS DENOTE QUANTITY OF #12 AWG CONDUCTORS OR AS NOTED		CONDUIT ROUTED EXPOSED. INSTALL PARALLEL TO WALLS AND CEILINGS. HASH MARKS DENOTE QUANTITY OF #12 AWG CONDUCTORS OR AS NOTED
	CONDUIT INSTALLED BELOW GRADE. HASH MARK DENOTES QUANTITY OF #12 AWG CONDUCTORS OR AS NOTED		DENOTES CONDUIT HOMERUN, 3/4" MINIMUM, PANEL DESTINATION AND CIRCUIT NUMBER(S) AS INDICATED
	SHORT TICK MARK DENOTES LINE (HOT) OR SWITCH LEG CONDUCTOR, #12 AWG MINIMUM.		LONG TICK MARK DENOTES NEUTRAL CONDUCTOR, #10 AWG MINIMUM
	DENOTES INSULATED GROUND WIRE, #12 AWG MINIMUM		SINGLE POLE 20 AMP 120-277 VOLT TOGGLE SWITCH INSTALLED 48" A.F.F.
	SINGLE POLE 20 AMP 120-277 VOLT KEY OPERATED TOGGLE SWITCH INSTALLED 48" A.F.F.		THREE WAY 20 AMP 120-277 VOLT TOGGLE SWITCH INSTALLED 48" A.F.F.
	MANUAL MOTOR STARTER, THERMAL OVERLOAD TOGGLE SWITCH		WALL MOUNTED OCCUPANCY SENSOR WITH OVERRIDE SWITCH
	SINGLE POLE 20 AMP 120-277 VOLT OCCUPANCY SENSOR WITH OVERRIDE DIMMER SWITCH INSTALLED 48" A.F.F.		SINGLE POLE 20 AMP 120-277 VOLT PILOT LIGHT SWITCH INSTALLED 48" A.F.F.

BIDDING NOTE

SEE DRAWING ME1.0 FOR GENERAL NOTES, HVAC/PLUMBING/ELECTRICAL COORDINATION SCHEDULE, AND ADDITIONAL DETAILS APPLICABLE TO THIS TRADE'S WORK.

SEE TECHNOLOGY CONSULTANT DRAWINGS FOR LOW VOLTAGE/DATA/AV AND ETC. FOR MORE INFO AND SCOPE OF WORK.

THIS CONTRACTOR SHALL PROVIDE AND INSTALL ALL RACEWAYS, POWER, BACKBOXES AND STUB-UPS PER T / TE AND K SERIES DRAWINGS.



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	DESCRIPTION	DATE

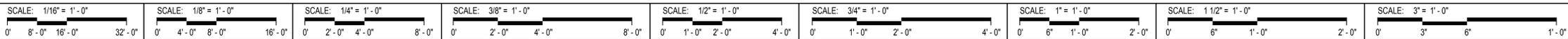
DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

NOTES AND SYMBOLS

Project Number:
02-5274-32
Drawn By:
S.JADHAV
Sheet:

E0.1





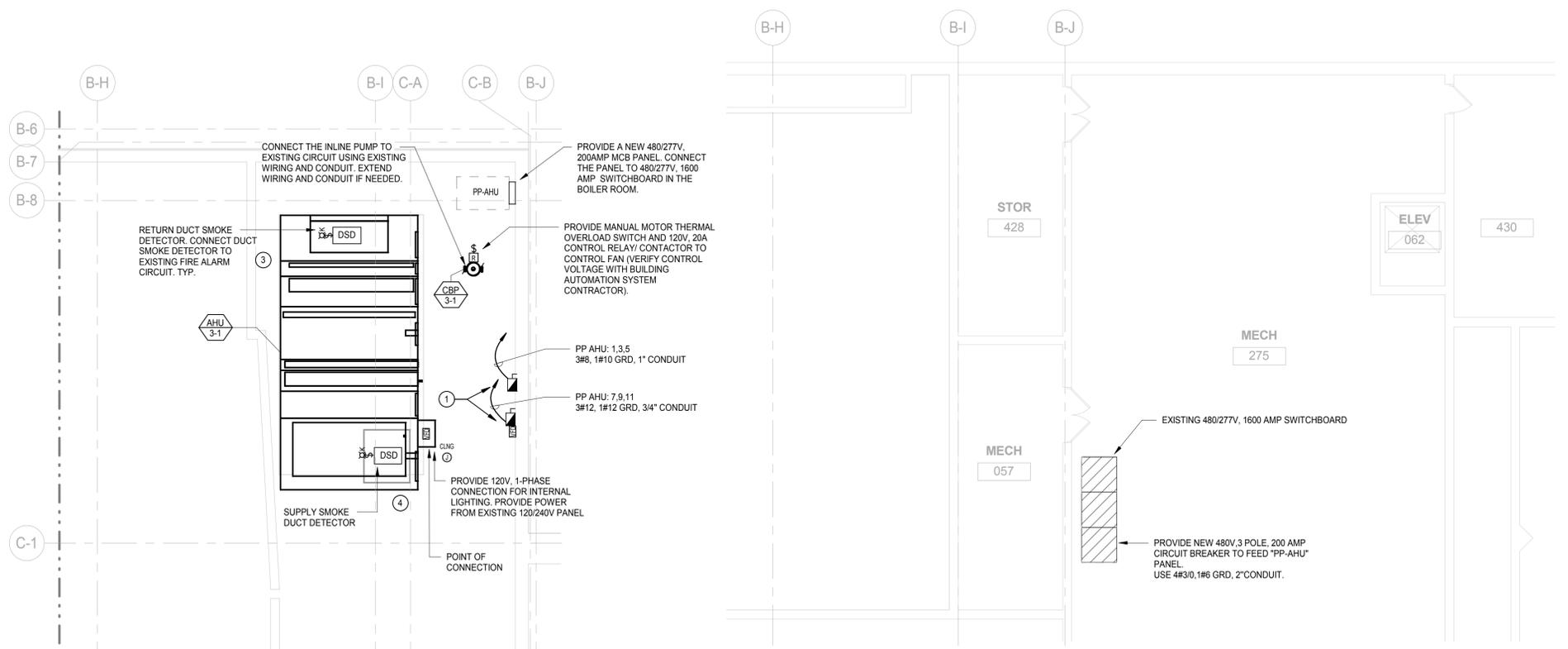
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POWER PLAN GENERAL NOTES

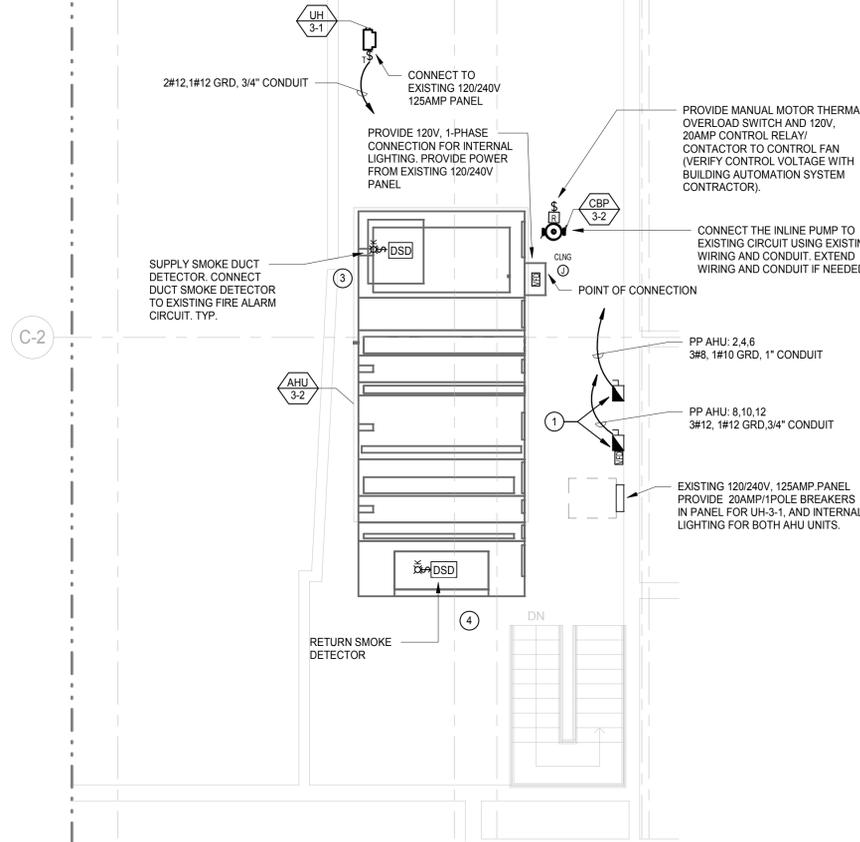
1. THE MINIMUM WIRE SIZE SHALL BE 12 AWG EXCEPT FOR SHARED NEUTRAL CONDUCTORS WHICH THE MINIMUM SIZE SHALL BE 10 AWG. THE MINIMUM CONDUIT SIZE FOR HOMERUNS AND BRANCH FEEDS TO POWER OUTLETS SHALL BE 3/4" 1/2" CONDUIT SHALL BE ACCEPTABLE FOR BRANCH WIRING TO END OF THE LINE RECEPTACLES ONLY. ALL POWER BRANCH CIRCUITS SHALL TERMINATE AT 20A, 1-POLE CIRCUIT BREAKERS IN PANELBOARD INDICATED UNLESS OTHERWISE NOTED.
2. CIRCUIT NUMBERS ARE FOR CLARIFICATION ONLY. CONTRACTOR SHALL PROVIDE ACTUAL CIRCUITING AS PART OF "AS BUILT" DRAWINGS.
3. REFER TO MECHANICAL AND PLUMBING SHEETS FOR ADDITIONAL EQUIPMENT INFORMATION.
4. REFER TO ELECTRICAL DETAILS SHEET FOR ADDITIONAL NOTES AND DETAILS.

KEYNOTES

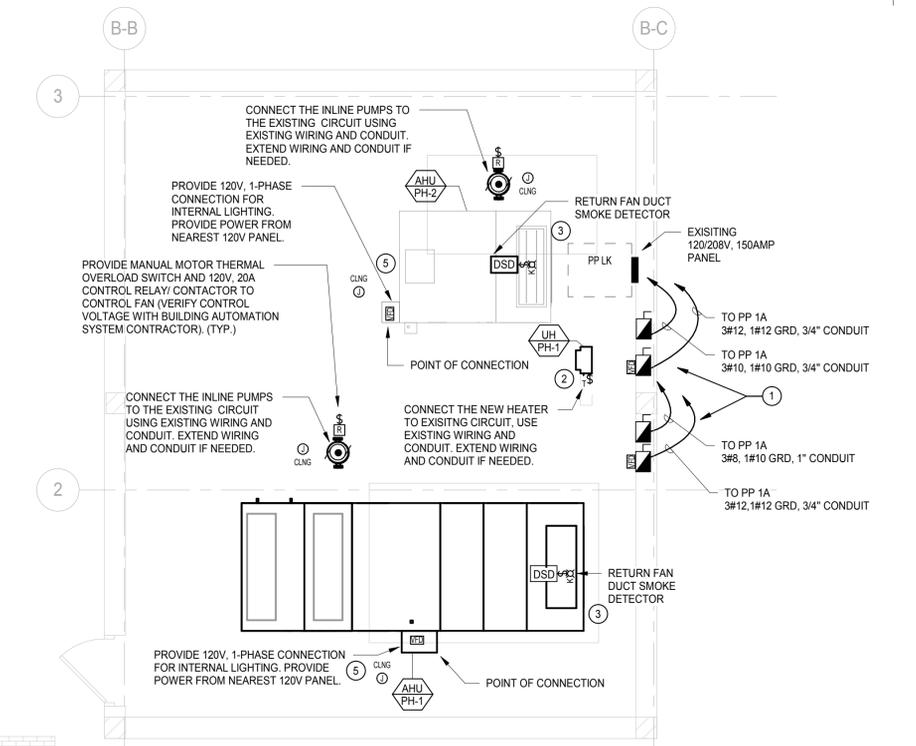
1. CONNECT TO EXISTING CIRCUIT BREAKERS THROUGH VFD. SUPPLY VFD TO BE PROVIDED BY THE MANUFACTURER RETURN VFD TO BE PROVIDED BY MECHANICAL CONTRACTOR.
2. RECONNECT THE NEW ELECTRIC HEATER TO EXISTING LOCATION. USE EXISTING CABLE AND CONDUIT.
3. CONNECT DUCT SMOKE DETECTOR TO EXISTING FIRE ALARM CIRCUIT.
4. PROVIDE NEW WIRING AND CONDUIT FOR DUCT SMOKE DETECTOR AND CONNECT TO EXISTING FIRE ALARM SYSTEM. PROVIDE SHUT DOWN RELAYS AS REQUIRED.
5. PROVIDE NEW CIRCUIT BREAKERS IF NECESSARY IN THE 120V PANEL FOR LIGHTING.



2 ELECTRICAL PARTIAL SECOND FLOOR HVAC POWER PLAN
SCALE: 1/8" = 1'-0"

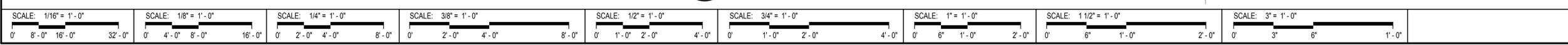


1 ELECTRICAL PARTIAL THIRD FLOOR HVAC POWER PLAN
SCALE: 3/16" = 1'-0"



3 ELECTRICAL PENTHOUSE HVAC POWER PLAN
SCALE: 1/4" = 1'-0"

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HVAC POWER PLAN- THIRD FLOOR AND PENTHOUSE

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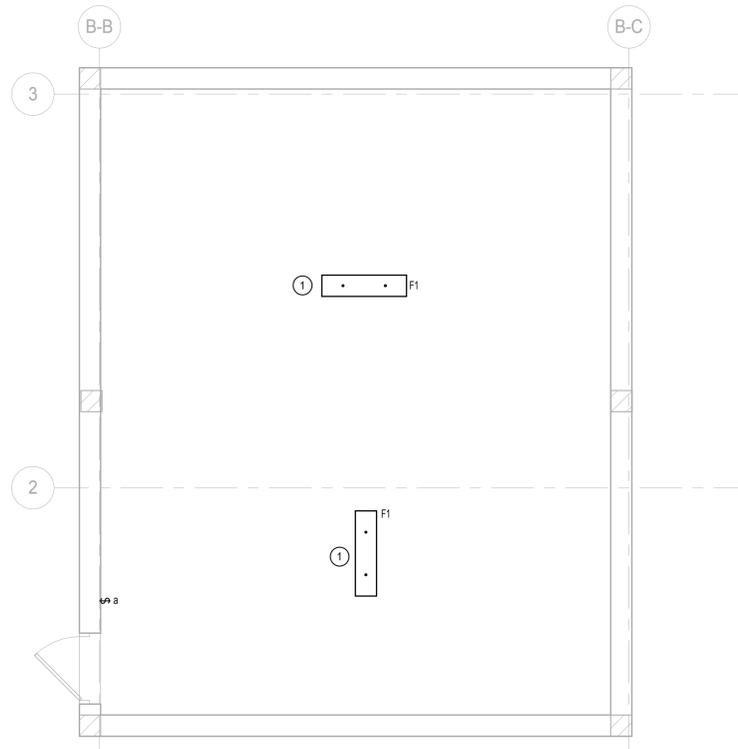
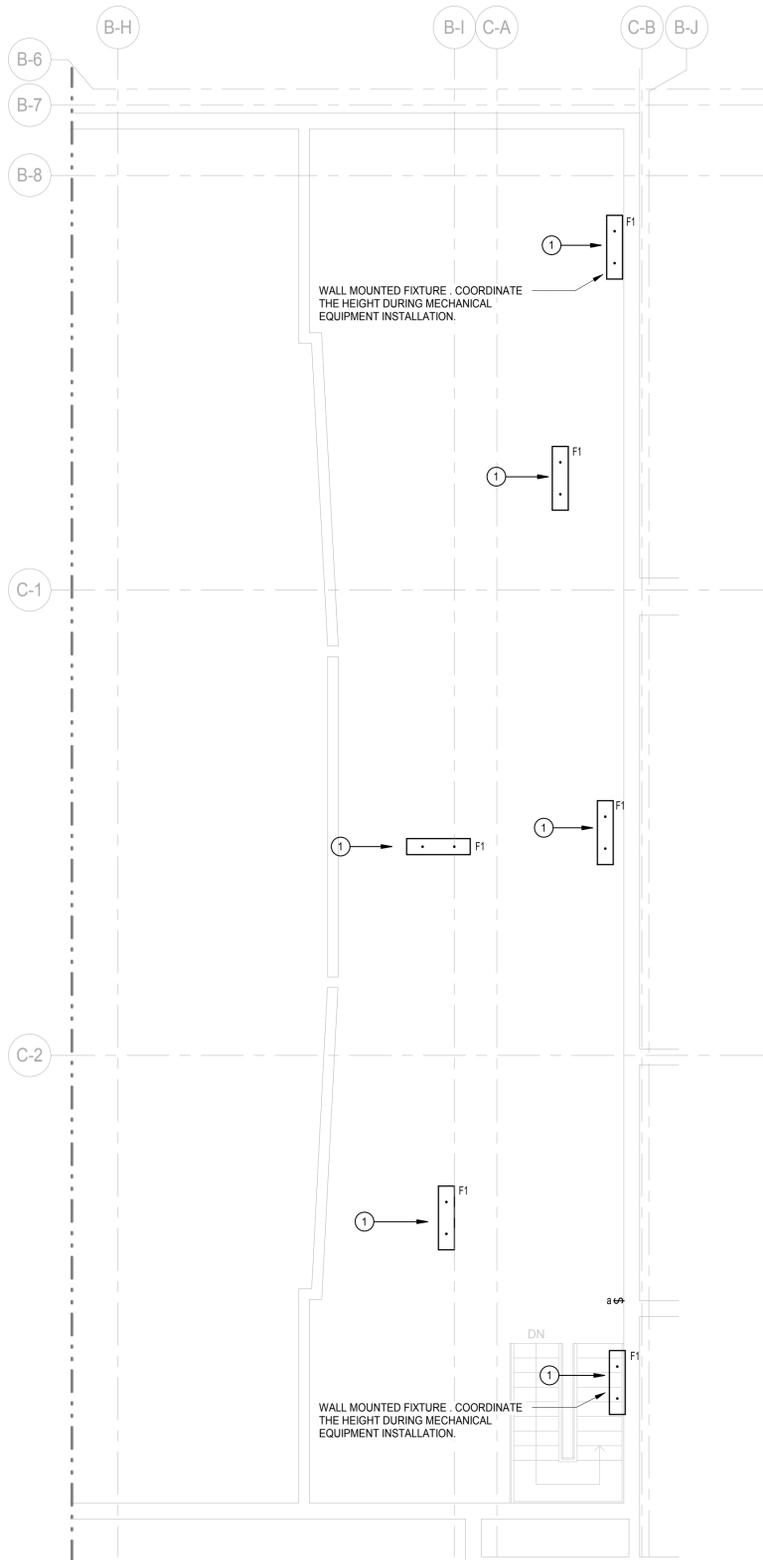
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LIGHTING PLAN GENERAL NOTES

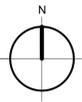
1. THE MINIMUM WIRE SIZE SHALL BE 12 AWG. THE MINIMUM CONDUIT SIZE FOR HOMERUNS SHALL BE 3/4" UNLESS OTHERWISE INDICATED LARGER. ALL LIGHTING BRANCH CIRCUITS SHALL TERMINATE AT 20A, 1-POLE CIRCUIT BREAKERS IN PANELBOARD INDICATED UNLESS OTHERWISE NOTED.

KEY NOTES

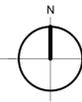
1. INSTALL NEW LIGHTING TO THE EXISTING LOCATION. CONNECT THE NEW LIGHTING FIXTURES TO EXISTING CIRCUIT. USE EXISTING WIRING AND CONDUIT. EXTEND THE WIRING IF NEEDED. (CO-ORDINATE DURING INSTALLATION OF MECHANICAL EQUIPMENT TO INSTALL THE LIGHT BELOW THE DUCT).



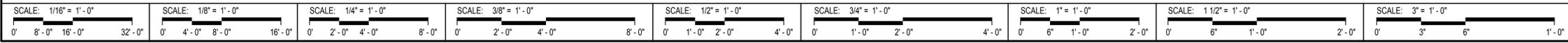
1
E2.0 ELECTRICAL THIRD FLOOR LIGHTING PLAN
SCALE: 3/16" = 1'-0"



2
E2.0 ELECTRICAL PENTHOUSE LIGHTING PLAN.
SCALE: 1/4" = 1'-0"



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DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

LIGHTING FLOOR PLAN- THIRD FLOOR AND PENTHOUSE

Project Number:
02-5274-32
Drawn By:
S.JADHAV
Sheet:

E2.0

Lighting Fixture Schedule					
Type Mark	Description	Manufacturer	Catalog Number	Lamp	Remarks
F1	4ft INDUSTRIAL STRIP LIGHT 120V	LITHONIA LIGHTING	LA-2-25W T8-MVOLT-GE810IS-SSR	25 W SUPER T8	

Branch Panel: PP-AHU

Location: MECHANICAL ROOM
 Supply From:
 Mounting: SURFACE
 Enclosure: NEMA 1

Volts: 480/277 Wye
 Phases: 3
 Wires: 4

A.I.C. Rating: 14,000 AMPS SYMMETRICAL
 Mains Type: MAIN CB
 Mains Rating: 225 A
 MCB Rating: 200 A

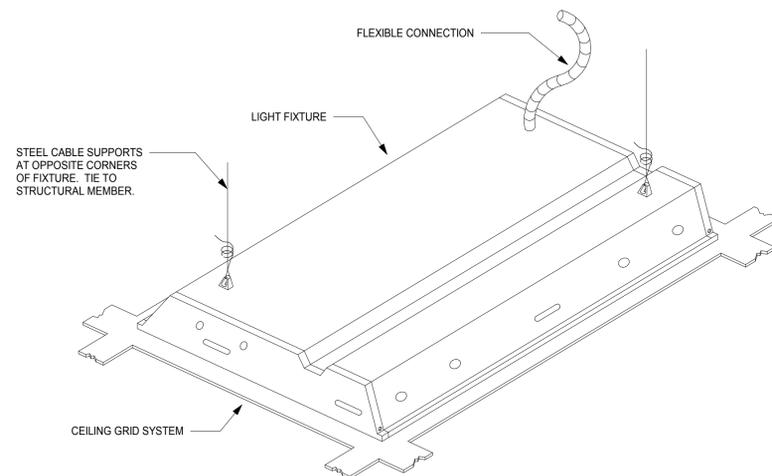
Notes:

CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT
1	SUPPLY FAN, AHU-3-1	60 A	3	1309...	1309...		3	60 A	SUPPLY FAN, AHU-3-2	2
3		--	--		1309... 1309...		--	--		4
5		--	--			1309... 1309...	--	--		6
7	RETURN FAN, RF-3-1	20 A	3	3811...	3811...		3	20 A	RETURN FAN, RF-3-2	8
9		--	--		3811... 3811...		--	--		10
11		--	--			3811... 3811...	--	--		12
13										14
15										16
17										18
19										20
21										22
23										24
25										26
27										28
29										30
31										32
33										34
35										36
37										38
39										40
41										42
				Total Load:	33810 VA	33810 VA	33810 VA			
				Total Amps:	122 A	122 A	122 A			

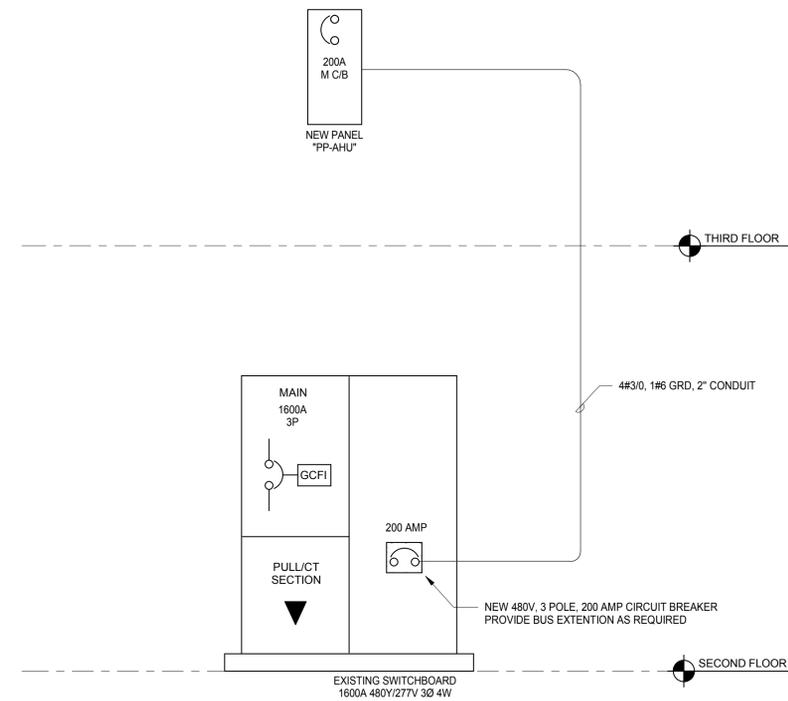
Legend:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals
HVAC	101430 VA	100.00%	101430 VA	
				Total Conn. Load: 101430 VA
				Total Est. Demand: 101430 VA
				Total Conn.: 122 A
				Total Est. Demand: 122 A

Notes:



2 LIGHT FIXTURE SUPPORT DETAIL
 E4.1 N.T.S.



1 ELECTRICAL RISER DIAGRAM
 E4.1 N.T.S.



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4436 Main St, Downers Grove, IL

SCHEDULES

Project Number:
 02-5274-32
 Drawn By:
 S.JADHAV
 Sheet:

E4.1



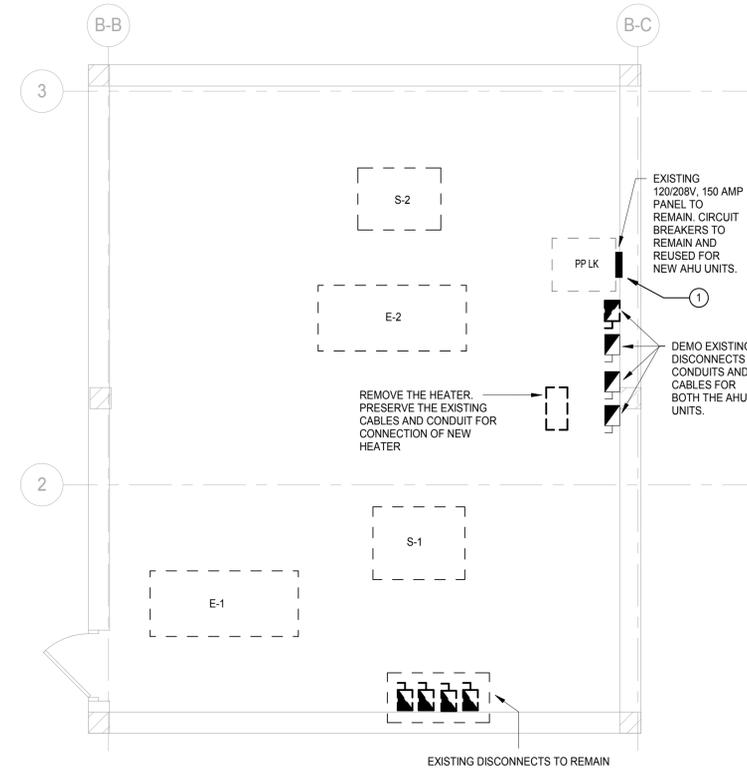
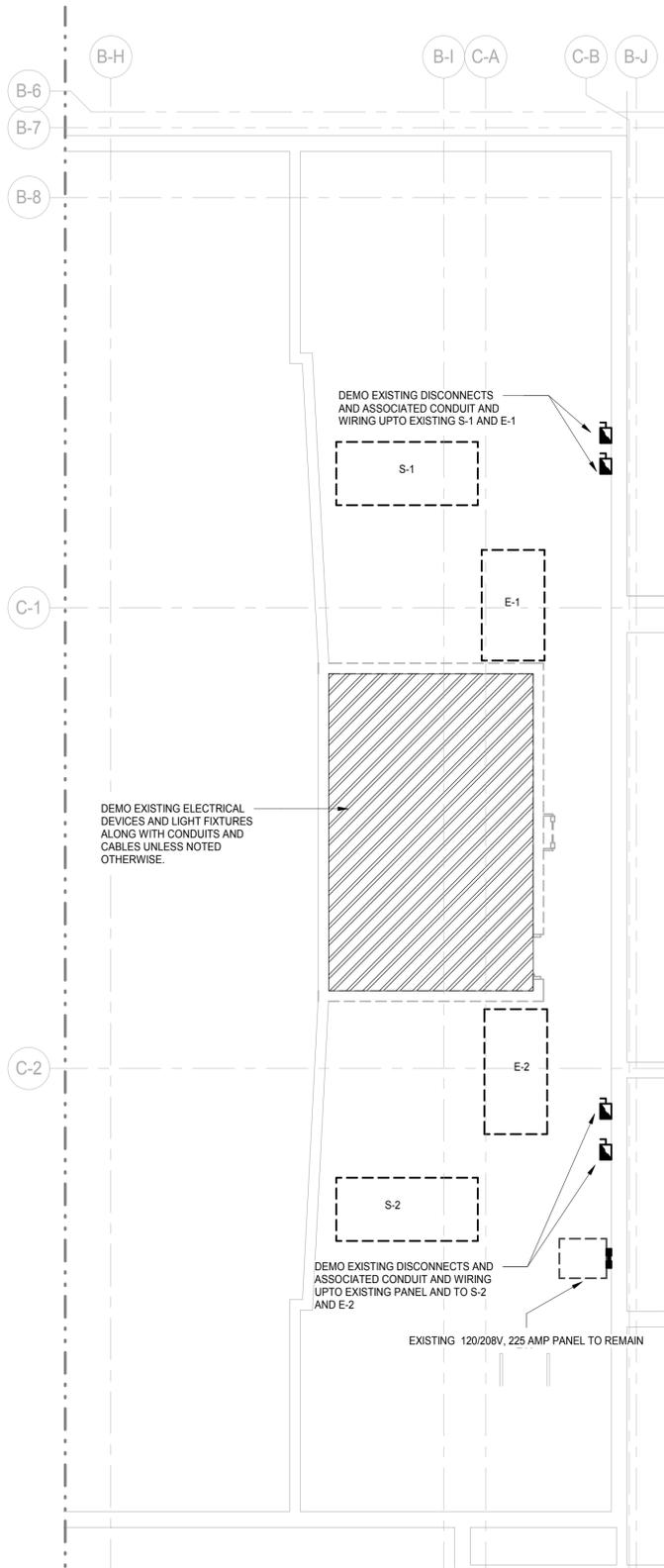
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DEMOLITION POWER PLAN GENERAL NOTES

1. ALL INDICATED ELECTRICAL EQUIPMENT, FIXTURES, DEVICES, RELATED CONDUIT, AND WIRING TO BE REMOVED UNLESS NOTED OTHERWISE.
2. ALL DEMOLITION OF THE ELECTRICAL SYSTEM AS NOTED FOR ON THE DEMOLITION DRAWINGS SHALL BE COORDINATED WITH THE RENOVATION REQUIREMENTS TO DETERMINE THIS CONTRACTORS WORK.
3. IT IS THE INTENT OF THE ELECTRICAL DEMOLITION DRAWING(S) TO INDICATE AREAS IN WHICH ELECTRICAL EQUIPMENT, CONDUIT, LIGHTING FIXTURES, DEVICES, ETC. NEED TO BE REMOVED, RELOCATED, OR MODIFIED BY THIS CONTRACTOR TO ALLOW FOR THE RENOVATION PHASE OF CONSTRUCTION. THE ELECTRICAL DEMOLITION PLAN IS FOR REFERENCE PURPOSES ONLY AND IT IS NOT INTENDED TO BE THE SOLE SOURCE OF EXISTING CONDITIONS.
4. THE CONTRACTOR SHALL VISIT THE BUILDING, BEFORE SUBMITTING HIS BID, TO VERIFY THE EXISTING CONDITIONS WHICH WILL AFFECT HIS WORK.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COMPLETE ELECTRICAL DEMOLITION REQUIRE D TO ACCOMMODATE THE RENOVATION. REMOVE AS REQUIRED ALL LIGHTING FIXTURES, RECEPTACLES, EQUIPMENT DEVICES, ETC. PULL OUT ALL UNUSED CONDUCTORS AND CABLES. REMOVE ALL ABANDONED CONDUIT. ELECTRICALLY DISCONNECT AIR HANDLING UNITS, ELECTRICAL WATER HEATERS, AND EQUIPMENT FOR REMOVAL BY OTHERS. ALL REMOVED EQUIPMENT SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM THE SITE.
6. REFER TO THE MECHANICAL AND PLUMBING DEMOLITION DRAWINGS FOR ALL MECHANICAL EQUIPMENT THAT IS TO BE ELECTRONICALLY DISCONNECTED OR REMOVED.
7. CONTRACTOR SHALL BE RESPONSIBLE TO ENSURE THAT ALL DOWN STREAM ELECTRICAL DEVICES AFFECTED BY THE DEMOLITION SHALL BE IN FULL OPERATION AFTER WORK IS COMPLETE.

KEYNOTES

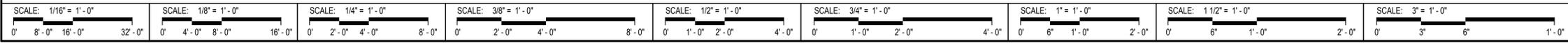
- 1 DEMO CABLES AND CONDUIT IN EXISTING 120/208V, 150AMP PANEL FOR BOTH AIR HANDLING UNITS. PANEL AND CIRCUIT BREAKERS TO REMAIN AND REUSED FOR THE NEW UNITS.



1 ELECTRICAL THIRD FLOOR DEMOLITION POWER PLAN
SCALE: 3/16" = 1'-0"

2 ELECTRICAL PENTHOUSE DEMOLITION POWER PLAN
SCALE: 1/4" = 1'-0"

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POWER DEMOLITION FLOOR PLAN-THIRD FLOOR AND PENTHOUSE

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S.JADHAV
Sheet:

ED1.1



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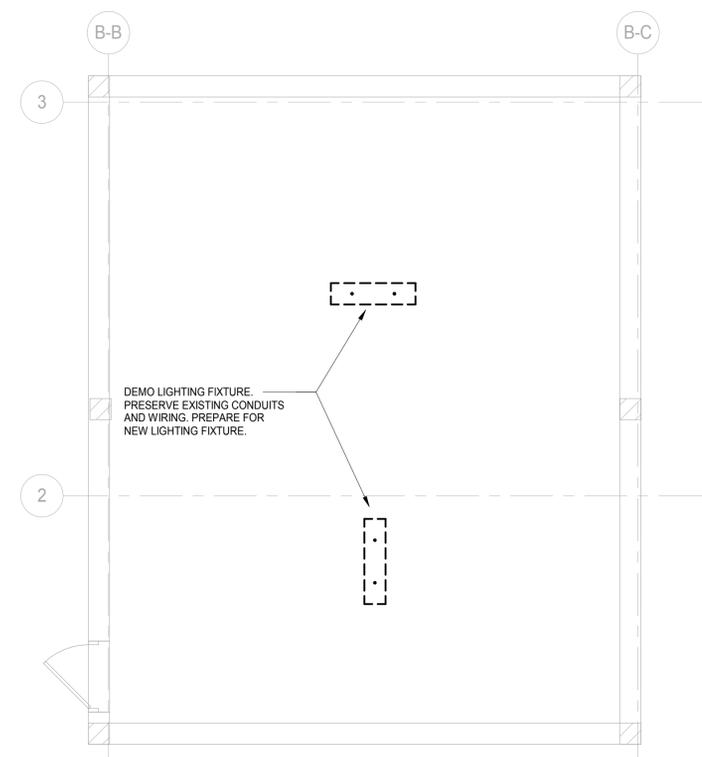
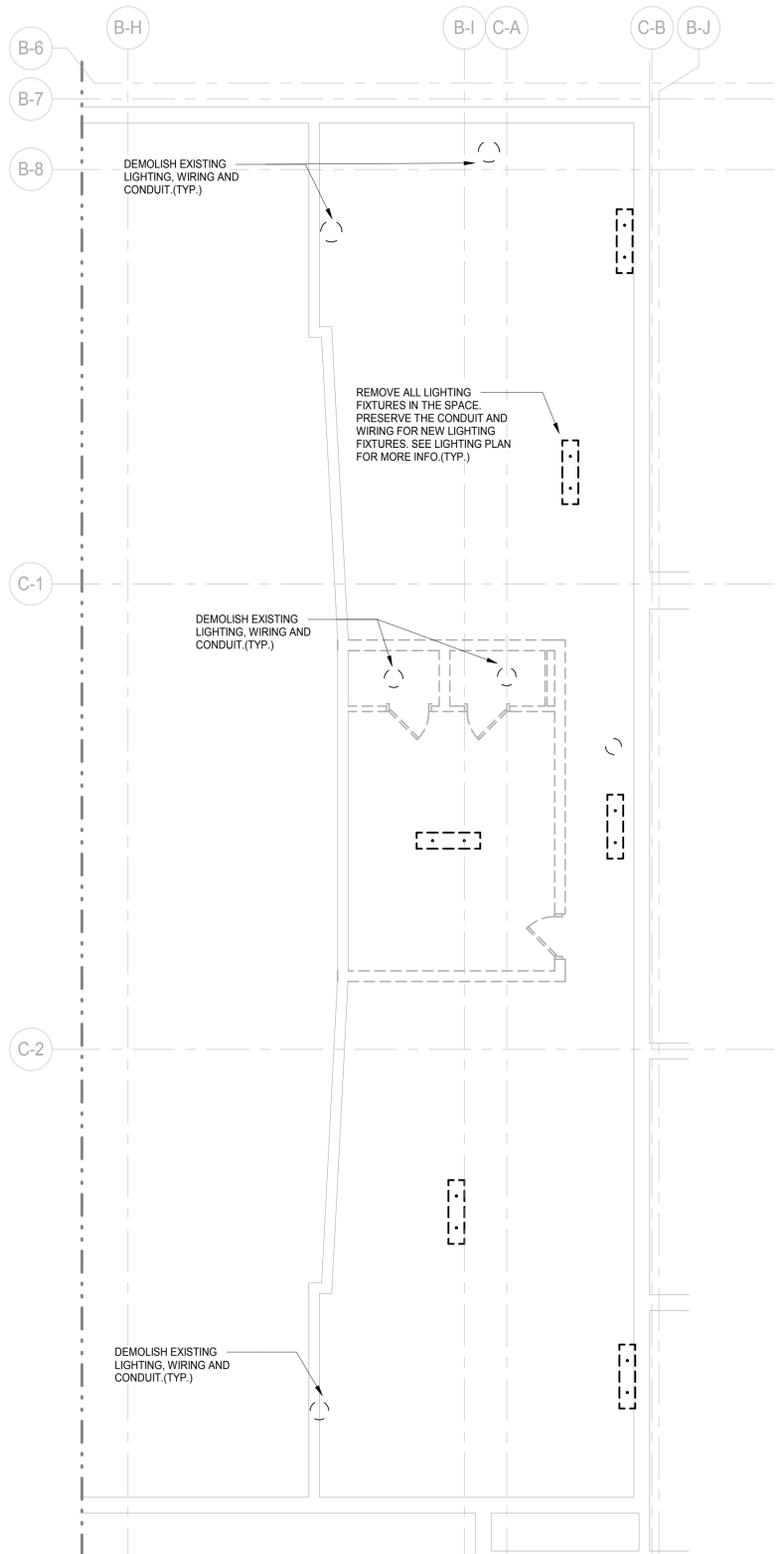
DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

LIGHTING DEMOLITION FLOOR PLAN- THIRD FLOOR AND PENTHOUSE

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 02-5274-32
 Drawn By:
 Author
 Sheet:

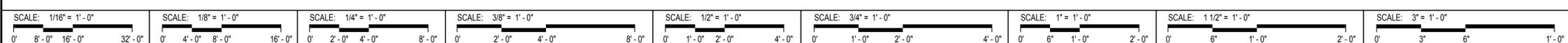
ED1.2



2 ELECTRICAL THIRD FLOOR DEMOLITION LIGHTING PLAN
 ED1.2 SCALE: 3/16" = 1'-0"

1 ELECTRICAL PENTHOUSE DEMOLITION PLAN
 ED1.2 SCALE: 1/4" = 1'-0"

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Community High School District 99

DOWNERS GROVE NORTH - AHU PROJECT

4436 Main St, Downers Grove, IL
01/18/17

ISSUED FOR BID

PROJECT TEAM

CLIENT

DOWNERS GROVE COMMUNITY
HIGH SCHOOL DISTRICT 99
6301 SPRINGSIDE AVE.
DOWNERS GROVE, IL 60516

CONTACT: JIM KOLODZIEJ

ARCHITECT:

WIGHT & COMPANY
2500 NORTH FRONTAGE ROAD
DARIEN IL, 60561
PHONE: (630)969-7000
FAX: (630)969-7979
CONTACT: AMY FULLER
Design Firm Registration #184-000451

MECHANICAL ENGINEER:

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2500 NORTH FRONTAGE ROAD
DARIEN IL, 60561
PHONE: (630)969-7000
FAX: (630)969-7979
CONTACT: SUDESH SARAF
Design Firm Registration #184-000451

ELECTRICAL ENGINEER:

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DARIEN IL, 60561
PHONE: (630)969-7000
FAX: (630)969-7979
CONTACT: TONY SULLENTRUP
Design Firm Registration #184-000451

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GENERAL

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G1.0 SITE PLAN

ARCHITECTURAL

A2.3 PENTHOUSE PLAN AND MEZZANINE PLAN

MECHANICAL

MD2.0 MECHANICAL PARTIAL THIRD FLOOR DEMOLITION PLAN
MD2.1 MECHANICAL PENTHOUSE DEMOLITION PLAN

MECHANICAL

M0.0 NOTES & SYMBOLS
M2.2 MECHANICAL PARTIAL THIRD FLOOR PLAN
M2.3 MECHANICAL PENTHOUSE DUCTWORK PLAN
M2.4 MECHANICAL PARTIAL ROOF PLAN
M5.0 SCHEDULE
M5.1 SCHEDULE
M6.0 MECHANICAL DETAILS
M6.1 MECHANICAL DETAILS
M6.2 MECHANICAL DETAILS
ME1.0 MECH. / ELEC. COORDINATION NOTES & SCHEDULE, ELEC. SPECS.
ME1.1 MECH. / ELEC. COORDINATION NOTES & SCHEDULE, ELEC. SPECS.
n-ME1.2 NORTH HIGH POOL AREA UPPER PIPING PLAN
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ELECTRICAL

E0.1 NOTES AND SYMBOLS
ED1.1 POWER DEMOLITION FLOOR PLAN-THIRD FLOOR AND PENTHOUSE
ED1.2 LIGHTING DEMOLITION FLOOR PLAN- THIRD FLOOR AND PENTHOUSE

ELECTRICAL

E1.0 HVAC POWER PLAN- THIRD FLOOR AND PENTHOUSE
E2.0 LIGHTING FLOOR PLAN- THIRD FLOOR AND PENTHOUSE
E4.1 SCHEDULES

Grand total: 24

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- YELLOW _____ GAS
- RED _____ ELECTRICAL
- ORANGE _____ PHONE / TV COMMUNICATION
- BLUE _____ WATER
- GREEN _____ SEWERS
- WHITE _____ SAFE TO DIG

STATEMENT OF COMPLIANCE

I HAVE PREPARED OR CAUSED TO BE PREPARED UNDER MY DIRECT SUPERVISION, THE ATTACHED PLANS AND SPECIFICATIONS AND STATE THAT, TO THE BEST OF MY KNOWLEDGE AND BELIEF AND TO THE EXTENT OF MY CONTRACTUAL OBLIGATION, THEY ARE IN COMPLIANCE WITH THE ENVIRONMENTAL BARRIERS ACT (IL. REV. STAT. 1985, CH. 111 1/2, PARS. 3711 ET SEQ AS AMENDED) AND THE ILLINOIS ACCESSIBILITY CODE, 71 IL ADM. CODE 400.

SIGNED: _____
ARCHITECT/ENGINEER

ILLINOIS REGISTRATION NO.: _____

DATE: _____

BUILDING CODE DATA

1. APPLICABLE CODES
BUILDING CODE: 2015 ICC BUILDING CODE
MECHANICAL CODE: 2015 ICC MECHANICAL CODE
ELECTRICAL CODE: 2008 NATIONAL ELECTRICAL CODE
PLUMBING CODE: 2014 PLUMBING CODE
ACCESSIBILITY CODE: 2010 ADA STANDARDS FOR DESIGN
ENERGY CODE: 2015 ICC ENERGY CODE

2. GENERAL BUILDING DESCRIPTION

GROSS BUILDING AREA, EXISTING: N/A
GROSS BUILDING AREA, TOTAL (NEW & EXISTING): N/A

3. BUILDING OCCUPANCY TYPE SECTION 302

OCCUPANCY CLASSIFICATION: EDUCATION

4. CONSTRUCTION TYPE SECTION 503, 602

CONSTRUCTION TYPE: TYPE II B
FIRE RESISTANCE RATING REQUIREMENTS TABLE 601
STRUCTURAL FRAME: 0 HR
BEARING WALLS (EXTERIOR) (ALSO SEE TABLE 602): 0 HR
BEARING WALLS: 0 HR
NON-BEARING WALLS (EXTERIOR): SEE TABLE 602
NON-BEARING WALLS (INTERIOR): 0 HR
FLOOR CONSTRUCTION: 0 HR
ROOF CONSTRUCTION: 0 HR
EXTERIOR WALL FIRE SEPARATION DISTANCE TABLE 602
LESS THAN 5': 1 HR
LESS THAN OR EQUAL TO 5' TO LESS THAN 10': 1 HR
LESS THAN OR EQUAL TO 10' TO LESS THAN 30': 0 HR
GREATER THAN OR EQUAL TO 30': 0 HR

5. ALLOWABLE HEIGHT AND AREA LIMITATIONS SECTION 503

BASE ALLOWABLE AREA: N/A
BASE ALLOWABLE HEIGHT (FEET): N/A
BASE ALLOWABLE HEIGHT (STORIES): N/A

HEIGHT MODIFICATIONS SECTION 504

AUTOMATIC SPRINKLER SYSTEM INCREASE (FEET): N/A
AUTOMATIC SPRINKLER SYSTEM INCREASE (STORIES): N/A

AREA MODIFICATIONS SECTION 506

FRONTAGE INCREASE
FORMULA: $If = 100 \times [F/P - 0.25] \times W/30$
BUILDING PERIMETER (P): N/A
BUILDING FRONTAGE (F): N/A
FRONTAGE WIDTH (W): N/A
TOTAL FRONTAGE INCREASE (If): N/A

AUTOMATIC SPRINKLER SYSTEM INCREASE: 0%

TOTAL ALLOWABLE BUILDING AREA

FORMULA: $Aa = At + [(At \times If)/100] + [(At \times Is)/100]$
TOTAL ALLOWABLE AREA: N/A
TOTAL ACTUAL AREA: N/A

TOTAL ALLOWABLE HEIGHT: N/A
TOTAL ACTUAL HEIGHT: N/A

TOTAL ALLOWABLE STORIES: N/A
TOTAL ACTUAL STORIES: N/A

LOCATION MAP: DOWNERS GROVE NORTH HIGH SCHOOL



North High School
4436 Main St, Downers Grove, IL



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COVER SHEET, INDEX, TEAM, LOCATION MAP

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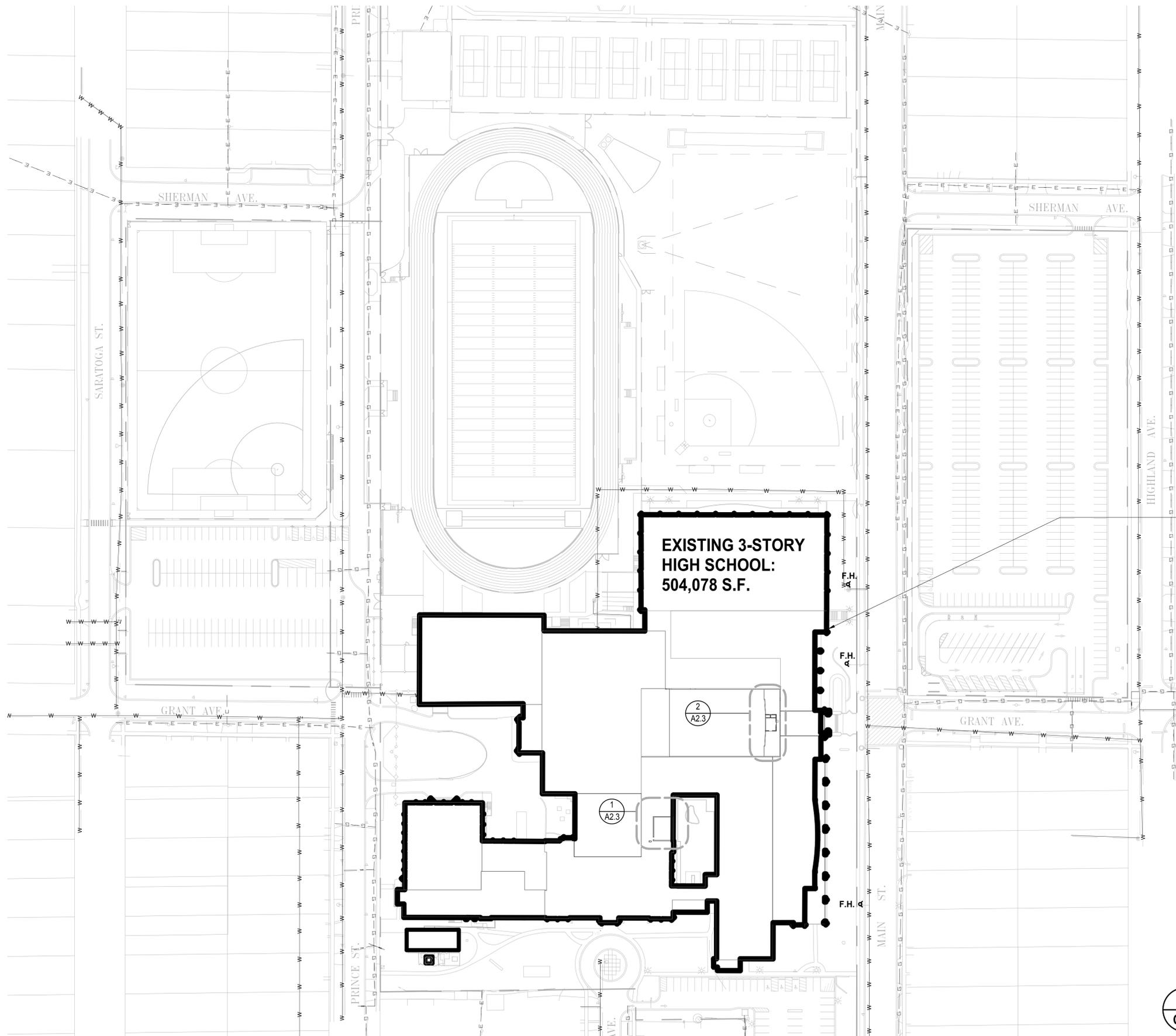
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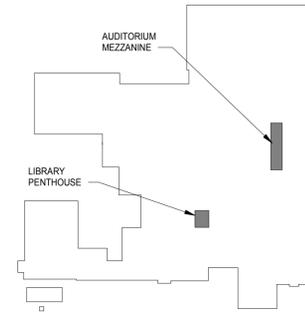


LEGEND

- E — E — ELECTRIC LINE
- G — G — GAS LINE
- V — V — WATER LINE
- F.H. FIRE HYDRANT



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**FIRE DEPARTMENT
 HOSE CONNECTION**

**EXISTING 3-STORY
 HIGH SCHOOL:
 504,078 S.F.**

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**DOWNERS GROVE
 NORTH**

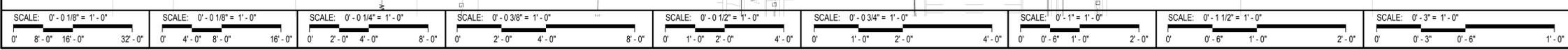
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SITE PLAN

1 OVERALL SITE PLAN
 G1.0 SCALE: 1/64" = 1'-0"

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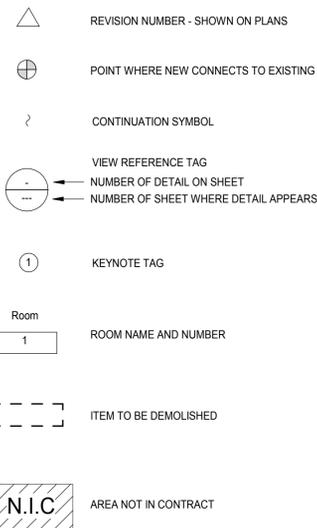
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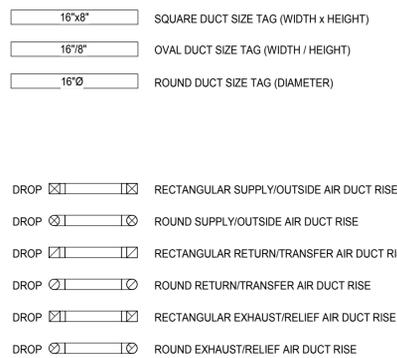


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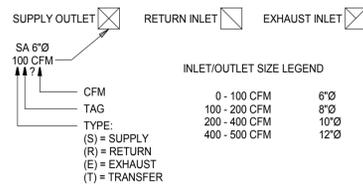
GENERAL MECHANICAL SYMBOLS



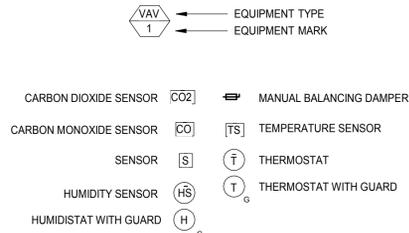
HVAC SYMBOLS



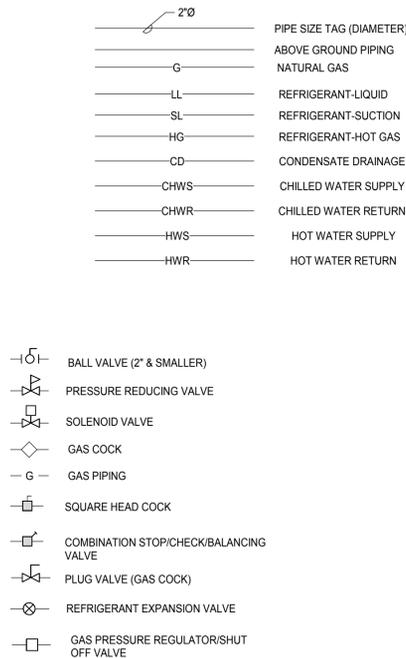
GRILLES, REGISTERS, AND DIFFUSERS TAG



MECHANICAL EQUIPMENT TAG



PIPING SYMBOLS



ABBREVIATIONS

AD	ACCESS DOOR	IH	INTAKE HOOD
AFF	ABOVE FINISHED FLOOR	IN	INCHES
AHU	AIR HANDLING UNIT	KMU	KITCHEN MAKE-UP UNIT
AP	ACCESS PANEL	LAT	LEAVING AIR TEMPERATURE
AS	AIR SEPARATOR	LWT	LEAVING WATER TEMPERATURE
BBH	BASEBOARD HEATER	MAX	MAXIMUM
BCP	BOILER CIRCULATING PUMP	MAU	MAKE-UP AIR UNIT
BFP	BACKFLOW PREVENTER	MBH	ONE THOUSAND BTU PER HOUR
BHP	BRAKE HORSEPOWER	MCA	MINIMUM CIRCUIT AMPS
BOP	BOTTOM OF PIPE	MIN	MINIMUM
BP	BYPASS	MOC	MAXIMUM OVERCURRENT PROTECTION
BTU	BRITISH THERMAL UNIT	MOD	MOTOR OPERATED DAMPER
BTUH	BRITISH THERMAL UNIT PER HOUR	NC	NEW CONNECTION
C	COMMON	N.C.	NORMALLY CLOSED
CBP	COIL BOOSTER PUMP	NG	NATURAL GAS PIPING
CC	COOLING COIL	N.O.	NORMALLY OPEN
CD	COMBINATION SMOKE/FIRE DAMPER	OV	OVAL
CFM	CUBIC FEET PER MINUTE	PA	PIPE ANCHOR
CUH	CABINET UNIT HEATER	PD	PRESSURE DROP
D	DRAIN LINE	PH	PHASE
DB	DRY BULB	PROP.	PROPELLER
DC	DUST COLLECTOR	PRV	PRESSURE REDUCING VALVE
DN	DOWN	PSI	POUNDS PER SQUARE INCH
DS	DUCT SILENCER	RCP	RADIANT CEILING PANEL
DSD	DUCT SMOKE DETECTOR	RH	RELIEF HOOD
EAT	ENTERING AIR TEMPERATURE	RPM	REVOLUTIONS PER MINUTE
ECV	ELECTRIC CONVECTOR	RTU	ROOFTOP UNIT
EF	EXHAUST FAN	SP	STATIC PRESSURE
ESP	EXTERNAL STATIC PRESSURE	SUH	SUSPENDED UNIT HEATER
ET	EXPANSION TANK	TC	TEMPERATURE CONTROL
EWT	ENTERING WATER TEMPERATURE	TSP	TOTAL STATIC PRESSURE
F	DEGREES FAHRENHEIT	TYP.	TYPICAL
FD	FIRE DAMPER	UV	UNIT VENTILATOR
FPB	SERIES FAN POWERED BOX	VAV	VARIABLE AIR VOLUME
FPF	FINS PER FOOT	VD	VOLUME DAMPER
FPM	FEET PER MINUTE	VFD	VARIABLE FREQUENCY DRIVE
FTR	FIN TUBE RADIATION	VRF	VARIABLE REFRIGERANT FLOW
FV	FACE VELOCITY	VVT	VARIABLE VOLUME AND TEMPERATURE
GAL	GALLON	WB	WET BULB
GFS	GLYCOL FILL STATION	W.C.	WATER COLUMN
GPM	GALLONS PER MINUTE	WG	WATER GAUGE
HP	HORSE POWER	WL	WALL LOUVER
HWB	HOT WATER BOILER		
HWC	HOT WATER COIL		
HWP	HOT WATER CIRCULATING PUMP		
HWR	HOT WATER RETURN		
HWS	HOT WATER SUPPLY		

A. GENERAL NOTES

THE GENERAL CONDITIONS, SPECIAL CONDITIONS, SUPPLEMENTARY CONDITIONS, BUILDING OWNER'S ESTABLISHED IN STANDARD FORM BY THE AMERICAN INSTITUTE OF ARCHITECTS SHALL APPLY TO ALL WORK ON THIS PROJECT EXCEPT AS MODIFIED BELOW. THIS CONTRACTOR SHALL BE FAMILIAR WITH THESE PROVISIONS AND ADHERE TO THESE REQUIREMENTS. THIS CONTRACTOR SHALL COORDINATE MECHANICAL WORK WITH ALL OTHER TRADES, AND BUILDING OWNER PRIOR TO INSTALLATION. ALL NEW WORK AND MATERIALS SHALL CONFORM TO IMC 2012 AND IECC 2015 / ASHRAE 90.1 - 2013 STANDARDS.

B. RELATED DOCUMENTS

1. THIS CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS, ELECTRICAL PLANS AND SPECIFICATIONS, SUCH PLANS AND SPECIFICATIONS ARE A PART OF THE CONTRACT DOCUMENTS. CONTRACTORS SHALL VISIT THE SITE AND FAMILIARIZE THEMSELVES WITH ALL CONDITIONS SURROUNDING THE WORK.

C. PLANS AND SPECIFICATIONS

1. THROUGHOUT THE COURSE OF THE WORK, THE BUILDING OWNER MAY REQUEST MINOR CHANGES AND ADJUSTMENTS TO THE PLANS AND SPECIFICATIONS. THE CONTRACTOR SHALL MAKE SUCH ADJUSTMENTS WITHOUT ADDITIONAL COST TO THE BUILDING OWNER, WHERE SUCH ADJUSTMENTS ARE NECESSARY FOR THE PROPER INSTALLATION AND OPERATION OF THE SYSTEMS, AND WITHIN THE INTENT OF THE CONTRACT DOCUMENTS.

2. IT IS THE INTENT OF THE PLANS AND SPECIFICATIONS TO FORM A GUIDE FOR A COMPLETE INSTALLATION. EVERYTHING NECESSARY FOR THE COMPLETION AND SUCCESSFUL OPERATION OF THE WORK, WHETHER OR NOT DEFINITELY SPECIFIED OR INDICATED ON THE DRAWINGS SHALL BE PROVIDED AS IF SO SPECIFIED OR INDICATED WITHOUT ADDITIONAL COST TO THE BUILDING OWNER. THE MECHANICAL CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION.

3. NOTWITHSTANDING ANY OTHER PROVISIONS OF THE CONTRACT DOCUMENTS, THE CONTRACTOR BEARS ULTIMATE RESPONSIBILITY FOR COMPLIANCE OF THE INSTALLATION WITH THE REQUIREMENTS OF THE BUILDING OWNER AND OF THE LOCAL AUTHORITY HAVING JURISDICTION.

4. CONTRACTORS SHALL SUBMIT COMPLETE COORDINATED FLOOR PLAN SHOP DRAWINGS OF HIS PROPOSED WORK INSTALLATION (1/4 INCH MINIMUM SCALE) FOR REVIEW BY ARCHITECT/ENGINEER/OWNER. "COORDINATED" MEANS WITH WORK OF ALL OTHER TRADES INCLUDING PROPOSED FEATURES OF THE GENERAL BUILDING CONSTRUCTION AND OTHER TRADES WORK.

D. MODIFICATIONS

1. IF ANY ERRORS, DISCREPANCIES OR OMISSIONS APPEAR IN THE DRAWINGS, SPECIFICATIONS OR OTHER CONTRACT DOCUMENTS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN WRITING OF SUCH ERROR OR OMISSION. IN THE EVENT OF THE CONTRACTOR FAILING TO GIVE SUCH NOTICE BEFORE CONSTRUCTION AND/OR FABRICATION OF THE WORK, THE CONTRACTOR WILL BE HELD RESPONSIBLE FOR THE RESULTS OF ANY SUCH ERRORS, DISCREPANCIES OR OMISSIONS AND THE ASSOCIATED COST OF RECTIFYING.

E. CODE COMPLIANCE

1. THIS CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS OF ALL STATE AND LOCAL CODES REGULATING THIS WORK. HOWEVER, THIS SHALL NOT BE CONSTRUED AS RELIEVING THE CONTRACTOR FROM COMPLYING WITH ANY REQUIREMENTS OF THE DRAWINGS AND SPECIFICATIONS THAT MAY BE IN EXCESS OF ANY GOVERNING CODES.

F. PERMITS, FEES, LICENSES

1. THIS CONTRACTOR SHALL PAY ALL FEES AND RELATED CHARGES FOR PERMITS, LICENSES, ETC., REQUIRED FOR INSTALLATION OF THE MECHANICAL SYSTEM.

G. WARRANTY

1. ALL CONSTRUCTION WORK SHALL BE PERFORMED IN A FIRST-CLASS WORKMANLIKE MANNER AND SHALL BE IN GOOD AND USABLE CONDITION AT THE DATE OF COMPLETION. THIS CONTRACTOR SHALL REQUIRE ANY PERSONS PERFORMING ANY SUCH WORK TO GUARANTEE THE SAME TO BE FREE FROM ANY AND ALL DEFECTS IN WORKMANSHIP AND MATERIALS FOR ONE (1) YEAR FROM THE DATE OF COMPLETION THEREOF. PROVIDE A 5 YEAR PARTS AND LABOR WARRANTY FOR CONDENSING UNIT COMPRESSOR. THIS CONTRACTOR SHALL ALSO REQUIRE ANY SUCH PERSONS TO BE RESPONSIBLE FOR THE REPLACEMENT OR REPAIR WITHOUT ANY ADDITIONAL COST TO ANY AND ALL WORK DONE OR FURNISHED BY OR THROUGH SUCH PERSONS WHICH SHALL BECOME DEFECTIVE WITHIN ONE (1) YEAR AFTER SUBSTANTIAL COMPLETION OF WORK. THE CORRECTION OF SUCH WORK SHALL INCLUDE WITHOUT ADDITIONAL COST ALL EXPENSES AND DAMAGES IN CONNECTION WITH SUCH REMOVAL, REPLACEMENT OR REPAIR OF ANY PART OF THE WORK WHICH MAY BE DAMAGED OR DISTURBED THEREBY.

2. ALL WARRANTIES OR GUARANTEES AS TO MATERIALS OR WORKMANSHIP WITH RESPECT TO THE BUILDING OWNER'S WORK SHALL BE WRITTEN SO THAT SUCH WARRANTIES OR GUARANTEES SHALL BE TO ENSURE THE BENEFIT OF BOTH BUILDING OWNER AND TENANT AS THEIR RESPECTIVE INTERESTS APPEAR AND CAN BE DIRECTLY ENFORCED BY EITHER.

H. FIELD QUALITY CONTROL

1. UPON COMPLETION OF INSTALLATION OF MECHANICAL EQUIPMENT, START-UP AND OPERATE EQUIPMENT TO DEMONSTRATE CAPABILITY AND COMPLIANCE WITH REQUIREMENTS.

2. REMOVE MALFUNCTIONING EQUIPMENT, REPLACE WITH NEW EQUIPMENT AND RETEST.

3. REMOVE MALFUNCTIONING HVAC UNITS, REPLACE WITH NEW HVAC UNITS AND RETEST.

4. NOISE AND VIBRATION WILL NOT BE TOLERATED. CONTRACTOR SHALL BID ON FURNISHING EVERY DETAIL TO ASSURE THIS END.

NOTE

ALL OF GENERAL NOTES ON THIS SHEET ARE TO BE APPLIED TO ALL OTHER DRAWINGS IN THIS SET. THE SYMBOLS AND ABBREVIATIONS SHOWN ON THIS SHEET MAY OR MAY NOT BE USED IN THIS SET OF DRAWINGS.

ISSUED FOR BID	01/18/2017
REV	DESCRIPTION
	DATE

DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

NOTES & SYMBOLS

Project Number:
02-5274-32
Drawn By:
B. DUNLAP
Sheet:

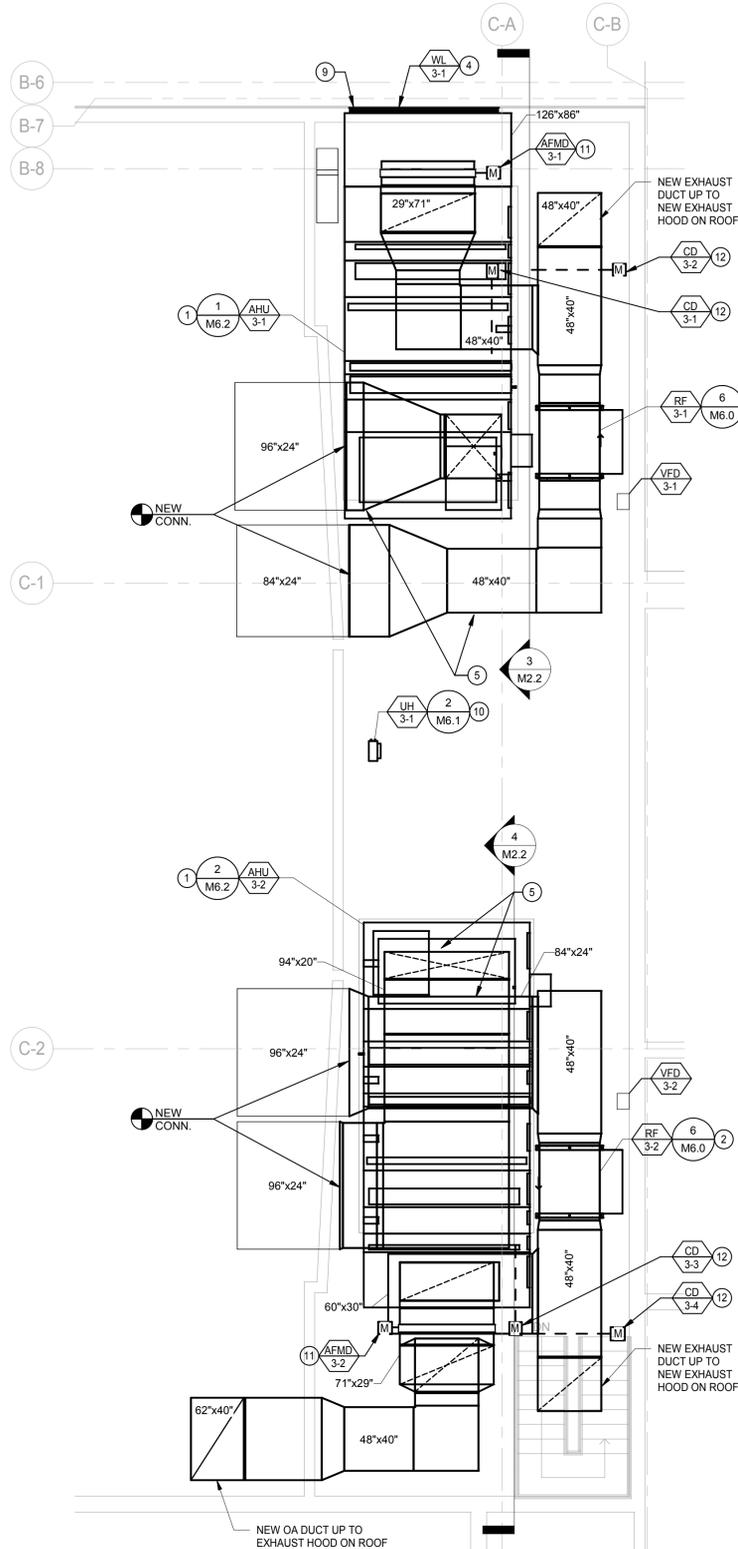
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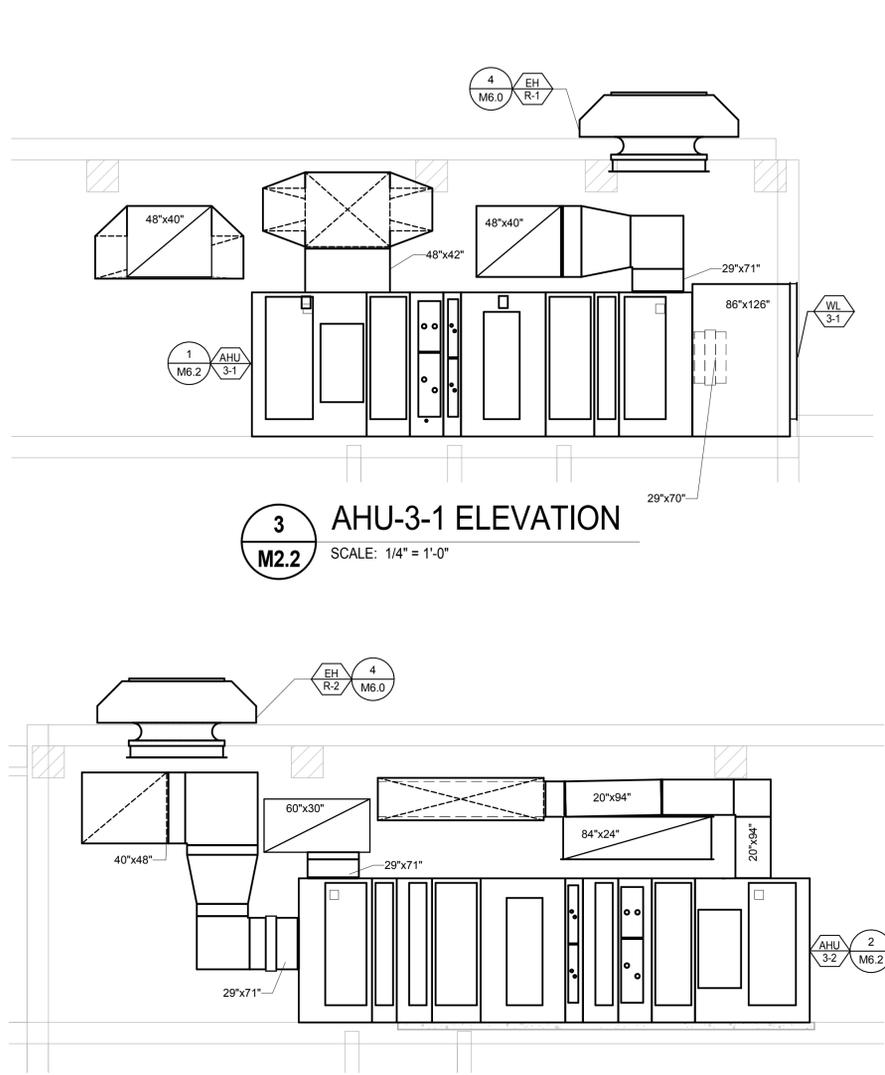
Wight

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1 MECHANICAL PARTIAL THIRD FLOOR DUCTWORK PLAN

M2.2 SCALE: 3/16" = 1'-0"



3 AHU-3-1 ELEVATION

M2.2 SCALE: 1/4" = 1'-0"

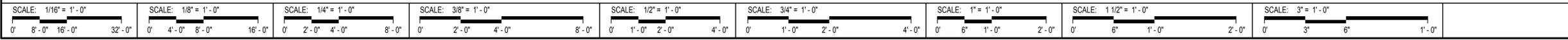
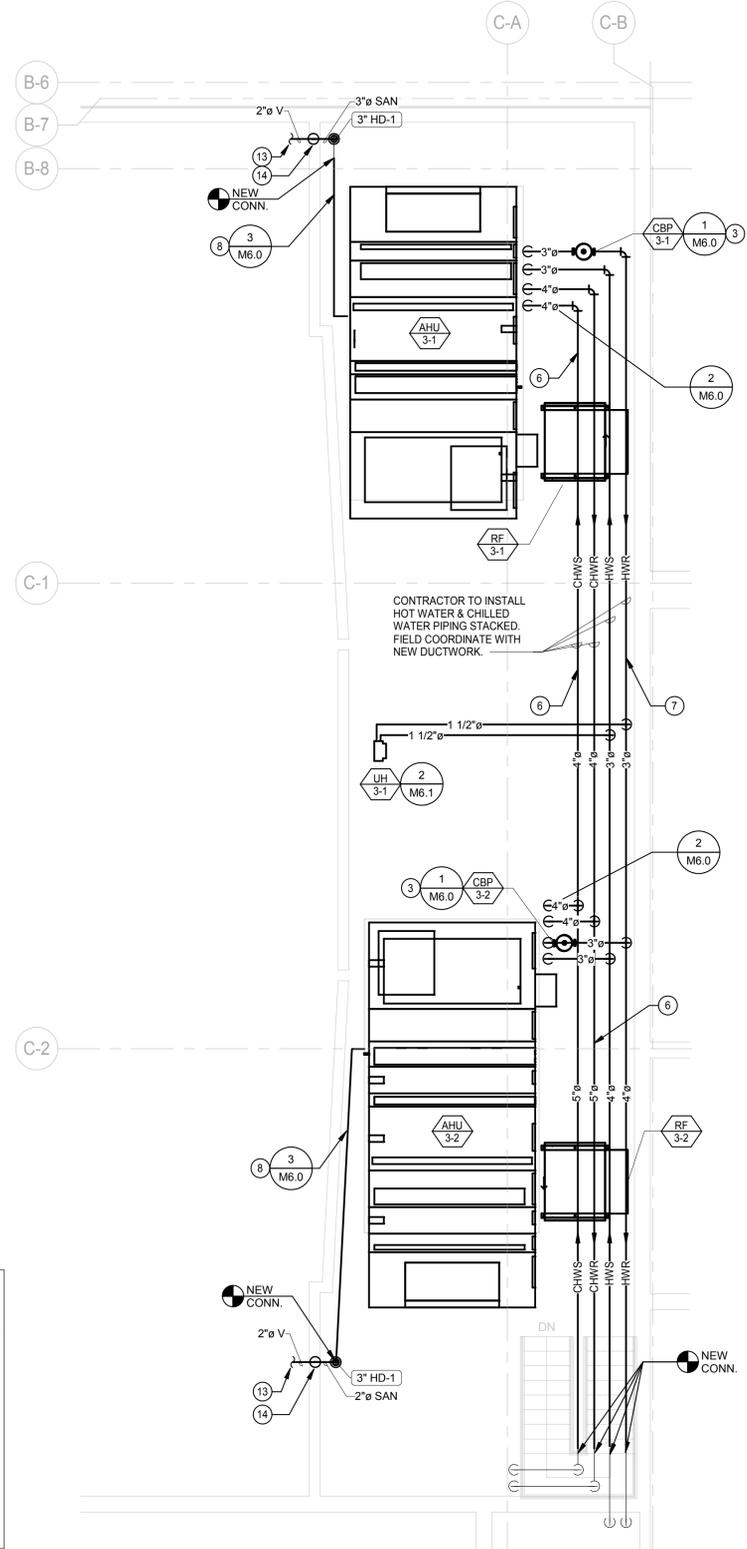
4 AHU-3-2 ELEVATION

M2.2 SCALE: 1/4" = 1'-0"

- KEYNOTES**
- 1 PROVIDE NEW CHILLED WATER AIR HANDLING UNIT AS INDICATED. SEE SCHEDULE ON SHEET M5.0. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. MAINTAIN RECOMMENDED SERVICE CLEARANCES.
 - 2 PROVIDE NEW RETURN FAN AS INDICATED AT APPROXIMATE LOCATION. SEE SCHEDULE ON SHEET M5.0. SEE DETAIL. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTION. MAINTAIN RECOMMENDED SERVICE CLEARANCES.
 - 3 PROVIDE NEW HOT WATER BOOSTER PUMPS AS INDICATED. SEE SCHEDULE ON SHEET M5.0. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. MAINTAIN RECOMMENDED SERVICE CLEARANCES.
 - 4 PROVIDE NEW OUTSIDE AIR INTAKE LOUVER AS INDICATED. SEE SCHEDULE ON SHEET M5.0. COORDINATE WITH ARCHITECTURAL.
 - 5 PROVIDE NEW DUCTWORK AS INDICATED. CONNECT TO EXISTING AT POINT AS INDICATED. INSULATE DUCTWORK PER SPECIFICATIONS. SEE DETAIL.
 - 6 PROVIDE NEW SUPPLY & RETURN CHILLED WATER PIPING AS INDICATED. INSULATE PIPING PER SPECIFICATIONS. CONNECT TO EXISTING AT POINT INDICATED.
 - 7 PROVIDE NEW SUPPLY & RETURN HOT WATER PIPING AS INDICATED. INSULATE PIPING PER SPECIFICATIONS. CONNECT TO EXISTING AT POINT INDICATED.
 - 8 PROVIDE NEW CONDENSATE DRAIN PIPING AS INDICATED. INSULATE PIPING PER SPECIFICATIONS. SEE TRAP DETAIL.
 - 9 CONTRACTOR SHALL ENLARGE LOUVER OPENING AS REQUIRED TO ACCOMMODATE LARGEST AHU MODULE LOUVER SIZE INDICATED FOR SPECIFIED AHU. CONTRACTOR SHALL VERIFY IN FIELD FOR OTHER MANUFACTURER AS REQUIRED.
 - 10 PROVIDE NEW HOT WATER UNIT HEATER AS INDICATED. SEE SCHEDULE ON SHEET M5.1 SEE DETAIL. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS.
 - 11 NEW AIR FLOW MEASURING DAMPER PROVIDED BY PRECISION CONTROLS. INSTALL AS INDICATED PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. COORDINATE WITH T.C.
 - 12 PROVIDE NEW MOTORISED CONTROL DAMPER AS INDICATED PER SCHEDULE ON SHEET M5.1. MOTOR ACTUATOR WILL BE PROVIDED BY PRECISION CONTROLS.
 - 13 CONNECT 2" V TO EXISTING VENT STACK. VERIFY LOCATION IN FIELD.
 - 14 2" SAN DN. CONNECT TO EXISTING SANITARY MAIN. VERIFY LOCATION IN FIELD.

2 MECHANICAL PARTIAL THIRD FLOOR PIPING PLAN

M2.2 SCALE: 3/16" = 1'-0"



ISSUED FOR BID 01/18/2017
REV DESCRIPTION DATE

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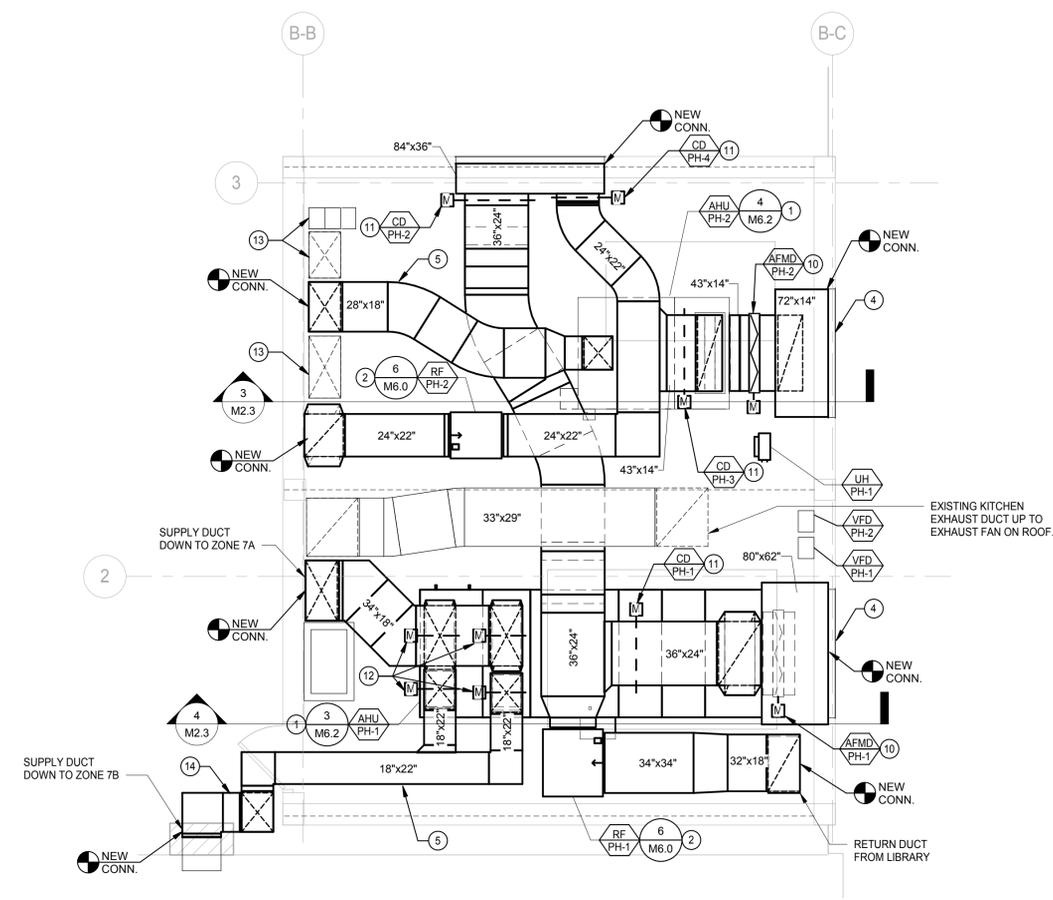
4436 Main St, Downers Grove, IL
MECHANICAL PARTIAL THIRD FLOOR PLAN

Project Number:
02-5274-32
Drawn By:
B. DUNLAP
Sheet:

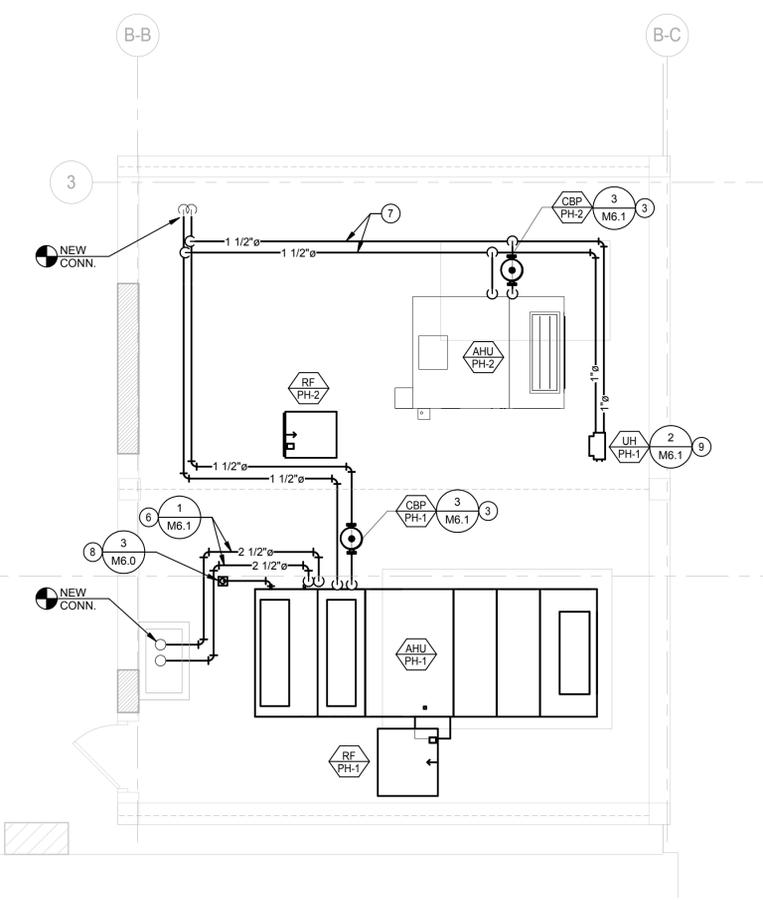
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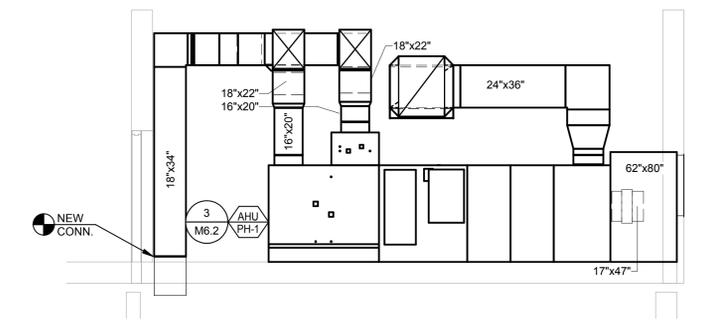
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1 MECHANICAL PENTHOUSE DUCTWORK PLAN
M2.3 SCALE: 1/4" = 1'-0"



2 MECHANICAL PENTHOUSE PIPING PLAN
M2.3 SCALE: 1/4" = 1'-0"



4 AHU-PH-1 ELEVATION
M2.3 SCALE: 1/4" = 1'-0"



3 AHU-PH-2 ELEVATION
M2.3 SCALE: 1/4" = 1'-0"

- # KEYNOTES**
- 1 PROVIDE NEW CHILLED WATER AIR HANDLING UNIT AS INDICATED. SEE SCHEDULE ON SHEET M5.0. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. MAINTAIN RECOMMENDED SERVICE CLEARANCES.
 - 2 PROVIDE NEW RETURN FAN AS INDICATED AT APPROXIMATE LOCATION. SEE SCHEDULE ON SHEET M5.0. SEE DETAIL. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTION. MAINTAIN RECOMMENDED SERVICE CLEARANCES.
 - 3 PROVIDE NEW HOT WATER BOOSTER PUMPS AS INDICATED. SEE SCHEDULE ON SHEET M5.0. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. MAINTAIN RECOMMENDED SERVICE CLEARANCES.
 - 4 EXISTING OUTSIDE AIR INTAKE LOUVER TO REMAIN.
 - 5 PROVIDE NEW DUCTWORK AS INDICATED. CONNECT TO EXISTING AT POINT AS INDICATED. INSULATE DUCTWORK PER SPECIFICATIONS. SEE DETAIL.
 - 6 PROVIDE NEW SUPPLY & RETURN CHILLED WATER PIPING AS INDICATED. INSULATE PIPING PER SPECIFICATIONS. CONNECT TO EXISTING AT POINT INDICATED.
 - 7 PROVIDE NEW SUPPLY & RETURN HOT WATER PIPING AS INDICATED. INSULATE PIPING PER SPECIFICATIONS. CONNECT TO EXISTING AT POINT INDICATED.
 - 8 PROVIDE NEW CONDENSATE DRAIN PIPING AS INDICATED FROM AHU TO EXISTING FLOOR DRAIN. INSULATE PIPING PER SPECIFICATIONS. SEE TRAP DETAIL.
 - 9 PROVIDE NEW HOT WATER UNIT HEATER AS INDICATED. SEE SCHEDULE ON SHEET M5.1 SEE DETAIL. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS.
 - 10 NEW AIR FLOW MEASURING DAMPER PROVIDED BY PRECISION CONTROLS. INSTALL AS INDICATED PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. COORDINATE WITH T.C.
 - 11 PROVIDE NEW MOTORIZED CONTROL DAMPER AS INDICATED PER SCHEDULE ON SHEET M5.1. MOTORIZED ACTUATOR WILL BE BY PRECISION CONTROLS. COORDINATE WITH T.C.
 - 12 NEW MULTI ZONE DAMPERS PROVIDED BY MANUFACTURER. ACTUATOR WILL BE PROVIDED BY PRECISION CONTROLS. COORDINATE WITH T.C.
 - 13 CAP & SEAL EXISTING DUCT WITH NEW SHEET METAL CAP.
 - 14 PROVIDE NEW SUPPLY DUCTWORK OUTSIDE THE PENTHOUSE AND CONNECT TO EXISTING AT POINT AS INDICATED. RUN DUCTWORK OVER THE DOOR. DO NOT BLOCK THE DOOR. SUPPORT DUCT ADEQUATELY FROM WALL AND ROOF. INSULATE DUCTWORK PER SPECIFICATIONS. SEE DETAIL.
 - 15 BLANK OFF UN-USED PORTION OF OUTSIDE AIR INTAKE LOUVER WITH 2" THICK INSULATED SHEET METAL PANEL.



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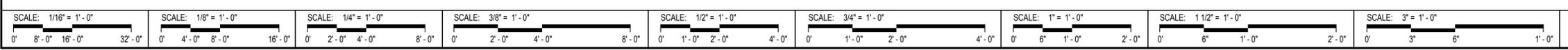
DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

MECHANICAL PENTHOUSE DUCTWORK PLAN

Project Number:
 02-5274-32
 Drawn By:
 B. DUNLAP
 Sheet:

M2.3

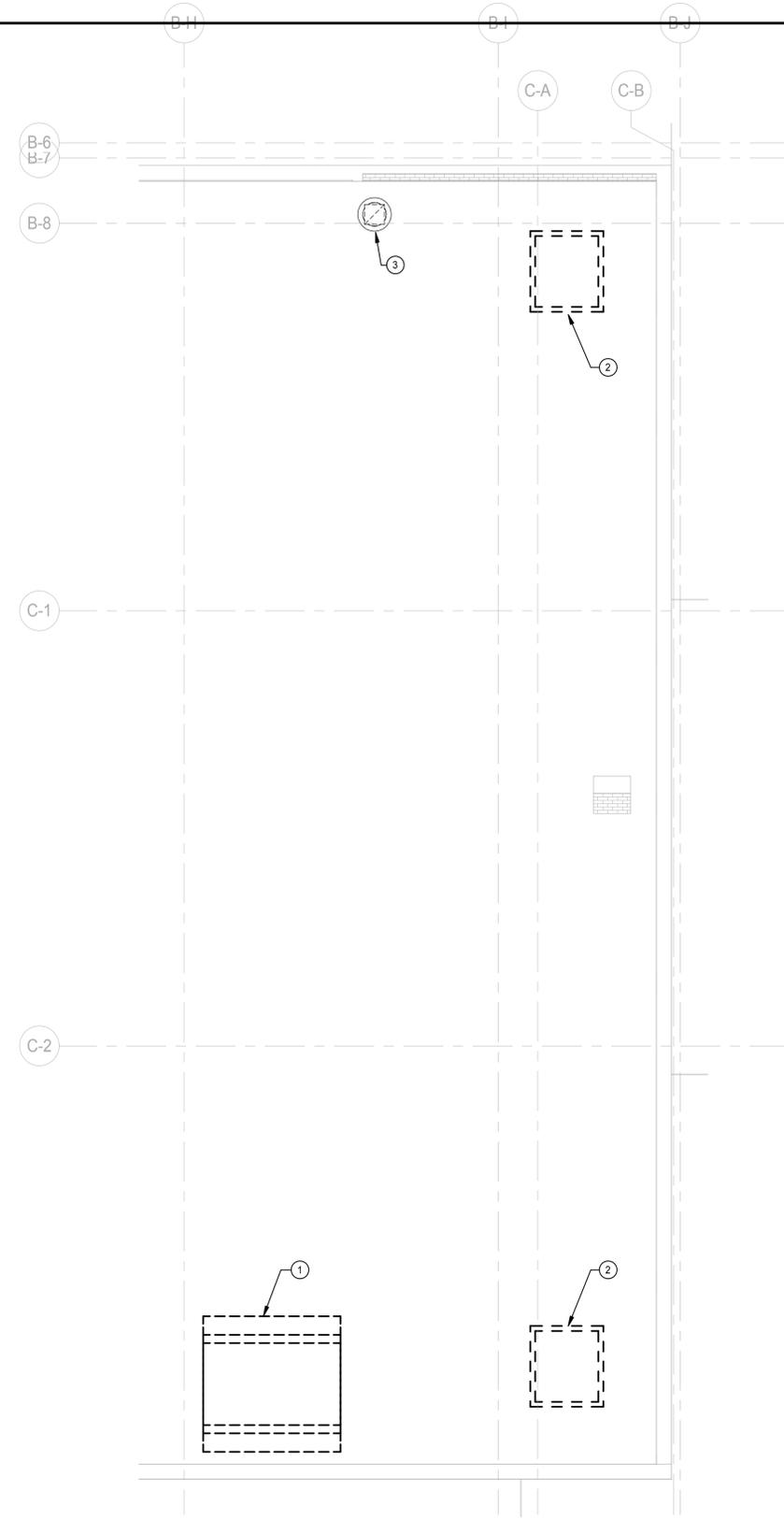


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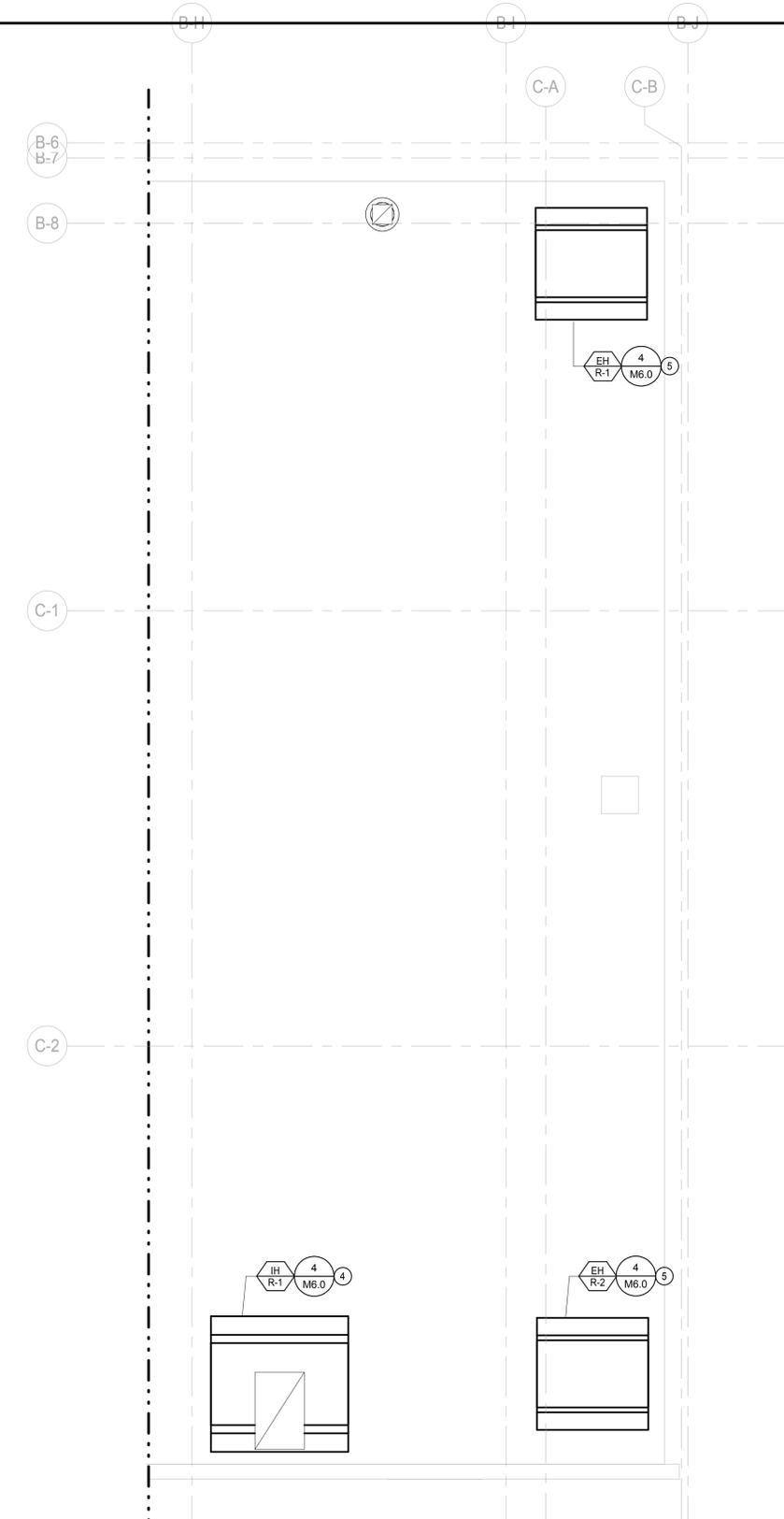
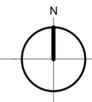


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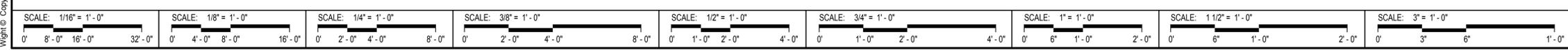
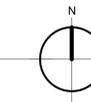
- KEYNOTES**
- DEMOLISH EXISTING OUTSIDE AIR INTAKE HOOD IN ITS ENTIRETY INCLUDING ASSOCIATED ROOF CURB, DUCTWORK, SUPPORTS ETC. AS INDICATED. EXISTING ROOF OPENING TO REMAIN. PREPARE OPENING TO RECEIVE NEW OUTSIDE AIR INTAKE HOOD.
 - DEMOLISH EXISTING ROOF EXHAUST GRATING IN ITS ENTIRETY AS INDICATED INCLUDING ROOF CURB, DUCTWORK. EXISTING ROOF OPENING TO REMAIN. PREPARE OPENING TO RECEIVE NEW EXHAUST HOOD.
 - EXISTING EXHAUST FAN TO REMAIN.
 - PROVIDE NEW OUTSIDE AIR INTAKE HOOD AS INDICATED. RE-USE EXISTING ROOF OPENING. SEE SCHEDULE ON SHEET M5.0. SEE DETAIL. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. COORDINATE WITH ARCHITECTURAL.
 - PROVIDE NEW EXHAUST AIR HOOD AS INDICATED. RE-USE EXISTING ROOF OPENING. SEE SCHEDULE ON SHEET M5.0. SEE DETAIL. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. COORDINATE WITH ARCHITECTURAL.



1 MECHANICAL PARTIAL ROOF DEMOLITION PLAN
M2.4 SCALE: 3/16" = 1'-0"



2 MECHANICAL PARTIAL ROOF PLAN
M2.4 SCALE: 3/16" = 1'-0"



REV	ISSUED FOR BID DESCRIPTION	01/18/2017 DATE

DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

MECHANICAL PARTIAL ROOF PLAN

Project Number:
 02-5274-32
 Drawn By:
 B. DUNLAP
 Sheet:

M2.4

AIR HANDLING UNIT SCHEDULE

EQUIPMENT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL	TYPE OF SYSTEM	TYPE OF UNIT	APPROX. OVERALL DIMENSIONS (IN)			CFM	CODE MINIMUM O.A.	OPERATING MINIMUM O.A.	ESP (IN.)	TYPE	FAN RPM	BHP	MOTOR			HOT WATER COIL										CHILLED WATER COOLING COIL										FILTERS					MIXING BOX	NOTES								
							L	W	H								RPM	HP(MAX.)	PHASE	HEATING CFM	MIN. ROW	MAX. FPF	MAX. VEL. (FPM)	EAT (°F)	LAT (°F)	MAX. SP. (IN.)	EWT (°F)	LWT (°F)	MAX. PD. (FT.)	GPM	TOTAL MBH	MIN. ROW	MAX. FPF	MAX. VEL. (FPM)	EAT (DB °F)	EAT (WB °F)	LAT (DB °F)	LAT (WB °F)	MAX. SP. (IN.)	MAX. PD. (FT.)	GPM	SENS. MBH	TOTAL MBH	FACE AREA (SQ.FT.)			FACE VELOCITY (FPM)	PRE FILTER TYPE	FINAL FILTERS			PRESS. DROP (IN. W.G.)		DAMPERS
																																																	TYPE	ASHRAE EFFICIENCY	FACE AREA (SQ.FT.)	PRE	FINAL	
AHU-3-1	3RD FLR. MECH. RM.	AUDITORIUM	TRANE	CSAA SIZE 50	SINGLE ZONE VAV	HORIZONTAL DRAW THRU	250	128	82	25,000	16%	16%	1.5	PLENUM	1,630	(2) 14.5	1800	(2) 15.0	3	460	16,250	2	80	345	46.0	104	0.06	180	160	2.1	101	1010	6	120	518	78.0	65.0	54.2	53.9	0.7	3.5	176.5	652.7	829.3	55.0	455	2" PLEATED MERV-8	4" CARTRIDGE ANGLED	MERV-13	100.0	0.63	0.56	BY OTHER	1-13
AHU-3-1	3RD FLR. MECH. RM.	AUDITORIUM	TRANE	CSAA SIZE 50	SINGLE ZONE VAV	HORIZONTAL DRAW THRU	290	126	82	25,000	16%	16%	1.5	PLENUM	1,630	(2) 14.5	1800	(2) 15.0	3	460	16,250	2	80	345	46.0	104	0.06	180	160	2.1	101	1010	6	120	518	78.0	65.0	54.2	53.9	0.7	3.5	176.5	652.7	829.3	55.0	455	2" PLEATED MERV-8	4" CARTRIDGE ANGLED	MERV-13	100.0	0.63	0.56	BY OTHER	1-13
AHU-PH-1	PENTHOUSE	LIBRARY	TRANE	CSAA SIZE 17	MULTI ZONE VAV	HORIZONTAL BLOW THRU	194	72	78	8,200	22%	22%	1.5	PLENUM	1,730	(1) 8.9	1800	(1) 10.0	3	208	5,300	2	92	547	38.0	95.0	0.2	180	160	1.0	24.7	247.5	6	106	525	80.0	65.0	55.0	54.3	0.6	2.6	52.1	220.2	261.5	18.9	434	2" PLEATED MERV-8	4" CARTRIDGE ANGLED	MERV-13	28.9	0.6	0.6	BY OTHER	1-9 & 14-16
AHU-PH-2	PENTHOUSE	SERVE LINE	TRANE	UCCA SIZE 10	SINGLE ZONE VAV	HORIZONTAL DRAW THRU	96	63	38	4,000	32%	32%	1.5	PLENUM	1,881	(1) 2.8	1800	(1) 5.0	3	208	4,000	1	144	403	47.0	97.8	0.1	180	160	2.9	21.5	215.3	HEATING ONLY UNIT										-	-	2" PLEATED MERV-8	2" 4" PLEATED COMBO FILTER	MERV-13	11.0	0.3	0.3	BY OTHER	1-9 & 17-18		

GENERAL NOTES:

- OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS.
- ENTIRE UNIT INCLUDING ACCESS DOORS TO BE DOUBLE SOLID WALL CONSTRUCTION.
- UNIT TO BE SHIPPED DISASSEMBLED FOR ACCESS INTO EXISTING BUILDING THROUGH OPENING. VERIFY IN FIELD.
- PROVIDE ACCESS DOOR, MARINE LIGHT & VIEW PORTS FOR EACH SECTION WHERE AVAILABLE.
- PROVIDE SINGLE POINT POWER CONNECTION.
- SEE PLANS FOR COOLING, HEATING COILS & CONDENSATE DRAIN CONNECTION & ACCESS DOOR SIDE.
- MOTOR TO BE OPEN DRIP-PROOF TYPE.
- CONTRACTOR TO FURNISH AND INSTALL 2" THROW-AWAY CONSTRUCTION FILTERS FOR INITIAL START-UP.
- PROVIDE MOUNTED & WIRED VFD FOR SUPPLY FANS.

NOTES (AHU-3-1 & AHU-3-2):

- PROVIDE BLENDER SECTION BETWEEN HEATING COIL & FINAL FILTER.
- PROVIDE ACCESS SECTION WITH DOOR & MARINE LIGHT AS INDICATED BELOW
- A. AHU-3-1 24" BETWEEN FAN & COOLING COIL SECTION.
- B. AHU-3-2 24" BETWEEN FAN & COOLING COIL SECTION. 20" BETWEEN HOT WATER & CHILLED WATER COILS. 20" BETWEEN PRE & FINAL FILTERS.
- PROVIDE 8" HIGH BASE RAILS
- PROVIDE DISCHARGE OPENINGS AS INDICATED BELOW. SEE PLAN FOR EXACT LOCATION.
- A. AHU-3-1 48"x42"
- B. AHU-3-2 96"x24"

NOTES (AHU-PH-1):

- MULTI ZONE VAV UNIT WITH HOT & COLD DECK CONFIGURATION WITH 2/3 RD BLADES IN ZONE 1 & 1/3 RD BLADES IN ZONE 2
- PROVIDE 24" ACCESS/ BLANK SECTION BETWEEN FAN & FINAL FILTER SECTION.
- PROVIDE 8" HIGH BASE RAILS

NOTES (AHU-PH-2):

- SINGLE ZONE VAV HEATING ONLY UNIT.
- PROVIDE HEATING COIL WITH ACCESS SECTION

RETURN / EXHAUST FAN SCHEDULE

EQUIPMENT TAG	LOCATION	AREA SERVED	MANUFACTURER	MODEL	TYPE	DRIVE	CFM	SP (IN.)	FAN RPM	BHP	MOTOR				NOTES
											HP	RPM	PHASE	VOLT	
RF-3-1	3RD FLR. MECH. RM.	AHU-3-1	GREENHECK	QEI-33-175	MIXED FLOW	BELT	22,500	0.7	947	7.3	7.5	1,725	3	460	1-17
RF-3-2	3RD FLR. MECH. RM.	AHU-3-2	GREENHECK	QEI-36-175	MIXED FLOW	BELT	22,500	0.7	947	7.3	7.5	1,725	3	460	1-17
RF-PH-1	PENTHOUSE	AHU-PH-1	GREENHECK	BSQ-240-20	CENTRIFUGAL	BELT	7,400	0.7	848	1.8	2.0	1,725	3	208	1-14, 18-19
RF-PH-2	PENTHOUSE	AHU-PH-2	GREENHECK	BSQ-160-15	CENTRIFUGAL	BELT	3,600	0.7	1,436	1.2	1.5	1,725	3	208	1-14, 18

NOTES:

- FOR OTHER ACCEPTABLE MANUFACTURERS, SEE SPECS.
- PROVIDE NEMA PREMIUM EFFICIENCY MOTOR
- PROVIDE VFD RATED MOTOR WITH SHAFT GROUNDING PROTECTION
- PROVIDE F CLASS INSULATION
- PROVIDE 2 SPARE SET OF BELTS
- PROVIDE CEILING HUNG MOUNTING SUPPORT WITH SPRING HANGING ISOLATORS
- PROVIDE BOLTED ACCESS DOOR
- PROVIDE COPPER EXTENDED LUBE LINES
- PROVIDE BELT GUARD
- PROVIDE MOUNTING RAILS
- FIELD VERIFY MOTOR POSITION
- PROVIDE MOTOR COVER
- PROVIDE 1.5 x STANDARD NUMBER OF BELTS
- UL LISTED POWER VENTILATOR
- PROVIDE L(10) 200K HOURS BEARING
- PROVIDE PUNCHED INLET, OUTLET & COMPANION FLANGES
- PROVIDE HEAVY DUTY DISCONNECT SWITCH
- PROVIDE DISCONNECT SWITCH WITH MOUNTED & WIRED JUNCTION BOX
- PROVIDE SIDE DISCHARGE

INTAKE / EXHAUST HOOD SCHEDULE

EQUIPMENT TAG	LOCATION	SERVICE	MANUFACTURER	MODEL / SERIES NUMBER	TYPE	CFM	NUMBER OF TIERS	THROAT SIZE (IN. x IN.)	HOOD FREE AREA (SQ. FT.)	MAX. THROAT VELOCITY (FPM)	STATIC PRESSURE (IN. W.G.)	NOTES
EH-R-1	ROOF	AHU-3-1	GREENHECK	FABRA HOOD FGI	INTAKE	25,000	--	54x54	40.5	1,200	0.2	1-4
EH-R-1	ROOF	AHU-3-1	GREENHECK	FABRA HOOD FGR	EXHAUST	22,500	--	48x48	32.0	703	0.4	1-4
EH-R-2	ROOF	AHU-3-2	GREENHECK	FABRA HOOD FGR	EXHAUST	22,500	--	48x48	32.0	703	0.4	1-4

- NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. PREFABRICATED ROOF CURB MIN. 24" HIGH. 3. GALVANIZED BIRD SCREEN. 4. FIELD VERIFY EXACT DIMENSIONS BEFORE ORDERING THE EQUIPMENT

VARIABLE FREQUENCY DRIVE SCHEDULE

EQUIPMENT TAG	LOCATION	EQUIPMENT SERVED	MANUFACTURER	MODEL	MOUNTING	SIZE (HxWxD)	MAX. DRIVE OUTPUT CURRENT	MOTOR				NOTES	
								HP(MAX.)	RPM	FREQ.(Hz)	PHASE		VOLTS
VFD-3-1	3RD FLR. MECH. RM.	RF-3-1	DANFOSS	VLT HVAC SERIES	WALL MOUNTED	19.1x5.2x9.6	11.0	7.5	1750	60	3	480	1,2,3
VFD-3-2	3RD FLR. MECH. RM.	RF-3-2	DANFOSS	VLT HVAC SERIES	WALL MOUNTED	19.1x5.2x9.6	11.0	7.5	1750	60	3	480	1,2,3
VFD-PH-1	PENTHOUSE MECH. RM.	RF-PH-1	DANFOSS	VLT HVAC SERIES	WALL MOUNTED	19.1x5.2x9.6	-	2.0	1750	60	3	208	1,2,3
VFD-PH-2	PENTHOUSE MECH. RM.	RF-PH-2	DANFOSS	VLT HVAC SERIES	WALL MOUNTED	19.1x5.2x9.6	6.6	1.5	1750	60	3	208	1,2,3

- NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. PROVIDE NEMA 1 ENCLOSURE, DC LINK REACTOR, AND INPUT DISCONNECT SWITCH. 3. PROVIDE BAS INTERFACE COMPATIBLE WITH SYSTEM SELECTED BY T.C. CONTRACTOR.

WALL LOUVER SCHEDULE

EQUIPMENT TAG	LOCATION	SERVICE	MANUFACTURER	MODEL	TYPE	SIZE			MIN. FREE AREA (%)	CFM	FACE AREA VELOCITY (FPM)	P.D. (IN. H2O)	NOTES
						W	H	D					
WL-3-1	3RD FLR. MECH. RM. NORTH WALL	OUTSIDE AIR	RUSKIN	ELF6350DMP	STATIONARY	9'-4"	6'-4"	0'-6"	66.0	25,000	643	0.06	1,2,3

- NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. PROVIDE BIRDSCREEN. 3. ANODIZED FINISH TO BE SELECTED BY ARCHITECT.

PUMP SCHEDULE

EQUIPMENT TAG	LOCATION	SERVICE	MANUFACTURER	MODEL	TYPE	GPM	HEAD (FT.)	IMP. DIA. (IN.)	MAX. RPM	FLANGE SIZE (IN.)	MINIMUM EFFICIENCY	TRIPLE DUTY VALVE			MOTOR			NOTES
												TYPE	SIZE	P.D. (FT.)	HP	PHASE	VOLT	
CBP-3-1	3RD FLR. MECH. RM.	HOT WATER	BELL & GOSSETT	E-60 STOCK E-610	IN LINE	65	15	4.12	1750	2	-	STRAIGHT PATTERN B STYLE	3.0	0.7	0.5	1	115	1-2
CBP-3-2	3RD FLR. MECH. RM.	HOT WATER	BELL & GOSSETT	E-60 STOCK E-610	IN LINE	65	15	4.12	1750	2	-	STRAIGHT PATTERN B STYLE	3.0	0.7	0.5	1	115	1-2
CBP-PH-1	PENTHOUSE MECH. RM.	HOT WATER	BELL & GOSSETT	652S-ECM	IN LINE	25	15	4.3	1750	1	-	STRAIGHT PATTERN	2.0	1.9	0.25	1	115	1-2
CBP-PH-2	PENTHOUSE MECH. RM.	HOT WATER	BELL & GOSSETT	652S-ECM	IN LINE	22	15	4.3	1750	1	-	STRAIGHT PATTERN	2.0	1.9	0.25	1	115	1-2
PWP-1-1	NORTH H.S.-POOL HEATING ROOM	POOL WATER HEATING	BELL & GOSSETT	SERIES E-80 3x3x9.5C	IN LINE	110	55	7.6	1750	3	-	STRAIGHT PATTERN B STYLE	3.0	2.0	5.0	3	480	1-4
PWP-1-2	SOUTH H.S.-POOL HEATING ROOM	POOL WATER HEATING	BELL & GOSSETT	SERIES E-80 3x3x9.5C	IN LINE	110	55	7.6	1750	3	-	STRAIGHT PATTERN B STYLE	3.0	2.0	5.0	3	480	1-4

- NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. PROVIDE TDV 3. PROVIDE SPECIAL COATING ON BRONZE IMPELLER FOR POOL HEATING WATER SERVICE. 4. PUMP CONSTRUCTION SHALL BE RATED FOR POOL WATER ENVIRONMENT

- CBP COIL BOOSTER PUMP CFP CUTTING FLUID PUMP CHWP CHILLED WATER PUMP CSP COOLER SPRAY PUMP CWP CONDENSER WATER PUMP HWP HOT WATER PUMP BCP BOILER CIRCULATING PUMP



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Drawn By:
B. DUNLAP
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CONTROL DAMPER SCHEDULE												
EQUIPMENT TAG	LOCATION	SERVICE	TYPE	CFM	BLADE TYPE	INSTALL TYPE	SIZE (IN.)		PRESSURE DROP (IN. W.G.)	MANUFACTURER	MODEL	NOTES
							LENGTH	WIDTH				
CD-3-1	3RD FLOOR - MECH. RM.	AHU-3-1	RETURN	23,800	PARALLEL	FLANGED	71	28	X	TAMCO	1500	1-5
CD-3-2	3RD FLOOR - MECH. RM.	AHU-3-1	EXHAUST	23,800	OPPOSED	FLANGED	48	40	X	TAMCO	9000	1-5
CD-3-3	3RD FLOOR - MECH. RM.	AHU-3-2	RETURN	23,800	PARALLEL	FLANGED	71	28	X	TAMCO	1500	1-5
CD-3-4	3RD FLOOR - MECH. RM.	AHU-3-2	EXHAUST	23,800	OPPOSED	FLANGED	48	40	X	TAMCO	9000	1-5
CD-PH-1	PENTHOUSE - MECH. RM.	AHU-PH-1	RETURN	7,800	PARALLEL	FLANGED	46	17	X	TAMCO	1500	1-5
CD-PH-2	PENTHOUSE - MECH. RM.	AHU-PH-1	EXHAUST	7,800	OPPOSED	FLANGED	36	24	X	TAMCO	9000	1-5
CD-PH-3	PENTHOUSE - MECH. RM.	AHU-PH-2	RETURN	3,800	PARALLEL	FLANGED	43	14	X	TAMCO	1500	1-5
CD-PH-4	PENTHOUSE - MECH. RM.	AHU-PH-2	EXHAUST	3,800	OPPOSED	FLANGED	28	18	X	TAMCO	9000	1-5

NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. COORDINATE ACTUATOR TORQUE REQUIREMENT WITH MANUFACTURER. 3. PROVIDE JACKET SHAFT AS REQUIRED. 4. FIELD VERIFY EXACT DIMENSIONS. 5. MOTOR ACTUATORS WILL BE PROVIDED BY PRECISION CONTROLS.

HOT WATER UNIT HEATER SCHEDULE																
EQUIPMENT TAG	LOCATION	MANUFACTURER	MODEL	TYPE	FAN			HEATING COIL				MOTOR			NOTES	
					TYPE	CFM	RPM	MBH	GPM	PRESS. DROP	EWT (F°)	EAT (F°)	HP	VOLT		PHASE
UH-3-1	3RD FLR. MECH. RM.	VULCAN	HV-108	HORIZONTAL	PROP.	1,800	1,000	78.4	7.9	0.4	180	60	1/12	120	1	1-4
UH-PH-1	PENTHOUSE MECH. RM.	VULCAN	HV-48	HORIZONTAL	PROP.	750	1050	34.8	3.5	0.2	180	60	1/20	120	1	1-4

NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. HORIZONTAL AND VERTICAL DEFLECTION LOUVERS. 3. PROVIDE THERMOSTAT WITH GUARD. 4. PROVIDE DISCONNECT/ STARTER.

AIRFLOW MEASURING DAMPER SCHEDULE (BY PRECISION CONTROLS)													
EQUIPMENT TAG	LOCATION	SERVICE	TYPE	CFM	BLADE TYPE	INSTALL TYPE	SIZE (IN.)		DAMPER SERIES	MANUFACTURER	MODEL	NOTES	
							LENGTH	WIDTH					
AFMD-3-1	3RD FLOOR - MECH. RM.	AHU-3-1	OUTSIDE AIR	25,000	OPPOSED	FLANGED	71	28	9000-SC	TAMCO / EBTRON	AIR-IQ	1-5	
AFMD-3-2	3RD FLOOR - MECH. RM.	AHU-3-1	OUTSIDE AIR	25,000	OPPOSED	FLANGED	71	28	9000-SC	TAMCO / EBTRON	AIR-IQ	1-5	
AFMD-PH-1	PENTHOUSE - MECH. RM.	AHU-PH-1	OUTSIDE AIR	8,200	OPPOSED	FLANGED	46	17	9000-SC	TAMCO / EBTRON	AIR-IQ	1-5	
AFMD-PH-2	PENTHOUSE - MECH. RM.	AHU-PH-2	OUTSIDE AIR	4,000	OPPOSED	FLANGED	43	14	9000-SC	TAMCO / EBTRON	AIR-IQ	1-5	

NOTES: 1. OTHER ACCEPTABLE MANUFACTURERS: SEE SPECIFICATIONS. 2. COORDINATE ACTUATOR TORQUE REQUIREMENT WITH MANUFACTURER. 3. PROVIDE JACKET SHAFT AS REQUIRED. 4. FIELD VERIFY EXACT DIMENSIONS. 5. PROVIDE TRANSMITTER.

FLOOR DRAIN SCHEDULE							
TAG	FIXTURE	MANUFACTURER	APPLICATION	DESCRIPTION	MODEL	(MEMBRANE FLOORS)	NOTES
HD-1	HUB DRAIN	MIFAB	MECHANICAL ROOMS	EPOXY COATED CAST IRON 5"Ø & 2" AFF	SERIES FD-1100-DD		1

NOTES: 1. SEE MANUFACTURERS RECOMENDATIONS PRIOR TO INSTALLATION.



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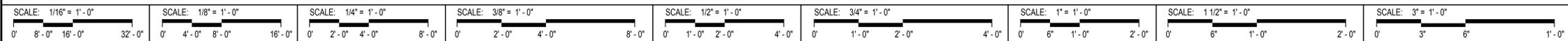
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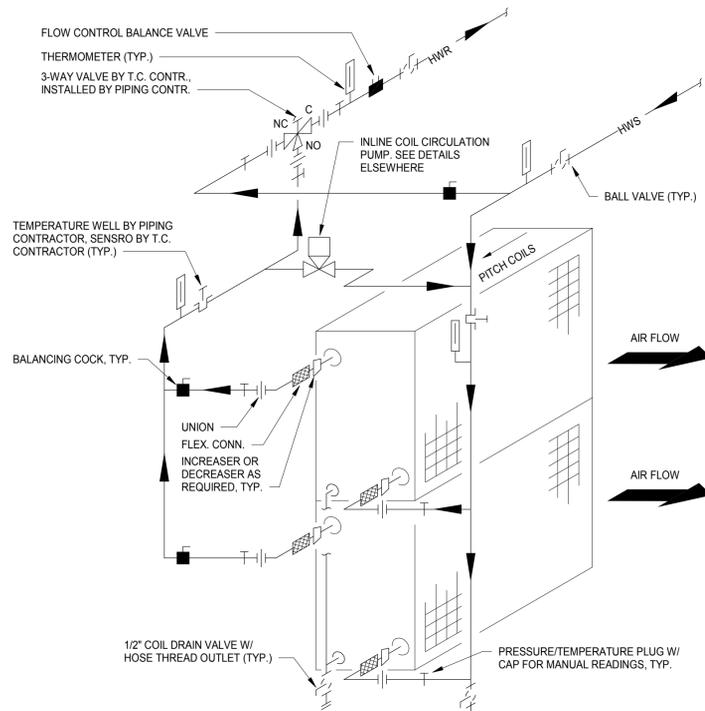
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 Author
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NOTES:

1. ALL VALVES 2" AND SMALLER TO BE BALL VALVES, 2 1/2" AND LARGER TO BE BUTTERFLY VALVES.
2. INSTALL PIPE UNIONS ON 2" AND SMALLER PIPE, FLANGED PIPE 2 1/2" AND LARGER.
3. ALL COILS TO BE FACTORY TAPPED FOR MANUAL AIR VENT AT HIGH POINT AND DRAIN AT LOW POINT OF COIL.
4. ALL COILS TO BE PIPED FOR COUNTER FLOW OF AIR AND WATER.
5. PIPING TO COIL SHALL BE ARRANGED SO AS NOT TO BLOCK OFF ANY ACCESS REQUIREMENTS OR SERVICE AREAS OF AIR HANDLING UNIT.
6. SEE FLOOR PLANS FOR PIPE SIZES.
7. PROVIDE FLEXIBLE PIPING CONNECTIONS AS SHOWN WHERE AIR HANDLING UNIT IS NOT INTERNALLY ISOLATED OR WHERE SPECIFICALLY CALLED FOR ON DRAWINGS.
8. PIPING CONTRACTOR SHALL FURNISH/INSTALL TEMPERATURE WELLS AS SHOWN FOR FUTURE USE EVEN IF SENSORS ARE NOT PROVIDED UNDER THIS PROJECT.

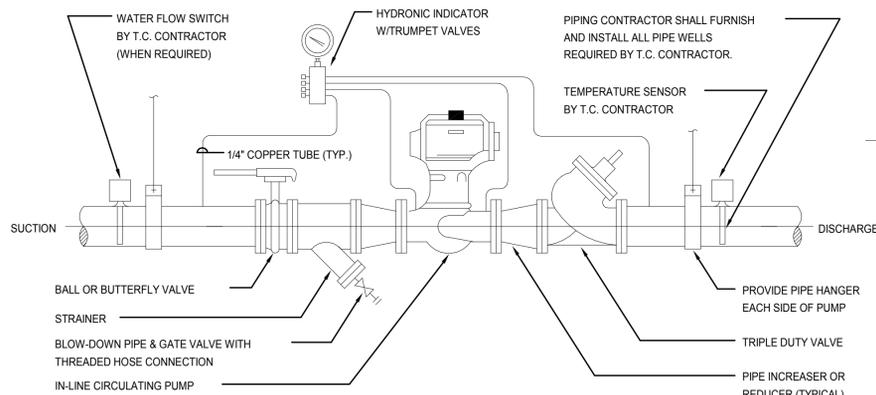


2 HIGH HOT WATER COIL W/ 3-WAY VALVE & PARALLEL CIRCULATION PUMP PIPING DETAIL

1
M6.0 N.T.S.

NOTES:

1. PIPING CONTRACTOR SHALL FURNISH/INSTALL WELL FOR TEMPERATURE SENSOR AND TAP FOR SWITCH AS SHOWN FOR FUTURE USE EVEN IF SENSOR OR FLOW SWITCH ARE NOT PROVIDED UNDER THIS PROJECT.
2. FOR PUMPS 1/2 HP OR SMALLER, CONTRACTOR MAY PROVIDE INDIVIDUAL PRESSURE/TEMPERATURE PLUGS IN LIEU OF HYDRONIC INDICATOR AND TUBING SHOWN.

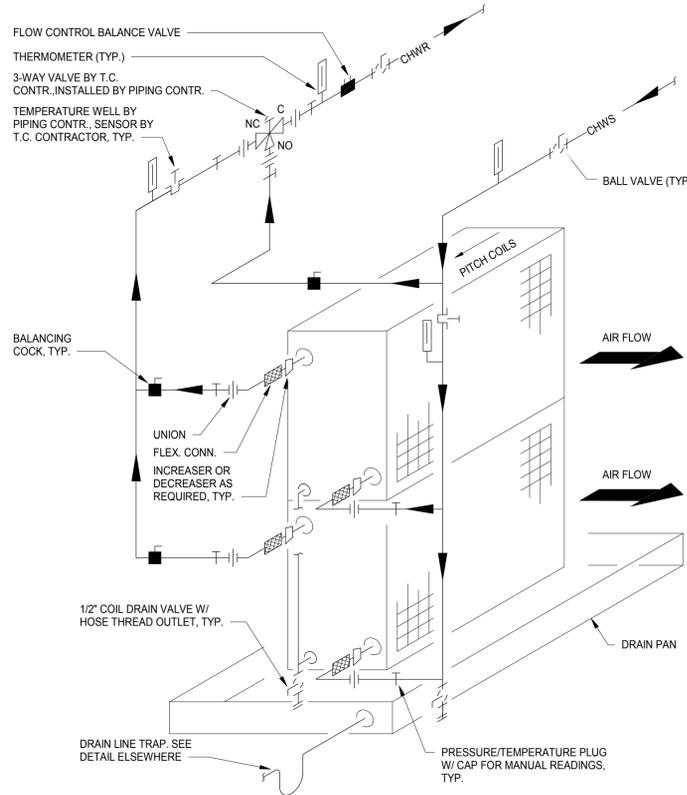


5 IN-LINE PUMP DETAIL

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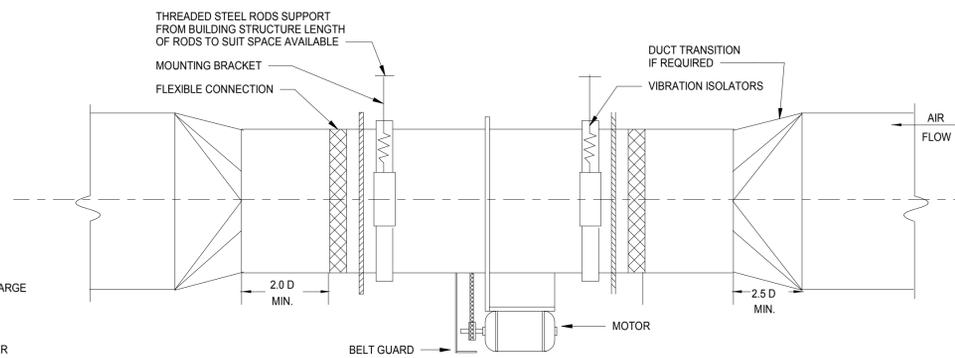
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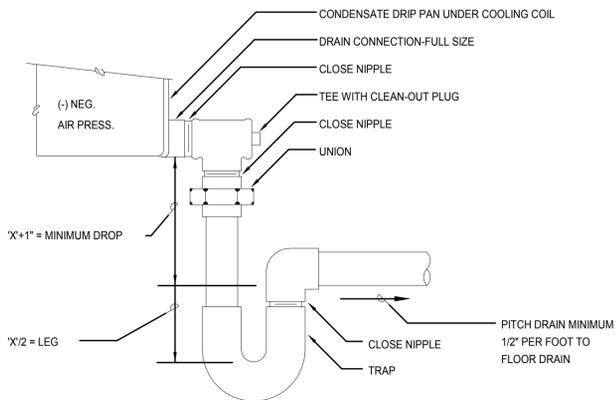
2 HIGH CHILLED WATER COIL W/ 3-WAY VALVE PIPING DETAIL

2
M6.0 N.T.S.



6 EXHAUST/ RETURN FAN SUPPORT DETAIL

M6.0 N.T.S.

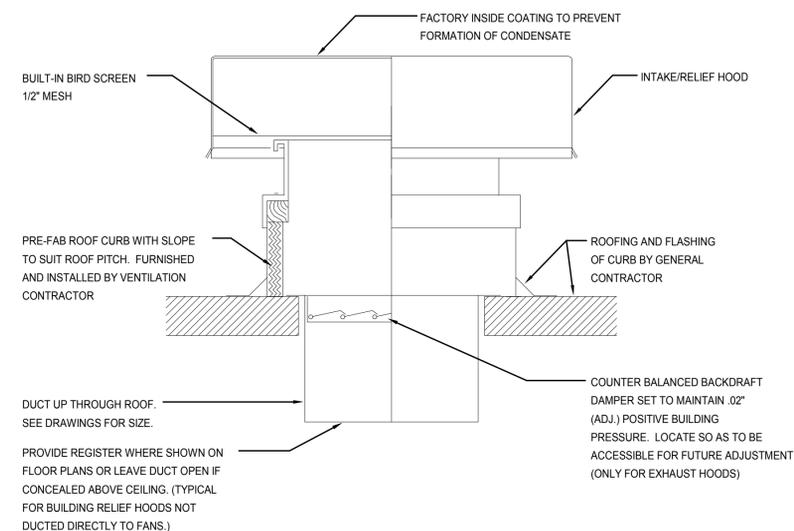


NOTES:

1. 'X' = SUCTION PRESSURE AT FAN INLET (NEGATIVE INTERNAL S.P.)

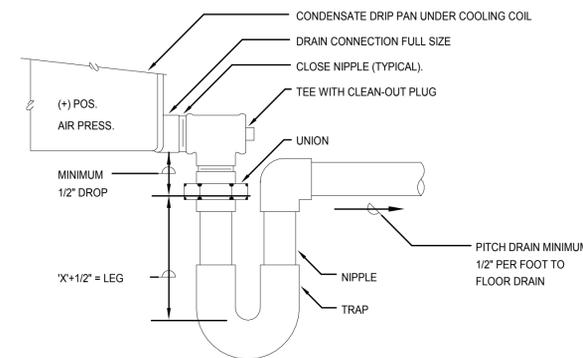
3 DRAW-THRU COOLING COIL DRIP PAN DRAIN DETAIL

M6.0 N.T.S.



4 INTAKE/RELIEF HOOD INSTALLATION DETAIL

M6.0 N.T.S.



NOTES:

1. 'X' = DISCHARGE PRESSURE OF FAN (POSITIVE INTERNAL S.P.)

H500 - BLOW-THRU COOLING COIL DRIP PAN DRAIN DETAIL

7 BLOW-THRU COOLING COIL DRIP PAN DRAIN DETAIL

M6.0 N.T.S.

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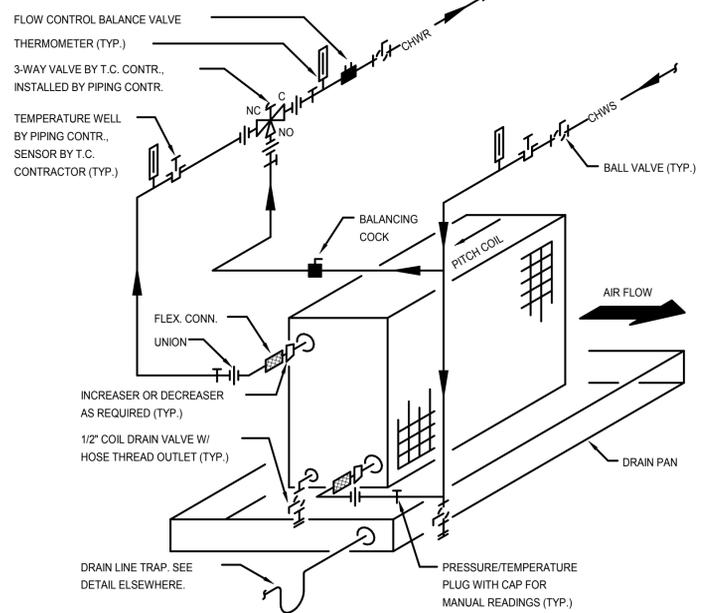
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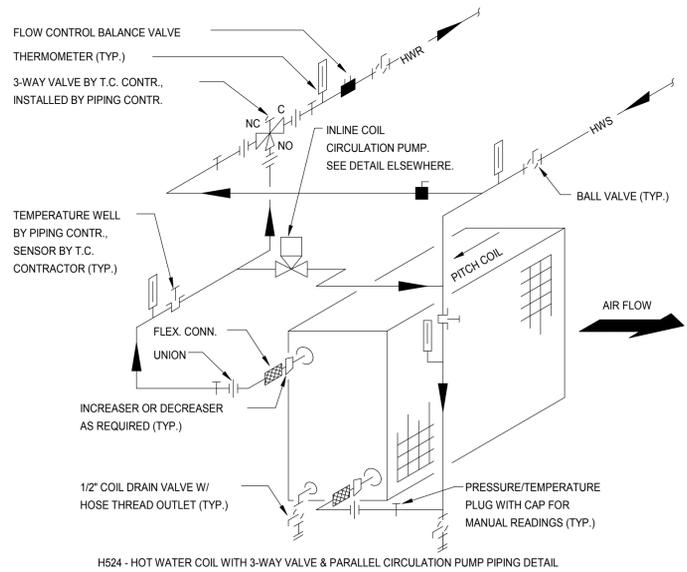


1 CHILLED WATER COIL WITH 3-WAY VALVE PIPING DETAIL

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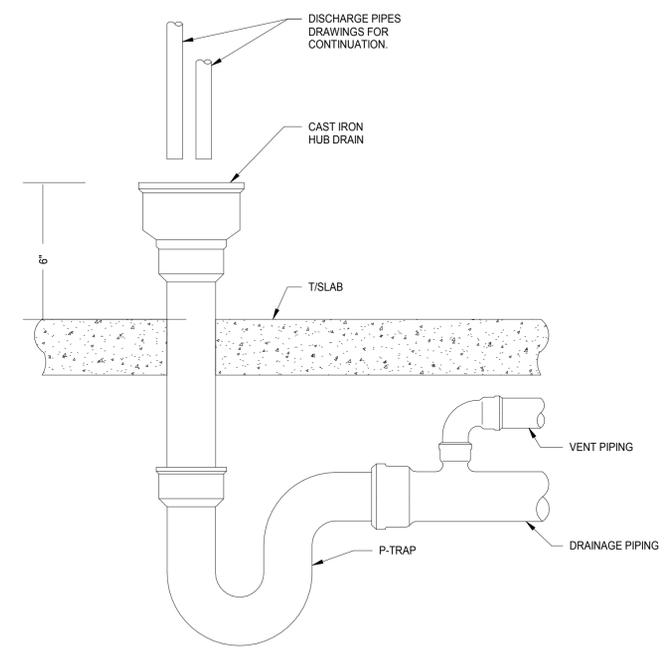
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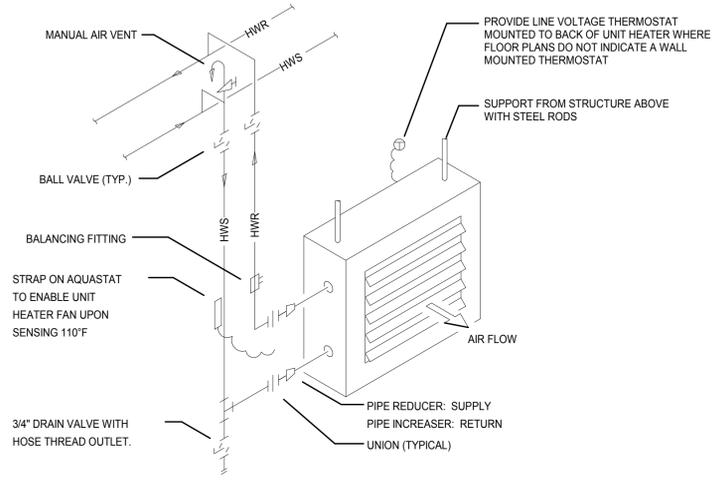
3 HOT WATER COIL WITH 3-WAY VALVE & PARALLEL CIRCULATION PUMP PIPING DETAIL

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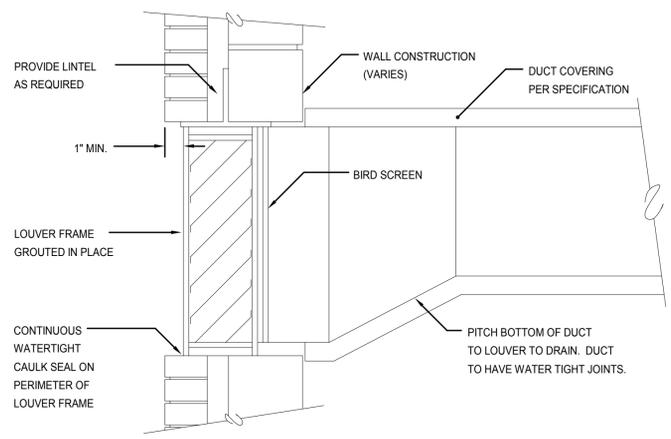
5 ELEVATED HUB DRAIN DETAIL

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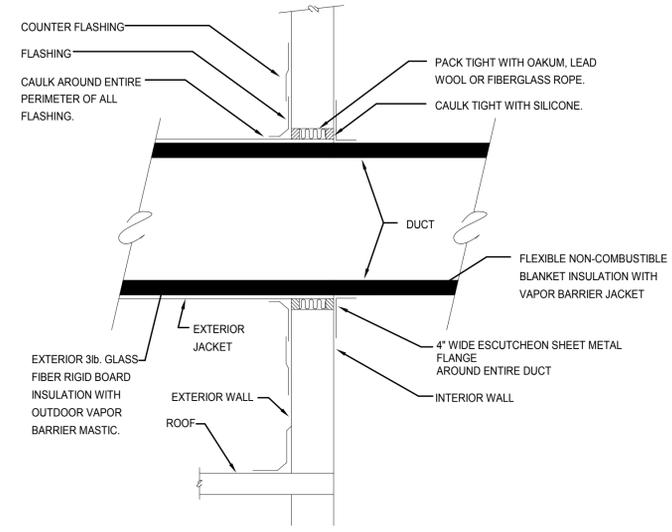
2 SUSPENDED UNIT HEATER PIPING DETAIL

M6.1 N.T.S.



4 DUCT CONNECTION TO WALL LOUVER DETAIL

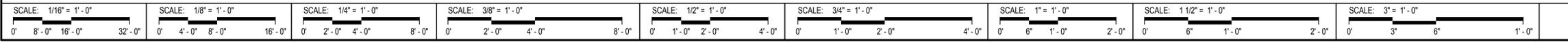
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6 TYPICAL EXTERIOR TO INTERIOR DUCT PENETRATION

M6.1 N.T.S.

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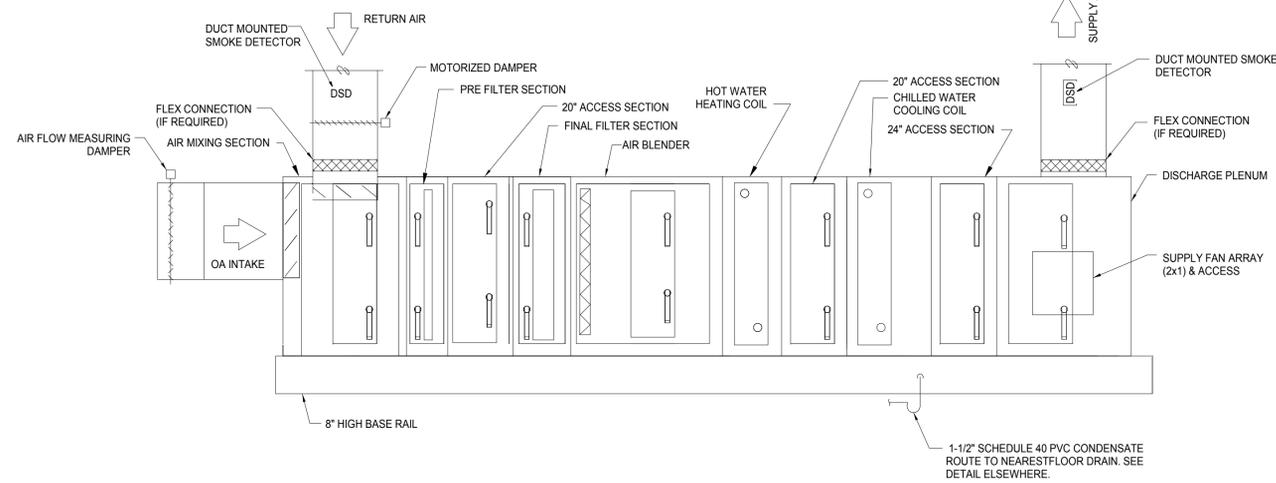
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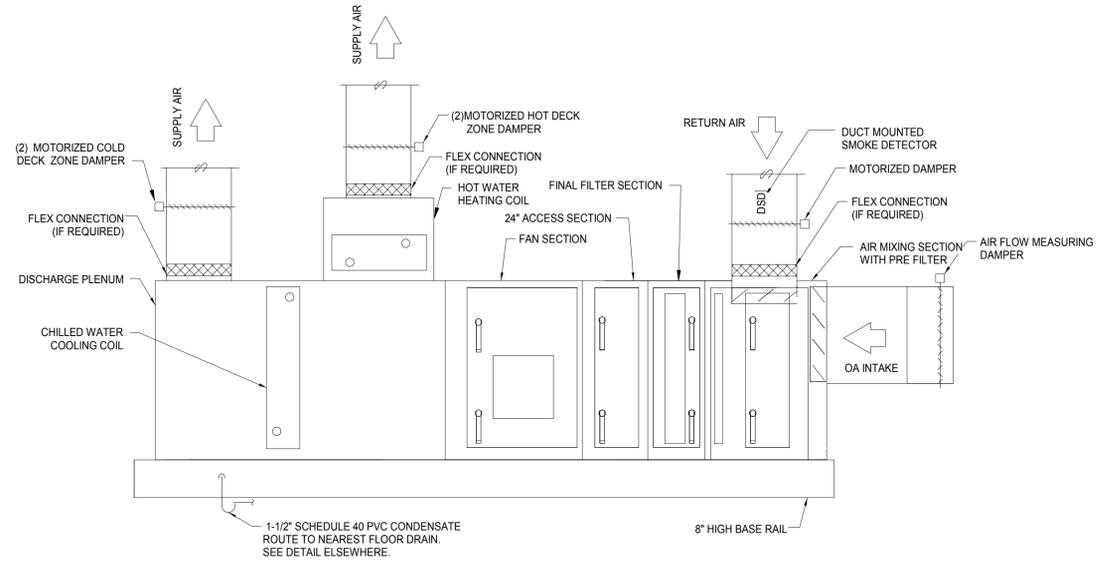
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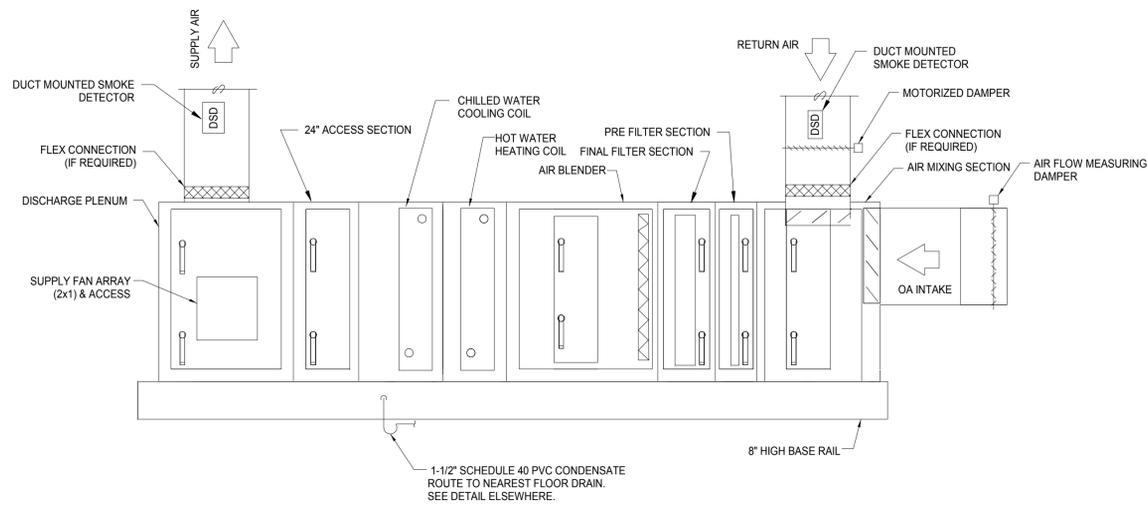
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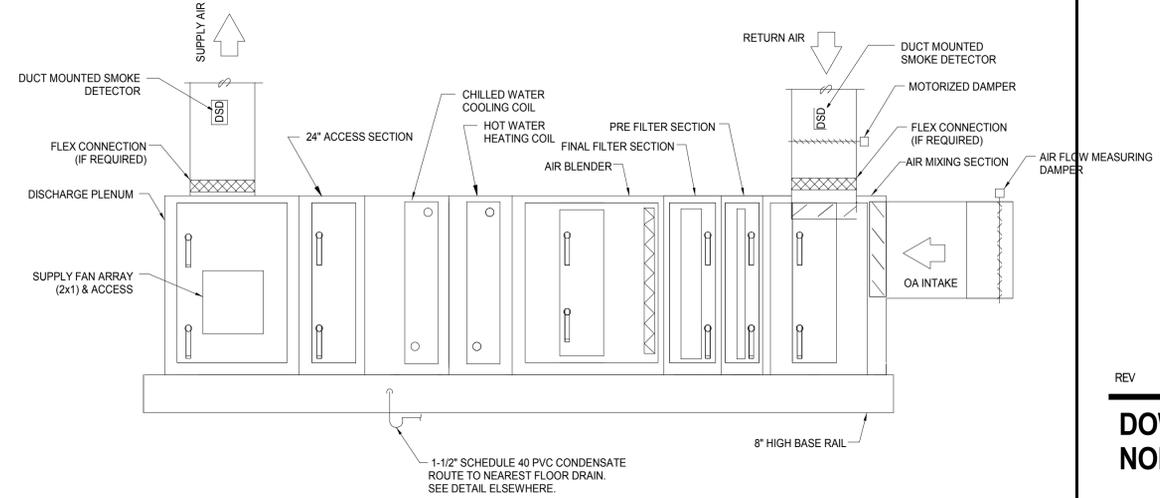
1 AHU-3-1 DETAIL
 M6.2 N.T.S.



3 AHU-PH-1 DETAIL
 M6.2 N.T.S.



2 AHU-3-2 DETAIL
 M6.2 N.T.S.



4 AHU-PH-2 DETAIL
 M6.2 N.T.S.

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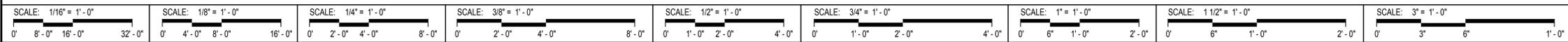
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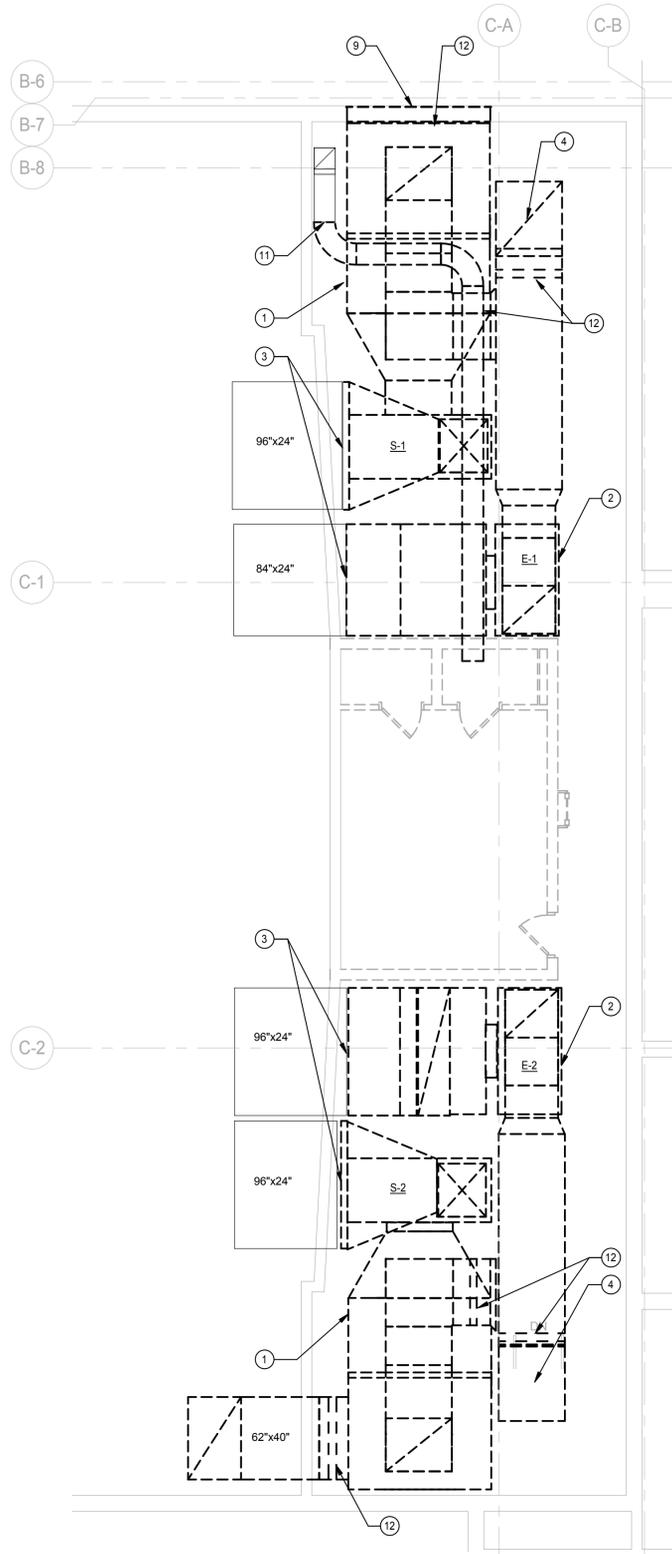
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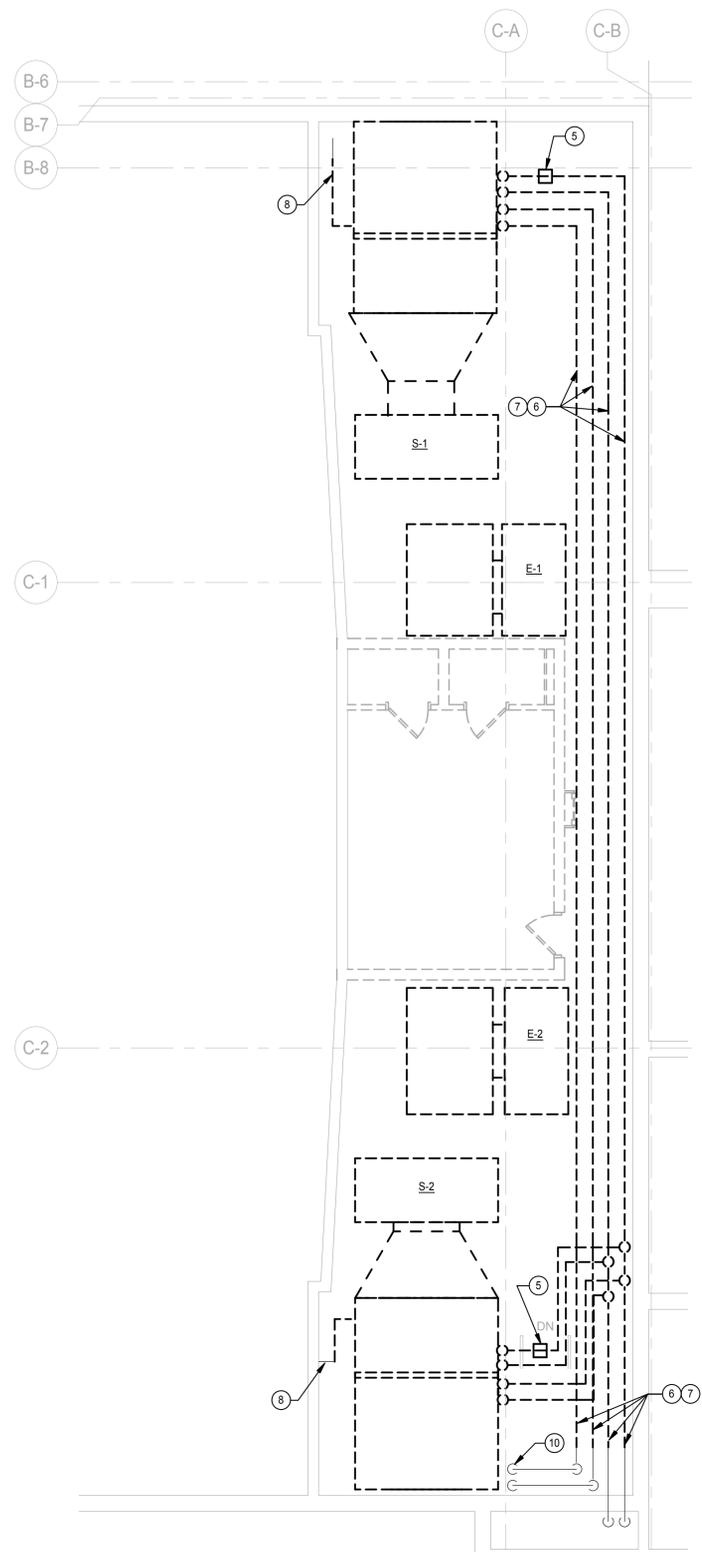
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1 MECHANICAL PARTIAL THIRD FLOOR DUCTWORK DEMOLITION PLAN
 MD2.0 SCALE: 3/16" = 1'-0"



2 MECHANICAL PARTIAL THIRD FLOOR PIPING DEMOLITION PLAN
 MD2.0 SCALE: 3/16" = 1'-0"

- # KEYNOTES
- 1 DEMOLISH EXISTING AIR HANDLING UNIT AS INDICATED IN ITS ENTIRETY INCLUDING ASSOCIATED FAN, COOLING & HEATING COILS, FILTERS, DAMPERS, ACTUATORS, HOUSING, DUCTWORK, PIPING, VALVES, FITTINGS, SUPPORTS AND HANGERS ETC. SHOWN DASHED. COORDINATE WITH OTHER TRADES FOR ASSOCIATED WORK.
 - 2 DEMOLISH EXISTING RETURN FAN AS INDICATED IN ITS ENTIRETY INCLUDING ASSOCIATED DUCTWORK, HANGERS & SUPPORTS ETC. SHOWN DASHED
 - 3 DEMOLISH EXISTING DUCTWORK IN ITS ENTIRETY INCLUDING SUPPORTS & HANGERS ETC. SHOWN DASHED UP TO WALL.
 - 4 DEMOLISH EXISTING DUCTWORK IN ITS ENTIRETY INCLUDING SUPPORTS & HANGERS ETC. SHOWN DASHED UP TO HOOD ON ROOF.
 - 5 DEMOLISH EXISTING HOT WATER BOOSTER PUMP AS INDICATED IN ITS ENTIRETY INCLUDING ASSOCIATED PIPING, FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASHED.
 - 6 DEMOLISH EXISTING SUPPLY & RETURN HOT WATER PIPING IN ITS ENTIRETY INCLUDING FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASHED FROM AHU TO POINT AS INDICATED.
 - 7 DEMOLISH EXISTING SUPPLY & RETURN CHILLED WATER PIPING IN ITS ENTIRETY INCLUDING FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASHED FROM AHU TO POINT AS INDICATED.
 - 8 DEMOLISH EXISTING CONDENSATE DRAIN PIPING IN ITS ENTIRETY INCLUDING FITTINGS, SUPPORTS & HANGERS ETC SHOWN DASHED UP TO WALL / FLOOR.
 - 9 DEMOLISH EXISTING OUTSIDE AIR INTAKE LOUVER SHOWN DASHED. COORDINATE WITH ARCHITECTURAL.
 - 10 EXISTING CHILLED WATER BOOSTER PUMPS TO REMAIN. CONTRACTOR TO MEASURE FLOW DOWN STREAM OF PUMP AND RE-BALANCE FLOW AS INDICATED ON NEW WORK PLAN.
 - 11 DEMOLISH EXISTING TOILET EXHAUST DUCT FROM BATHROOM TO POINT AS INDICATED IN ITS ENTIRETY INCLUDING SUPPORTS & HANGERS ETC SHOWN DASHED. CAP DUCT AT POINT OF DISCONNECTION. EXISTING VERTICAL DUCT RISER & ASSOCIATED EXHAUST FAN ON ROOF TO REMAIN.
 - 12 DEMOLISH EXISTING PNEUMATIC DAMPERS IN THEIR ENTIRETY INCLUDING TUBING, ACTUATOR, SUPPORTS & HANGERS ETC. DEMOLISH TUBING UP TO MAIN. CAP AT MAIN.



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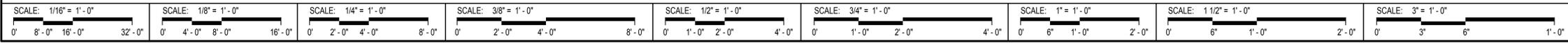
DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

MECHANICAL PARTIAL THIRD FLOOR DEMOLITION PLAN

Project Number:
 02-5274-32
 Drawn By:
 B. DUNLAP
 Sheet:

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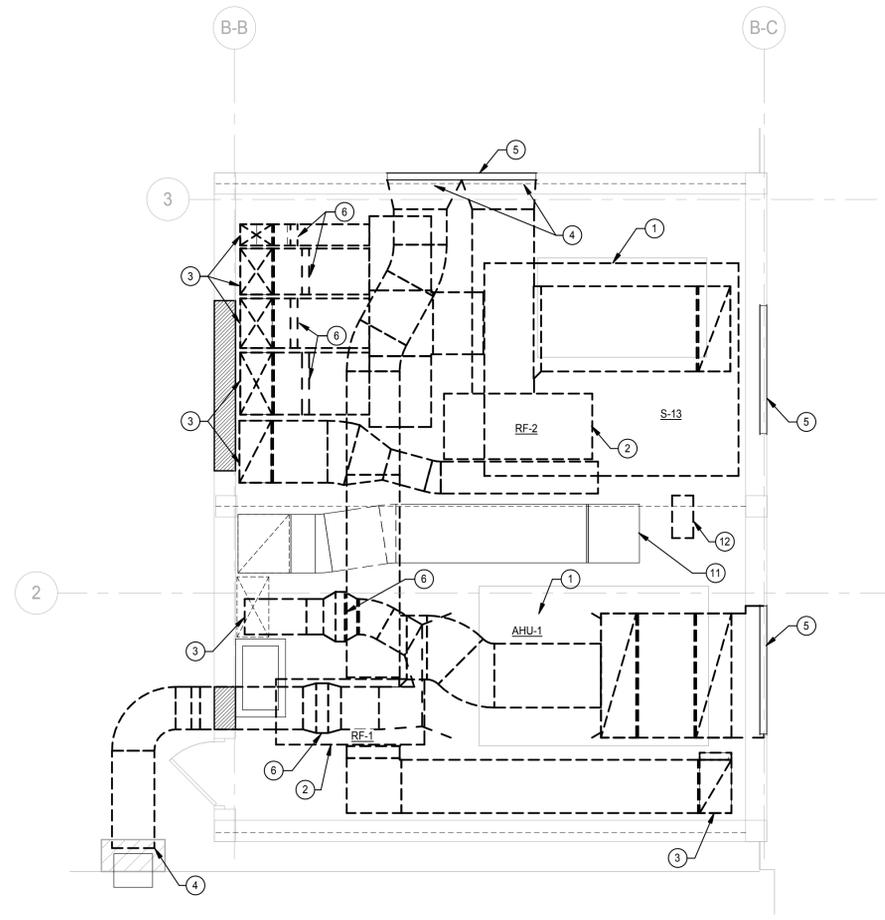


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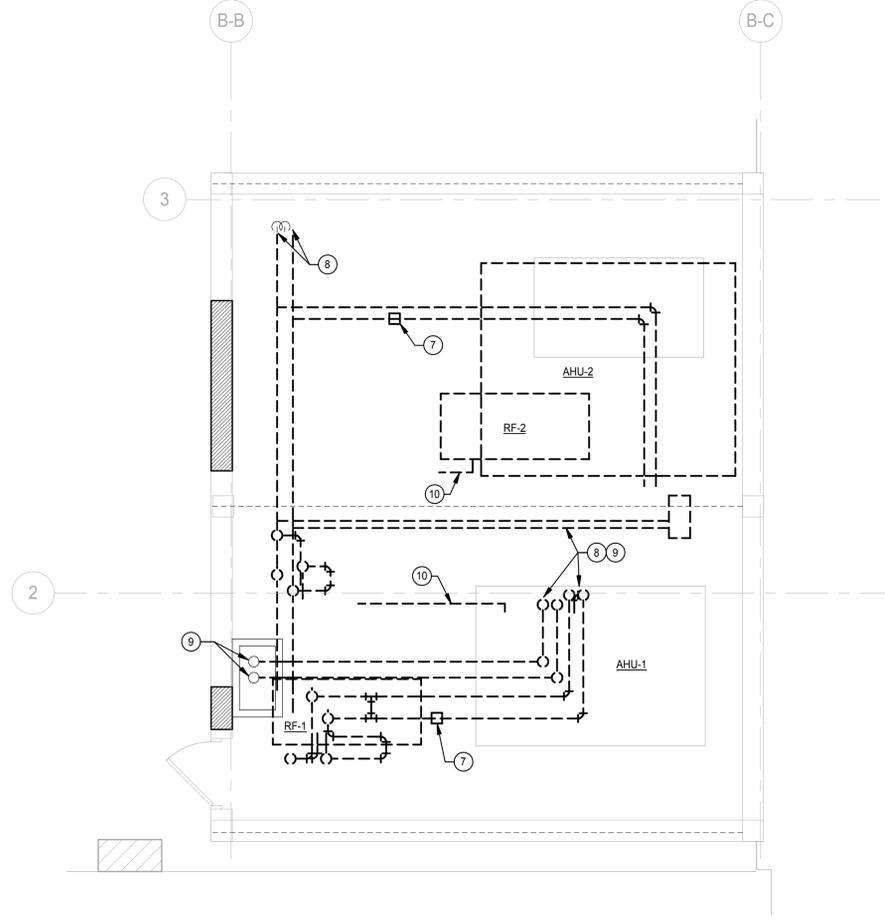


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- KEYNOTES**
- 1 DEMOLISH EXISTING CHILLED WATER AIR HANDLING UNIT AS INDICATED IN ITS ENTIRETY INCLUDING ASSOCIATED FAN, COOLING & HEATING COILS, FILTERS, DAMPERS, ACTUATORS, HOUSING, DUCTWORK, PIPING, VALVES, FITTINGS, SUPPORTS AND HANGERS ETC. SHOWN DASED. COORDINATE WITH OTHER TRADES FOR ASSOCIATED WORK.
 - 2 DEMOLISH EXISTING RETURN FAN AS INDICATED IN ITS ENTIRETY INCLUDING ASSOCIATED DUCTWORK, HANGERS & SUPPORTS ETC. SHOWN DASED.
 - 3 DEMOLISH EXISTING DUCTWORK IN ITS ENTIRETY INCLUDING SUPPORTS & HANGERS ETC. SHOWN DASED UP TO FLOOR LEVEL. CAP DUCTWORK UNLESS NEW CONNECTION SHOWN.
 - 4 DEMOLISH EXISTING DUCTWORK IN ITS ENTIRETY INCLUDING SUPPORTS & HANGERS ETC. SHOWN DASED UP TO WALL.
 - 5 EXISTING OUTSIDE AIR INTAKE & EXHAUST LOUVERS TO REMAIN.
 - 6 DEMOLISH EXISTING HOT WATER RE-HEAT COILS IN ITS ENTIRETY INCLUDING FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASED.
 - 7 DEMOLISH EXISTING HOT WATER BOOSTER PUMP AS INDICATED IN ITS ENTIRETY INCLUDING ASSOCIATED PIPING, FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASED.
 - 8 DEMOLISH EXISTING SUPPLY & RETURN HOT WATER PIPING IN ITS ENTIRETY INCLUDING FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASED FROM AHU TO POINT AS INDICATED.
 - 9 DEMOLISH EXISTING SUPPLY & RETURN CHILLED WATER PIPING IN ITS ENTIRETY INCLUDING FITTINGS, VALVES, SUPPORTS & HANGERS ETC. SHOWN DASED FROM AHU TO POINT AS INDICATED AT FLOOR LEVEL.
 - 10 DEMOLISH EXISTING CONDENSATE DRAIN PIPING IN ITS ENTIRETY INCLUDING FITTINGS, SUPPORTS & HANGERS ETC SHOWN DASED AS INDICATED.
 - 11 EXISTING KITCHEN EXHAUST DUCT TO REMAIN.
 - 12 DEMOLISH EXISTING CEILING MOUNTED HOT WATER UNIT HEATER IN ITS ENTIRETY INCLUDING PIPING, FITTINGS, VALVES, SUPPORTS & HANGERS ETC. AS INDICATED.



1
MD2.1 MECHANICAL PENTHOUSE DUCTWORK DEMOLITION PLAN
 SCALE: 1/4" = 1'-0"



2
MD2.1 MECHANICAL PENTHOUSE PIPING DEMOLITION PLAN
 SCALE: 1/4" = 1'-0"

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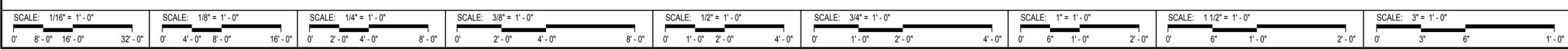
DOWNERS GROVE NORTH

4436 Main St, Downers Grove, IL

MECHANICAL PENTHOUSE DEMOLITION PLAN

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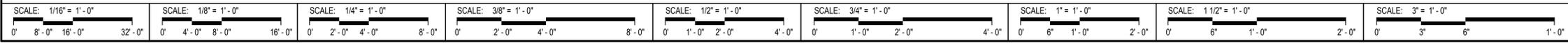
HVAC/PLUMBING COORDINATION SCHEDULE									
NOTES:									
1. DEVICES TO BE FURNISHED BY THE ELECTRICAL CONTRACTOR (MARKED "E"), HVAC CONTRACTOR (MARKED "HV"), BAS CONTRACTOR (MARKED "B"), PLUMBING CONTRACTOR (MARKED "P") OR MANUFACTURER (MARKED "MANUF").									
2. ALL CONDUIT AND WIRING FOR TEMPERATURE CONTROL AND EQUIPMENT INTERLOCK SHALL BE BY BAS CONTRACTOR. OTHER CONTROLS AND CONTROL CONDUIT/WIRING BY TRADE FURNISHING RESPECTIVE EQUIPMENT.									
3. IT IS THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR TO COORDINATE AND REVIEW THE ELECTRICAL CHARACTERISTICS, AMPACITY AND OTHER REQUIREMENTS OF COMPONENTS BEFORE INSTALLATION OF WORK. ALL OTHER CONTRACTORS SHALL ADVISE ELECTRICAL CONTRACTOR OF ANY MOTOR/DEVICE CHANGES.									
4. ALL LOOSE STARTERS SHALL INCLUDE HOA SWITCH, CONTROL TRANSFORMER, AND ONE N.O. AND ONE N.C. AUXILIARY CONTACTS. ALL SINGLE PHASE EXHAUST FAN CONTROL SWITCHES SHALL HAVE IDENTIFICATION NAMEPLATE AND PILOT LIGHT.									
5. SEE SPECIFICATIONS AND DRAWINGS FOR TYPES AND LOCATIONS OF DEVICES SCHEDULED BELOW.									
EQUIPMENT TAG	EQUIPMENT DESCRIPTION	UNIT MOUNTED DEVICES				REMOTE OR LOOSE DEVICES			REMARKS
		STARTER	DISCONNECT	OVERCURRENT PROTECTION	SINGLE POINT CONNECTION	STARTER	DISCONNECT	OVERCURRENT PROTECTION	
AHU	AIR HANDLING UNIT	VFD	-	-	-	E		E	
RF	RETURN FAN	VFD	-	-	-	E		E	
CBP	COIL BOOSTER PUMP	-	-	-	-	E		E	
PWP	POOL HEATING WATER PUMP	-	-	-	-	E		E	
VFD	VARIABLE FREQ. DRIVE	MANUF	MANUF	MANUF	MANUF	-	-	E	

GENERAL REMODELING NOTES - ALL CONTRACTORS

- ALL WORK SHOWN ON DRAWINGS SHALL BE CONSIDERED NEW AND IN CONTRACT UNLESS SPECIFICALLY INDICATED OTHERWISE.
- DRAWINGS ARE GENERALLY DIAGRAMMATIC. ROUTING OF PIPING, DUCTWORK, CONDUITS, RACEWAYS, ETC., AS SHOWN ON DRAWINGS, DOES NOT INTEND TO SHOW EVERY RISE, DROP, OFFSET, FITTING NOR EVERY STRUCTURAL ELEMENT THAT MAY BE ENCOUNTERED DURING THE INSTALLATION OF THIS WORK. EACH CONTRACTOR SHALL MAKE ANY REQUIRED CHANGES FROM THE GENERAL ROUTING SHOWN ON THESE DRAWINGS, SUCH AS OFFSETS, BENDS OR CHANGES IN ELEVATION DUE TO COORDINATION WITH THE WORK OF OTHER TRADES AND BUILDING CONSTRUCTION. ALL CHANGES SHALL BE MADE WITHOUT ADDITIONAL COST TO THE OWNER OR DELAY IN COMPLETION DATE OF THE PROJECT.
- IT IS INTENDED THAT EQUIPMENT SHALL BE LOCATED SYMMETRICALLY WITH THE ARCHITECTURAL ELEMENTS OF THE BUILDING, NOTWITHSTANDING THE FACT THAT LOCATIONS INDICATED BY THESE DRAWINGS MAY BE DISTORTED FOR CLARITY OF PRESENTATION.
- CONTRACTOR SHALL CHECK DRAWINGS OF OTHER TRADES TO VERIFY THAT SPACES IN WHICH THEIR WORK WILL BE INSTALLED ARE CLEAR OF OBSTRUCTIONS. WORK SHALL BE INSTALLED TO MAINTAIN MAXIMUM HEADROOM AND SPACE CONDITIONS AT ALL POINTS IN THE BUILDING. WHERE THE HEADROOM OR SPACE CONDITIONS APPEAR INADEQUATE, CONTRACTOR SHALL NOTIFY OWNER/ARCHITECT/ENGINEER BEFORE PROCEEDING WITH THE INSTALLATION OF THEIR WORK.
- CONTRACTOR SHALL FURNISH OTHER TRADES ADVANCE INFORMATION AND/OR SHOP DRAWINGS ON LOCATIONS AND SIZES OF PIPING, DUCTWORK, CONDUIT, RACEWAYS, EQUIPMENT, FRAMES, BOXES, SLEEVES AND OPENINGS, ETC. NEEDED FOR THEIR WORK TO PERMIT OTHER TRADES AFFECTED TO INSTALL THEIR WORK PROPERLY AND WITHOUT DELAY.
- WHERE THERE IS EVIDENCE THAT WORK OF ONE TRADE WILL INTERFERE WITH WORK OF OTHER TRADES, ALL TRADES SHALL MEET ON JOB SITE TO WORK OUT SPACE CONDITIONS AND MAKE SATISFACTORY ADJUSTMENTS TO INSTALLATION OF THE NEW WORK. CONTRACTORS SHALL VERIFY EXACT LOCATIONS OF ALL DEVICES AND EQUIPMENT WITH FIELD CONDITIONS, SHOP DRAWINGS, AND WORK OF OTHER TRADES PRIOR TO ROUGH-IN. EACH CONTRACTOR SHALL BE RESPONSIBLE, AT THEIR OWN EXPENSE, FOR THE REMOVAL AND REINSTALLATION OF ANY PART OF THEIR WORK IF SAME WAS INSTALLED WITHOUT CONSULTING WITH OTHER TRADES BEFORE INSTALLING THEIR WORK.
- CONTRACTOR SHALL PROVIDE SLEEVES IN BEAMS, FLOORS, COLUMNS AND WALLS AS SHOWN ON THE DRAWINGS, AS REQUIRED BY JOB SITE CONDITIONS, AND/OR AS SPECIFIED, WHEN INSTALLING THEIR WORK. ALL BEAMS AND COLUMNS WHICH ARE REQUIRED TO BE SLEEVED SHALL BE CUT AND REINFORCED AS REQUIRED BY FIELD CONDITIONS AND LOCATIONS AND SIZES SHALL BE CHECKED AND APPROVED BY ARCHITECT BEFORE CONTRACTOR CUTS ANY STRUCTURAL BUILDING MEMBER.
- THE SEQUENCE FOR THE INSTALLATION OF ALL WORK SHALL BE COORDINATED BETWEEN ALL CONTRACTORS ON THE PROJECT AND IN STRICT ACCORDANCE WITH ARCHITECT/ENGINEER AND OWNERS STIPULATION AS DIRECTED.
- CONTRACTOR SHALL REFER TO THE ARCHITECTURAL AND STRUCTURAL CONTRACT DRAWINGS (BEFORE SUBMITTING THEIR BIDS) TO FAMILIARIZE THEMSELVES WITH THE EXTENT OF THE GENERAL CONTRACTOR'S WORK, CEILING HEIGHTS AND CLEARANCE FOR INSTALLING THEIR WORK.
- CONTRACTOR SHALL BE RESPONSIBLE AND PAY FOR ALL CORING, CUTTING, PATCHING, REPAIRING, REFINISHING AND REMOVAL/REPLACEMENT OF NEW OR EXISTING BUILDING CONSTRUCTION REQUIRED TO ACCOMMODATE THE INSTALLATION OR REMOVAL OF THEIR WORK. ALL PATCHING, REPAIRING AND REFINISHING WORK SHALL BE PERFORMED BY THOSE REGULARLY INVOLVED IN THAT TRADE AND SHALL MATCH THE ADJACENT CONSTRUCTION AS CLOSELY AS POSSIBLE. CARE SHALL BE TAKEN SO AS NOT TO DAMAGE ANY EXISTING BUILDING CONSTRUCTION OR ITEMS THAT ARE TO REMAIN. ANY EXISTING FINISHES THAT ARE DAMAGED DURING THE INSTALLATION OF NEW WORK OR REMOVAL OF EXISTING WORK SHALL BE REPAIRED, REPLACED AND PAID FOR BY THE INSTALLING CONTRACTOR, TO THE SATISFACTION OF THE ARCHITECT AND OWNER. REFER TO ARCHITECTURAL DRAWINGS FOR EXISTING BUILDING CONSTRUCTION THAT IS TO REMAIN AND, THEREFORE, SUBJECT TO PATCHING, REPAIRING, REFINISHING, AND REMOVAL/REPLACEMENT. (NOTE: ALL ROOF WORK TO BE BY CROWTHER ROOFING UNDER A SEPARATE CONTRACT)
- SOME OF THE EXISTING ITEMS AND EQUIPMENT SCHEDULED TO BE REMOVED SHALL BE TURNED OVER TO THE OWNER. ANY ITEMS THAT THE OWNER WANTS TO RETAIN SHALL BE REMOVED CAREFULLY SO AS NOT TO DAMAGE THEM. ALL OTHER ITEMS TO BE REMOVED SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND REMOVED FROM THE SITE.
- CONTRACTOR SHALL BE RESPONSIBLE FOR THEIR OWN CLEAN-UP DURING CONSTRUCTION. IF CONTRACTOR FAILS TO PROVIDE SUCH CLEAN-UP, THE ARCHITECT/ENGINEER WILL DIRECT ANOTHER CONTRACTOR TO PERFORM THE CLEAN-UP AND THE NEGLIGENT CONTRACTOR SHALL PAY THE ASSOCIATED BACK-CHARGES AS DEEMED APPROPRIATE BY THE ARCHITECT/ENGINEER.
- CONTRACTOR SHALL INSTALL ALL AUXILIARY SUPPORTING STEEL AS REQUIRED FOR THE SUPPORTING OF THEIR PIPING, DUCTWORK, CONDUIT, TANKS, EQUIPMENT, ETC. ALL SUPPORTING STEEL FOR ITEMS ABOVE A SUSPENDED CEILING SHALL BE FROM BUILDING STRUCTURAL MEMBERS ONLY.
- IT IS MANDATORY THAT THE COMPLETE EXISTING BUILDING REMAIN IN CONTINUOUS AND NON-INTERRUPTED OPERATION DURING REMODELING/ALTERING OF SAID EXISTING BUILDING. THE SPECIFIC AREA(S) BEING REMODELED/ALTERED AT ANY SCHEDULED TIME ARE OBVIOUSLY EXCLUSIVE OF THIS STATEMENT. SERVICES TO EXISTING BUILDING SHALL BE KEPT IN CONTINUOUS OPERATION INCLUDING POWER, SIGNAL SYSTEMS, LIGHTING, TELEPHONE, HEATING, COOLING, VENTILATING, TEMPERATURE CONTROL, SEWERS AND HOT AND COLD WATER. ANY ABSOLUTELY NECESSARY INTERRUPTION OF THESE SERVICES TO ACCOMPLISH CONTRACT WORK SHALL BE ARRANGED WITH THE OWNER A MINIMUM OF TEN (10) WORKING DAYS IN ADVANCE. SUCH INTERRUPTIONS SHALL BE KEPT TO AN ABSOLUTE MINIMUM AS FAR AS TIME INTERVAL IS INVOLVED AND TEMPORARY SERVICES SHALL BE FURNISHED AND INSTALLED UNDER THIS CONTRACT WHERE NECESSARY TO ACCOMPLISH THIS PURPOSE. TEMPORARIES SHALL BE REMOVED BY THE CONTRACTOR ONLY AFTER NEW PERMANENT SERVICES ARE INSTALLED AND FULLY OPERATIONAL.
- UNLESS INDICATED OTHERWISE, THE ARCHITECT/ENGINEER MAKES NO REPRESENTATION AS TO WHETHER OR NOT ANY HAZARDOUS OR CONTAMINATED MATERIALS (INCLUDING BUT NOT LIMITED TO ASBESTOS, PCB'S, CONTAMINATED SOILS, ETC.) ARE PRESENT WITHIN THE EXISTING BUILDING OR ON THE SITE. WORK SHOWN ON THE DRAWINGS AND/OR INDICATED IN THE SPECIFICATIONS SHALL NOT BE CONSTRUED TO CALL FOR CONTACT WITH ANY OF THESE MATERIALS. IF THESE MATERIALS ARE ENCOUNTERED OR SUSPECTED, THE CONTRACTOR SHALL NOT DISTURB THEM AND SHALL CONTACT THE ARCHITECT/ENGINEER IMMEDIATELY.
- WHERE WORK CALLED FOR ON THE DRAWINGS OR IN THE SPECIFICATIONS INVOLVES THE REMOVAL OR RELOCATION OF PIPING OR EQUIPMENT CONTAINING REFRIGERANT, ALL REFRIGERANT SHALL BE RECOVERED BY APPROVED METHODS PER EPA REGULATIONS.
- CONTRACTOR SHALL STORE ALL MATERIALS AND EQUIPMENT SHIPPED TO THE SITE IN A PROTECTED AREA. IF MATERIAL IS STORED OUTSIDE OF THE BUILDING, IT MUST BE STORED OFF THE GROUND A MINIMUM OF SIX INCHES (6") SET ON 6 X 6 PLANKS AND/OR WOOD PALLETS. ALL MATERIAL AND EQUIPMENT MUST BE COMPLETELY COVERED WITH WATERPROOF TARP OR VISQUIN. ALL PIPING AND DUCTWORK WILL HAVE THE ENDS CLOSED TO KEEP OUT DIRT AND OTHER DEBRIS. NO EQUIPMENT WILL BE ALLOWED TO BE STORED OUTSIDE THE BUILDING ON THE SITE UNLESS IT IS SUPPORTED OFF THE GROUND AND COMPLETELY PROTECTED WITH WEATHERPROOF COVERS.
- THE DRAWINGS, SCHEDULES AND SPECIFICATIONS HAVE BEEN PREPARED USING ONE MANUFACTURER FOR EACH PIECE OF EQUIPMENT AS THE BASIS FOR DIMENSIONAL DESIGN. IF THE CONTRACTOR PURCHASES EQUIPMENT FROM A SPECIFIED ACCEPTABLE MANUFACTURER, BUT NOT THE SCHEDULED MANUFACTURER USED FOR THE BASE DESIGN, THE CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING ALL THE DIMENSIONS OF THE EQUIPMENT TO VERIFY THAT IT WILL FIT IN THE SPACE SHOWN ON THE DRAWINGS. MINOR DEVIATIONS IN DIMENSIONS WILL BE PERMITTED, PROVIDED THE RATINGS MEET THOSE SHOWN ON THE DRAWINGS AND EQUIPMENT WILL PHYSICALLY FIT INTO THE SPACE ALLOCATED WITH SUITABLE ACCESS AROUND EQUIPMENT FOR OPERATION AND MAINTENANCE OF THE EQUIPMENT. WHEN EQUIPMENT SUBMITTED FOR REVIEW DOES NOT MEET THE PHYSICAL SIZE OR ARRANGEMENT OF THAT SCHEDULED AND SPECIFIED, CONTRACTOR SHALL PAY FOR ALL ALTERATIONS REQUIRED TO ACCOMMODATE SUCH EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER. CONTRACTOR WILL ALSO PAY ALL COSTS FOR ADDITIONAL WORK REQUIRED BY OTHER CONTRACTORS, OWNER, ARCHITECT OR ENGINEER TO MAKE CHANGES WHICH WOULD ALLOW THE EQUIPMENT TO FIT IN THE SPACE AND FUNCTION AS INTENDED.
- CONTRACTOR AND/OR MANUFACTURER SHALL VERIFY THAT THE CHARACTERISTICS OF THE EQUIPMENT HE SUBMITS FOR REVIEW MEET THE CAPACITY AND DUTY SPECIFIED. WHEN EQUIPMENT SUBMITTED FOR REVIEW REQUIRES MODIFICATIONS TO THE WORK OF OTHER CONTRACTORS, SUBMITTING CONTRACTOR SHALL PAY FOR ALL COSTS FOR ADDITIONAL WORK REQUIRED BY OTHER CONTRACTORS, OWNER, ARCHITECT OR ENGINEER TO MAKE CHANGES WHICH WOULD ALLOW THE EQUIPMENT FUNCTION SAFELY AND PROPERLY.
- CONTRACTOR SHALL FIELD VERIFY THE SIZE OF EXISTING OPENINGS, WINDOWS, DOORS, CORRIDORS, ROOMS, ETC. FOR ACCESS OF THE NEW EQUIPMENT INTO OR REMOVAL OF EXISTING EQUIPMENT FROM THE BUILDING. IF OPENINGS ARE TOO SMALL FOR ACCESS THEN CONTRACTOR SHALL, AT HIS OWN EXPENSE, PROVIDE NEW OR ENLARGED OPENINGS AND RESTORE SAME TO ORIGINAL SIZE AND CONDITION. CONTRACTOR MAY ELECT TO ORDER THE EQUIPMENT DISASSEMBLED AND/OR WITH SPLIT HOUSING FOR ENTRANCE INTO THE EXISTING SPACE OR BUILDING. CONTRACTOR SHALL REASSEMBLE EQUIPMENT AFTER IT IS IN THE SPACE AT HIS OWN EXPENSE.
- CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND THEIR ASSOCIATED FEES.

PLUMBING SPEC:

- ALL PIPING, INSULATION AND INSTALLATION METHODS REQUIREMENTS: CONTRACTOR TO STRICTLY ADHERE TO BASE BUILDING STANDARDS AS PRESENTLY INSTALLED AND APPLICABLE CODES. CONTRACTOR TO OBTAIN APPROVAL FROM BUILDING MANAGEMENT FOR ANY DEVIATION FROM BASE BUILDING STANDARDS. WASTE AND VENT PIPING SHALL MATCH EXISTING COPPER CONDENSATE DRAINAGE LINES. CONTRACTOR TO COMPLY WITH ALL STATE, LOCAL CODES AND REGULATIONS.
- PIPING MATERIALS - ABOVE GROUND DRAINAGE & SANITARY - COPPER DWV TUBE: ASTM B 306, DRAINAGE TUBE, DRAWN TEMPER. COPPER DRAINAGE FITTINGS: ASME B16.23, CAST COPPER OR ASME B16.29, WROUGHT COPPER, SOLDER JOINT FITTINGS.
- PIPING INSULATION - 1" MINERAL FIBER INSULATION WITH ASJ JACKET. PIPING INSULATION - 1" MINERAL FIBER INSULATION WITH ASJ JACKET.



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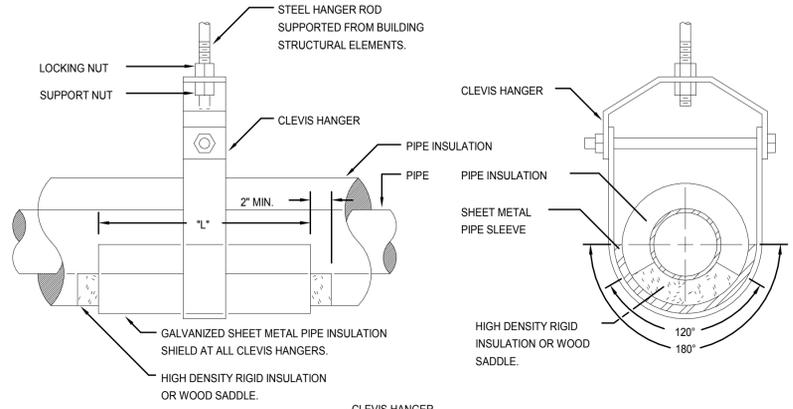
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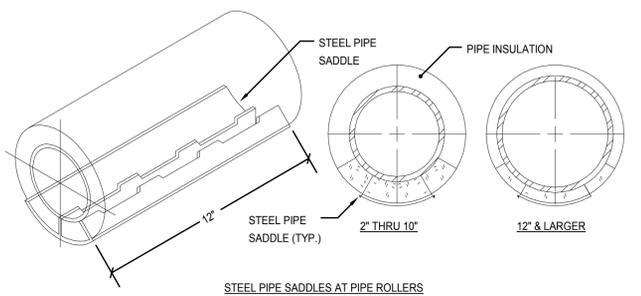
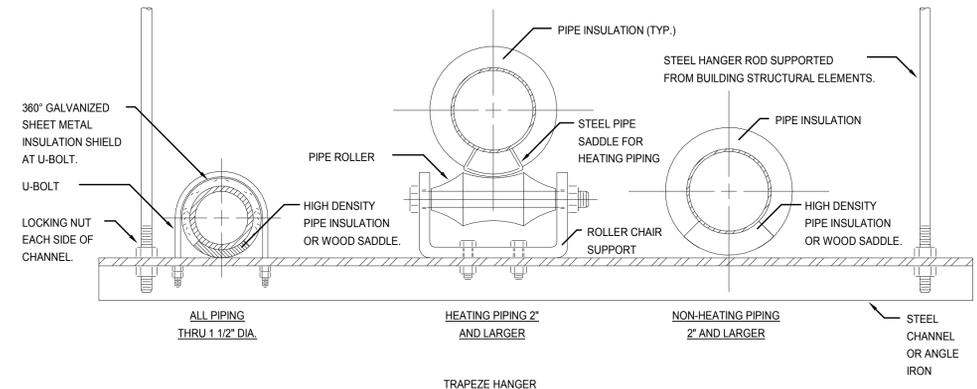
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CLEVIS HANGER

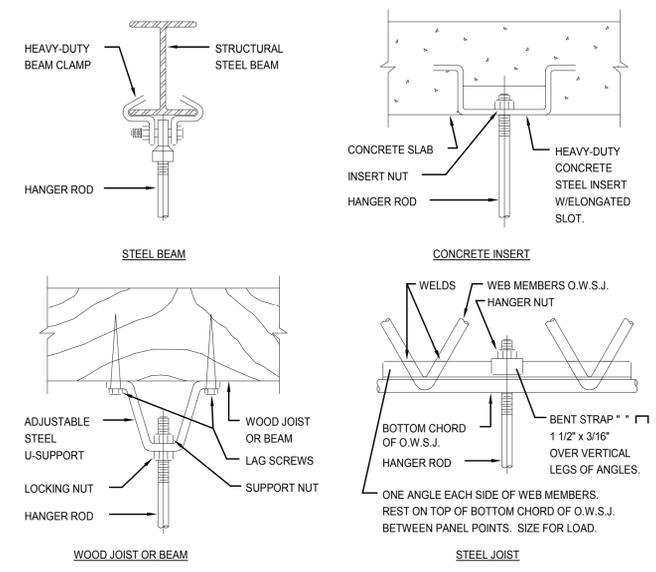
PIPE INSULATION SHIELD SCHEDULE		
PIPE SIZE	LENGTH	GAUGE
UP TO 3/4"	8"	20 GA.
1" - 2"	12"	18 GA.
2 1/2" - 4"	12"	16 GA.
5" & 6"	18"	16 GA.
8" & UP	24"	14 GA.

NOTE: 1. CONFER WITH ARCHITECT AND REFER TO STRUCTURAL DRAWINGS FOR ADDITIONAL INFORMATION ON ACCEPTABLE METHODS AND LOCATIONS FOR HANGER SUPPORTS.



M009 - TYPICAL PIPE HANGER DETAILS

1 TYPICAL PIPE HANGER DETAILS
ME1.1 N.T.S.



M008 - PIPE HANGER DETAILS

SUPPORT HORIZONTAL STEEL AND COPPER PIPING AS FOLLOWS:

NOMINAL PIPE SIZE	DISTANCE BETWEEN SUPPORTS	HANGER ROD DIAMETERS
1/2"	6'	3/8"
3/4 TO 1-1/2"	6'	1/2"
2" TO 2-1/2"	10'	1/2"
3" AND 4"	12'	5/8"
6" TO 12"	14'	7/8"
14" TO 18"	20'	1"

PLACE HANGER WITHIN 1 FOOT OF EACH HORIZ. ELBOW. SUPPORT HORIZ. SOIL WASTE AND STORM PIPE NEAR EACH HUB, WITH 5 FEET MAXIMUM SPACING BETWEEN HANGERS.

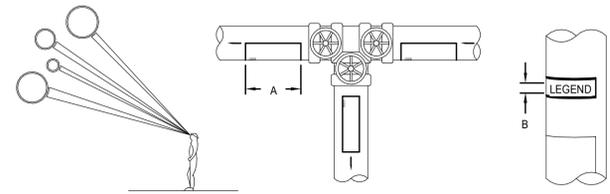
VERTICAL PIPING:

- SUPPORT VERTICAL WATER PIPING AT EVERY FLOOR.
- SUPPORT VERTICAL SOIL PIPE AT EACH FLOOR AT HUB.

WHERE SEVERAL PIPES CAN BE INSTALLED IN PARALLEL AND AT SAME ELEVATION PROVIDE MULTIPLE OR TRAPEZE HANGERS.

WHERE PRACTICAL, SUPPORT RISER PIPING INDEPENDENTLY OF CONNECTED HORIZ. PIPING.

2 PIPE HANGER DETAILS
ME1.1 N.T.S.



NOTE: IDENTIFICATION MARKERS OR STRIPS TO BE PLACED ON ALL EXPOSED COVERED AND UNCOVERED PIPES AT 50'-0" INTERVALS, ADJACENT TO ALL VALVES OR BRANCHES, AND AT BOTH SIDES OF WALL/FLOOR PENETRATIONS. ARROWS OF SAME COLOR AS IDENTIFICATION MARKERS SHALL ALSO BE PLACED ON PIPES POINTING AWAY FROM MARKER INDICATING DIRECTION OF FLOW.

SIZE OF LEGEND LETTERS

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD A	SIZE OF LETTERS B
3/4" TO 1 1/4"	8"	1/2"
1 1/2" TO 2"	8"	3/4"
2 1/2" TO 6"	12"	1 1/4"
8" TO 10"	24"	2 1/2"

SERVICE	BACKGROUND OR COLOR BAND	IDENTIFICATION MARKER
CHILLED WATER SUPPLY	GREEN	WHITE ON GREEN
CHILLED WATER RETURN	GREEN	WHITE ON GREEN
CONDENSATE	YELLOW	BLACK ON YELLOW
HOT WATER HEATING SUPPLY	YELLOW	BLACK ON YELLOW
HOT WATER HEATING RETURN	YELLOW	BLACK ON YELLOW
REFRIGERANT SUCTION	GREEN	WHITE ON GREEN
REFRIGERANT LIQUID	GREEN	WHITE ON GREEN
REFRIGERANT HOT GAS	GREEN	WHITE ON GREEN
NATURAL GAS	YELLOW	BLACK ON YELLOW
NATURAL GAS VENT	YELLOW	BLACK ON YELLOW
MAKE-UP WATER	GREEN	WHITE ON GREEN
SANITARY DRAIN	GREEN	WHITE ON GREEN
PLUMBING VENT	GREEN	WHITE ON GREEN
STORM WATER	GREEN	WHITE ON GREEN
CITY WATER	GREEN	WHITE ON GREEN
DOMESTIC COLD WATER	GREEN	WHITE ON GREEN
DOMESTIC HOT WATER	YELLOW	BLACK ON YELLOW
DOMESTIC HOT WATER CIRC.	YELLOW	BLACK ON YELLOW
FIRE PROTECTION (SPRINKLER)	RED	WHITE ON RED

3 TYPICAL PIPE IDENTIFICATION MARKERS
ME1.1 N.T.S.

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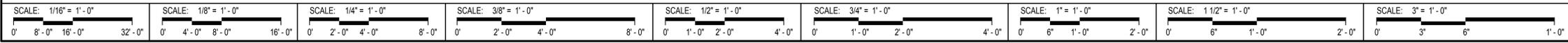
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DRAWING NOTES

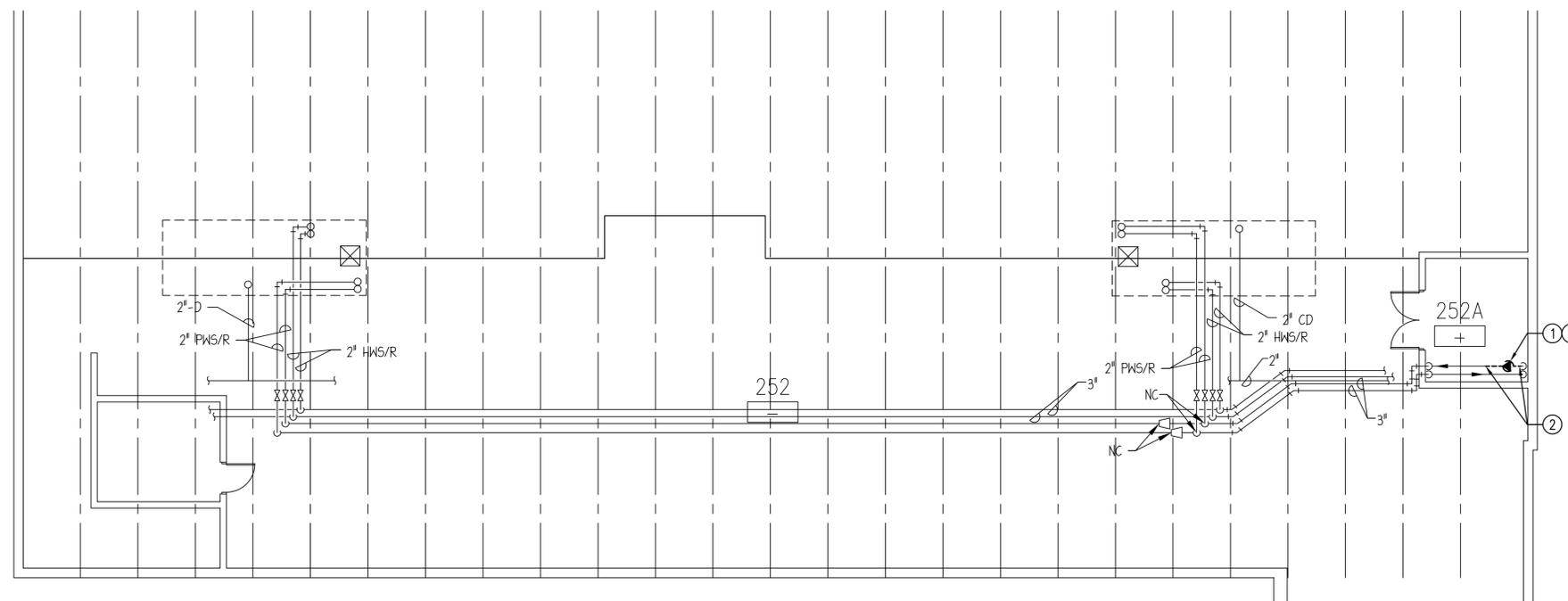
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MECHANICAL KEY NOTES:

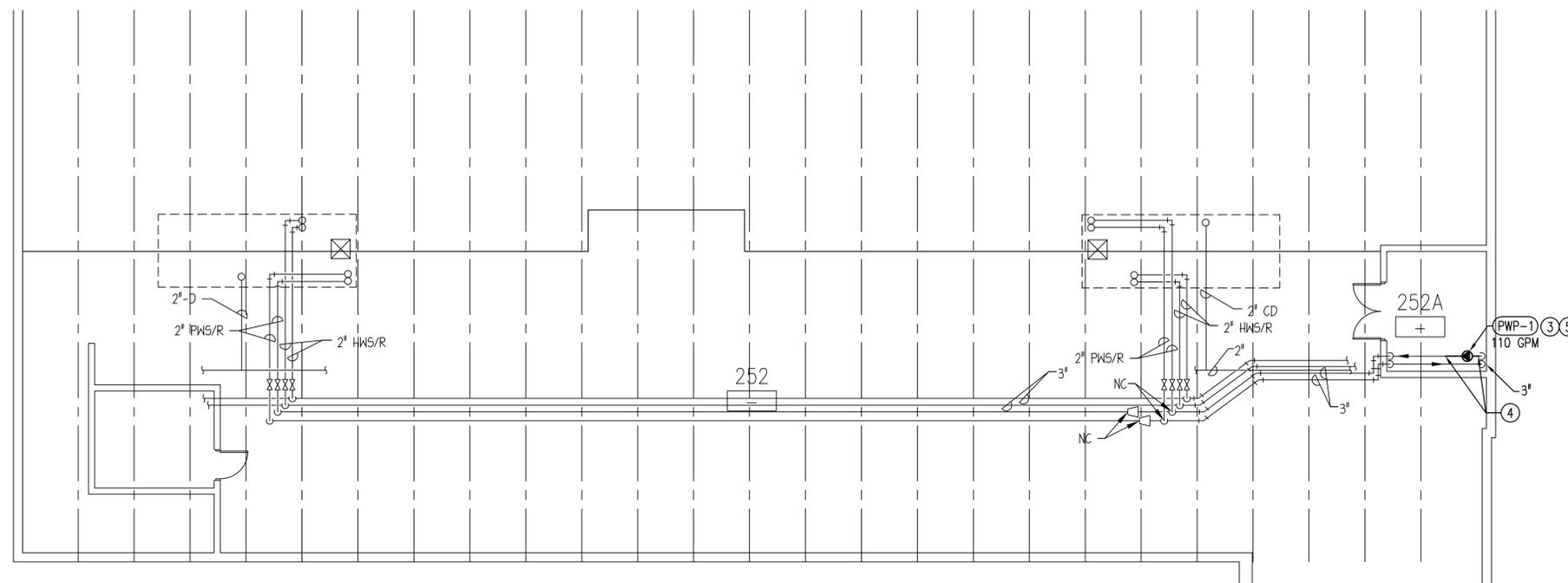
- ① DEMOLISH EXISTING POOL HEATING WATER PUMP AS INDICATED INCLUDING FITTING, VALVES, SUPPORT & HANGERS ETC.
- ② DEMOLISH EXISTING SECTION OF PIPING UPSTREAM & DOWNSTREAM OF POOL HEATING WATER PUMP AS INDICATED TO ALLOW FOR INSTALLATION OF NEW POOL HEATING WATER PUMP.
- ③ PROVIDE NEW POOL HEATING WATER PUMP PER SCHEDULE ON SHEET M5.0. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. SEE DETAIL #5/M6.0. COORDINATE WITH ELECTRICAL.
- ④ PROVIDE SECTION OF NEW PIPING UPSTREAM & DOWNSTREAM OF POOL HEATING WATER PUMP AS INDICATED. CONNECT TO EXISTING AT POINT SHOWN.

ELECTRICAL KEY NOTES:

- ⑤ REMOVE STARTER/ DISCONNECT SWITCH ASSOCIATED WITH EXISTING 2HP PUMP. PROVIDE NEW NEMA-0 COMBINATION STARTER FOR NEW 5HP PUMP. FVNR-STARTER WITH DISCONNECT SWITCH AND HAND ON/OFF AUTO CONTROL. EXTEND EXISTING WIRING AND CONDUIT TO FEED NEW 5 HP PUMP.



1 PARTIAL POOL AREA UPPER LEVEL PIPING DEMOLITION PLAN
M3.0 SCALE: 1/8" = 1'-0"



2 PARTIAL POOL AREA UPPER LEVEL PIPING NEW WORK PLAN
M3.0 SCALE: 1/8" = 1'-0"



REV	DESCRIPTION	DATE
	ISSUED FOR BID	01/18/17

DOWNERS GROVE NORTH

4436 Main St., Downers Grove, IL

NORTH HIGH POOL AREA UPPER PIPING PLAN

Project Number:
02-5274-32
Drawn By:
J. VALMIK
Sheet:

n-ME1.2



Wight

Wight & Company
wightco.com
2500 North Frontage Road
Darien, IL 60561
P 630.969.7000
F 630.969.7979

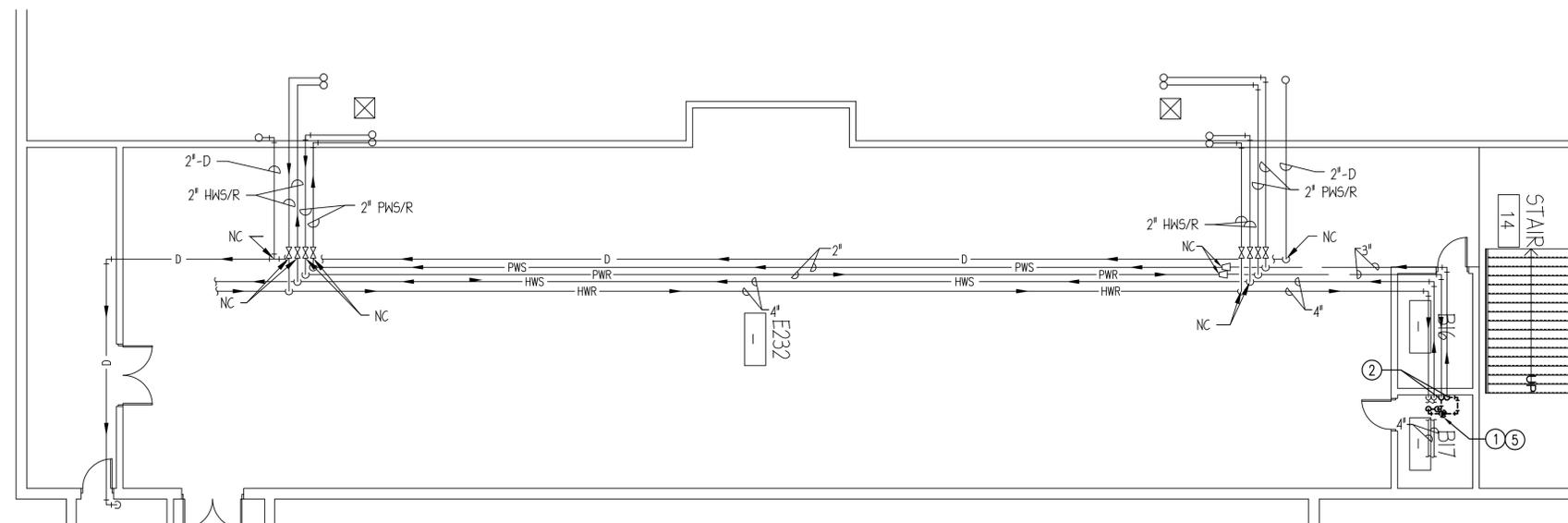
DRAWING NOTES (TYPICAL FOR THIS DRAWING ONLY)

MECHANICAL KEY NOTES:

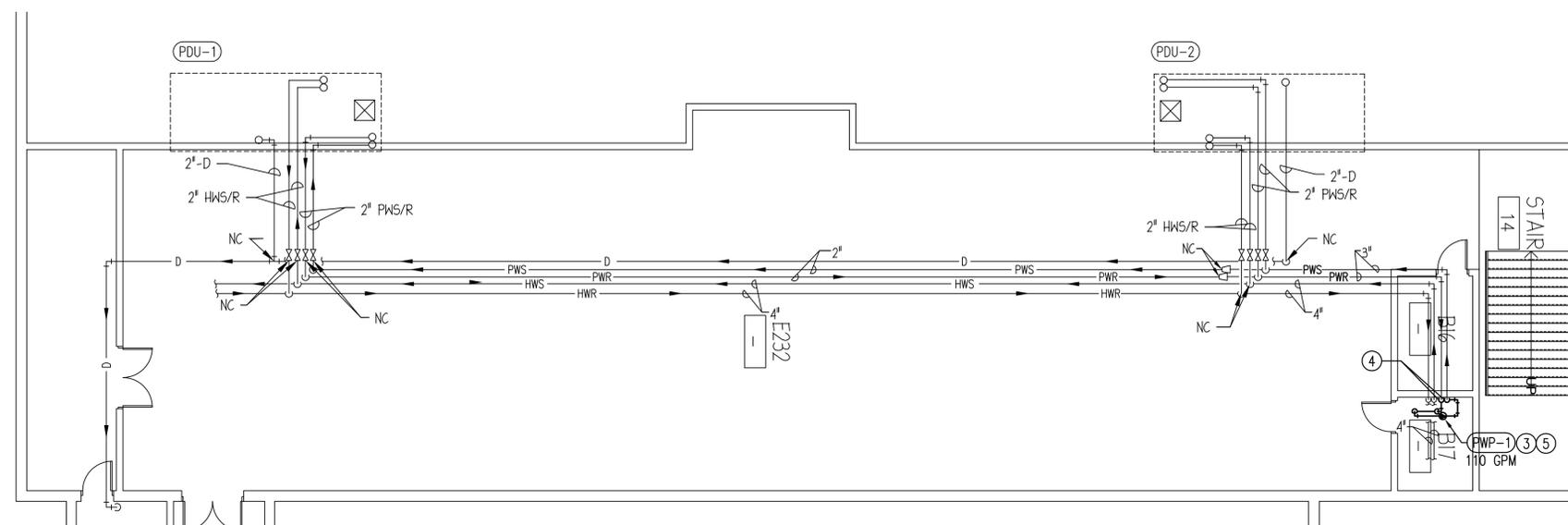
- 1 DEMOLISH EXISTING POOL HEATING WATER PUMP AS INDICATED INCLUDING FITTING, VALVES, SUPPORT & HANGERS ETC.
- 2 DEMOLISH EXISTING SECTION OF PIPING UPSTREAM & DOWNSTREAM OF POOL HEATING WATER PUMP AS INDICATED TO ALLOW FOR INSTALLATION OF NEW POOL HEATING WATER PUMP.
- 3 PROVIDE NEW POOL HEATING WATER PUMP PER SCHEDULE ON SHEET M5.0. INSTALL PER MANUFACTURER'S INSTALLATION INSTRUCTIONS. SEE DETAIL #5/M6.0. COORDINATE WITH ELECTRICAL.
- 4 PROVIDE SECTION OF NEW PIPING UPSTREAM & DOWNSTREAM OF POOL HEATING WATER PUMP AS INDICATED. CONNECT TO EXISTING AT POINT SHOWN.

ELECTRICAL KEY NOTES:

- 5 REMOVE STARTER/ DISCONNECT SWITCH ASSOCIATED WITH EXISTING 2HP PUMP. PROVIDE NEW NEMA-0 COMBINATION STARTER FOR NEW 5HP PUMP. FVAR-STARTER WITH DISCONNECT SWITCH AND HAND ON/OFF AUTO CONTROL. EXTEND EXISTING WIRING AND CONDUIT TO FEED NEW 5 HP PUMP.



1 POOL AREA UPPER LEVEL PIPING DEMOLITION PLAN
M3.0 SCALE: 1/8" = 1'-0"



1 POOL AREA UPPER LEVEL PIPING NEW WORK PLAN
M3.0 SCALE: 1/8" = 1'-0"



REV	DESCRIPTION	DATE
	ISSUED FOR BID	01/18/17

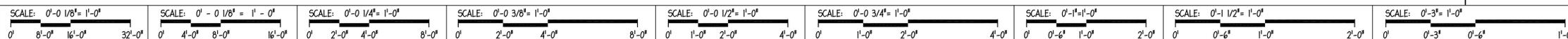
DOWNERS GROVE SOUTH

1436 Norfolk St, Downers Grove, Illinois 60516

SOUTH HIGH POOL AREA UPPER LEVEL PIPING PLAN

Project Number:
02-5274-32
Drawn By:
Wight & Co. MEP
Sheet:

s-ME1.3



3/18/2014 3:24:19 PM C:\Users\shahant\Documents\02-5274-32\Downers Grove_South High Pool Area Upper Level Piping Plan_REV17.rvt, 2/17/17, Centric_Markham.rvt
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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with

indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: **Class F**.
- J. Code Letter Designation:
 - 1. Motors **15** HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than **15** HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes **324T** and larger; rolled steel for motor frame sizes smaller than **324T**.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 5. All motors with variable frequency controllers shall be premium efficiency type.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20-psig.
 - 3. Sealing Elements: EPDM-rubber or Nitrile (Buna N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 - 4. Pressure Plates: Carbon steel.
 - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description:
 - 1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
 - 2. Plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable

(self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space

between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeve-seal fittings.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls Above Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves and Sleeve-seal fittings.
 - 2. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.

END OF SECTION 230517

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

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. Liquid-in-glass thermometers.
 - 2. Duct-thermometer mounting brackets.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.
 - 6. Test plugs.
 - 7. Test-plug kits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers:
 - a. Terrice, H.O. Co
 - b. Miljoco Corporation
 - c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation
 - c. Tel-Tru Manufacturing Company
 - d. Watts Instruments, Inc.
 - e. WICA Instrument Corporation
2. Standard: ASME B40.200.
3. Case: Plastic; 6-inch nominal size.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI.
 4. Material for Use with Steel Piping: CRES.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1 ASME B1.20.1 pipe threads.
 7. Internal Threads: 3/4 with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowells internal screw thread to size of thermometer connection.

2.4 DIAL-TYPE PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 1. Manufacturers:
 - a. Ashcroft, Inc.
 - b. Flo Fab Inc
 - c. Miljoco Corporation
 - d. Tel-Tru Manufacturing Corporation
 - e. Trerice, H.O. Company
 - f. Watts Instruments, Inc.
 - g. WICA Instruments Corporation
 2. Standard: ASME B40.100.
 3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Brass.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers:
 - a. Ashcroft, Inc.
 - b. Flo Fab Inc
 - c. Miljoco Corporation
 - d. Tel-Tru Manufacturing Corporation
 - e. Trerice, H.O. Company
 - f. Watts Instruments, Inc.
 - g. WICA Instruments Corporation
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Manufacturers:
 1. Flow Design Inc.
 2. Miljoco Corporation
 3. Trerice, H.O. Company
 4. Watts Instruments, Inc.
- B. Description: Test-station fitting made for insertion in piping tee fitting.

- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

- A. Manufacturers:
 - 1. Flow Design Inc.
 - 2. Miljoco Corporation
 - 3. Terrice, H.O. Company
 - 4. Watts Instruments, Inc.
- B. Furnish one test-plug kit containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- D. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and syphon fitting in piping for each pressure gage for steam.

- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic coil in air-handling units.
 - 3. Outside-, return-, supply-, and mixed-air ducts.
- J. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Suction and discharge of each pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:
 - 1. Direct-mounted, metal or plastic-case, vapor-actuated type.
 - 2. Compact-style, liquid-in-glass type.
 - 3. Test plug with EPDM self-sealing rubber inserts.
- A. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
 - 1. Direct-mounted, metal or plastic-case, vapor-actuated type.
 - 2. Compact-style, liquid-in-glass type.
 - 3. Test plug with EPDM self-sealing rubber inserts.
- B. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
 - 1. Direct-mounted, metal or plastic-case, vapor-actuated type.
 - 2. Compact-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.
- C. Scale Range for Air Ducts: Minus 40 to plus 110 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
 - 3. Test plug with EPDM self-sealing rubber inserts.
- B. Pressure gages at suction and discharge of each pump shall be one of the following:
 - 1. Liquid-filled, direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
 - 3. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 200 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 200 psi.

END OF SECTION 230519

SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

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. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Iron ball valves

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.1 for power piping valves.
 - 7. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Refer to HVAC valve schedule articles for applications of valves.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handle of non thermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.
- H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

- A. Brass Ball Valves, One-Piece:
 - 1. Manufacturers:
 - a. Apollo Valves

- b. Kitz Corporation
- c. Approved Equal

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 400 psig.
- c. Body Design: One piece.
- d. Body Material: Forged brass.
- e. Ends: Threaded.
- f. Seats: PTFE.
- g. Stem: Brass.
- h. Ball: Chrome-plated brass.
- i. Port: Reduced.

B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim:

1. Manufacturers:

- a. Apollo Valves
- b. Crane
- c. Hammond Valves
- d. Jomar Valve

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

- a. Hammond Valves
- b. Jamesbury
- c. Legend Valve and fittings
- d. Milwaukee Valve Company
- e. NIBCO Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.

- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One-Piece with Bronze Trim:

1. Manufacturers:

- a. Apollo Valves
- b. NIMCO Inc.
- c. Watts

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 400 psig.
- c. Body Design: One piece.
- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE.
- g. Stem: Bronze.
- h. Ball: Chrome-plated brass.
- i. Port: Reduced.

B. Bronze Ball Valves, Two-Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers:

- a. Apollo Valves
- b. Crane
- c. Hammond Valves
- d. Legend Valve & Fittings

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

1. Manufacturers:
 - a. Apollo Valves
 - b. Hammond Valves
 - c. Lance Valves
 - d. Milwaukee Valve Co.,
 - e. NIBCO, Inc.

2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.4 IRON BALL VALVES

A. Iron Ball Valves, Class 125:

1. Manufacturers:
 - a. American Valve Inc.
 - b. Apollo Valves
 - c. KITZ Corporation
 - d. Watts

2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Brass or bronze ball valves, one or two piece, with brass or bronze trim, and regular port.
 - 1. Valves may be provided with solder-joint ends instead of threaded ends.
- B. Pipe NPS 2-1/2:
 - 1. Iron ball valves, Class 125.
 - a. Iron Valves, NPS 2-1/2: May be provided with threaded ends instead of flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Brass or bronze ball valves, one or two piece with brass or bronze trim, and full or regular port.
 - 1. Valves may be provided with solder-joint ends instead of threaded ends.
- B. Pipe NPS 2-1/2:
 - 1. Iron ball valves, Class 125.
 - a. Iron Valves, NPS 2-1/2: May be provided with threaded ends instead of flanged ends.

END OF SECTION 230523.12

SECTION 230523.13 - BUTTERFLY VALVES FOR HVAC PIPING

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. Iron, single-flange butterfly valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B16.5 for pipe flanges and flanged fittings, NPS 1/2 through NPS 24.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.1 for power piping valves.
 - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions with extended necks.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:
 - 1. Manufacturers:
 - a. Apollo Valves
 - b. Hammond Valves
 - c. Jenkins Valves
 - d. Milwaukee Valve Company
 - e. NIBCO, Inc.
 - f. Spence
 - g. Watts
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:

1. Manufacturers:

- a. Apollo Valves
- b. Hammond Valves
- c. Jenkins Valves
- d. Milwaukee Valve Company
- e. NIBCO, Inc.
- f. Spence
- g. Watts

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated ductile iron.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Larger:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: Aluminum-bronze disc, 200 CWP, and EPDM seat.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Larger:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: Aluminum-bronze or Ductile-iron disc, 200 CWP, and EPDM seat.

END OF SECTION 230523.13

SECTION 230523.14 - CHECK VALVES FOR HVAC PIPING

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. Bronze swing check valves.
 - 2. Iron swing check valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B16.18 for solder joint.
 - 5. ASME B31.1 for power piping valves.
 - 6. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
 - 1. Manufacturers:
 - a. Apollo Valves
 - b. Crane
 - c. Jenkins Valves
 - d. KITZ Corporation
 - e. Milwaukee Valve Company
 - f. NIBCO, Inc.
 - g. Stockham
 - 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.

- e. Ends: Threaded.
- f. Disc: Bronze.

B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:

1. Manufacturers:

- a. Hammond
- b. Crane
- c. Jenkins Valves
- d. KITZ Corporation
- e. Milwaukee Valve Company
- f. Watts.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE.

2.3 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Nonmetallic-to-Metal Seats, Class 125:

1. Manufacturers:

- a. Hammond
- b. Crane
- c. Milwaukee Valve Company
- d. Stockham.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.
- i. Disc: PTFE.
- j. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
- F. Install valve tags. Comply with requirements for valve tags and schedules in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:

- a. NPS 2 and Smaller: Bronze swing check valves with bronze or non-metallic disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.
- B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze swing check valves with bronze or nonmetallic disc, Class 150.
- B. Pipe NPS 2-1/2 and Larger:
1. NPS 2-1/2 to NPS 4: Iron valves may be provided with threaded ends instead of flanged ends.
 2. NPS 2-1/2 to NPS 12: Iron swing check valves with lever and weight closure control, Class 125.

3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze swing check valves with bronze or nonmetallic disc, Class 125.
- B. Pipe NPS 2-1/2 and Larger:
1. NPS 2-1/2 to NPS 4: Iron valves may be provided with threaded ends instead of flanged ends.
 2. NPS 2-1/2 to NPS 12: Iron swing check valves with lever and weight-closure control, Class 125.

END OF SECTION 230523.14

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.
- 4. Pipe stands.
- 5. Equipment supports.

- B. Related Sections:

- 1. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
- 2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.

4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Metallic Coating: Hot-dipped galvanized.
7. Paint Coating: Epoxy.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 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 a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel [pipe hangers and supports] [metal trapeze pipe hangers] [and] [metal framing systems] and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 4. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 5. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 - 6. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

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. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Housed-spring isolators.
 - 4. Housed-restrained-spring isolators.
 - 5. Pipe-riser resilient supports.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Vibration isolation equipment bases.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation device.
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 2. Size: Factory or field cut to match requirements of supported equipment.
 - 3. Pad Material: Oil and water resistant with elastomeric properties.
 - 4. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
 - 5. Infused nonwoven cotton or synthetic fibers.
 - 6. Load-bearing metal plates adhered to pads.
 - 7. Sandwich-Core Material: [Resilient] [and] [elastomeric] <Insert compound>.
 - a. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts: <Insert drawing designation>.
 - 1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded[with threaded studs or bolts].
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.4 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: .
 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.5 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.6 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.7 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.8 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete"

END OF SECTION 230548.13

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers:
 - a. Brady Corporation
 - b. Carlton Industries

- c. Craftmark Paper Markers
 - d. Kolbi Pipe Marker Co.
 - e. LEM products, Inc.
 - f. Marking Services, Inc.
 - g. Seton Identification Products
 2. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 3. Letter Color: Black.
 4. Background Color: Yellow.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
1. Manufacturers:
 - a. Brady Corporation
 - b. Carlton Industries
 - c. Craftmark Paper Markers
 - d. Kolbi Pipe Marker Co.
 - e. LEM products, Inc.
 - f. Marking Services, Inc.
 - g. Seton Identification Products
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 3. Letter Color: Black.
 4. Background Color: White.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 8. Fasteners: Stainless-steel rivets or self-tapping screws.
 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

1. Manufacturers:

- a. Brady Corporation
- b. Carlton Industries
- c. Craftmark Paper Markers
- d. LEM products, Inc.
- e. Marking Services, Inc.
- f. Seton Identification Products
- g. Stranco, Inc.

- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Red.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

1. Manufacturers:

- a. Brady Corporation
- b. Carlton Industries
- c. Craftmark Paper Markers
- d. Kolbi Pipe Marker Co.

- e. LEM products, Inc.
 - f. Marking Services, Inc.
 - g. Seton Identification Products
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
- 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

- 1. Manufacturers:
 - a. Brady Corporation
 - b. Carlton Industries
 - c. Craftmark Paper Markers
 - d. Kolbi Pipe Marker Co.
 - e. LEM products, Inc.
 - f. Marking Services, Inc.
 - g. Seton Identification Products
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: Blue.
- D. Background Color: Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.

- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 VALVE TAGS

- 1. Manufacturers:
 - a. Brady Corporation
 - b. Carlton Industries
 - c. Craftmark Paper Markers
 - d. Kolbi Pipe Marker Co.
 - e. LEM products, Inc.
 - f. Marking Services, Inc.
 - g. Seton Identification Products
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- 1. Manufacturers:
 - a. Brady Corporation
 - b. Carlton Industries
 - c. Craftmark Paper Markers
 - d. Kolbi Pipe Marker Co.
 - e. LEM products, Inc.
 - f. Marking Services, Inc.
 - g. Seton Identification Products

- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Heating Water Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

A. Install [plastic-laminated] [self-adhesive] duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Chilled Water: 2 inches, round.
- b. Hot Water: 2 inches, round.

2. Valve-Tag Colors:

- a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
- b. Flammable Fluids: Black letters on a safety-yellow background.
- c. Combustible Fluids: White letters on a safety-brown background.
- d. Potable and Other Water: White letters on a safety-green background.

- e. Compressed Air: White letters on a safety-blue background.
- f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - b. Heat-transfer coils.
5. Testing, adjusting, and balancing existing systems and equipment.
6. Sound tests.
7. Vibration tests.
8. Duct leakage tests.
9. Control system verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.

- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 15 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. TAB Specialists Qualifications: Certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.

2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.
- 3.2 PREPARATION
- A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
 2. Strategies and step-by-step procedures for balancing the systems.
 3. Instrumentation to be used.
 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Piping is complete with terminals installed.
 - c. Water treatment is complete.
 - d. Systems are flushed, filled, and air purged.
 - e. Strainers are pulled and cleaned.
 - f. Control valves are functioning per the sequence of operation.
 - g. Shutoff and balance valves have been verified to be 100 percent open.
 - h. Pumps are started and proper rotation is verified.
 - i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - j. Variable-frequency controllers' startup is complete and safeties are verified.
 - k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

- d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
 - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:

- a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
 - d. Mark final settings.
 - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
 - f. Verify tracking between supply and return fans.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
 1. Check liquid level in expansion tank.
 2. Check highest vent for adequate pressure.
 3. Check flow-control valves for proper position.
 4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 5. Verify that motor starters are equipped with properly sized thermal protection.
 6. Check that air has been purged from the system.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust pumps to deliver total design gpm.
 - 1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
 - 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gage heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
 - 3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
 - 1. Measure flow at terminals.
 - 2. Adjust each terminal to design flow.
 - 3. Re-measure each terminal after it is adjusted.
 - 4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
 - 5. Perform temperature tests after flows have been balanced.
- D. For systems without pressure-independent valves or flow-measuring devices at terminals:
 - 1. Measure and balance coils by either coil pressure drop or temperature method.
 - 2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- E. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

F. Verify that memory stops have been set.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.
- B. Adjust the variable-flow hydronic system as follows:
1. Verify that the differential-pressure sensor is located as indicated.
 2. Determine whether there is diversity in the system.

3.10 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
- B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.12 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 10 locations as designated by the Architect.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.

7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:
 - a. Location.
 - b. System tested.
 - c. dBA reading.
 - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.13 VIBRATION TESTS

- A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10.
- B. Instrumentation:
 1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
 2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
 3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
 4. Verify calibration date is current for vibration meter before taking readings.
- C. Test Procedures:
 1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
 2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
 3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
 4. Record CPM or rpm.
 5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.14 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.

3.15 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 1. Verify temperature control system is operating within the design limitations.
 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 3. Verify that controllers are calibrated and function as intended.
 4. Verify that controller set points are as indicated.
 5. Verify the operation of lockout or interlock systems.
 6. Verify the operation of valve and damper actuators.
 7. Verify that controlled devices are properly installed and connected to correct controller.
 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.16 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.
- 3.17 TOLERANCES
- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 4. Cooling-Water Flow Rate: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.18 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.

- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Cooling-coil static-pressure differential in inches wg.
- g. Heating-coil static-pressure differential in inches wg.
- h. Outdoor airflow in cfm.
- i. Return airflow in cfm.
- j. Outdoor-air damper position.
- k. Return-air damper position.
- l. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Hot Deck, Leaving-air dry bulb temperature in deg F.
- i. Cold Deck, Leaving-air, wet- and dry-bulb temperature in deg F.
- j. Water flow rate in gpm.
- k. Water pressure differential in feet of head or psig.
- l. Entering-water temperature in deg F.
- m. Leaving-water temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.
- h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Suction static pressure in inches wg.

H. Round, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

- a. System and air-handling-unit number.
- b. Location and zone.
- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft.
- g. Indicated airflow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual airflow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.

I. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

J. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.20 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.

- B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
 - 3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

3.21 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

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 insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 5. Outdoor, concealed supply and return.
 - 6. Outdoor, exposed supply and return.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sheet Form Insulation Materials: 12 inches square.

2. Sheet Jacket Materials: 12 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Manufacturers:
 - a. Armaflex USA, Inc.
 - b. Armacell, LLC
 - c. K Flex USA
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I.
 - 1. Manufacturers:
 - a. CertainTeed Corporation
 - b. Johns Manville
 - c. Knauf Insulation
 - d. Manson Insulation, Inc.

e. Owens Corning

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket.

1. Manufacturers:

- a. CertainTeed Corporation
- b. Johns Manville
- c. Knauf Insulation
- d. Manson Insulation, Inc.
- e. Owens Corning

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers:

- a. Armaflex USA, Inc.
- b. Armacell, LLC
- c. Foster Brand; H.B. Fuller
- d. K Flex USA

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers:

- a. Childers Brand
- b. Eagle Bridges
- c. Foster Brand; H.B. Fuller
- d. Mon-Eco Industries, Inc.

- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers:

- a. Childers Brand
- b. Eagle Bridges
- c. Foster Brand; H.B. Fuller
- d. Mon-Eco Industries, Inc.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Manufacturers:
 - a. Childers Brand
 - b. Foster Brand; H.B. Fuller
 - c. Knauf Insulation
 - d. Vimasco Corporation
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Manufacturers:
 - a. Childers Brand
 - b. Foster Brand; H.B. Fuller
 - c. Vimasco Corporation
 - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 3. Service Temperature Range: 0 to plus 180 deg F.
 - 4. Color: White.

2.5 SEALANTS

- A. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
 - 1. Manufacturers:
 - a. Childers Brand
 - b. Foster Brand; H.B. Fuller
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
 - 1. Manufacturers:
 - a. Childers Brand
 - b. Foster Brand; H.B. Fuller
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Manufacturers:
 - a. Foster Brand; H.B. Fuller
 - b. Vimasco Corporation

2.7 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
 - 1. Manufacturers:
 - a. Alpha Associates, Inc.
 - b. Foster Brand; H.B. Fuller

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Manufacturers:
 - a. Avery Dennison Corporation
 - b. Compac Corporation
 - c. Ideal Tape Co., Inc.
 - d. Knauf Insulation
 - e. Venture Tape

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers:

- a. Avery Dennison Corporation
- b. Compac Corporation
- c. Ideal Tape Co., Inc.
- d. Knauf Insulation
- e. Venture Tape

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers:

- a. ITW Insulation Systems
- b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated.

a. Manufacturers:

- 1) AGM Industries, Inc.

- 2) Gemco
 - 3) Harcast, Inc.
 - 4) Midwest Fasteners
 - 5) Nelson Stud Welding
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
- a. Manufacturers:
 - 1) AGM Industries, Inc.
 - 2) Gemco
 - 3) Harcast, Inc.
 - 4) Midwest Fasteners
 - 5) Nelson Stud Welding
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Manufacturers:
 - 1) AGM Industries, Inc.
 - 2) Gemco
 - 3) Midwest Fasteners
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.
1. Manufacturers:
 - a. C&F Wire

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, exposed supply and outdoor air.
 - 2. Indoor, exposed return located in unconditioned space.
 - 3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 5. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums and casings.
 - 4. Flexible connectors.
 - 5. Vibration-control devices.
 - 6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Exposed, round supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
- B. Exposed, round return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

- C. Exposed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
- D. Exposed, rectangular, return-air duct insulation shall be[one of] the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- E. Exposed, rectangular, outdoor-air duct insulation shall be[one of] the following:
 - 1. Flexible Elastomeric: 1-1/2 inch thick.
 - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
- F. Exposed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- G. Exposed, supply-air plenum insulation shall be[one of] the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density.
- H. Exposed, return-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- I. Exposed, outdoor-air plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Exposed:
 - 1. None.
 - 2. FSK aluminum foil face.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

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 insulating the following HVAC piping systems:

1. Heating hot-water piping, indoors.
2. Chilled water piping, indoors
3. Condensate Piping, indoors

- B. Related Sections:

1. Division 23 Section "Duct Insulation."
2. Division 23 Section "Hydronic Piping"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I.
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Ramco Insulation, Inc.; Super-Stik.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SEALANTS

- A. Joint Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 4. Color: White or gray.
 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White Color-code jackets based on system. Color as selected by Architect.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- #### A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- #### B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for

appropriate coating materials and application methods for operating temperature range.

- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- N. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.

3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.12 INDOOR PIPING INSULATION SCHEDULE (Based on IECC 2015)

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 1-1/2" and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
 - 2. NPS 2" and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.
- C. Chilled-Water Supply and Return, 100 Deg F and Below:
 - 1. NPS 1-1/2" and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
 - b. Flexible Elastomeric: 1 inch thick
 - 2. NPS 2" and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
 - b. Flexible Elastomeric: 1 inch thick

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 - 1. PVC: 20 mils thick.

END OF SECTION 230719

SECTION 230923.12 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following types of control dampers and actuators for DDC systems:
 - 1. Rectangular control dampers.
 - 2. General control-damper actuator requirements (By Precision controls directly with School District, not part of this project)
 - 3. Electric and electronic actuators (By Precision controls directly with School District, not part of this project)

1.3 DEFINITIONS

- A. DDC: Direct-digital control.
- B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 - 3. Product description with complete technical data, performance curves, and product specification sheets.
 - 4. Installation instructions, including factors affecting performance.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.

2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control dampers and actuators, including the following.
 - a. Flow at project design and minimum flow conditions.
 - b. Face velocity at project design and minimum airflow conditions.
 - c. Pressure drop across damper at project design and minimum airflow conditions.
 - d. AMCA 500D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
 - e. Maximum close-off pressure.
 - f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
 - g. Torque required at worst case condition for sizing actuator.
 - h. Actuator selection indicating torque provided.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Product installation location shown in relationship to room, duct, and equipment.
 2. Size and location of wall access panels for control dampers and actuators installed behind walls.
 3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- D. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- E. Environmental Conditions:
 - 1. Provide electric control-damper actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control-damper actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.
 - a. Hazardous Locations: Explosion-proof rating for condition.
 - 2. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
 - 3. Select modulating dampers for a pressure drop of 5 percent of fan total static pressure unless otherwise indicated.
 - 4. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

- A. General Requirements:
 - 1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
 - 2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
 - 3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.
- B. Rectangular Dampers with Aluminum Airfoil Blades:

1. Manufacturers:
 - a. TAMCO Series 1500
 - b. Approved Equal
2. Performance:
 - a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure.
 - b. Pressure Drop: 0.05-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
 - c. Velocity: Up to 6000 fpm.
 - d. Temperature: Minus 40 to plus 185 deg F.
 - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
 - f. Damper shall have AMCA seal for both air leakage and air performance.
3. Construction:
 - a. Frame:
 - 1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.07 inch thick.
 - 2) Hat-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
 - 3) Width not less than 5 inches.
 - b. Blades:
 - 1) Hollow, airfoil, extruded aluminum.
 - 2) Parallel or opposed blade configuration as required by application.
 - 3) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.07 inch thick.
 - 4) Width not to exceed 6 inches.
 - 5) Length as required by close-off pressure, not to exceed 48 inches.
 - c. Seals:
 - 1) Blades: Replaceable, mechanically attached extruded silicone, vinyl, or plastic composite.
 - 2) Jambs: Stainless steel, compression type.
 - d. Axles: 0.5-inch- diameter plated steel, mechanically attached to blades.
 - e. Bearings:
 - 1) Molded synthetic or stainless-steel sleeve mounted in frame.
 - 2) Where blade axles are installed in vertical position, provide thrust bearings.
 - f. Linkage:
 - 1) Concealed in frame.

- 2) Constructed of aluminum and plated steel.
- 3) Hardware: Stainless steel.

g. Transition:

- 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
- 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
- 3) Damper size and sleeve shall be connection size plus 2 inches.
- 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
- 5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

- 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
- 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

C. Insulated Rectangular Dampers:

1. Manufacturers:

- a. TAMCO Series 9000
- b. Approved Equal

2. Performance:

- a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 3 cfm/sq. ft. against 1-in. wg differential static pressure and shall not exceed 4.9 cfm/sq. ft. against 4-in. wg differential static pressure at minus 40 deg F.
- b. Pressure Drop: 0.1-in. wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
- c. Velocity: Up to 4000 fpm.
- d. Temperature: Minus 100 to plus 185 deg F.
- e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

a. Frame:

- 1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch thick.
- 2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
- 3) Width not less than 4 inches.

- 4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
 - 5) Damper frame shall be insulated with polystyrofoam on four sides.
- b. Blades:
- 1) Hollow shaped, extruded aluminum.
 - 2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
 - 3) Parallel or opposed blade configuration as required by application.
 - 4) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.08 inch thick.
 - 5) Width not to exceed 6 inches.
 - 6) Length as required by close-off pressure, not to exceed 48 inches.
- c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.
- d. Axles: 0.44-inch- diameter plated steel, mechanically attached to blades.
- e. Bearings:
- 1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
 - 2) Where blade axles are installed in vertical position, provide thrust bearings.
- f. Linkage:
- 1) Concealed in frame.
 - 2) Constructed of aluminum and plated steel.
 - 3) Hardware: Stainless steel.
- g. Transition:
- 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
 - 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
 - 3) Damper size and sleeve shall be connection size plus 2 inches.
 - 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
 - 5) Sleeve material shall match adjacent duct.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

- A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

- B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
- C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
- E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
- F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- G. Provide mounting hardware and linkages for connecting actuator to damper.
- H. Select actuators to fail in desired position in the event of a power failure.
- I. Actuator Fail Positions: As indicated below:
 - 1. Exhaust Air: Close.
 - 2. Outdoor Air: Close.
 - 3. Supply Air: Open.
 - 4. Return Air: Open.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS (BY OTHERS)

- A. Type: Motor operated, with or without gears, electric and electronic.
- B. Voltage:
 - 1. 24 V.
 - 2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
 - 3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.
- C. Construction:
 - 1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 - 2. 100 up 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.
 - 3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
- D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
 2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.
- E. Two-Position Actuators: Single direction, spring return or reversing type.
- F. Modulating Actuators:
1. Capable of stopping at all points across full range, and starting in either direction from any point in range.
 2. Control Input Signal:
 - a. 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.
 - b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-V dc and 4- to 20-mA signals.
 - c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to a pulse duration (length) of signal from a dry-contact closure, triac sink or source controller.
 - d. Programmable Multi-Function:
 - 1) Control input, position feedback, and running time shall be factory or field programmable.
 - 2) Diagnostic feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
 - 3) Service data, including at a minimum, number of hours powered and number of hours in motion.
- G. Position Feedback:
1. Where indicated, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
 2. Where indicated, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
 3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.
- H. Fail-Safe:
1. Where indicated, provide actuator to fail to an end position.
 2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
 3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.
- I. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

J. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

K. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

L. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with a heater and controller where required by application.

M. Stroke Time:

1. Operate damper from fully closed to fully open within 60 seconds.
2. Operate damper from fully open to fully closed within 15 seconds.
3. Move damper to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

N. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL-DAMPER APPLICATIONS

- A. Control Dampers:
- B. Select from damper types indicated in "Control Dampers" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
 - 1. Rectangular Exhaust Air Duct Applications: Insulated rectangular dampers.
 - 2. Rectangular Outdoor Air Duct Applications: Insulated rectangular dampers.
 - 3. Rectangular Return Air Duct Applications: Rectangular dampers with aluminum airfoil blades.

3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
 - 1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
 - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL DAMPERS

- A. 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.
- B. Clearance:
 - 1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
 - 2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
- C. Service Access:
 - 1. Dampers and actuators shall be accessible for visual inspection and service.
 - 2. 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 Section 233300 "Air Duct Accessories."
- D. 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.
- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.6 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with damper identification on damper.

3.8 CHECKOUT PROCEDURES

- A. Control-Damper Checkout:
 - 1. Check installed products before continuity tests, leak tests, and calibration.
 - 2. Check dampers for proper location and accessibility.
 - 3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
 - 4. Verify that control dampers are installed correctly for flow direction.
 - 5. Verify that proper blade alignment, either parallel or opposed, has been provided.
 - 6. Verify that damper frame attachment is properly secured and sealed.
 - 7. Verify that damper actuator and linkage attachment are secure.
 - 8. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
 - 9. Verify that damper blade travel is unobstructed.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING:

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.12

SECTION 232113 - HYDRONIC PIPING

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 pipe and fitting materials and joining methods for the following:
 - 1. Copper tube and fittings.
 - 2. Steel pipe and fittings.
 - 3. Joining materials.
 - 4. Transition fittings.
 - 5. Dielectric fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Bypass chemical feeder.
- B. Delegated-Design Submittal:
 - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

E. Preconstruction Test Reports:

1. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on water quality.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Hot-Water Heating Piping: 100 psig at 180 deg F.
 - 2. Chilled-Water Piping: 150 psig at 73 deg F.
 - 3. Condensate-Drain Piping: 150 deg F.
 - 4. Air-Vent Piping: 180 deg F.
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.

2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 125 psig minimum at 180 deg F
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 125 psig minimum at 180 deg F.
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Description:

- a. Standard: IAPMO PS 66.
- b. Electroplated steel nipple, complying with ASTM F 1545.
- c. Pressure Rating: 300 psig at 225 deg F.
- d. End Connections: Male threaded or grooved.
- e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

- 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
 3. joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- E. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- F. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.

- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using [mechanically formed]tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to the following:
 - 1. Section 230523.11 "Globe Valves for HVAC Piping."
 - 2. Section 230523.12 "Ball Valves for HVAC Piping."
 - 3. Section 230523.13 "Butterfly Valves for HVAC Piping."
 - 4. Section 230523.14 "Check Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet.
 - 2. NPS 1: Maximum span, 7 feet.
 - 3. NPS 1-1/2 : Maximum span, 9 feet.
 - 4. NPS 2: Maximum span, 10 feet.
 - 5. NPS 2-1/2: Maximum span, 11 feet.
 - 6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
 - J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
 - K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
 - L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

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 special-duty valves and specialties for the following:
 - 1. Hydronic specialty valves.
 - 2. Air-control devices.
 - 3. Strainers.
 - 4. Connectors.
- B. Related Requirements:
 - 1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for expansion fittings and loops.
 - 2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
 - 3. Section 230523.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
 - 4. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
 - 5. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Hydronic Specialty Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Strainers.
 - 4. Connectors.
 - 5. Chemical Treatment
 - 6. Test Equipment

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

- A. Bronze, Calibrated-Orifice, Balancing Valves:

- 1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
- 2. Ball: Brass or stainless steel.
- 3. Plug: Resin.
- 4. Seat: PTFE.
- 5. End Connections: Threaded or socket.
- 6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
- 7. Handle Style: Lever, with memory stop to retain set position.
- 8. CWP Rating: Minimum 125 psig.
- 9. Maximum Operating Temperature: 250 deg F.

- B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

- 1. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
- 2. Ball: Brass or stainless steel.
- 3. Stem Seals: EPDM O-rings.
- 4. Disc: Glass and carbon-filled PTFE.
- 5. Seat: PTFE.
- 6. End Connections: Flanged or grooved.
- 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.

8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

C. Automatic Flow-Control Valves:

1. Body: Brass or ferrous metal.
2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
7. Minimum CWP Rating: 175 psig.
8. Maximum Operating Temperature: 200 deg F

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

2.3 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.

4. CWP Rating: 125 psig

2.4 CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

2.5 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Manufacturers: Griswold Water Systems, Calgon, Wessels.

B. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

C. The mechanical contractor shall meter the initial water fill for the purpose of hydrostatic pressure testing and/or system flushing. After completion of this requirement the water shall be metered out. This will provide the contractor with a precise measure of coolant required to fill the system as well as the amount of water trapped in the system. This process will allow for any adjustments required prior to delivery of the premixed glycol solution and ensure that the solution strength is in compliance with the specification.

D. For buildings with an existing chemical treatment system, add chemicals as required to make up for loss of chemicals as a result of the new piping and equipment addition or replacement to the facility.

2.6 TEST EQUIPMENT

A. Furnish enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titration burettes and associated reagents.

B. Furnish following test kits:

1. Alkalinity titration test kit.
2. Chloride titration test kit.
3. Sulphite titration test kit.
4. Total hardness titration test kit.
5. Low phosphate test kit.
6. Conductivity bridge, range 0 - 10,000 micro-ohms.
7. Creosol red pH slide, complete with reagent.

8. Portable electronic conductivity meter.
9. High nitrite test kit.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

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. Close-coupled, in-line centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Armstrong Pump, Inc.
 - 2. Bell & Gossett, Inc.; ITT Corporation
 - 3. PACO Pumps
 - 4. Peerless Pump Company
 - 5. TACO Comfort Solutions
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
 - 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 - 3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
 - 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
 - 5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - 6. Pump Bearings: Permanently lubricated ball bearings.
- D. Motor: Single speed and rigidly mounted to pump casing.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.2 PUMP SPECIALTY FITTINGS

A. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
 1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration Controls for HVAC."
 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

- A. Perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install triple-duty valve and shutoff valve on discharge side of pumps.
- F. Install Y-type strainer and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

- A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 232923 – VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections:
 - 1. Division 26 Section "Motor-Control Centers" for VFCs installed in motor-control centers.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. IGBT: Insulated-gate bipolar transistor.
- F. LED: Light-emitting diode.
- G. MCP: Motor-circuit protector.
- H. NC: Normally closed.
- I. NO: Normally open.
- J. OCPD: Overcurrent protective device.
- K. PCC: Point of common coupling.
- L. PID: Control action, proportional plus integral plus derivative.
- M. PWM: Pulse-width modulated.

- N. RFI: Radio-frequency interference.
- O. TDD: Total demand (harmonic current) distortion.
- P. THD(V): Total harmonic voltage demand.
- Q. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of enclosed unit.
 - f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
 - g. Specified modifications.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs 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 thermal-magnetic circuit breaker and MCP trip settings.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without de-rating, under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
 - 3. Humidity: Less than 95 percent (non-condensing).
 - 4. Altitude: Not exceeding 3300 feet.

1.8 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 - 1. Torque, speed, and horsepower requirements of the load.
 - 2. Ratings and characteristics of supply circuit and required control sequence.
 - 3. Ambient and environmental conditions of installation location.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. The VFC shall be warranted by the manufacturer for a period of 24 months from date of shipment. The warranty shall include parts and labor expenses incurred by the manufacturer to provide factory authorized on-site service.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. ABB.
 2. Danfoss Inc.; Danfoss Drives Div.
 3. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 4. Emerson
 5. Siemens Energy & Automation, Inc.
 6. Square D; a brand of Schneider Electric.
 7. Toshiba International Corporation.
 8. Yaskawa Electric America, Inc; Drives Division

2.2 GENERAL

- A. Provide variable frequency drive package matched to motor being controlled. Ensure that motor being controlled has been manufactured per NEMA Standard MG1, Section 31.4 Inverter Duty Motors.
1. The standard Variable Frequency Controller (VFC) and all the optional modifications shall mount within a packaged NEMA 1 or NEMA 12 (1-60 HP @ 460 Volts, -25 HP @ 208 Volts) enclosure.
 2. All HP ratings shall meet or exceed Table 430-150 of the NEC, 3 Phase Motor Full Load Currents. HP, Maximum Current, and Rated Voltage shall appear on the drive nameplate.
 3. Provide output reactors as close to the input of the motor as possible if the lead distance between the motor and drive exceeds 150 feet. If the distance is less than 150 feet, additional equipment is not required. If the distance is greater than 600 feet, provide output filtering per the VFC manufacturer's recommendations.
 4. All VFC's shall be BACNET MS/TP compatible.

2.3 CODES AND STANDARDS

- A. VFC and options shall be installed in a UL 508A Listed industrial control panel. If required, the enclosed VFC shall be UL approved for mounting in conditioned air ducts and plenums per UL 1995. The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA, National Electric Code NEC, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, CE 96. VFC manufacturer shall be ISO 9001 certified.

2.4 DRIVE FUNCTIONS

- A. The VFC shall have the following basic features:

1. An electronic overload circuit designed to protect an AC motor operated by the VFC output from extended overload operation on an inverse time basis. This electronic overload shall be UL and NEC recognized as adequate motor protection. No additional hardware such as motor overload relays or motor thermostats shall be required.
2. An LCD display mounted on the door of the cabinet that digitally indicates:
 - a. Frequency output
 - b. Voltage output
 - c. Current output
 - d. Motor RPM
 - e. Input kW
 - f. Elapsed Time
 - g. Time Stamped Fault Indication
 - h. DC Bus Volts
3. The VFC shall have the capability of riding through power dips up to 10 seconds without a controller trip depending on load and operating condition. In this extended ride through, the drive shall use the energy generated by the rotating fan as a power source for all electronic circuits.
4. RS232 Port and Windows based software for Configuration, Control, and Monitoring.
5. An isolated 0-20mA, 4-20mA or 0-4, 0-8, 0-10 volt analog speed input follower.
6. An isolated 0-10 V or 4-20mA output signal proportional to speed or load.

2.5 PROTECTIVE CIRCUITS AND FEATURES

- A. The VFD shall include the following protective circuits and features:
 1. Motor current exceeds 180% of drive continuous current rating.
 2. Output phase-to-phase short circuit condition.
 3. Total ground fault under any operating condition.
 4. High input line voltage.
 5. Low input line voltage.
 6. Loss of input or output phase.
 7. External fault. (This protective circuit shall permit wiring of remote N.C. safety contact to shut down the drive). User supplied end switches, thermal switches, fire-stats, freeze-stats inputs will be connected to this VFC supplied circuit.
 8. Metal oxide varistors for surge suppression shall be provided at the VFC input terminals.

2.6 OTHER FEATURES

- A. Complete Contactor Bypass shall be provided to allow motor to be safely transferred from VFC output to the AC line, or from the AC line to the VFC, while the motor is at zero speed. The contactor Bypass shall utilize two motor contactors electrically interlocked. One contactor is to open and close the connection between the VFC output and the motor. The other contactor will open and close the connection between the Bypass power line and the motor, providing Δ across the line@ starting. Motor protection is to be provided in the Bypass@ mode by a bi-metallic Class 20 Smart Motor Protection adjustable overload relay. Relay control logic shall also be included within the VFD enclosure to allow the same START/STOP command to operate the motor in

either mode. The relay logic shall be 115 Volts. The Bypass circuit shall include a second lockable disconnect installed in the VFC to provide the ability to safely troubleshoot and test the controller, both energized and de-energized, while the motor is running in the Bypass mode. A contact closure shall be provided to indicate that the drive is in the Bypass mode. Auto and Hand selections shall be available to transfer control from the keypad to user wired signals. Normally Open and Normally Closed contacts shall be provided for both Run and IET/Drive Stopped. The entire Bypass option shall be packaged in a metal enclosure and be mechanically isolated from the VFC.

- B. A main fused disconnect shall mount within the NEMA 1 or NEMA 12 metal enclosure for positive power disconnect of the VFC. It shall have the capability for door padlocking.
- C. A 3% impedance AC or DC Input Line Reactor shall be provided to minimize drive harmonics on the AC line and protect the drive from damaging electrical system transients.
- D. Drive shall be capable of communicating directly to building automation systems via BACnet protocols without additional components. Drive manufacturer shall provide appropriate card required by Building Automation System and include points list for mapping by BAS contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-

steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

- C. Install fuses in each fusible-switch VFC.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- E. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. VFCs will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges.
- F. Set field-adjustable pressure switches.

3.8 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 232923

SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
- 2. Single-wall round ducts and fittings.
- 3. Sheet metal materials.
- 4. Duct liner.
- 5. Sealants and gaskets.
- 6. Hangers and supports.

- B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
- 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg., positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel.
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Exhaust Ducts: Seal Class B.
10. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components 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, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

E. 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; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Ducts:

1. Ducts Connected to Variable-Air-Volume Air-Handling Units:

- a. Pressure Class: Positive 4-inch wg
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 3.
- d. SMACNA Leakage Class for Round: 3.

2. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive 3-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round: 6.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 6.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 12.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 12.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 12.
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
- G. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:

- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
- b. Velocity 1000 to 1500 fpm:
- 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
- a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233423 - HVAC POWER VENTILATORS

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. Centrifugal roof ventilators.
 - 2. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs.
 - 7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers:

1. ACME Engineering & Manufacturing Corp.
2. Carnes Company
3. Greenheck Fan Company
4. Loren Cook Company
5. PennBarry

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.
3. Sound Curb: Curb with sound-absorbing insulation.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.

6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 IN-LINE CENTRIFUGAL FANS

A. Manufacturers:

1. ACME Engineering & Manufacturing Corp.
2. Carnes Company
3. Greenheck Fan Company
4. Loren Cook Company
5. PennBarry

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and spring hangers or spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 233423

SECTION 233723 - HVAC GRAVITY VENTILATORS

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. Louvered-penthouse ventilators.
 - 2. Roof hoods.

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. For louvered-penthouse ventilators specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- C. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of shop-fabricated ventilators.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members to which roof curbs and ventilators will be attached.
 - 2. Sizes and locations of roof openings.
- B. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
 2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVERED-PENTHOUSE VENTILATORS

- A. Manufacturers:
1. ACME Engineering & Manufacturing Corp.
 2. Carnes Company
 3. Greenheck Fan Company
 4. Loren Cook Company
 5. PennBarry
- B. Construction: All-welded assembly with 4-inch -deep louvers, mitered corners, and aluminum or galvanized-steel sheet roof.
- C. Frame and Blade Material and Nominal Thickness: Extruded aluminum, of thickness required to comply with structural performance requirements, but not less than 0.080 inch for frames and 0.080 inch for blades.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 16 inches.

E. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

F. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

G. Accessories:

1. Dampers:
 - a. Location: Inside louver face.
 - b. Control: Manual.

2.4 ROOF HOODS

A. Manufacturers:

1. ACME Engineering & Manufacturing Corp.
2. Carnes Company
3. Greenheck Fan Company
4. Loren Cook Company
5. PennBarry

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 16 inches.

E. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

F. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 237313 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

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. Variable-air-volume, single-zone air-handling units.
 - 2. Variable-air-volume, multi-zone air-handling units

1.3 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 4. Certified coil-performance ratings with system operating conditions indicated.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Filters with performance characteristics.
- B. Delegated-Design Submittal: For vibration isolation indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
 - 2. Support location, type, and weight.
 - 3. Field measurements.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each air-handling unit.
 - 2. Gaskets: One set for each access door.
 - 3. Fan Belts: One set for each air-handling unit fan.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. AHRI Certification: Air-handling units and their components shall be factory tested according to AHRI 430, "Performance Rating of Central-Station Air-Handling Unit Supply Fans," and shall be listed and labeled by AHRI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- F. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of $L/200$ where "L" is the unsupported span length within completed casings.

2.2 AIR HANDLING UNIT MANUFACTURERS

- A. AAON
- B. CARRIER, A UNITED TECHNOLOGIES CO.
- C. DAIKIN
- D. TRANE (Basis of Design)
- E. JOHNSON CONTROLS, INC.

2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings:
 - 1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
 - 2. Casing Joints: Sheet metal screws or pop rivets.
 - 3. Sealing: Seal all joints with water-resistant sealant.
 - 4. Factory Finish for Steel and Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 5. Factory Finish for Steel and Galvanized-Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.

6. Casing Coating: Hot-dip galvanized.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type I.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.
3. Location and Application: Encased between outside and inside casing.

C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
 - a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
 - a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Fabricate windows in doors of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.
 - d. Size: At least 24 inches wide by full height of unit casing up to a maximum height of 72 inches.
4. Locations and Applications:
 - a. Fan Section: Doors.
 - b. Access Section: Doors.

- c. Coil Section: Inspection and access panel.
 - d. Damper Section: Inspection and access panels.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - f. Air Blender Section: Doors.
 - g. Mixing Section: Doors.
5. Service Light: 100-W vaporproof fixture with switched junction box located outside adjacent to door.
- a. Locations: Each section accessed with door.

D. Condensate Drain Pans:

- 1. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - b. Depth: A minimum of 2 inches deep.
- 2. Integral part of floor plating.
- 3. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
- 4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
 - a. Minimum Connection Size: NPS 2.
- 5. Pan-Top Surface Coating: Asphaltic waterproofing compound.
- 6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

- 1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to air-handling unit sections, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when air-handling unit frame is anchored to building structure.

2.4 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

- 1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.

- a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontal-Flanged, Split Housing: Bolted construction.
 3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
 4. Flexible Connector: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized-steel sheet or 0.032-inch- thick aluminum sheets; select metal compatible with casing.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
 - 1) Fabric Minimum Weight: 26 oz./sq. yd.
 - 2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3) Fabric Service Temperature: Minus 40 to plus 200 deg F.
- C. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.
- D. Airfoil, Centrifugal Fan Wheels: Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. Fan Shaft Bearings:
1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 120,000 hours according to ABMA 9.
 2. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
- F. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.3 service factor based on fan motor.
1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch-

thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.

- G. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
- H. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Enclosure Type: Totally enclosed, fan cooled.
 - 2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - 5. Mount unit-mounted disconnect switches on exterior of unit.
- I. Variable Frequency Controllers:
 - 1. All VFC's shall be BACNET MS/TP certified and compatible with the existing building automation system for the facility.
 - 2. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
 - 3. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
 - 4. Unit Operating Requirements:
 - a. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
 - b. Input frequency tolerance of 06/11 Hz, plus or minus 6 percent.
 - c. Minimum Efficiency: 96 percent at 60 Hz, full load.
 - d. Minimum Displacement Primary-Side Power Factor: 96 percent.
 - e. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
 - f. Starting Torque: 100 percent of rated torque or as indicated.
 - g. Speed Regulation: Plus or minus 1 percent.
 - 5. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
 - 6. Internal Adjustability Capabilities:
 - a. Minimum Speed: 5 to 25 percent of maximum rpm.
 - b. Maximum Speed: 80 to 100 percent of maximum rpm.
 - c. Acceleration: 2 to a minimum of 22 seconds.
 - d. Deceleration: 2 to a minimum of 22 seconds.
 - e. Current Limit: 50 to a minimum of 110 percent of maximum rating.
 - 7. Self-Protection and Reliability Features:
 - a. Input transient protection by means of surge protection device (SPD).

- b. Undervoltage and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
 - c. Adjustable motor overload relays capable of NEMA ICS 2, Class 20 performance.
 - d. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 - e. Instantaneous line-to-line and line-to-ground overcurrent trips.
 - f. Loss-of-phase protection.
 - g. Reverse-phase protection.
 - h. Short-circuit protection.
 - i. Motor overtemperature fault.
8. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
9. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
10. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
11. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
12. Door-mounted LED status lights shall indicate the following conditions:
 - a. Power on.
 - b. Run.
 - c. Overvoltage.
 - d. Line fault.
 - e. Overcurrent.
 - f. External fault.
13. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual-speed-control potentiometer and elapsed time meter.
14. Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
 - a. Output frequency (Hertz).
 - b. Motor speed (rpm).
 - c. Motor status (running, stop, fault).
 - d. Motor current (amperes).
 - e. Motor torque (percent).
 - f. Fault or alarming status (code).
 - g. Proportional-integral-derivative (PID) feedback signal (percent).
 - h. DC-link voltage (volts direct current).
 - i. Set-point frequency (Hertz).
 - j. Motor output voltage (volts).

15. Control Signal Interface:
 - a. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 - b. Remote signal inputs capable of accepting any of the following speed-setting input signals from the control system:
 - 1) 0 to 10-V dc.
 - 2) 0-20 or 4-20 mA.
 - 3) Potentiometer using up/down digital inputs.
 - 4) Fixed frequencies using digital inputs.
 - 5) RS485.
 - 6) Keypad display for local hand operation.
 - c. Output signal interface with a minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hertz).
 - 2) Output current (load).
 - 3) DC-link voltage (volts direct current).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set-point frequency (Hertz).
 - d. Remote indication interface with a minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - 1) Motor running.
 - 2) Set-point speed reached.
 - 3) Fault and warning indication (overtemperature or overcurrent).
 - 4) High- or low-speed limits reached.
16. Communications: RS485 interface allows VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
17. Integral Disconnecting Means: NEMA KS 1, nonfusible switch or NEMA KS 1, fusible switch with lockable handle.
18. Accessories:
 - a. Devices shall be factory installed in controller enclosure unless otherwise indicated.
 - b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
 - c. Standard Displays:
 - 1) Output frequency (Hertz).
 - 2) Set-point frequency (Hertz).
 - 3) Motor current (amperes).
 - 4) DC-link voltage (volts direct current).
 - 5) Motor torque (percent).

- 6) Motor speed (rpm).
- 7) Motor output voltage (volts).

2.5 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with AHRI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
4. Coils shall not act as structural component of unit.

B. For more details on hydronic coils, refer to specification Section 238216.11 "Hydronic Air Coils".

2.6 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

B. Extended-Surface, Disposable Panel Filters:

1. Factory-fabricated, dry, extended-surface type.
2. Thickness: Pre: 2 inches, Final: 4 inches.
3. Initial Resistance: Pre: 0.2 inches wg, Final : 0.5 inches wg
4. Recommended Final Resistance: Pre: 0.5 inches wg , Final: 1.0 inches wg
5. MERV (ASHRAE 52.2): Pre: MERV 7, Final: MERV 13.
6. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
7. Media-Grid Frame: Fire-retardant, 3/4-inch particleboard with gaskets.
8. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.

C. Filter Gage:

1. 3-1/2-inch diameter, diaphragm-actuated dial in metal case.
2. Vent valves.
3. Black figures on white background.
4. Front recalibration adjustment.
5. 3 percent of full-scale accuracy.
6. Range: 0- to 2.0-inch wg.

7. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch aluminum tubing, and 2- or 3-way vent valves.

2.7 DAMPERS (AS REQUIRED)

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.
- B. Damper Operators: Comply with requirements in Section 230923.12 "Control Dampers."
- C. Electronic Damper Operators:
 1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 2. Most actuators on this project shall be provided by Precision Controls directly for the Owner, however the actuators for dampers included with AHU's (multi-zone hot and cold deck dampers) shall be by this section.
 3. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
 4. Operator Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
 7. Size dampers for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 8. Coupling: V-bolt and V-shaped, toothed cradle.
 9. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

10. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
 11. Power Requirements (Two-Position Spring Return): 24-V ac.
 12. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 13. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 14. Temperature Rating: Minus 22 to plus 122 deg F.
 15. Run Time: 12 seconds open, 5 seconds closed.
- D. Hot and Cold Deck Dampers: Opposed-blade, galvanized-steel dampers with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.
- E. Return-Air Mixing Dampers: Parallel-blade, extruded-aluminum dampers mechanically fastened to steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
- F. Outdoor-Air Dampers: Low-leakage, double-skin, airfoil-blade, extruded-aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with steel operating rods rotating in sintered bronze or nylon bearings mounted in a single aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.
- G. Blender Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing box section.

2.8 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting:
 - 1. Install air-handling units on manufacturer supplied rails. Refer to manufacturers details on the rails. Refer to plans for height of the rails.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4 , ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
 - 2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

SECTION 238216.11 - HYDRONIC AIR COILS

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 hydronic heating and cooling air coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
 - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.6 FIELD CONDITIONS

- A. Altitude above Mean Sea Level: 250 feet.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

- A. Manufacturers:
 - 1. Coil Company, LLC
 - 2. Heatcraft Worldwide Refrigeration
 - 3. RAE Coils; a division of RAE Corporation
 - 4. Trane
 - 5. USA Coil and Air
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.
- F. Fins: Aluminum, minimum 0.010 inch thick.
- G. Headers: Seamless copper tube with brazed joints, prime coated.
- H. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for slip-in mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.

- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Install stainless-steel drain pan under each cooling coil.
 - 1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
 - 2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.
 - 3. Extend drain pan upstream and downstream from coil face.
 - 4. Extend drain pan under coil headers and exposed supply piping.
- D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.
- E. Straighten bent fins on air coils.
- F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 230923.11 "Control Valves," and other piping specialties are specified in Section 232116 "Hydronic Piping Specialties."

END OF SECTION 238216.11

SECTION 238239.16 - PROPELLER UNIT HEATERS

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 propeller unit heaters with hot-water coils.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include location and size of each field connection.
 - 4. Include details of anchorages and attachments to structure and to supported equipment.
 - 5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - 6. Indicate location and arrangement of piping valves and specialties.
 - 7. Indicate location and arrangement of integral controls.
 - 8. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which propeller unit heaters will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Airtherm; a Mestek Company
 - 2. CCI Thermal technologies
 - 3. Sterling
 - 4. Trane
 - 5. Vulcan

2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in vertical discharge configuration with adjustable discharge louvers.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 2021.

- D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

- A. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.
- B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.7 CONTROLS

- A. Control Devices:
 - 1. Unit or Wall-mounted, variable fan-speed switch.
 - 2. Wall-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters to comply with NFPA 90A.
- B. Install propeller unit heaters level and plumb.
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Piping installation requirements are specified in the following Sections:
 - 1. Section 232113 "Hydronic Piping."
 - 2. Section 232116 "Hydronic Piping Specialties."
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to propeller unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Comply with safety requirements in UL 1995.
- E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of propeller unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."

- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

END OF SECTION 238239.16

SECTION 260010 – BASIC DIVISION 26 REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general administrative, material, and procedural requirements for Division 26 to expand the requirements specified in Division 01.

1.2 REGULATORY REQUIREMENTS

- A. Work and materials shall conform to and be executed, inspected and tested in accordance with the latest edition of the National Electric Code and with the governing rules and regulations of federal, state and local governmental agencies. References to "NEC" within the Division 26 Sections shall be considered synonymous to this electrical code.
- B. Other codes which will apply to this installation include the current editions of:
 - 1. ANSI C2 - National Electrical Safety Code.
 - 2. NFPA 70E – Standard for Electrical Safety Requirements for Employee Workspaces.
 - 3. NFPA 101 - Life Safety Code.
 - 4. Underwriters Laboratories.
- C. Where governing codes indicate the Drawings and Specifications do not comply with the minimum requirements of applicable codes, be responsible for either notifying the Architect in writing during the bidding period of the revisions required to meet code requirements, or providing an installation which will comply with the code requirements.

1.3 PERMIT AND INSPECTIONS

- A. Permits: Obtain and pay for all permits, bonds, licenses, tap-in fees, etc., required by the City, State, or other authority having jurisdiction over the work, as a part of the work of the affected sections.
- B. Inspections: Arrange and pay for all inspections required by the above when they become due as part of the work of the sections affected. Conceal no work until approved by these governing authorities. Coordinate inspection period with Authorities Having Jurisdiction and Engineer Gilbane, Inc. Present the Engineer with properly signed certificate of final inspection.

1.4 SUBMITTAL PROCEDURES

- A. General: Provide required submittals in accordance with Division 01 "Submittal

Procedures".

B. Definitions:

1. Submittals: A written or graphic expression of the Contractor's interpretation of requirements in the Contract Documents to show how the Contractor intends to fulfill those requirements. Identify deviations from Contract Documents.
2. Action Submittals: Required submittal which Engineer reviews and approves or takes other appropriate action to communicate to the Contractor the status if the submittal and subsequent action required.
3. Other (Information, Closeout and Maintenance and Material) Submittals: Required submittals which Engineer reviews and may elect to respond. If rejected by Engineer for not complying with requirements, resubmittal or other action may be required on the part of the Contractor.

C. Failure to Submit:

1. Contractor's failure to provide submittals does not alleviate the responsibility to provide the requirements in the Contract Document as interpreted by the Engineer. Correct non-compliant items.

1.5 ACTION SUBMITTALS

A. Submit action submittals in groups by systems. For example, all lighting fixtures, lamps, ballasts and accessories shall be submitted simultaneously in one package.

B. Submit the following action submittals as qualified in associated Division 26 Sections:

1. Back to back recessed box or cabinet installation locations list.
2. Cable tray systems.
3. Conduit fittings.
4. Contactors.
5. Control/Signal transmission media (submit with associated system).
6. Control voltage electrical power cables (may be submitted with associated system).
7. Dimming systems.
8. Disconnect switches.
9. Electrical identification.
10. Hangers and supports.
11. Isolated power systems.
12. Lighting.
13. Lighting control equipment.
14. Motor controllers.
15. Multi-Service boxes and assemblies.
16. Panelboards.
17. Protective devices.
18. Surface raceways.
19. Underfloor ducts.
20. Uninterruptible power supplies.

21. Wiring devices.

C. Action submittals submitted for other than those listed above or specifically required in the appropriate Specification Section will not be reviewed or returned.

D. Contractor Certificates:

1. Contractor certification forms may be submitted in accordance with Division 01 Section "Submittal Procedures" in lieu of system action submittal product data requirements except for the systems or products listed below:

- a. Dimming systems.
- b. Luminaire and lighting systems.
- c. Networked lighting control systems.
- d. Protective devices.
- e. UPS systems.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Submit general coordination drawings in accordance with Division 01 Section "Project Management Coordination," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

- a. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:
 - 1) Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
 - 2) Exterior wall and foundation penetrations.
 - 3) Wall and floor sleeve penetrations.
 - 4) Floor box and poke-through assembly installations.
 - 5) Equipment connections and support details.
 - 6) Sizes and location of required concrete pads and bases.
- b. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
- c. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- d. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, luminaires, communications systems components, sprinklers, and other ceiling-mounted devices.

2. Submit the following specific coordination drawings and others as defined in other Division 26 Sections:
 - a. Access door locations and sizes (as specified in Division 08).
 - b. Cable tray systems.
 - c. Communication rooms.
 - d. Electrical equipment rooms.
 - e. Feeder routings.
 - f. Underfloor duct systems.
3. Contract Document Drawing copies may be used as base for coordination drawings, then marked to depict actual equipment sizes and other requirements of coordination drawings. Those not marked will be rejected.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Prepare and submit operations and maintenance manuals in accordance with Division 01 Sections "Operation and Maintenance Data" and "Closeout Procedures". In addition to the requirements specified in Division 01, include specific Division 26 Section requirements, and the following general information for equipment items:
 - a. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - b. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - c. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - d. Servicing instructions and lubrication charts and schedules.
2. Include the following minimum information in the operations and maintenance manual:
 - a. Individual characteristics for trouble shooting sequences for each item of each:
 - 1) Branch circuit panel.
 - 2) Communication system.
 - 3) Fire alarm system.
 - 4) Individual motor controller.

- b. Catalog cut sheets for every item for which a shop drawing is required.
- c. Schedule of loads served from each:
 - 1) Branch circuit panel.
 - 2) Distribution panel.
- d. Overload element schedule for each motor controller whether individual or in a motor control center.
- e. Manufacturers' recommended cleaning intervals and special procedures for each:
 - 1) Electrical equipment interior.
 - 2) Electrical equipment ventilation opening.
 - 3) Luminaire lenses, louvers, and reflectors.
- f. Main and arcing contact adjustment and replacement for each:
 - 1) Contactor.
 - 2) Circuit breaker.
 - 3) Fused switch.
- g. Calibration and exercise procedures and intervals for each:
 - 1) Molded case breaker.
- h. Testing interval and target values for ground fault protection circuit relays.
- i. Testing and troubleshooting procedures unique to special systems. For example:
 - 1) Water tightness tests for manholes and handholes.
 - 2) Infrared scanning.
 - 3) Phase balancing.
 - 4) High-pot tests.
- j. Approved special construction details that differ from the details shown on Drawings.
- k. Permits and inspections certificates.
- l. Testing results.
- m. Final submittal copy.
- n. Special warranty information.
- o. Service contract data.

B. Record Documents:

- 1. Prepare record documents in accordance with the requirements in Division 01 Section "Project Closeout Procedures." In addition to the requirements specified in Division 01, indicate installed conditions for:
 - a. Major raceway systems, size and location, for both exterior and interior;

- locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 - b. Major equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - c. Contract Modifications and actual equipment and materials installed.
 - d. Training and demonstration videos.
 - e. Keying schedules.
 - f. Software CDs.
 - g. Final field quality control test reports.
2. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified in Division 01 Section "Execution" to record the locations and invert elevations of underground installations.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Material:

- 1. Provide four (4) keys for every different piece of electrical equipment which is equipped with a lock.
- 2. Provide all other loose equipment and extra material specified or supplied for use with all systems.

1.9 QUALITY ASSURANCE

- A. General: Follow the procedures specified in Division 01 Section "Quality Requirements."
- B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- C. Obtain similar products through one source from a single manufacturer.
- D. Ensure all material meets all sustainable design requirements as listed in related specification according to LEED v4 criteria.
- E. Testing Agency Qualifications: An agency with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.
 - 1. For electrical power equipment and systems, the agency shall be a member company of the International Electrical Testing Association (NETA) or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
 - 2. For other than electrical power equipment or where NETA is not a recognized testing agent, the testing agency shall be as defined in the appropriate Division 26 Section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.11 COORDINATION

- A. Coordinate facility services as outlined in Division 20 Section "Common Work Results, Division 21 through 28."
- B. Coordinate arrangement, mounting, and support of Division 26 equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. To assure connections of raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
 - 1. Ensure access doors are sized to permit complete access for concealed or inaccessible junction boxes, control and monitoring devices, elevator shaft and duct mounted fire alarm detectors and other items of equipment requiring access, maintenance, and/or operation.
 - a. Assure access to devices per codes and local authorities having jurisdiction.
- E. Wiring and Controls:
 - 1. Coordinate equipment furnished by Division 26: Install and wire in accordance with the manufacturer's recommendations and applicable standards and codes. Provide installation instructions, locating dimensions and wiring diagrams for the other trades. Supervise the installation and start-up and test the equipment unless otherwise specified.
 - 2. Coordinate Equipment Furnished by Other Divisions: Equipment specified in other Divisions and requiring electrical supply will be erected, aligned, leveled

and prepared for operation. Provide required controls and accessories along with installation instructions, diagrams, dimensions and supervision of installation and start-up. Provide the required electrical rough-ins and confirm the electrical controls and accessories furnished under the specifications for the other divisions. Install those controls and accessories not located in the mechanical piping and ductwork. Provide additional electrical controls, accessories, fittings and devices not specified under the equipment but required for a finished, operating job. Make final electrical connections. Participate in the start-up and test services.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Products and the terms materials, equipment, devices, components, assemblies and systems are considered synonymous.
- B. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Seconds, rejects, or damaged materials will be rejected.
- C. The materials to be provided under these Specifications shall be essentially the standard commercial grade product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer.
- D. The listing of a manufacturer for certain products does not indicate acceptance of a standard or catalogued item of equipment. All products shall conform to the Specifications.
- E. All equipment and materials specified shall be products currently in production.
 - 1. If the specified item is not available or is discontinued, a similar product with the same features and functionality shall be provided from the same manufacturer in the newer/upgraded series of product.
 - 2. Equipment and/or devices discovered to be discontinued after submission approval will not be accepted and will require resubmittal for an approved replacement.
- F. Product Selection for Restricted Space: Drawings indicated maximum dimensions for products including clearances between products and adjacent surfaces and other items. Comply with indicated maximum product dimensions.
 - 1. Assembly Selection: The Drawings indicated sizes, profiles and dimensional requirements of assembly equipment. Equipment having equal performance characteristics and complying with indicated maximum dimensions and profiles may be considered, provided deviations do not change the design concept intended performance, or code/future extension provision clearances. The burden of proof of equality is on the proposer a minimum of 10 days prior to bid.

2.2 U.L. LISTING

- A. All electrical equipment, products and materials shall bear the Underwriter's Laboratories (UL), or other approved agency, listing label. Acceptable alternates include:
1. Intertek Testing Service NA, Inc. (ITSNA) (formerly ETL).
 2. Wherein an item of equipment is specified to be U.L. Listed, the entire assembly shall be listed by Underwriters Laboratories, Inc. Any modifications to suit the intent of the Specifications shall be performed in accordance with the National Electrical Code and listed by U.L.
- B. Definitions:
1. Listed: Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintain periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for use in a specified manner.
 2. Labeled: Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicated compliance with appropriate standards or performance in a specified manner.

2.3 LEAP YEAR SOFTWARE PROTECTION

- A. All software supplied with new equipment shall be warranted against leap year program failure.
- B. All software supplied with the new equipment shall be warranted against Daylight Savings Time program disruption or failure. Refer to Division 01 Section "Warranties and Supplementary Conditions for Requirements".
- C. All software shall be the most current release of the latest available software of the equipment provided.
1. BETA software versions will not be accepted.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General:
1. Comply with NECA 1 – "Standard For Good Workmanship in Electrical

Contracting."

2. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
3. 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.
4. 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.
5. Right of Way: Give to piping systems installed at a required slope.

B. Manufacturer's Directions and Supervision:

1. Follow all instructions where supervision by a manufacturer is specified. Provide recommended manufacturer and specified field tests, and other recommendations of the manufacturer. The manufacturer shall supervise the installation, connection, start-up, testing, adjustment, instruction of the Owner and final tests of such equipment or system. Where two or more manufacturer's equipment are interrelated, take responsibility to coordinate their work and provide supervision.
2. Have the manufacturer instruct the Owner in the proper operation and maintenance techniques of all equipment, systems, etc., at the time of completion of all work.

C. Rough-In:

1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
2. Refer to equipment specifications in Divisions 02 through 28 for rough-in requirements.

3.2 ELECTRICAL INSTALLATION

A. General:

1. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment.
2. Workmanship shall conform to NECA 1 – "Standard for Good Workmanship in Electrical Contracting" published by the National Electrical Contractors Association.

B. Locations:

1. When Drawing details are not available, the Architect shall control the placement of wall and ceiling mounted electrical devices, luminaires and outlets. The intent is to aesthetically locate luminaires/outlets by providing rough-in hardware, boxes and/or mounting plates, as required, when stud or furring may

- not be readily available for direct mounting. Consult with Architect's representative for actual placement.
2. Coordinate electrical systems, equipment, and materials installation with other building components. Be responsible for any changes in openings and locations necessitated by the equipment installed.
 3. Verify all dimensions by field measurements.
 4. Install systems, materials, and equipment to provide the maximum headroom possible, where mounting heights are not detailed or dimensioned.
 5. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 6. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
 7. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 8. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

C. Field Coordination:

1. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
2. Coordinate the installation of required supporting devices and sleeves to be set in poured- in-place concrete and other structural components, as they are constructed.
3. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
4. Protect all equipment and materials from the elements, dirt and other damage from the time it is removed from the point of storage until final acceptance.
5. Include setting equipment to accurate line and grade, leveling equipment, aligning equipment components, providing and installing couplings, bolts, guards, and anchor bolts.
6. Alignment and level and meet the quality of workmanship subject to manufacturer's installation instructions.
7. Provide all trench and conduit excavation and backfilling required for his work inside and outside the building, including repairing of finished surfaces, all required shoring, bracing, pumping, and all protection for safety of persons and property. In addition, check the indicated elevations of the utilities entering and leaving the building. If such elevations require excavations lower than the footing levels, the Architect shall be notified of such conditions and a redesign shall be made before excavations are commenced. Make the excavations at the minimum required depths in order not to undercut the footings.
8. Provide all scaffolding, rigging, hoisting and services necessary for erection and

delivery of equipment and apparatus furnished into the premises. These items shall be removed from the premises when no longer required.

9. No electrical equipment, raceways or other work of any kind shall be covered up or hidden from view before it has been examined and approved. Any unsatisfactory work or materials shall be removed and corrected immediately.
10. Coordinate installation of access panel or doors where units are concealed behind finished surfaces.

D. Equipment Manufacturer Coordination:

1. Distribution Equipment Assembly Selection: The Drawings indicate sizes, profiles, and dimensional requirements of assembly equipment. Equipment having equal performance characteristics and complying with indicated maximum dimensions and profiles may be considered, provided deviations do not change the design concept, intended performance, or code/future extension provision clearances. The burden of proof of equality is on the proposer a minimum of 10 days prior to bid.
2. Include the component parts thereof equipment such as disconnect switches, motor controllers, motors, drives, and guards necessary to the satisfactory and safe operation of the equipment.
3. All manufacturers' finished equipment surfaces damaged during construction shall be brought to an "as new" condition by touch up or repainting. Any rust shall be completely removed and the surface primed prior to repainting as specified in Division 09.

E. Excavation:

1. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.
2. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - a. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut to of sheeting at an elevation of 30 inches below finished grade elevation.
3. Install sediment and erosion control measures in accordance with local codes and ordinances.
4. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and form flooding project site and surrounding area.
 - a. 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.
 - b. 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.
5. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
 - a. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - b. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
 6. Excavation for Underground Vaults and Electrical 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.
 - a. Excavate, by hand, areas within dri-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.
 - b. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
 7. Trenching: Excavate trenches for electrical installations as follows:
 - a. 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 raceways and equipment.
 - b. Excavate trenches to depth indicated or required.
 - c. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
 - d. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.
 8. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg. F (1 deg. C).
 9. 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.
 - a. Under walls and pavements, use a combination of subbase materials and excavated or borrowed materials.
 - b. Under building slabs, use drainage fill materials.
 - c. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 - d. For raceways less than 30 inches below surface of roadways, provide 4 inch thick concrete base slab support. After installation of raceways,

- provide a 4 inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
- e. Other areas, use excavated or borrowed materials.
10. 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.
 11. 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.
 12. 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.
 13. 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.
 14. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
 - a. 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).
 - 1) 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.
 - 2) 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.
 - 3) 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.

- b. **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.
15. **Subsidence:** Where subsidence occurs at electrical 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 of finish to match adjacent areas.

F. **Cutting and Patching:**

1. **General:** Perform cutting and patching in accordance with Division 01 Section "Cutting and Patching." In addition to the requirements specified in Division 01, the following requirements apply:
 - a. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - 1) Uncover Work to provide for installation of ill-timed Work.
 - 2) Remove and replace defective Work.
 - 3) Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4) Remove samples of installed Work as specified for testing.
 - 5) Install equipment and materials in existing structures.
 - 6) Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.
 - b. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
 - c. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 - d. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - e. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - f. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - 1) Refer to Division 01 Section "Quality Requirements" for definition of experience "Installer."

- g. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

- 1) Refer to Division 01 Section "Quality Requirements" for definition of experienced "Installer."

G. Painting:

- 1. Provide the prime painting of all equipment and materials furnished under Division 26 specifications, unless specifically stated otherwise. In general, all equipment except raceways and galvanized boxes that are not provided with a factory-applied final finish shall be delivered to the job site with a shop applied prime coat of paint. Refer to Division 09 Sections "Interior Painting" and "Exterior Painting."

3.3 FIELD QUALITY CONTROL

- A. Refer to Division 26 Section "Electrical Inspections and Testing."

END OF SECTION 260010

SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes conductors, cables, and connectors rated 100 to 600 volts.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements."

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. MI cable and associated connectors and tools.
 - 2. Multiconductor cables.
 - 3. Pre-fabricated MC cable wiring system assemblies.
 - 4. Prewired MC cable modular wiring systems.
- B. Shop Drawings:
 - 1. Pre-fabricated MC cable wiring system assemblies and layout drawings in AutoCad.
 - 2. Prewired MC cable modular wiring system layout drawings in AutoCad.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents:
 - 1. Indicate all feeder sizes on the record drawings riser diagrams.
 - 2. Indicated homerun junction box locations for all branch circuits.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following code:
 - 1. NFPA 70 National Electrical Code.
 - a. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
 - 2. UL Compliance: Provide components which are listed and labeled by UL under the following standards.
 - a. UL Std. 4 - Armored Cable.
 - b. UL Std. 44 – Thermoset-Insulated Wires and Cables.
 - c. UL Std. 83 - Thermoplastic-Insulated Wires and Cables.
 - d. UL Std. 183 - Modular Wiring Systems.
 - e. UL Std. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - f. UL Std. 1569 - Metal-Clad Cable.
 - 3. NEMA/ICEA Compliance: Provide components which comply with the following standards:
 - a. WC-70 – Standard for Non-Shielded Power Cables Rated 2000 volts or less.
 - 4. IEEE Compliance: Provide components which comply with the following standard:
 - a. Std. 82 - Test procedures for Impulse Voltage Tests on Insulated Conductors.
- B. Field Testing: Refer to Division 26 Section "Electrical Inspections and Testing" for field inspections and testing requirements related to this Section including:
 - 1. Electrical Acceptance Testing Responsibilities.
 - 2. General Electrical Field Quality Control.
 - 3. Testing Agency Qualifications.
- C. Comply with ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems for field testing.
- D. Maximum Cable Pull Compliance: Comply with manufacturer's maximum cable tension pulling characteristics so as not to damage wire and cable.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Conductors and Cables:

- a. Aetna Insulated Wire, Inc.
- b. AFC Cable Systems, Inc., a Division of Tyco.
- c. Alcan Products Corporation; Alcan Cable Division.
- d. American Insulated Wire Corp.; a Leviton Company.
- e. Cerro Wire LCC.
- f. Encore Wire Corporation.
- g. General Cable Corp.
- h. Nexans.
- i. Senator Wire & Cable Co.
- j. Southwire Company.

2. Connectors and Splices for Conductors and Cable Conductors:

- a. AFC Cable Systems, Inc., a Division of Tyco.
- b. AMP.
- c. Burndy Corporation.
- d. Hubbell Power Systems, Inc.
- e. O-Z/Gedney Co.; EGS Electrical Group LLC.
- f. 3M Company; Electrical Products Division.
- g. Raychem Corporation.
- h. Square D Company.
- i. Thomas and Betts Corporation.
- j. Tyco Electronics Corp.

2.2 WIRES AND CABLES

A. General: Provide wire and cable suitable for the temperature, conditions and location where indicated.

1. Derate conductors per the NEC for installations that are exposed to direct sunlight, are on and/or above rooftops where ambient temperatures are other than 30 deg. C (86 deg. F).

B. Conductor Material: Copper.

C. Conductors: Provide solid conductors for power and lighting circuits sizes No. 12 AWG and smaller. Provide stranded conductors for sizes No. 10 AWG and larger.

D. Insulation: Provide insulation type in accordance with Part 3 below.

E. Color Coding:

208/120Volts		480/277 Volts		Isolated Power	
Phase	Color	Phase	Color	Phase	Color
A	Black	A	Brow	A	Brown
B	Red	B	Orange	B	Yellow
C	Blue	C	Yellow		
Neutral	White	Neutral	Gray	Neutral	Orang
Ground	Green	Ground	Gree	(All	Color
IsoGround	Green w/Yellow Strips	IsoGround	Green w/Yellow Strips		

F. Jackets: Factory-applied nylon or PVC external jacketed wires and cables for pulls in raceways over 100-feet in length, for pulls in raceways with more than three equivalent 90 deg. bends, for pulls in conduits underground or under slabs on grade, and where indicated.

G. Multiconductor Cables: Provide the following type(s) of cables in NEC approved locations and applications where indicated. Provide cable UL listed for particular application:

1. Metal-Clad Cable: Type MC:
 - a. Complete with ground conductor.
2. Underground Feeder and Branch-Circuit Cable: Type UF.
3. Portable Cord: Type SO.

2.3 PRE-FABRICATED MC CABLE WIRING SYSTEM ASSEMBLY OPTION

A. At Contractors option, but subject to other requirements of this Section and other Division 26 Sections, UL listed assemblies may be used which allow:

1. Floor or wall bracket, with one to four gang openings for pre-installed outlet boxes, with far side support arm(s).
2. Pre-installed box trim rings for flush device installation given specific wall construction.
3. Wiring device pigtail connector option.
4. MC cable whip appropriate for application(s), with NEC cable support at boxes.
5. Adjacent communication device boxes and associated box fittings.

B. Basis of assembly design shall be:

1. Alcan Modex™.
2. Hubbell/Denier Manufacturing Rough-in Ready.
3. Legrand Cabofil FAS Power™.

C. If used, submit custom shop drawing per assembly type for Engineer's approval.

2.4 PRE-WIRED MC CABLE MODULAR WIRING SYSTEM

A. Subject to other requirements of this Section and other Division 26 Sections, provide UL listed assemblies for a complete preassembled branch circuit system.

1. The system shall include plug-in connectors on the MC cables line side end and associated modular wiring receiving box tied to a rigid metallic homerun above ceiling raceway.
2. MC cable load side male and female plug-in connectors may be used with branch circuit loads on maximum 6 foot whips to lighting systems and 10 foot whips to first wiring device.
3. The system may be used with the pre-fabricated MC cable system assembly option for maximum flexibility.

B. Basis of system design shall be:

1. AFC-ASC/Uni-Fab series, a Division of Tyco.
2. Wiremold-Walker flex series, a Division of Legrand.

2.5 CONNECTORS FOR CONDUCTORS

A. Provide UL listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

1. Split-bolt connectors shall not be used for any application.

2.6 CONDUCTOR PULLING GRIPS

A. At Contractor's option, factory installed pulling grips may be provided to allow potential reduced pulling tension and a low profile head.

B. Basis of Design shall be Southwire SIMpull Head™.

2.7 CONDUCTOR PULLING JACKET

A. At Contractor's option, lubricated type conductor pulling jackets may be provided for

THHN and XHHW conductors to allow potential reduced pulling tension.

- B. Basis of design shall be Southwire NoLube® SIMpull cable series.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

- A. General: Install electrical cables, conductors and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation," and in accordance with recognized industry practices.
1. Install all conductors within raceways or approved cables.
 2. Install conductors and cables run under the building slab in raceways.
 3. Install minimum No. 12 AWG for circuits 100 volts and above.
 4. Increase conductor size as required due to NEC derating requirements and availability. Minimum feeder conductor sizes, based upon NEC Table 310.16 and maximum 40 percent conduit raceway fill, are shown on Drawings. If conductor size increased, be responsible for associated feeder conduit size, based upon NEC Table 310.16 and maximum 40 percent conduit raceway fill, and increased ground conductor size per NEC. If raceway type altered, also be responsible for associated feeder conduit raceway size per NEC to meet 40 percent maximum fill.
 5. Keep conductor splices to a minimum.
 6. Do not bend conductors and cables, either permanently or temporarily during installation to radii less than that recommended by the manufacturer.
 7. Provide slack wire for all future connections with ends of wires taped and blank box covers installed.
 8. Provide conductors of the same size from the protective device to the last load.
 9. Make conductor length identical for parallel feeders.
 10. Ground and continuously polarize systems properly throughout following the color coding specified.
 11. Support conductors in vertical raceways. One cable support shall be provided at the top or as close to the top as practical, plus a support for each additional interval of spacing per NEC.
 12. Install exposed cable parallel and perpendicular to surfaces, or exposed structural members, and following surface contours, where possible.
 13. Support cables according to Division 26 Sections "Hangers and Supports."
- B. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of

- NFPA 70, Article 300, without pigtails.
4. When conductors larger than No. 12 AWG are installed on 15 – 20-A circuits, splice No. 12 AWG pigtails for device connections.
 5. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- C. Dedicated Branch Circuit Neutrals:
1. Provide dedicated neutrals for all branch circuits.
- D. Coordinate conductor and cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires and cables with other work.
1. Pull conductors simultaneously where more than one is being installed in same raceway.
 2. Use of pull compound or lubricant is to be avoided unless absolutely necessary and other reduced cable tension pulling methods exhausted; compound used must not deteriorate conductor or insulation, and be one of the following:
 - a. Ideal-Aqua-Gel.
 - b. Polywater.
 - c. Yellow 77.
 3. Use pulling means including lubricated conductor jackets, fish tape, cable, rope and basket weave wire and cable grips which will not damage cables or raceway.
- E. Use conductors with 90 degree C insulation and appropriate NEC derating factors when wiring is within seven feet of passing over or attached to the following:
1. Boilers and other heat producing equipment.
 2. Hot water heaters.
 3. Rooftop and exposed exterior locations.

3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper.
- B. Branch Circuits: Copper.
- C. Ground conductor material shall match feeder type.

3.3 CONDUCTOR APPLICATIONS

- A. Install UL Type UF cable with nonmetallic outer jacketing, for direct buried underground feeders not encased in conduit.
- B. Install UL Type THHN or THWN wiring in conduit, for branch circuits #10 and smaller.
 - 1. Include wet location label when installed in underground or above grade exterior raceways.
- C. Install UL Type XHHW or THHN wiring in conduit, for feeders and branch circuits #8 and larger.
 - 1. Include wet location label when installed in underground or above grade exterior raceways.
- D. Install UL Type XHHW or THWN wiring in conduit, for feeders and branch circuits installed outside of the building envelope, in raceway in contact with soil, or whenever raceway may be subject to moisture and/or condensation.
- E. Install UL Type XHHW wiring in conduit for isolated power branch circuits.
- F. Install SO hard service cord with stainless steel, wire mesh, strain relief at terminations to suit application.

3.4 TRENCH HEADER WIRING

- A. Bundle branch circuit wiring in trench headers together into individual circuits. Each bundled circuit shall consist of phase conductor and associated neutral conductor. Branch circuit wiring in the trench headers shall be installed in the power compartment, with bundled circuits identified by circuit numbers on five foot intervals. Bundling of individual branch circuits shall be done with nylon straps made of self-extinguishing nylon with a locking hub or head on one end and a taper on the other end. Nylon straps shall be Thomas and Betts "TY-RAP" or approved equal.

3.5 EQUIPMENT CONNECTIONS

- A. Follow circuit numbers shown on Drawings in connecting circuits to panelboards. In the event that field observation shows that the indicated circuit numbers are not connected to the corresponding panel overcurrent device, make all corrections necessary. Each branch circuit homerun containing two or more circuits with a common neutral shall be connected to the circuit breaker or switch in a three- or four-wire branch circuit panelboard so that no two of the circuits will be fed from the same phase.

- B. Provide all wiring to and between motors, controllers, line voltage (120-600 volt) control devices, disconnect switches, and other related electrical equipment, except where such items are factory wired.
- C. Provide power and all wiring connections to the control devices for electrically operated overhead doors, door operators and control devices which will be provided under another division.
- D. Connectors for Splices, Taps, and Terminations:
 - 1. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connector and terminals to comply with tightening torques specified in UL Std. 486A and B.
 - 2. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings that unspliced conductors.
 - 3. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
 - 4. Make splices and taps in wiring No. 10 AWG and smaller mechanically and electrically secure with mechanical pressure type splicing devices.
 - 5. Make splices and taps of conductors No. 8 AWG or larger and all splices in motor terminal boxes using compression connectors requiring the use of compression tools for securing the conductors in the connectors. Termination of conductors at all distribution equipment, except transformers, shall be made using mechanical lugs. Connectors shall be of high conductivity, corrosion-resistant material and have actual contact area that shall provide at least the current carrying capacity of the wire or cable. For conductors No. 1/0 and larger, connector lugs shall be of the two-hole type. Connector lugs shall be bolted to bussing using Belleville washers in combination with flat washers and nuts. Compression connectors shall be as manufactured by Thomas & Betts, Burndy, or approved equal.
 - 6. Each conductor lug or bus connection shall be individually made with separate lug and/or bolt as required for the termination.
 - 7. Provide insulated connectors for splices and taps with a self-fusing rubber insulating tape that is non-corrosive to the connector and the conductor. Insulation tape shall have a minimum of 350 volts per mil dielectric strength. Friction or vinyl tape shall be applied directly over rubber insulating tape equal to 3M Scotch 88 type.

3.6 METAL-CLAD CABLE (TYPE MC CABLE)

- A. May be used only when approved by the local authority having jurisdiction and only for concealed branch circuit wiring in spaces above ceilings and in hollow studded interior partitions.
- B. In general, may be used only for lighting and convenience outlet wiring, and only for those branches and areas which are not identified herein as exceptions.

- C. Armor: Interlocked aluminum.
- D. The exception branches and areas where MC Cable is not acceptable for lighting and convenience outlet wiring are as follows:
 - 1. Computer rooms.
 - 2. Emergency branch circuit.
 - 3. Exposed locations.
 - 4. Isolated grounding device branch circuits.
 - 5. Kitchen equipment feeder and branch circuits.
 - 6. Life safety branch circuits.
 - 7. Mechanical, electrical, generator, battery and boiler rooms.
 - 8. Through fire and smoke barriers.
 - 9. Wet and damp locations.
- E. MC cable shall be secured at intervals not exceeding 6 feet and within 12 inches of every outlet box or fitting. Luminaire whips may be 6 feet maximum without support.
- F. At all terminations, a fitting shall be provided to protect the conductors from abrasion. Approved insulating bushings shall be provided between the conductors and the armor. The connector or clamp by which the cable is fastened to boxes or cabinets shall be metal, of double lock-nut construction, UL approved for use with MC cable, and of such design that the insulating bushing will be visible for inspection. Internal box cable clamps are not acceptable.

3.7 PRE-WIRED MC CABLE MODULAR WIRING SYSTEM

- A. Install system per manufacturer's instructions except in HVAC plenum areas where the system is prohibited.
- B. The modular wiring receiving box shall be installed with a single point connection to an adjacent homerun raceway box to allow overall system removal.
- C. Identify modular wiring receiving boxes at associated plug-in MC cables per Division 26 Section "Electrical Identification." Provide self-adhesive write-on tags identical to box identification requirements at each plug-in connection.

3.8 MAXIMUM BRANCH CIRCUIT LENGTHS

- A. Per NEC and as shown on Drawings.

3.9 CONDUCTOR AND CABLE IDENTIFICATION

- A. Color code cable at splices and terminations per Division 26 Section "Electrical Identification."

3.10 WIRING METHODS

- A. The following wiring methods shall not be used:
 - 1. Non-metallic sheathed cable.

3.11 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling".

3.12 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

3.13 FIELD QUALITY CONTROL

- A. Inspection and Tests:
 - 1. Perform inspections and test procedures as required by Division 26 Section "Electrical Inspections and Testing", ANSI/NETA ATS "Cables, Low-Voltage, 600-Volts Maximum", "System Functional Tests", and "Thermographic Survey" requirements, and the following additional requirements:
 - a. Limit tests to:
 - 1) Service entrance conductors.
 - 2) Feeder and 3 phase motor conductors.
 - 3) Branch circuit conductors feeding generator loads.
 - b. Follow-up thermographic survey shall not be required.
 - c. Prepare test and inspection reports.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications. Types of grounding systems include the following:

1. Surge Protective Device (SPD) Grounding.
2. Telecommunications Grounding.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements."

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding 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. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS and NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.
- B. Record Documents: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Grounding arrangements and connections for separately derived systems.
2. Grounding for sensitive electronic equipment.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with UL 837 for substation grounding connections.
- D. Field Testing: Refer to Division 26 Section "Electrical Inspections and Testing" for field inspections and testing requirements related to this Section including:
 1. Electrical Acceptance Testing Responsibilities.
 2. General Electrical Field Quality Control.
 3. Testing Agency Qualifications.
- E. Comply with ANSI/TIA/EIA-607A – Commercial Building Grounding, Earthing and Bonding Requirements for Telecommunications.
- F. Comply with ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems for field testing.
- G. Comply with ANSI/TIA/EIA-607B – Commercial Building Grounding, Earthing and Bonding Requirements for Telecommunications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following listed manufacturers:
 1. Ground Rods:
 - a. Burndy.
 - b. Erico Products.
 - c. Knight Metalcraft.
 - d. Nehring.
 - e. Harger Lightning and Grounding.
 2. Molded Fusion Welding Material:

- a. Burndy.
 - b. Cadweld.
 - c. ThermOweld.
 - d. Harger Lightning and Grounding UltraWeld®.
3. Ground Clamps/Connectors:
- a. Adalet – PLM Division; a Division of Scott Felzer.
 - b. Anderson Corp.
 - c. Anixter Bros., Inc.
 - d. Burndy.
 - e. Chance – A.B. Chance Co.
 - f. Crouse-Hinds, a Division of Cooper Industries.
 - g. Erico Products.
 - h. Ideal Industries, Inc.
 - i. Joslyn Corporation.
 - j. Harger Lightning and Grounding.
 - k. O-Z/Gedney Co.
 - l. Raco, Inc.
 - m. Thomas & Betts Corp.
4. Enclosure Equipment Grounding Kits:
- a. Same manufacturer as box/cabinet or for ground clamps/connectors.

2.2 GROUNDING AND BONDING PRODUCTS

- A. Products: Of types indicated and of sizes and ratings to comply with NEC requirements. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE AND CABLE CONDUCTORS

- A. General: Comply with Division 26 Section "Low Voltage Electrical Power Conductors and Cables."
- B. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- C. Equipment Grounding Conductor: Green insulated. Conductors No. 8 and larger may use green taped conductor ends.
- D. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at

least three bands of green and two bands of yellow.

2.4 TELECOMMUNICATIONS GROUNDING EQUIPMENT

A. Grounding Busbars:

1. Telecommunications Main Grounding Busbar (TMGB) - 24"W x 4"H x 1/4"D electro-tin plated copper bus, with two (2) rows of holes on 1 inch centers for 1/4 inch bolts, to receive cables from two directions.
2. Telecommunications Grounding Busbar (TGB) - 12"W x 2"H x 1/4"D electro-tin plated copper bus, with two (2) rows of holes on 1 inch centers for 1/4 inch bolts, to receive cables from two directions.
3. Acceptable Manufacturer/Series – Erico; Eritechn #TMGB/#TGB Series or equal by Newton or Harger.

B. Bonding Conductors for Telecommunications (BCT):

1. Similar to Grounding Conductors. Provide with green insulation for 6 AWG or smaller diameter.
2. Size (diameter) based on final installed length; approximately 2kc mils per linear foot. Refer to chart in Part 3.
 - a. Telecommunications Bonding Backbone (TBB).
 - b. Grounding Equalizer (GE).

C. Telecommunications Grounding and Bonding Conductor Label Kit:

1. Meets labeling requirements of J-STD-607-A; each telecommunications grounding and bonding conductor shall be labeled "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."
2. Nonmetallic machine printed tags minimum 2.75" x 1.38".
3. Flag marker 90 degrees to cable.
4. Manufacturer:
 - a. Panduit LTYK.
 - b. Harger GRNTAG607PK10.
 - c. Or equal by Brady.

2.5 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.
 2. Split-bolt connectors shall not be used for any application.
- C. Molded Fusion Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ground all equipment, furnished by this Division or by others.
1. Split-bolt connection methods shall not be used.
- B. Provide ground connection for communication/special systems services including underground, aerial, and antenna delivery systems.
- C. All transformer enclosures and secondary neutrals shall be separately grounded to a separate ground electrode with a continuous grounding electrode conductor sized per NEC. Do not ground directly to building steel. Refer to "single line diagram" and details on Drawings.
- D. Make molded fusion welds connections in strict accordance with supplier's instructions. Clamp cables securely in place, independent of connection. Clean and inspect all connections.
- E. At least one connection shall be made between the building ground, the electrical service ground for the building, and a metallic cold water pipe ground larger than one inch trade diameter.
- F. Grounding cable shall not be buried directly in concrete, but a grounded metallic or non-metallic conduit sleeve shall be provided where cable passes through concrete.
- G. Where ground conductors are shown on Drawings and for all feeders, the use of the metallic raceway in place of the ground conductor shall not be permitted. Provide grounding bushings at each end of all low voltage feeder raceways. Where non-metallic conduit is used, coordinate the installation of a code sized ground conductor.
- H. All grounding conductors run inside the building shall be run within NEC sized metallic raceways with raceway grounding bushings at each end and bonding jumper to the enclosure or ground bus. Extend raceway to associated equipment enclosures and to within 6 inches of exposed ground terminal bar installations. Raceway installations shall be in accordance with Division 26 Section "Raceways."
1. Each ground conductor bus connection shall be terminated with individual

- compression lug and associated individual lug bolt.
- 2. Split-bolt connection methods shall not be used for any application.
- I. Welded connections may have multiple ground conductors to suit mold and may be considered "continuous."

3.2 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations. Only when a disconnect-type connection is indicated, use a bolted clamp.

3.3 ELECTRIC SERVICE AND TRANSFORMER GROUNDING INSTALLATIONS

- A. Make grounding connections electrically ahead of any overcurrent or disconnect device or tap connection such that disconnection of neutral load conductors does not interfere with or remove the system ground connection. Use separate lugs on the transformer neutral terminal for neutral and main grounding jumper when cable is used for transformer connections.
- B. Connect low voltage transformer grounds to common grounding electrode conductor(s) and not to building steel.
- C. Make all connections to the grounding electrode system accessible.

3.4 TELECOMMUNICATIONS SIGNAL GROUNDING SYSTEM INSTALLATION

- A. Definitions:
 - 1. TBB: Telecommunications Building Backbone.

2. TGB: Telecommunications Grounding Busbar.
 3. TMGB: Telecommunications Main Grounding Busbar.
- B. Install a complete telecommunications grounding electrode system with room grounding buses, grounding electrodes, and interconnecting cables per ANSI/EIA/TIA-607A.
- C. Install main and room ground busbars at 18 inches AFF. Mount busbar by anchors and bolts using 1-1/2 inch long insulated spacer between bar and plywood. Use a minimum of two supports for each busbar.
1. Provide signal ground (TBB) homeruns from the TMGB to the furthest (highest) TGB in each group of stacked telecom rooms with grounding conductor in conduit. Sleeves may be utilized to pass through telecom rooms in lieu of conduit. Bond conduit at each end to the local TGB.
 - a. TBB shall be routed through each telecom room in route to the highest TGB in each vertical of stacked telecommunications rooms. Determine the TBB conductor size (diameter) by its final length from TMGB to furthest TGB approximately 2kc mils per linear foot. Refer to chart in PART 3.
 - b. Connect each TGB to TBB in each TR with a maximum 8 inch copper grounding whip with irreversible connection. Size (diameter) whip one gage smaller than that of TBB.
 2. Lug main grounding bus to grounding electrodes with No. 1/0 grounding electrode conductor per Division 26 Section "Grounding and Bonding."
 3. Provide a Bonding Conductor (BC) terminated at the TMGB and the electrical service ground bar. Size similar to a TBB.
 - a. Determine the size (diameter) of the BC by its final length, approximately 2kc mils per linear foot. Refer to chart in PART 3. Provide size equal to or greater than the diameter of the longest TBB.
- D. Provide a grounding equalizer (GE) bonding each TGB to all other TGBs on every third (3rd) floor (and at top floor) of buildings with multiple stacked telecommunications rooms.
1. The GE shall be continuous and extend from a TGB in the Telecommunications Room to each TGB in Telecommunications Rooms on the same floor.
 2. Determine the GE size (diameter) by its final length, approximately 2kc mils per linear foot. Refer to chart in PART 3. Provide size equal to or greater than the diameter of the longest TBB.
- E. Provide an exterior service entrance grounding electrode system specific to telecommunications system.

1. Install three (3) ground rods equidistant from each other (minimum of 6 feet).
 2. Extend a BC to TMGB from one ground rod.
 - a. Determine the size (diameter) of the BC by its final length, approximately 2kc mils per linear foot. Refer to chart in PART 3. Provide size equal to or greater than the diameter of the longest TBB.
- F. Provide TBB from TMGB to Equipment Room Ground Terminal Bar. Size TBB one size larger than longest TBB in building.
- G. Label each telecommunications bonding conductor as close as practicable to its point of termination in a readable position, "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER".
- H. Provide ground connection to anti-static floor where required.
- I. Install room terminal ground bus directly adjacent to main and room ground buses at 18 inch AFF. Tie to room ground bus with bare No. 1/0 AWG.
- J. Bond metallic telecommunications pathways (e.g. conduit, sleeves, cable trays, fire rated assemblies, etc.) to ground. Use structural steel where available. When a bonding conductor is installed in metallic conduit, bond the bonding conductor to the conduit at both ends.
- K. All exterior/underground terminations shall be made with exothermic welds.
- L. Measure impedance of grounding conductors upon completion and record on as-built documents.
- M. Size all Telecommunications Signal Bonding Conductors per the following schedule:

INSULATED GROUNDING CONDUCTOR SIZING SCHEDULE

CONDUCTOR LENGTH	INSULATED CONDUCTOR SIZE	MAXIMUM AREA (CIRCULAR)
13	6	26.24

CONDUCTOR LENGTH	INSULATED CONDUCTOR SIZE	MAXIMUM AREA (CIRCULAR)
21	4	41.74
26	3	52.62
33	2	66.36

42	1	83.69
53	1/0	105.600
67	2/0	133.100
84	3/0	167.800
106	4/0	211.600
125	250	250.000
150	300	300.000
175	350	350.000
200	400	400.000
250	500	500.000
300	600	600.000
350	700	700.000
375	750	750.000
400	800	800.000
450	900	900.000
500	100	1,000.000
625	125	1,250.000
750	150	1,500.000
875	175	1,750.000
100	200	2,000.000

1. DESIGN GUIDE BASIS:
 - A. MAXIMUM VALUE OF 0.1 OHM AT EACH
 - B. POINT 2K CIRCULAR MILS NEEDED
 - C. FOR EVERY FOOT NEC TABLE 8
2. MINIMUM REQUIREMENTS:
 - A. EQUIPMENT GROUND CONDUCTOR: 6
 - B. AWG (MIN.) TELECOMMUNICATIONS BUILDING BACKBONE (TBB: 2 AWG

3.5 ELECTRICAL EQUIPMENT GROUNDING CONDUCTOR INSTALLATIONS

- A. Unless indicated otherwise, form one equipment ground circuit with rigid metallic raceways (e.g. EMT, rigid steel conduit) where used. Install a bonding jumper for continuity around all fittings and terminations where the conductive raceway is made non-continuous (i.e. underground feeder non-metallic raceways).
1. Bond all grounding conductors to boxes or enclosures at each access point utilizing approved grounding kits. Do not use building steel as equipment grounding path.
 2. Bond all conductive metallic piping system in each mechanical equipment room as required by NEC utilizing approved clamps. Minimum size of conductors as required by NEC. Locate all connections where access is unrestricted for inspection. Looping of conductor from one system to another is acceptable provided the conductor is without splice and has each end of loop bonded.
 3. If non-metallic raceways are used for power distribution feeders (i.e., panels, transformers, HVAC equipment), where the feeder is a single feeder and not a parallel feeder, a second insulated grounding conductors shall be provided inside the conduit (conduit size shall be adjusted accordingly), or a bare grounding conductor shall be provided strapped to the outside of the conduit. The grounding conductor shall be the same size as the grounding conductor provided inside the conduit. Terminate at grounding bushings or bus on each end. Where the feeder is a parallel feeder, a second grounding conductor shall not be required.
 4. Where non-metallic raceways are used for branch circuit wiring (such as lighting, receptacles and miscellaneous equipment circuits), a second insulated grounding conductor shall be provided inside the conduit (conduit size shall be adjusted accordingly), or, a bare grounding conductor shall be provided strapped to the outside of the conduit. The grounding conductor shall be the same size as the grounding conductor provided inside the conduit.
- B. Provide, in the same raceway with the associated phase and/or neutral conductors, a green colored equipment ground conductor having the same type insulation and connected as described below to provide equipment ground redundancy.
1. Install a ground conductor in each raceway to augment the circuit formed by the metallic raceway system. Bond the conductor to each box or enclosure in which access is possible utilizing enclosure equipment ground kits, through metallic conduit insulated ground bushings or wedges and/or enclosure threaded grounding studs. Size conductor as specified, shown or required by Code, whichever is larger. Install a raceway grounding bushing and bonding jumper to the enclosure or contained ground bus for the following: each termination of conduits 1 inch trade size and larger at a switchboard, panelboard, or other enclosure, each location where multiple ring knockouts are damaged during conduit installation, each location where conduits are stubbed up into floor mounted enclosures; each conduit termination at a painted enclosure where paint is not removed before installation of raceway and each feeder.

- a. All branch circuits shall be provided with an equipment grounding conductor sized per NEC Table 250-122. This includes all lighting and power branch circuits.
 - b. Provide a ground conductor to all light switches, receptacles, motors, light fixtures and all other branch circuit loads.
 - c. Install a ground conductor inside all flexible raceways (e.g., flexible steel, liquid tight). Bond the conductor to the enclosure or ground bus in the nearest box or access on either side of the flexible section. Size conductor as specified, indicated, or required by Code, whichever is larger.
 - d. Install a ground conductor in all sectional raceways with removable covers for access (e.g. plug-in strips, surface raceway systems, and wireways) unless specified otherwise. Size conductor in accordance with the NEC for the largest phase conductor size installed in raceway, or as indicated. Bond all sections of the raceway to the ground conductors. Connect all receptacle ground terminals in the raceway to the ground conductor, and make other ground connections shown on Drawings.
- C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 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 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.6 SURGE PROTECTION DEVICE PROTECTION DEVICE (SPD) GROUND

CONDUCTOR INSTALLATIONS

- A. Extend separate transient voltage surge suppressor dissipation ground conductors to local equipment ground bus and to common grounding electrode conductors. Size conductors per (SPD) manufacturer recommendations and National Electrical Code. Refer to details on Drawings.

3.7 LABELING

- A. Comply with requirements in Division 26 Section "Electrical Identification" for instruction signs. The label or its text shall be green.
 - 1. Install labels on bonding conductor or on bonding conductor raceway every 15 feet. Identify system/service and bonding termination locations.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the Facility Manager."

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform inspections and test procedures as required by Division 26 Section "Electrical Inspections and Testing", ANSI/NETA ATS "Grounding Systems" requirements and the following additional requirements:
 - a. Grounding system will be considered defective if it does not pass tests and inspections.
 - b. Prepare test and inspection reports.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS

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.
- B. Provide bases, inertia pads, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus shown on Drawings.
- C. Floor mounted electrical equipment shall be installed on 4-inch-high floor doweled concrete housekeeping pads with equipment inset 4 inches on all sides. Concrete shall be in accordance with referenced concrete specification section.
- D. Solidly anchor steel support channel framework to floor and ceiling slabs and mount the designated equipment thereto.
- E. Provide concrete pads for floor mounted equipment such as:
 - 1. Transformers.
- F. Provide steel support channels for wall mounted equipment such as:
 - 1. Cable Trays.
 - 2. Communication and Special Systems Cabinets.
 - 3. Dimming Systems.
 - 4. Disconnect Switches.
 - 5. Panelboards.
 - 6. Raceways.
 - 7. Wall Mounted Transformers.

1.2 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.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements".

1.4 ACTION SUBMITTALS

A. Product Data:

- 1. Trapeze hangers.
- 2. Steel slotted support systems.
- 3. Nonmetallic slotted support systems.

B. Shop Drawings:

- 1. Signed and sealed by a qualified professional engineer.
- 2. Show fabrication and installation details and include calculations for the following:
 - a. Trapeze hangers.
 - b. Steel slotted channel systems.
 - c. Nonmetallic slotted channel systems.
 - d. Equipment supports.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

- 1. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 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, a Division of Tyco.
 - b. Line Systems.
 - c. Cooper B-Line, Inc.; a Division of Cooper Industries.
 - d. ERICO International Corporation.
 - e. GS Metals Corporation.
 - f. Thomas & Betts Corporation.
 - g. Unistrut; Tyco International, Ltd.
 - h. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 - 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. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) 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, 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) 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 GENERAL

- A. Comply with NEC, 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. Take care not to weaken concrete or penetrate waterproofing where equipment supports are on concrete construction.
- C. Obtain prior approval for installation method where structural steel is required to frame into building structural members for the support of equipment, conduit, etc. Welding is permitted only when approved by Engineer's field representative.
- D. Coordinate with the building structural system and with other electrical installation.
 - 1. Metal Decking: Nothing is to be suspended from steel roof decks (no concrete).
- E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel or angle iron racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- F. In overhead spaces, boxes shall be supported independently of raceways and raceways independent of the boxes. Support boxes directly from the building structure or by bar hangers.
 - 1. Where bar hangers are used for boxes, attach the bar to raceways on opposite sides of the box and support the raceway with an independent approved type of fastener not more than 24 inches from the box. To clarify, box or raceway removal should not require re-supporting of the other.
- G. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- H. 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.

3.2 SUPPORT INSTALLATION

- A. Comply with NEC, 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 structural 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. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 6. To Light Gage Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. 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. Coordinate dimensions of concrete housekeeping pads with requirement for equipment supplied.
- B. 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.
 - 1. 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."
 - 2. Drill and grout steel reinforcing bar dowels to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
- 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 epoxy coated 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 RUBBER MATS

- A. Provide in operating and maintenance aisles on all sides of each electrical assembly.
- B. Provide as shown on Drawings or otherwise extending the longer of the electrical assembly or associated housekeeping pad and 4 foot minimum width.

END OF SECTION 260529

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SECTION 260533 – RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways for electrical wiring. Types of raceways in this Section include the following:

1. Rigid galvanized steel conduit (RGS).
2. Intermediate metal conduit (IMC).
3. Electrical metallic tubing (EMT).
4. PVC externally coated rigid steel conduit.
5. Rigid nonmetallic conduit (RNC).
6. Optical Fiber and Communication Raceway (Innerduct).
7. Flexible metal conduit.
8. Liquidtight flexible metal conduit.
9. Conduit bodies.
10. Conduit fittings.
11. Surface raceways.
12. Wireway and auxiliary gutters.
13. Multi-outlet assemblies.
14. Steel wall duct.
15. Steel trench duct.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements."

1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways and all conduit fittings only.
- B. Shop Drawings:
1. Layout Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.
 - a. Structural members in the paths of conduit groups with common supports.
 - b. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
 - c. Include plans, elevations, sections, details and attachments to other work.

1.4 CLOSEOUT SUBMITTALS

- A. Record Documents.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NFPA 70.

- C. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

1. National Electrical Manufacturers Association (NEMA):

- a. NEMA, FB1 Fittings for Metallic Conduit
- b. NEMA, RN 1 PVC Externally Coated Galvanized Rigid Conduit and Intermediate Metal Conduit
- c. NEMA, TC2 Schedule 40 and Schedule 80 PVC
- d. NEMA, TC 3 PVC Fittings for Use with Rigid PVC and Tubing

2. American National Standards Institute (ANSI):

- a. ANSI-C80.1 Rigid Steel Conduit
- b. ANSI-C80.2 Rigid Steel Conduit, Enameled
- c. ANSI-C80.3 Electrical Metallic Tubing, Zinc-
- d. ANSI-C80.5 Rigid Aluminum Conduit
- e. ANSI-C80.6 Intermediate Metal Conduit (IMC)

3. American Society for Testing Materials (ASTM):

- a. ASTM F 512-84 Standard Specification for Smooth Wall Poly Vinyl Chloride (PVC) Conduit and Fittings for Underground Installation

- D. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, or ETL:

- 1. UL 1 Flexible Metal Electrical Conduit
- 2. UL 5 Surface Metal Electrical Raceways and Fittings

- | | | |
|-----|-----------------|--------------------------------------------------------|
| 3. | UL 6 | Rigid Metal Electrical Conduit |
| 4. | UL 360 | Liquidtight Flexible Steel Conduit, Electrical |
| 5. | UL 514B | Fittings for Conduit and Outlet Boxes |
| 6. | UL 651 | Schedule 40 and 80 PVC Conduit |
| 7. | UL 797 | Electrical Metallic Tubing |
| 8. | UL 870 | Electrical Wireways, Auxiliary Gutters, and Associated |
| 9. | UL 91- and 2024 | Plenum Optical Fiber Raceways |
| 10. | UL 1242 | Intermediate Metal Conduit |

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate with other Work, including metal and concrete deck installation, as necessary to interface installation of electrical raceways and components with other Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. Rigid Metallic Conduit:
1. Allied, a Division of Tyco.
 2. Republic Conduit.
 3. Wheatland Tube Co.
- C. PVC Coated Rigid Steel Conduit and Fittings:
1. Ocal, a Division of Thomas and Betts.
 2. Perma-Cote Industries.
 3. Rob-Roy.
- D. Rigid Nonmetallic Conduit and Fittings:
1. Allied, a Division of Tyco.
 2. Can-Tex.
 3. Carlon.
 4. Condux.
 5. IPEX.
 6. National.
- E. Flexible Nonmetallic Conduit and Fittings:
1. Arnco Corporation.
 2. Endot Industries, Inc.

3. Carlon Plenum-Guard.
 4. Kwikpath, IPEX, Inc.
- F. Flexible Metal Conduit and Fittings:
1. AFC Cable Systems, a Division of Tyco.
 2. Al-flex (Steel).
 3. Liquatite.
- G. Liquidtight Flexible Metal Conduit and Fittings:
1. AFC Cable Systems, a Division of Tyco.
 2. Al-flex.
 3. American Flexible Conduit.
 4. Anamet, Inc.

 5. Electro Flex.
 6. Liquatite.
 7. PDU Cables.
 8. RACO.
- H. Conduit Bodies:
1. Appleton Electric Co.
 2. Carlon (PVC).
 3. Crouse-Hinds Division, Cooper Industries, Inc.
 4. Killark Electric Mfg. Co.
 5. O-Z/Gedney.
- I. Conduit Fittings:
1. Allied, a Division of Tyco.
 2. Arlington.
 3. Bridgeport Fittings, Incorporated.
 4. Cooper Crouse-Hinds.
 5. Midwest Electric.
 6. O-Z/Gedney.
 7. RACO.
 8. Steel City.
 9. Thomas and Betts.
- J. Wireways and Auxiliary Gutters:
1. Hoffman Engineering Co.
 2. Lee Products Co.
 3. Walker-Parkersburg.

K. Surface Metal Raceway:

1. Hubbell, Inc.
2. Mono-Systems.
3. Post Glover Life Link.
4. The Wiremold Co. 500 Series; a Div. of Legrand.

L. Surface Nonmetallic Raceway:

1. Hubbell, Inc.
2. Mono-Systems.
3. Panduit Corp.
4. The Wiremold Co.; a Div. of Legrand.

M. Surface Metallic Raceway:

1. Hubbell, Inc. 3000 and 4800 series and ALU3800 and ALU4800 series.
2. Mono-Systems, Inc. SMS3000, SMS4200, and SMS4800 series.
3. Post Glover Versa-Duct 100 and 200 series.
4. The Wiremold Co. G3000, AL3100, and G4000 series; or Div. of Legrand.

N. Multi-Outlet Assemblies:

1. Hubbell, Inc. Metal PlugTrak.
2. Mono-Systems.
3. The Wiremold Co. 2400 series; a Div. of Legrand.

O. Steel Wall Duct:

1. Mono-Systems.
2. Square D.
3. Wiremold.

P. Steel Trench Duct:

1. Mono-Systems.
2. Square D.
3. Wiremold.

Q. Aluminum Surface Raceway:

1. As fabricated by local fabricators.
2. Mono-Systems.

2.2 METAL CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit: ANSI C80.1.

- B. Intermediate Steel Conduit: UL 1242.
- C. PVC Externally Coated Rigid Steel Conduit and Fittings: ANSI C80.1 and NEMA RN 1.
- D. Electrical Metallic Tubing and Fittings: ANSI C80.3.
- E. Flexible Metal Conduit: UL 1, zinc-coated steel.
- F. Liquidtight Flexible Metal Conduit and Fittings: UL 360. Fittings shall be specifically approved for use with this raceway.

2.3 NONMETALLIC CONDUIT AND DUCTS

- A. Rigid Nonmetallic Conduit: NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
- C. Conduit and Duct Accessories: Types, sizes, and materials complying with manufacturers published product information. Mate and match accessories with raceway.

2.4 OPTICAL FIBER AND COMMUNICATIONS RACEWAY (INNERDUCT) FITTINGS

- A. General: UL 910 approved corrugated plenum optical fiber raceway for telecommunications plenum, riser, and general purpose cable applications per NEC Articles 770 and 800.
- B. Raceway shall be supplied with a factory installed 1250 lb. tensile pre-lubricated pull tape.
- C. Raceway shall be per Division 26 Section "Electrical Identification."

2.5 CONDUIT BODIES

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements for feeder runs only. Branch circuit use is prohibited. Provide matching gasketed covers secured with corrosion-resistant screws.
- B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways. Use bodies with set screw or compression type hubs for EMT according to fitting application specified below.
- C. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL 514

B.

2.6 CONDUIT FITTINGS

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Die cast fittings are not acceptable.
- B. Rigid Galvanized Steel, Intermediate Steel: Use threaded type with bushed connections. Factory-installed conduit couplings are acceptable.
- C. Electrical Metallic Tubing Conduit: Use nylon insulated fittings. Steel body or integral conduit sleeve dual double set-screw type fittings are acceptable for EMT conduits except for mechanical rooms, kitchens and damp locations where threaded compression types are required. Die cast fittings are not acceptable.
 - 1. Nylon fittings may be eliminated if rounded box teeth type fitting are used (i.e. Cooper Crouse Hinds Space Saver).
 - 2. Colored fittings may be used to meet raceway identification requirements of Division 26 Sections "Boxes and Cabinets" and "Electrical Identification."
- D. Rigid Nonmetallic Conduit: Use fittings designed specifically for conduit type of same manufacturer.
- E. Flexible Metal Conduit: Use nylon insulated throats of the following type:
 - 1. Wedge and screw type.
 - 2. Squeeze on clamp type with one or two screws.
 - 3. Steel multiple-point type for threading into internal wall of conduit.
- F. Liquidtight Flexible Conduit: Use threaded grounding cone with steel compression ring and tightening gland, steel body with insulated throat.
- G. Unlike Conduit: Use connectors which meet individual conduit fittings requirements for both and are UL listed and labeled for such use.
- H. Expansion and Deflection Fittings:
 - 1. Conduit movement in straight line direction:
 - a. O-Z/Gedney type AX series.
 - 2. Up to 3/4 inch deflection and movement in all directions:
 - a. O-Z/Gedney type DX series.
 - 3. Deflection and movement beyond 3/4 inch in all directions:
 - a. O-Z/Gedney type AXDX series.

I. Conduit Bushings:

1. Rigid Steel and Intermediate Steel Conduit: Threaded, grounded, insulating type with thermosetting or fiber insert in a metal body.
2. Electrical Metallic Tubing Conduit: Identical to rigid steel or intermediate steel conduit bushing on electrical metallic tubing combination coupling.
3. Insulated Grounding Bushings or grounding wedges on metallic conduits shall be installed per Division 26 Section "Grounding and Bonding."
4. Plenum Conduit: UL approved for air handling spaces when so installed.

J. Conduit Seals:

1. Cast in place with pressure ring and sealing grommet:
 - a. O-Z/Gedney type FSK series with FSKA membrane clamp adapter.
2. Cast in place with two pairs of pressure rings and sealing grommets:
 - a. O-Z/Gedney type WSK series.
3. For sealing conduits installed in core-drilled, sleeved, or precast holes:
 - a. O-Z/Gedney type CSM series with CSMC membrane clamp adapter.
 - b. Thunderline Link-Seal series.

2.7 SURFACE RACEWAYS

- A. General: Sizes and channels as shown on Drawings. Provide fittings that match and mate with raceway.
- B. Surface Metal Raceway: Construct of galvanized steel or extruded aluminum with snap-on covers, with 1/8-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer's standard prime coating suitable for finish paint selected by Architect. Provide one wire clip for every 12 inch length of raceway for holding conductors in place.
- C. Surface Nonmetallic Raceway: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color. Raceway and system components shall meet UL 94 requirements for nonflammable, self-extinguishing characteristics.
- D. Surface Metal Ducts: Construct of galvanized steel or extruded aluminum with snap-on covers, with 1/8 inch mounting screw knockouts in base approximately 8 inches o.c. with accessories as required to accomplish the arrangement indicated and NEC separation. Finish with manufacturer's standard prime coating suitable for finish paint selected by Architect. Provide one wire clip for every 12-inch length of raceway for holding conductors in place. Provide wiring device in assembly as

indicated.

1. Provide a separately run No. 12 AWG THHN or THWN insulated copper conductor bonded to each base section as a ground bus.

2.8 WIREWAYS AND AUXILIARY GUTTERS

- A. General: Electrical wireways and auxiliary gutters shall be generally NEMA 1 construction of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, connectors, tees, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Provide corrosion resistant phosphate primer and baked gray epoxy finish. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC and NEMA standards.
- B. Wireway covers shall be hinged type, as indicated, otherwise screw cover type.

2.9 MULTI-OUTLET ASSEMBLIES

- A. Two piece continuous outlet system equipped with knockouts for 1/2 inch conduit at approximately 8 inch centers and screw knockouts/piercings on 2 inch centers. Snap-on cover with openings on 6 inch centers for single NEMA 5-15R receptacle with openings on 6 inch centers for single NEMA 5-15R receptacle with (grey) (ivory) face. Receptacles arranged for two circuit (alternate receptacles on opposite circuit) three-wire operation and prewired with #12 AWG THHN or THWN insulated copper conductors. Red face receptacles or receptacle red marking tag shall be utilized if connected to emergency circuits. Finish shall be as selected by Architect except in laboratory areas where anodized aluminum shall be utilized. Wiring devices shall conform to Division 26 Section "Wiring Devices" as appropriate.
- B. Provide end caps, feed section and additional fittings required to accomplish the arrangement indicated. Provide blank sections at sinks as indicated or required.

2.10 STEEL WALL DUCT

- A. Sheet metal duct suitable for installation of diagnostic and treatment equipment cables; with removable covers, partitions and accessories as indicated or required by the equipment manufacturer's representative.
- B. Size: As shown on Drawings.
- C. The wall duct raceway (body and cover) shall be fabricated from 14-gauge galvanized steel. Galvanized steel shall be of a paintable finish, such that no further preparation except for normal cleaning will be required to paint the raceway.

- D. Coverplate widths shall be equal to the body width when raceway is surface mounted and shall exceed the body by 2 inch when the raceway is flush mounted.
- E. The wall duct raceway shall be furnished in standard 5 foot lengths. Each 5 foot length shall consist of one body and two 30 inch long coverplates. 18 inch lengths of raceway (with one coverplate) shall also be used when appropriate.
- F. When necessary, field modifications shall be made to the product to insure compliance with the manufacturer's layout drawings.
- G. Accessories: Provide the necessary accessories as required to make a complete installation. Accessories shall include but not be limited to internal coupling angles, snap-in-place wire retainers and end closures.
- H. A non-adjustable partition shall be provided to maintain separation of services.
- I. Fittings: All tee, horizontal elbow, internal elbow, external elbow and vertical elbows shall be provided as required. These fittings shall be provided with tunneling to maintain separation of services. Transitions from wall duct to trench duct shall be provided as required. Other miscellaneous fittings shall be provided as required to conform to [equipment manufacturer's] layout drawings.

2.11 STEEL TRENCH DUCT

- A. Sheet metal duct suitable for installation of diagnostic and treatment equipment cables; with removable covers and accessories as indicated or required by the equipment manufacturer's representative.
- B. Size: As shown on Drawings.
- C. The trench duct shall be full bottom type fabricated from steel and extruded aluminum conforming to UL 209 thickness.
- D. Openings: Provide transitions to wall duct as necessary and grommets openings in trench duct coverplates as necessary to distribute wires to designated equipment.
- E. Removable Covers: Covers shall conform to UL 209 thickness roller leveled steel (after size shearing). Retain covers in position by countersunk hold down screws threaded into a continuous slotted side rail. Coverplates shall be a maximum of 3 feet in length with overlapping joints and shall be fully gasketed. Continuously slotted side rail shall allow for interchangeable relocation of coverplates.
- F. External Leveling: External leveling screws shall be provided for pre-pour leveling of the trench duct as a unit. Coverplate and side rail shall allow for a maximum of 3/4 inch internal height adjustment prior to concrete pour.
- G. Fabrication: Body shall be three piece (2 side rails and 1 bottom pan) rigidly supported by adjoining concrete. Minimum width of trench duct body shall be 3/4

inch less than the coverplate width. Combination coupling support shall permit proper alignment of the trench duct. Fully adjustable compartment dividers shall be of 16 gauge steel with minimum 1/2 inch wide shelf at top longitudinal bearing of coverplate.

- H. Field Modification: The trench duct shall be fabricated such that disassembly shall allow for field modification of individual components and reassembly using the same components. There shall be no welding required for reassembly of the trench duct.
- I. Fittings: All tee and horizontal elbows shall be provided as required. Fittings shall be provided with tunneling to maintain separation of service as required to conform to manufacturer's layout drawings.
- J. Accessories: Provide the necessary accessories as required to make a complete installation. Accessories shall include but shall not be limited to coupling mechanisms, closures, and coverplate lifting devices.

PART 3 - EXECUTION

3.1 CONDUIT RACEWAY APPLICATION

A. Rigid Galvanized Steel Conduit:

- 1. May be used in:
 - a. Interior locations.
 - b. Direct contact with concrete.
- 2. Shall be used in:
 - a. Exposed exterior locations.
 - b. Exposed interior damp or wet locations.
 - c. Hazardous locations.
 - d. Medium voltage interior applications (throughout).
 - e. Within seven foot area around boilers, incinerators and other heat producing equipment.
 - f. Exposed interior locations within seven feet of the floor for all low voltage power and signal conductors (except electrical rooms).
 - g. Interior parking levels and exterior decks where exposed.
 - h. Biological and bio-safety laboratories.
 - i. Metal decking cells above beams.

B. Intermediate Metallic Conduit:

- 1. May be used in:

- a. All applications noted for rigid galvanized steel conduit except hazardous locations and interior medium voltage cable installations.
- C. Electrical Metal Tubing:
1. May be used in:
 - a. Concealed interior locations above ceilings, in hollow studed partitions and in the cores of concrete masonry unit partitions.
 - b. Exposed interior locations above seven feet.
 - c. Low voltage electric and communication room applications.
 2. Shall be used:
 - a. All exposed interior locations above seven feet for conductors of any type.
- D. Coated Conduit:
1. Shall be used in:
 - a. All rooms containing swimming pools, saunas, spas, hydrotherapy tubs, and their associated equipment rooms.
 - b. Direct contact with earth.
 2. Shall not be used in HVAC plenums.
- E. (Schedule 80) Nonmetallic Conduit:
1. May be used in:
 - a. Direct contact with earth.
 - b. Locations embedded in concrete.
 2. Shall not be used in HVAC plenums.
- F. (Schedule 40) Nonmetallic Conduit:
1. May be used in:
 - a. Locations embedded in concrete.
 - b. Exposed parking garage applications when used with proper hangers and expansion fittings for expansion and contraction and where not subject to vehicular damage.
 2. Shall not be used in HVAC plenums.
- G. Optical Fiber and Communication Raceways:

1. Shall be used in:
 - a. Fiber optic cable applications (throughout).
 2. Shall not be used in HVAC plenums.
- H. Flexible Metal Conduit:
1. May be used in:
 - a. Four to six feet long lengths for final connection to luminaries.
 - b. Steel studwalls between outlets and from outlet to rigid raceway leaving wall.
 2. Shall be used in:
 - a. 18 inches to 22-inch-long lengths to form a slack "U" between rigid raceway system and:
 - 1) Busway plug-in devices.
 - 2) Rotating equipment.
 - 3) Vibrating equipment.
 - 4) Equipment requiring adjustments in position.
 - 5) Transformers.
- I. Liquid-tight Flexible Metal Conduit shall be used as specified for flexible metal conduit as follows:
1. Shall be used in:
 - a. Final connection to fire pump motor.
 - b. Final connection to all kitchen and laboratory equipment.
 - c. Damp locations.
 - d. Mechanical rooms.
 - e. Wet locations.
 - f. 18 inch to 22 inch long lengths to form a slack "U" between rigid raceway system and motors.
 2. Shall not be used in HVAC plenums.

3.2 INSTALLATION

- A. General: Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of NEC, NECA1, and as follows:
1. Provide power and wiring raceways to control devices for equipment by this or other Divisions.
 2. Minimum conduit raceway size shall be 3/4 inch except switch legs, which

may be 1/2 inch and 3/8 inch flexible conduit may be use for final connection to luminaires.

3. Provide supports for raceways as specified elsewhere in Division 26 Section "Hangers and Supports."
4. Cut square, free of burrs due to field cutting or manufacture, and use bushings approved for use where necessary.
5. Increase conduit raceway size as required due to NEC conductor derating requirements and availability. Minimum feeder conductor sizes, based upon NEC Table 310.16 and 40 percent maximum conduit raceway fill, shall be as shown on Drawings. If raceway type altered, be responsible for associated feeder conduit raceway size per NEC to meet 40 percent maximum fill.

B. Raceway Routing:

1. Conceal in finished rooms except where exposure is clearly indicated. Provide stainless steel escutcheon plates for all finished wall, floor, and ceiling penetrations.
2. Install raceways exposed in mechanical and electrical equipment rooms and electrical closets. Maintain a minimum 7 ft. head room.
3. Install raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical.
4. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.
5. Route raceways as required by job conditions unless dimensioned positions are shown on Drawings. Verify exact locations of all raceways, pull boxes, and junction boxes; resolve any conflicts before installation. Give priority in available space to large steam mains, steam lines that pitch, waste lines, drain lines, large air ducts, and all structural steel, unless indicated otherwise.
 - a. Maintain raceway and box separations per NEC.
6. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
7. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. Bends shall exceed minimum bending radii of wire and cable to be run within.
8. Install with not more than three 90 degree bends or more than 100 feet of straight conduit between pull boxes. Provide and install all additional pull boxes to meet this requirement.
9. Minimum Spacing: 3 inches between raceways and cold water or waste piping, and 12 inches between raceways and parallel steam pipes,

condensate pipes, hot water pipes and air ducts.

10. Do not place raceway less than one inch apart where they cross each other.
11. Install to provide adequate grounding between all outlets and the established electrical system ground.
12. Install to prevent water pockets.
13. Make no horizontal raceway runs in masonry walls.

C. Raceway Installation:

1. Prevent foreign matter from entering raceways by using temporary closure protection.
2. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
3. Raceways embedded in slabs:
 - a. Refer to Division 03 Section "Cast-in Place Concrete" for limitation on placement of conduit in concrete.
 - b. Tie raceways to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement.
 - c. Do not embed any aluminum raceways in concrete unless a special coating is applied that prevents chemical reaction between conduit and concrete.
 - d. Maximum outside diameter of embedded conduit shall be 1 inch. Minimum spacing between conduits shall be 3 conduit diameters clear.
 - e. Where conduit runs perpendicular to steel deck flutes, place conduit directly on steel deck. Where conduit runs parallel to steel deck flutes, place on 3/4-inch chair in low flute, with one conduit per flute maximum.
 - f. Do not place conduit between reinforcing bars and concrete surface. Provide minimum 1-1/2-inch concrete cover over conduits.
 - g. Do not lap or cross conduits at any point.
 - h. Do not tie conduits to headed shear studs. Place conduits parallel to beams with headed shear studs at least 18 inches away from studs.
 - i. Single conduit penetrations shall not be permitted in more than 3 consecutive deck flutes. Submit all variations to the Architect for review prior to the routing of conduits.
 - j. Where nonmetallic conduit is used, raceways must be converted to rigid galvanized steel conduit before rising above floor and a second "redundant" ground conductor must be run. Refer to Division 26 Section "Grounding and Bonding."
4. When installed embedded in concrete, or, in direct contact with the earth:
 - a. Provide rigid galvanized steel or IMC elbows for vertical rise through the concrete.
 - b. Provide rigid galvanized steel or IMC conduit for the first ten foot section when leaving or entering a building.
 - c. Make watertight with asphaltum or other approved compound applied to conduit joints before assembled.

5. Join raceways with fittings and make joints tight. Use bonding jumpers to provide electrical continuity of the raceway system for all metallic feeder conduits one inch and larger. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Use insulating bushings to protect conductors.
6. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
7. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
8. Complete installation of electrical raceways before starting installation of conductors within raceways.
9. Install a bonding wire in all flexible metal conduits.
10. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 lbs. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire. Tag at each end identifying other end location.
11. Refer to Division 26 Section "Conduit Rough-In Systems" for special raceway installation requirements for telecommunications, systems (low-voltage, signaling systems) cabling.
12. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid galvanized steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs with floor.
13. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.
14. If it is necessary to cut holes through webs of beams or girders, call such points to the attention of the Architect with size of hole before proceeding with work. All holes shall be cut no larger than absolutely necessary.
15. Whenever conduit is installed on exposed steel columns, the conduit shall be installed on the column web, and not on the flange.
16. All penetrations through existing floors shall be core drilled and sleeved.
17. All conduit knockouts or holes on electrical apparatus which are not used shall be provided with new plugs to match the NEMA rating of the enclosure.

D. Conduit Fittings:

1. Run with couplings approved for the conduit being used. Running threads and chase nipples will not be accepted in runs of threaded conduit.
2. Generally use mechanical dual set-screw type on EMT conduit except-use threaded compression type on EMT conduit within mechanical rooms,

- kitchens, and damp locations.
- 3. Install grounding bushings per Division 26 Section "Grounding and Bonding."
- E. Raceway Identification:
 - 1. Provide raceway identification per Division 26 Section "Electrical Identification."
- F. Expansion-Deflection Fittings:
 - 1. Install in all raceways at the expansion joints of the building in such a manner that the expansion joints of the building will function properly and not stress any electrical raceways. Movement will be required in all directions. Refer to "A" Series Drawings for facility expansion joint locations.
 - 2. Install on all straight conduit runs 1 inch trade size or larger in excess of 100 feet. Movement will be required in straight line direction only.
 - 3. Maintain grounding continuity at each expansion-contraction fitting.
- G. Conduit Seals:
 - 1. Use type "FSK" cast-in-place where conduit passes through foundation walls less than 60 inches below finished grade.
 - 2. Use type "WSK" cast-in place where conduit passes through foundation walls at 60 inches or more below finished grade.
 - 3. Install watertight seals at all conduits passing through horizontal barriers. These seals may be types "FSK," "WSK," or "CSML." Sleeves shall extend at least two inches above the finished floor with 1/2 inch space around the conduit and this space sealed permanently watertight with a removable material (concrete not acceptable).
 - 4. Install where conduits pass through barriers having a 30 degree F or greater temperature differential in the spaces on either side at anytime, and in conduits entering or leaving supply and return air plenums. Install pliable removable plastic compounded in the nearest box at the top of vertical runs and at the hot end of horizontal runs.
- H. Surface Raceways:
 - 1. Support with expansion shields, concrete inserts or masonry shields, as required for wall where wireway is mounted. Provide supports at 5 foot centers.
- I. Surface Non-Metallic Raceways: Install only as specifically indicated on Drawings. Substitute surface metal raceways in areas of public assembly.
- J. Surface Metal Raceways: Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle of luminaire ground terminals.
 - 1. Select each surface metal raceway outlet box to which a luminaire is attached to be of sufficient diameter to provide a seat for the fixture canopy.

2. Where a surface metal raceway is used to supply a fluorescent luminaire having central stem suspension with a backplate and a canopy, with or without extension ring, the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.
3. Provide surface metal raceway outlet box, in addition to the backplate and canopy, at the feed-in location of each fluorescent luminaires having end stem suspension.
4. Where a surface metal raceway extension is made from an existing outlet box on which a luminaire is installed, provide a backplate slightly smaller than the luminaire canopy, and no additional surface mounted outlet box need be installed.

K. Wireways and Auxiliary Gutters:

1. Support horizontally with expansion shields, concrete inserts or masonry shields, as required for wall where wireway is mounted. Provide supports at 5 foot centers.
2. Provide at least 42 inch clear in front of all wireways with front covers.

L. Multi-Outlet Assemblies:

1. Support assemblies at 18 inch centers maximum, at each end, branch, and box. Provide blank cover sections at sinks and basins extending 6 inches on either side of basin. Make transition to other wiring method with proper fittings.

M. Steel Wall Duct:

1. Review the equipment manufacturer's installation drawings and become familiar with all components used. Wall duct shall be installed and used in accordance with appropriate National Electrical Code articles. Derating of power conductors as explained in the National Electrical Code shall govern. The maximum wire fill shall not exceed 40 percent of the interior cross sectional area of the wall duct.
2. Mount wall duct with screws through the sides or back. Screws must be installed so the head of the screw is inside the wall duct body. Exposed threads are not permitted on the inside of the raceway. Overhead runs of wall duct may be mounted directly to structural members or hung via trapeze.
3. Install all wall duct, minus coverplates, before any wiring is placed in any portion of the system. Wall duct and fittings are to be assembled, minus coverplates, using couplings and screws provided by the manufacturer from the inside of the bodies.
4. Field drill coupling holes when necessary to field cut a straight length to suit conditions. Use the coupling as a template for proper hole placement. Do not enlarge diameter of coupling holes when field drilling duct body coupling holes.
5. Field install accessories such as partitions, etc., by match drilling holes in the duct body using holes in items as templates and installing self-tapping screws provided with each item.

N. Steel Trench Duct:

1. Inspect parts for damage and verify proper quantity of parts received. Compare shop drawings with actual job site conditions. Do not remove covers from trench. Covers remain on trench during pour.
2. Determine a reference point before the pour for the start of assembly work. This includes an elevation mark as well as horizontal placement. Position trench section, being careful of location of power compartment. Install and assembly to trench, if required. Couple trench sections. Carefully align the trench as shown on the plans and shop drawings. Fasten the support feet securely to the concrete form. Install endcaps as required.
3. Assembly of Components: Match the power compartment of trench as shown on drawings. Continuity of ground must be assured between all metal parts.
4. Couple trench sections using coupling clip furnished on the profile at the end of the trench. Clip may be part of support assembly. Check match of internal partition before completing couple. Set screws on trench coupling clip must be tightened to assure continuity of ground. Tape underfloor raceway if ingress of concrete could occur.
5. Cut trench where necessary using band saws, hacksaws or cutting wheels. When cutting do not remove cover to assure proper finished joint.
6. Secure, elevate and level system prior to pour. The top of the system must be at screed level. Specifically, this includes the trench covers. When elevating system, use laser level, electronic level, transit or conventional level. Turn leveling screws of the trench support assembly to bring the cover of the trench to screed. Level the trench in one direction to prevent distortion of system.
7. During and after Pour: The covers of the system serve as the screed line. They must be protected from accidental movement before and during pour. Correcting components for elevation after concrete has set requires extensive labor. If concrete mix is especially thin, gaps and openings in the system should be sealed with duct tape or other. For aggregate greater than 1/4 inch, concrete flow around components must be assured.
8. Covers of trench serve as a guide for pouring concrete to the level of the finished floor. The concrete must be inserted under trench by shovel or trowel. Hand screed to top of trench edges. The covers of the trench must be exposed when the concrete floor is finished. Remove sufficient covers to allow ventilation after concrete is set.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

- A. Protect coatings, finishes and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.6 ADJUSTING AND CLEANING

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris before installing or pulling conductors.

END OF SECTION 260533

SECTION 260553 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Identification for raceway and cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Test/Inspection identification labels.
8. Miscellaneous identification products.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements."

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated including labeling machines if used.
- B. Shop Drawings:
1. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification specific products.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 and NFPA 70E.
- B. Comply with 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive attached labeling materials, including label stocks, laminating

adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. 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.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady USA, Inc. Industrial Products Division.
 - 2. BW Industries, Inc.
 - 3. Ideal Industries, Inc.
 - 4. Rhino/DYMO, a Newell Rubbermaid Company.
 - 5. Seton Name Plate Corporation.

2.2 FONT

- A. Arial uppercase.
- B. Text abbreviations other than equipment identifications permitted only as approved.

2.3 RACEWAY AND CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for System Identification and Printed Text:
 - 1. Per system or NEC branch color coding specified.
 - 2. Identification Label: Indicate system or service. Include branch and voltage text for NEC electrical distribution.

- C. 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.

2.4 BOX WIRING IDENTIFICATION MATERIALS

- A. Self-Adhesive Labels: Field machine printed by thermal transfer or equivalent process with System/Panelboard, Circuit No. and Load text.

2.5 CONDUCTOR, WALL PLATE, AND COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

- 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 text machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from 0.014 inch (0.35-mm- thick aluminum sheet, with stamped, embossed, or scribed text, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped text, punched for use with self-locking nylon tie fastener.
- E. Tie-On Write-On Tags: Polyester tag, 0.015 inch (0.38 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.

2.6 UNDERGROUND RACEWAY MARKING TAPE

- A. Provide heavy gauge, not less than 5 mils thick, by 6" (150 mm) wide, polyethylene marking tape with integral metallic detection foil applied therein:
 - 1. Color: APWA Yellow.
 - 2. Wording: "CAUTION BURIED UTILITY LINE BELOW".
- B. Acceptable Manufacturers:
 - 1. Seton.
 - 2. Panduit Corp.
 - 3. Emedco.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- 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. Baked Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4 inch (6.4 mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose- acetate butyrate signs with 0.0396 inch (1 mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4 inch (6.4 mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

2.8 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.
 - 1. Engraved text with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Electrical Assembly Single-Line:
 - 1. Framed acrylic screw mounted full size record drawing.
 - 2. Printed operating instructions may be included as an option to separate signage.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting, color coded by system. Minimum letter height shall be 1/2 inch (6.4 mm).

2.10 EQUIPMENT TEST LABELS

- A. Adhesive Film Label: Machine printed, color coded by system, by thermal transfer or equivalent process. Minimum letter height shall be 1/2 inch (6.4 mm).

2.11 COMPONENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Minimum letter height shall be 1/4 inch (93.2 mm).

2.12 ABOVE CEILING EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Dot Label: 1/2 inch (64 mm) vinyl dot color coded by system.

2.13 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Per system color coding.

- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Red.

2.14 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 GENERAL COLOR CODING OF SYSTEMS

A. Provide NEC electrical distribution branch color coding as follows:

1. Normal:

- a. System ID or Nameplate: Black
- b. Text: White
- c. Conductors: Per associated Section

2. Generator:

- a. System ID or Nameplate: Green
- b. Text: White
- c. Conductors: Per associated Section

3. Life Safety:

- a. System ID or Nameplate: Yellow
- b. Text: Black
- c. Conductors: Per associated Section

4. Optional, Non-Required Standby:

- a. System ID or Nameplate: Orange
- b. Text: Black
- c. Conductors: Per associated Section

5. UPS:

- a. System ID or Nameplate: Brown
- b. Text: White
- c. Conductors: Per associated

B. Provide Division 23 systems color coding as follows:

1. Building Automation System:

- a. System ID or Nameplate: Orange
- b. Text: Yellow
- c. Cable Jacket: Orange with Yellow Strips

C. Provide Division 26 systems color coding as follows:

1. Center Hung Cable Tray (tips):

- a. System ID: Per associated Section

- 2. Wiring Devices and Wall Plates:
 - a. System ID: Per associated Section

- 3. Lighting Control Systems:
 - a. System ID or Nameplate: Gray
 - b. Text: White
 - c. Cable Jacket: Gray with White Stripes

- 4. Miscellaneous Control:
 - a. System ID or Nameplate: Gray
 - b. Text: Yellow
 - c. Cable Jacket: Gray with Yellow Stripes

- D. Provide Division 27 systems color coding as follows:
 - 1. Structured Cabling:
 - a. System ID/Cable Jacket:
 - 1) OF Multimode Orang
 - 2) OF Multimode Aqua
 - 3) OF Singlemode Yellow
 - 4) Copper backbone Gray
 - 5) Horizontal cable Blue

 - b. Nameplate/Text: Per EIA/TIA
 - c. Raceway: Blue

 - 2. Telephone:
 - a. System ID/Cable Jacket:
 - 1) Copper Backbone Gray
 - 2) Horizontal Cable Blue or White

 - b. Nameplate/Text: Per EIA/TIA
 - c. Raceway/Innerduct: Blue

 - 3. Public Address:

- a. System ID/Cable Jacket: Gray
- b. Nameplate: Dark
- c. Text: White
- d. Raceway: White

4. Audio-Visual:

- a. System ID/Cable Jacket: TP Purple or Coax
- b. Nameplate: Dark Brown
- c. Text: Yellow
- d. Raceway: Black

5. Intercom:

- a. System ID/Cable Jacket: Gray
- b. Nameplate: Light
- c. Text: Black
- d. Raceway: White

E. Provide Division 28 systems color coding as follows:

1. Security:

- a. System ID/Cable Jacket: White or
- b. Nameplate: Dark Green
- c. Text: White
- d. Raceway: Yellow

2. Fire Alarm:

- a. System ID/Cable Jacket: Red
- b. Nameplate: Red
- c. Text: White
- d. Raceway: Red

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products. Use Drawing nomenclature unless otherwise directed.
- B. Location: Install identification materials and devices for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Box and Equipment Identification: Attach to box or enclosure cover in locations shown on Drawings or with high visibility.
- G. Test and Inspection Identification: Attach to appropriate box, enclosure or device for most convenient viewing to operation and maintenance personnel. Install inside device door in finished areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground Raceway Marking Tape: Prior to backfilling of underground raceway, duct and ductbank trenches, install continuous length of underground marking tape directly above buried raceways, ducts and ductbanks, at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of raceways and ducts installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

3.3 APPLICATION

- A. Raceway Systems and Cables Identification:
 - 1. Raceways and Duct Banks More Than 600 V Concealed within Buildings: Identify with 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil text "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:
 - a. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
 - b. Wall surfaces directly external to raceways concealed within wall.
 - c. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
 - 2. Accessible Enclosures, Raceways and Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches (50 mm) high, with self- adhesive vinyl labels. Repeat legend at 10-foot (3-m)

maximum intervals.

3. Accessible Raceways, AC and MC Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 Amperes: Identify with self-adhesive vinyl label per NEC electrical distribution branch color coding including identification label. Install at box and conduit fittings within 12 inches, each side of joints, and at bushed conduits.
 4. Accessible Raceways and Cables of Division 23 through 28 Systems: Identify the systems with preprinted identification label, self adhesive vinyl tape applied in bands per color coding. Install at box and conduit fittings within 12 inches, each side of joints, and at bushed conduits.
 - a. Exception: No identification required for raceways and cable with readily identifiable terminations within the same room.
- B. Box Identification:
1. Color Coded, Field Painting: Initial color coded field painting of inside of system boxes and enclosures are allowable for Contractor identifications during wiring installation.
 2. Wiring Identification: Identify Division 21-28 system or panelboard, circuit number, and load on outside of box cover with self-adhesive labels.
 - a. For finished areas or exterior areas, locate identification inside box cover.
- C. Conductor Identification:
1. Field-Applied, Color-Coding Conductor Tape: Use the colors listed in Division 26 Section "Low Voltage Electrical Power Conductors and Cables (100-600 Volts)" for ungrounded conductors. Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
 2. Feeder Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use tie on write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
 3. Branch Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.
 4. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.
 5. Pull Wires in Empty Raceways: Tag pull wires at each end and in each intermediate box, manhole, or other enclosure identifying other end location using metal tags.
 6. Division 23 through 28 Systems Conductor Identification: Identify field-

installed alarm, control, signal, sound, intercommunications, voice, and data connections.

- a. Identify conductors, cables, and terminals within boxes, enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- b. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- c. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

D. Wiring Device and Coverplate Identification:

1. General:

- a. Wiring devices and coverplates shall be provided with specific identification.
- b. ID shall be not less than 1/8 inch tall, uppercase letters and numerals.
 - 1) ID may be machine printed, self-adhesive backed tape, or labels.
- c. Coverplate ID for wiring devices connected to a "normal" power branch circuit shall be engraved and filled in black color paint stick.
- d. Coverplate ID for wiring devices connected to an "emergency" power branch circuit shall be:
 - 1) Engraved and filled in red color paint stick, where the coverplate is stainless steel, or other material, where the coverplate color is not red.
 - 2) Engraved and filled in white color paint stick, where the coverplate color is red.

2. Wiring Devices:

- a. Refer to Division 26 Section "Wiring Devices" for wiring device face color identification specifications.
- b. Lighting control devices need not be specifically identified, except as follows:
 - 1) Preset Lighting Control Devices: Provide machine printed identification labels, indicating specifically the scene, luminaire group, or area, the device controls.
- c. Receptacles: Regardless of configuration, ampere rating, type, etc., shall each be provided with identification, as follows:
 - 1) The serving panelboard name/designation and circuit number shall be identified on the face or strap of receptacle.
 - 2) ID shall be machine printed type, applied to receptacle.

3. Wiring Device Coverplates:

- a. Refer to Division 26 Section "Wiring Devices" for coverplate face color identification specifications.
- b. The following lighting control device coverplates shall be specifically identified:
 - 1) Where shown, noted, and/or otherwise identified.
 - 2) Where more than 3 lighting control devices are ganged together at a common location, under a single coverplate, provide machine printed, self adhesive type ID, on face of coverplate, specifically identifying the luminaire group, or area, the devices control.
- c. Coverplates for receptacles shall be provided with machine printed, self adhesive type ID, on face of coverplate.
- d. Single and duplex, NEMA 5-15R and 5-20R receptacles, connected to a "normal" power branch circuit, shall be provided with the following ID information, machine printed, on face of coverplate:
 - 1) Serving Panelboard Name/Designation
 - 2) Branch Circuit Number
 - 3) Ex: 1LNL1-3
- e. Single and duplex receptacles, other than NEMA 5-15R and 5-20R, connected to a "normal" power branch circuit, shall be provided with the following ID information, machine printed, on face of coverplate:
 - 1) Operating Voltage/Phases
 - 2) Ampere Rating
 - 3) Serving Panelboard Name/Designation
 - 4) Ex: 208V/3PH/50A
1LNL1
-3
- f. Single and duplex, NEMA 5-15R and 5-20R receptacles, connected to any NEC Article 700, 701, or 702 branch circuit, shall be provided with the following ID information, machine printed, on face of coverplate:
 - 1) The word "EMERGENCY" - at/near top
 - 2) Serving Panelboard Name/Designation - at/near bottom
 - 3) Branch Circuit Number - at/near bottom
 - 4) Ex: EMERGENCY
1LGL
1-4
- g. Coverplates on receptacles protected upstream by a ground fault circuit interrupter device shall also be provided with ID indicating "GFCI PROTECTED" on the face of coverplate.

- h. Coverplates for fractional horsepower manual motor starters shall be provided with machine printed ID on face reading "DISCONNECT - EQUIPMENT DESIGNATION". Example: DISCONNECT – EXH. FAN EF01.

E. Warning Tapes, Labels, and Signs:

1. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground- line warning tape for both direct-buried cables and cables in raceway.
2. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush mounted panelboards and similar equipment in finished spaces.
3. Warning labels and signs shall include, but are not limited to, the following texts:
 - a. Low Voltage Room Door Sign: "DANGER-ELECTRICAL HAZARD – AUTHORIZED PERSONNEL ONLY".
 - b. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs or metal-backed, butyrate warning signs. Identify system voltage with black text on an orange background. Apply to exterior of door, cover, or other access.
 - c. Fused and Non-Fused Motor Disconnect Switches: Install baked enamel warning sign with white legend on red background with minimum 3/8 inch high lettering with the following designation – "DANGER, DO NOT USE TO START OR STOP MOTOR. USE FOR ISOLATION ONLY."

F. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

G. Equipment Identification Labels:

1. Apply equipment identification labels of engraved, laminated acrylic or melamine label on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text in field designating the equipment served. Utilize NEC electrical distribution branch color coded field and lettering for equipment connected. Text shall match terminology and numbering of the Contract Documents and shop drawings. Electrical equipment nameplates shall also designate line side source (i.e. FED FROM: " _____ " ROOM # " ") in smaller 1/8 inch

(3.2 mm) text. Smaller nameplate text may be used where adequate nameplate mounting space is not available, but in no case shall the text be smaller than 1/8-inch (3.2 mm). Apply labels mechanically with machine screws or pop rivets for each unit of the following categories of electrical equipment and those scheduled on Drawings for electrical equipment and panelboard designations. Transfer switches shall include similar emergency and normal fed from and load identification text.

- a. Boxes (Pull, Junction, or Branch Circuit) when given specific designation on Drawings.
 - b. Communication/special systems cabinets and backboards.
 - c. Control devices.
 - d. Dimming racks and panels.
 - e. Disconnect switches.
 - f. Distribution panelboards protective devices.
 - g. Emergency power off (EPO) stations.
 - h. Fire alarm system field processing units, terminal cabinets, peripheral monitor and control addressable relay modules, fire phone cabinets and remote duct detector test stations.
 - i. Motor controllers:
 - 1) Designate motor function (i.e. "CW Pump P-1"), not "P-1."
 - j. Other systems.
 - k. Panelboards.
 - l. Standard telecommunication system.
 - m. Transformers.
2. Refer to appropriate sections for other identification marking requirements and nomenclature.
 3. Attach identification after finish painting.

H. Component Identification Labels:

1. Apply component identification labels to distribution panelboard and MCC assemblies as follows:
 - a. Assembly Nameplate: Apply per equipment identification label requirements except 1-inch (80 mm) identification text.
 - b. Cubicle Label: Apply 1/2-inch (40 mm) black text on white plate identifying left-to- right number with 1/4-inch (20 mm) black text below identification section type(s):
 - 1) Main Circuit Breaker.
 - 2) Transformer # XX.
 - 3) Distribution #XX.
 - 4) Main Lugs.
 - 5) Panelboard.
 - 6) Circuit Breaker.
 - 7) Tie Breaker.

- 8) Spare.
 - 9) Space.
 - 10) Motor Controller.
- c. Protective Device Load Label: Apply 1/4-inch (20 mm) text on plate per system color coding identifying load served. For medium voltage feeders, also identify "FEEDER NO. XX"
 - d. Miscellaneous Component Labels: Apply 1/4-inch (20 mm) black text on white plate identifying components and instruments mounted on front or within the assembly such as relays, fuses, switches, terminal blocks.
- I. Equipment Test Labels:
- 1. Apply equipment test labels of adhesive film label on each major unit of electrical equipment and components identified to be tested in Division 26 Section "Electrical Inspections and Testing" and associated Sections, after satisfactory completion of tests and inspections.
 - 2. Indicate test results, responsible agency, representative and date.
- J. Above Ceiling Equipment Identification Labels:
- 1. Apply adhesive dot labels to nearest exposed ceiling grid or associated access panel latch for the following above ceiling equipment:
 - a. System type occupancy sensor control and relay units.
 - b. Fire alarm addressable relay.
 - c. Remote lighting ballast.
 - d. Power supply.
 - e. Strategic termination box enclosure.
 - f. Data location:
 - 1) Wireless access point.
 - 2) Camera (IP) location.
 - 3) Projection unit.

END OF SECTION 260553

SECTION 260575 – CONDUIT ROUGH-IN SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes Conduit Rough-In Systems and pathways for communication and signaling systems cabling and boxes including all work incidental thereto as shown on Drawings and specified.

1.2 QUALITY ASSURANCE

- A. Comply with the following Standards and Codes:

1. ANSI/EIA/TIA – 568B: Commercial Building Telecommunications Cabling Standard
2. ANSI/EIA/TIA – 569B: Commercial Building Standard for Telecommunications Pathways and Spaces
3. ANSI/EIA/TIA – 606A: Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. ANSI-J-STD-607-A: Commercial Building Grounding, Earthing and Bonding Requirements for Telecommunications
5. ANSI/NECA/BICSI 568-2001: Installing Commercial Building Telecommunications Cabling
6. NFPA 70 National Electrical Code
7. All addenda, technical service bulletins, etc., associated with the above reference standards.

1.3 DEFINITIONS

- A. Pathway: Routing of cabling from device outlet box to system cabinet or rack. Pathways may consist of outlet boxes, cabinets, surface raceways, conduit, conduit stub, conduit sleeve(s), cable tray, J-Hooks, etc. where system cabling will be run.
- B. Rough-In: Preparation for system(s) cabling and equipment installations.
- C. System Cabling: Low voltage signal and control cabling. System cabling is designated by the manufacturer for a particular system in each specification section.

1.4 COORDINATION

- A. Coordinate all requirements of the Owner's and manufacturer's representatives for all room preparation, pathways and specific rough-in installation requirements, including associated sizing, location and labeling, for the following systems:
1. Division 02 - 25 Systems:
 - a. Power and control for equipment furnished under these Divisions.
 2. Division 23 Systems:
 - a. Instrumentation and Control for HVAC.
 3. Division 25 Systems:
 - a. Integrated Facility Control.
 4. Division 26 Systems:
 - a. Automatic Line Voltage Lighting Control Equipment.
 5. Division 27 Systems:
 - a. Structured Telecommunications Cabling.
 - b. Intercom.
 - c. Public Address.
 - d. Master Clock.
 - e. Digital Broadband Video Distribution.
 - f. Audio Visual Cabling.
 6. Division 28 Systems:
 - a. Fire Alarm.
 - b. Video Surveillance.
- B. Coordinate equipment backboard installations including:
1. Meet Owner's and manufacturer's representative layout requirements.
 2. Ensure that installer:
 - a. Provides spacers between wall and backboard to support and locate intended equipment.
 - b. Locates backboard 6 inches above finish floor level around room.
 - c. Paints backboard white on all sides with appropriate paint.
 - d. Allows for flush rough-in of wiring devices.
 - e. Allows for cable management and slots behind backboards.
 - f. Allows for signal grounding bus installations per Division 26 Section "Grounding and Bonding."
- C. Coordinate sleeves for pathways and cable per Division 26 Section "Sleeves and

Sleeve Seals for Electrical Raceways and Cabling".

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements".

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Provide per "Basic Division 26 Requirements". Include:
 - 1. Details for all identified systems equipment rooms including, but not limited to those rooms labeled:
 - a. Cable Pull.
 - b. Communications.
 - c. Data.
 - d. Network.
 - e. MDF.
 - f. Server.
 - g. Tel/Data.
 - h. Telecommunications.
 - 2. Floor plans for each system local equipment room service area depicting:
 - a. Cabling pathways, color coding and field equipment, identification labels.
 - b. Specific equipment, outlet and patching identification labels.
 - 3. Sign-offs of Owner's and manufacturer's representatives for each document submitted.

1.7 CLOSEOUT SUBMITTALS

- A. Record Documents:
 - 1. Submit updated Coordination Drawings as Record Documents.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Flush wall mounted 4-11/16 inches square, 3-5/8 inches deep pressed galvanized steel minimum.

1. Utilize 4-11/16-inch square, 2-1/8-inch-deep backbox with 4-11/16-inch square, 1-1/2-inch-deep extension ring to meet backbox depth requirement; if 3-5/8-inch-deep box not available.
2. Utilize 3-5/8-inch-deep tile box for block or brick wall construction.

B. Cable Bushings:

1. Provide plastic bushings at grommet of outlet box where open cabling installation is allowed to directly enter outlet box (in ceiling spaces).

2.2 PLASTER COVER

- A. Single gang, galvanized steel, for single gang device.
- B. Two gang, galvanized steel, for two-gang device.

2.3 COVER PLATES

- A. Same material, finish and color as for wiring devices. Refer to Division 26 Section "Wiring Devices."
- B. Single gang for single device with appropriate opening, split plate, etc. for device to be installed.
- C. Two gang for combination NEMA 5 receptacle and communications/device with appropriate openings for receptacle and opening, split plate, etc. for device to be installed.
- D. Two gang as required for system outlets.
- E. Device opening shall be bushed one-inch when used for wire pull.
- F. Blank as shown on Drawings or when single device type not used.

2.4 RACEWAYS

- A. Refer to Division 26 Section "Raceways" for requirements. Provide with insulated throats and bushings on all conduit runs, stubs and sleeves.

2.5 SLEEVES

- A. Refer to Division 07 and Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling" for firestopping requirements.

2.6 CABLE J-HOOKS

2.7

- A. Metallic J-hook bracket (1-1/2 inches wide) with cable retainer or Velcro strap, ceiling or support rod mounted.
 - 1. Provide system manufacturer recommended fasteners.
- B. Category 6A compliant.
- C. Acceptable Manufacturers/Series:
 - 1. Caddy Cat. 32 Series.
 - 2. B-Line BCH32 Series.
 - 3. Mono Systems The Hook™.
 - 4. Or Approved Equivalent.

2.8 CABLE TRAY

- A. Refer to Division 26 Section "Ladder Type Cable Trays" for cable tray requirements.

2.9 EQUIPMENT BACKBOARDS

- A. Refer to Division 06 for plywood equipment backboard requirements.

2.10 CABLE DISTRIBUTION SPOOLS FOR BACKBOARDS

- A. Fire retardant, high strength composite material.
- B. 1-1/2-inch length.
- C. Promotes compliance with T568B bend radius (4 x cable diameter).

2.11 CABINETS AND COMMUNICATION RACKS

- A. Refer to Division 27 Section "Communications Cabinets and Racks" for communications type rack assemblies.

PART 3 - EXECUTION

3.1 CONDUIT AND PATHWAYS APPLICATIONS

- A. Conduit Raceways (completely enclosed wiring):

1. Shall be used for separate and independent horizontal system cabling routing for each of the following systems:
 - a. Division 02-25 Systems:
 - 1) Power and control for equipment furnished under these Divisions.
 - b. Division 26 Systems:
 - 1) Automatic Line Voltage Lighting Control Equipment.
 - c. Division 27 Systems:
 - 1) Intercom.
 - 2) Broadband Television Distribution.
 - 3) Structured Telecommunications Cabling.
 - 4) Public Address.
 - 5) Digital Broadband Video Distribution.
 - 6) Audio Visual Cabling.
 - 7) Clocks.
 - d. Division 28 Systems:
 - 1) Fire Alarm.
 - 2) Video Surveillance.
 2. Shall be used for:
 - a. Systems backbone and trunk risers.
 - b. Systems outlet boxes to accessible ceiling.
 - c. Systems outlet boxes to accessible corridor ceiling.
 - d. Systems outlet boxes to cable tray termination.
- B. Cable Trays:
1. Shall be used for MDF Room cabling for the following systems:
 - a. Division 27 Systems:
 - 1) Structured Telecommunications Cabling.
- C. J – Hooks:
1. Shall be used for area horizontal ceiling space corridor cabling for the following systems:
 - a. Division 23 Systems:

- 1) Instrumentation and Control for HVAC.
 - b. Division 25 Systems:
 - 1) Integrated Facility Control.
 - c. Division 26 Systems:
 - 1) Automatic Line Voltage Lighting Control Equipment.
 - d. Division 27 Systems:
 - 1) Structured Telecommunications Cabling.
 - 2) Intercom.
 - 3) Public Address.
 - 4) Master Clock.
 - 5) Digital Broadband Video Distribution.
 - 6) Audio Visual Cabling.
 - e. Division 28 Systems:
 - 1) Fire Alarm.
 - 2) Video Surveillance.
2. Shall be used for:
- a. Equipment room backboard cable management.
 - b. Accessible ceiling cabling not installed in other pathways.

3.2 INSTALLATION

A. General:

1. Install all pathways in accordance with EIA/TIA 569A Standards, associated addenda and technical service bulletins and per manufacturer's requirements.
 - a. Install all pathways in a safe, neat, professional, workmanlike manner.
 - b. Coordinate size of pathways such that EIA/TIA maximum fill requirements are not exceeded for that raceway size at 40 percent fill maximum.
2. Provide pathways to conceal all cabling in the facility except where specifically indicated otherwise.
3. Coordinate pathway installation such that it is independently supported.
4. Install all pathways parallel and perpendicular to building lines and tight to structure. Install pathways such that multiple cabling runs to the same geographic location will utilize similar pathway routing to destination point.
5. Route cabling pathways to the system equipment room from indicated zone or

- as shown on Drawings. In general, provide system outlet box pathways to the equipment room on the same floor to a system cabinet or identified equipment.
6. Install pathways to avoid elevator shafts, elevator equipment rooms or any areas that contain or store hazardous materials.
 7. Install pathways to avoid sources of electromagnetic interference (EMI) for all pathways.
 - a. Maintain one foot minimum from fluorescent lighting (ballast).
 - b. Maintain four-foot minimum from all transformers.
 - c. Maintain ten-foot minimum from electrical power cabling or distribution panels exceeding 480 volts.
 - d. Maintain one foot minimum from electrical power cabling.
 - e. Maintain two-inch minimum from electrical power cabling less than 220 volts.
 - f. Shorten distances if sufficient EMI isolation is provided and given prior approval by engineer.
 8. Avoid routing pathways in areas subject to excessive environmental conditions. Acceptable conditions are:
 - a. Temperature Range: 5°C – 50°C.
 - b. Relative Humidity Range: 5 percent - 95 percent.
 9. Install raceway and equipment identifications per Division 26 Section "Electrical Identification." Label all pathways and associated termination points.
 - a. Provide system identifying nameplate centered on main trunk riser boxes, equipment backboards, ground buses, and cabinets (i.e. DATACOM, CCTV, etc.).
 - b. Identify fiber optic labeling risers installed in ENT or Innerduct every 10 feet on center "Fiber Optic Cabling."
- B. Outlet Boxes:
1. General:
 - a. Install systems outlets flush in new wall construction.
 - b. Do not install backboxes back-to-back.
 - 1) Maintain a minimum of 12" separation.
 - 2) Maintain a minimum of 24" separation in fire-rated walls.
 - c. Mount outlets alongside associated power receptacles where applicable.
 - d. Mount all outlet boxes vertically, unless otherwise noted.
 - e. Install raceway to avoid obstructions in the field such as molding, built-in cabinets, wiring devices, etc.
 - f. Install blank coverplates where device type is not installed. Coordinate such locations with the appropriate systems representatives, and the Owner.

2. Renovation:

- a. Utilize installation methods for datacom/systems outlets in the following order as available in renovation areas.
 - 1) Install systems outlet boxes flush in existing wall. Fish wall as required. Cabling may be run exposed in wall cavity.
 - 2) Install surface-mounted metal backbox fed with surface mounted metal raceway in renovated areas that cannot be fished and do not require adjacent power receptacles.
 - 3) Install systems outlets in multi-channel metal surface raceway only where specifically shown on Drawings. Install associated power receptacle adjacent to outlet where required. Provide all mounting bracket hardware and accessories.
 - a) Locate vertical section of surface raceway discretely in corner of room for data entrance.
 - b) Locate surface raceway outlet rough-in with required spacing as shown on architectural drawing elevations to accommodate knee space at millwork/desks.
 - 4) Cut/trench wall and install conduit stub and backbox for system device cabling.
 - b. Feed surface raceway in rooms, etc. from conduit extended into corridor space. Cabling may be exposed above accessible corridor/room ceilings. Install conduit in corridors in areas without accessible ceilings.
3. Rework existing surface raceway as required to accommodate new surface raceway and devices.

C. Raceways:

1. Refer to Division 26 Section "Raceways" for basic routing and installation requirements.
 - a. Refer to Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling" for sleeve requirements.
 - b. Refer to Division 07 for firestopping.
2. Furnish and install trunk riser raceways, junction boxes, outlet box raceways and outlet boxes as specified and shown on Drawings.
3. Stub trunk riser and extend system outlet box raceways into accessible ceiling space.
4. Provide cap for all conduit stubs and cover for outlet boxes to eliminate debris from entering boxes or conduits. Remove any debris found in conduits or outlet boxes upon cable installation.
5. Provide a dedicated conduit for cable installation for each Division 27

structured telecommunications cabling system outlet box. These outlet boxes shall not be connected together with conduit between boxes.

6. Provide minimum outlet box conduit size and conduit sleeve size at 1 inch.
 - a. Use chart below for minimum conduit size requirements based on maximum 40% fill for indicated quantity of cables.

Inside Diameter mm	Trade Size	Cable Outside Diameter mm (in)									
		3.3 (0.13)	4.6 (0.18)	5.6 (0.22)	6.1 (0.24)	7.4 (0.29)	7.9 (0.31)	9.4 (0.37)	13.5 (0.53)	15.8 (0.62)	17.8 (0.70)
21	3/4	6	5	4	3	2	2	1	0	0	0
27	1	8	8	7	6	3	3	2	1	0	0
35	1-1/4	16	14	12	10	6	4	3	1	1	1
41	1-1/2	20	18	16	15	7	6	4	2	1	1
53	2	30	26	22	20	14	12	7	4	3	2
63	2-1/2	45	40	36	30	17	14	12	6	3	3
78	3	70	60	50	40	20	20	17	7	6	6
91	3-1/2							22	12	7	6
103	4							30	14	12	7

7. Mark each conduit end for identification and destination of raceway.
8. Install all raceways such that the cabling manufacturer's minimum bend radius is not exceeded.
9. Furnish and install 200-pound test, braided nylon pullcords in all conduits and as shown on Drawings. Label all pullcords.
10. Provide complete conduit systems in areas with non-accessible ceilings for all cable systems.
11. Utilize surface raceway in finished areas where cabling cannot be concealed.
12. Feed multi-channel surface raceway, where shown on Drawings, with one conduit for special outlets and one conduit for each power channel to feed multiple outlets. Refer to ANSI/EIA/TIA 569-A and NFPA 70 for conduit size requirements.
13. Special Optical Fiber and Communication Raceways:
 - a. Install backbone fiber optic cabling in plenum rated Optical Fiber and Communication (innerduct) raceway per Division 26 Section "Raceways." Install Optical Fiber and Communication in cable tray if available, using proper connectors and fittings.
 - b. Install centralized or horizontal fiber optic cabling in plenum rated Optical Fiber and Communication (innerduct) raceway per Division 26 Section "Raceways." Install Optical Fiber and Communication in cable tray if available using proper support and connection fittings.
 - 1) Install pathway for centralized cabling exceeding 300 feet in length through the Telecommunications Room serving the work

area in that area prior to termination at the work area outlet.

- a) Provide a wall mounted pull box sized to allow a 20-foot cable service loop to provide future termination location if required. Coordinate location.
14. Provide conduit segment length at no more than 100 feet with a maximum of two 90-degree bends. Additional junction/pull boxes shall be installed to allow more bends or length of conduit. Refer to EIA/TIA 569A. Coordinate location to nearby cable spool or cable management device.
 15. Install telecommunications raceways to within six inches of equipment backboards, data racks and termination units.
 - a. Coordinate location and termination to cable management device.
 16. Provide a minimum of 10-inches inside curve radius of conduits for each 1-inch in diameter of installed conduit.
- D. J-Hook Installation:
1. Provide independent J-hook pathways per system where cable tray is not shown, (minimum of 4 J-hooks mounted horizontally) in accessible ceiling space mounted a maximum of 4 and 5 feet on center. Mount pathway level, tight to structure and allow accessible installation of cabling.
 2. Furnish and install single mounted J-hooks from individual conduits serving outlet boxes, mounted 4 feet on center maximum.
 3. Ensure cabling is supported properly and cable does not sag or droop in excess of 8" from between supports.
- E. Cable Distribution Spools:
1. Install distribution cable spools (mushrooms) on equipment backboards to allow cable support/routing. Mount spools along edge of boards, 6 inches from each corner and 1 foot on center, minimum.

3.3 RECORD DRAWINGS

- A. Post copy of appropriate systems record drawings in local equipment room as required by Owner's representative. Hang set on equipment backboard using proper anchoring techniques.

END OF SECTION 260575

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 volt or less.

1.2 DEFINITIONS

- A. Lighting and Appliance Panelboard: A panelboard with thermal magnetic circuit breaker branches, bolt-in type only, designed for heavy commercial use, operating at 600 V and below, 3-phase versions, equipped as either surface or flush mounting. Panelboard shall have more than 10 percent of its overcurrent devices rated 30 amperes or less for which neutral connections are provided.
- B. Electronic Grade Panelboard: A panelboard with integral mounted surge protection device (SPD) and high frequency electrical live noise filtering connected in parallel with the panelboard buses through a panelboard mounted circuit breaker disconnect.
- C. Stage Panelboard: A panelboard, commonly known as a "company switch," with a main circuit breaker and means of connecting temporary power loads, such as light fixtures and dimmers that are either rented for local supplies or brought in by touring companies.
- D. Surge Protection Device (SPD): A device to reduce the effect of voltage spikes to sensitive electronic equipment by shunting these disturbances to earth ground.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic 26 Division Requirements."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings:

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices. Series rated protective devices are not acceptable.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring diagrams detailing control wiring and differentiating between manufacturer- installed and field-installed wiring.
3. Electronic panelboard SPD data, associated loads, circuit breaker disconnects, and dimensioned room layouts ensuring proper NEC clearances and coordination.
 - a. Installation instructions shall be reviewed to determine whether the system requires an external overcurrent device in order to maintain the systems UL 1449 3rd Edition listing.
 - b. A UL 1449 3rd Edition stipulation is required for all submittals. The stipulation will verify the use of additional fusing via manufacturer's signature.
4. Stage panelboard connecting means and/or plugs-receptacles, main circuit breaker data and enclosure information showing all openings, interlocks, and nameplates.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality control test reports including the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent

- protective devices.
- 2. Include copy of typed directions depicting branch circuit loads.

B. Record Documents:

- 1. Panelboard Schedules: For installation in panelboards.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Keys: Two (2) spares for each type of panelboard cabinet lock.
- 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two (2) spares for each panelboard.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Field Testing: Refer to Division 26 Section "Electrical Inspections and Testing" for field inspections and testing requirements related to this Section including:

- 1. Electrical Acceptance Testing Responsibilities.
- 2. General Electrical Field Quality Control.
- 3. Testing Agency Qualifications.

G. Comply with ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems for field testing.

1.9 PROJECT CONDITIONS

- A. 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 Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.10 COORDINATION

- 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, and encumbrances to workspace clearance requirements.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Panelboards:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Protection Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D.
 - 2. Integral SPD Electronic Grade Panelboards:
 - a. Current Technology, Inc. – EGPE2 Series.
 - b. L.E.A. Dynatech - MDP Series.
 - c. Liebert - LPG Series.
 - 3. Remote SPD Electronic Grade Panelboards:
 - a. As defined in Division 26 Section "Surge Protection Devices for Low Voltage Electrical Power Circuits" for panelboards.

4. Stage Panelboards:
 - a. Per appropriate E5 SERIES details and associated sections herein.

2.2 PANELBOARDS, GENERAL REQUIREMENTS

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as shown on Drawings. Comply with Division 26 Section "Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.
- B. Supports and Bracing for Buses: Adequate strength of all panelboard components, including OCPD's, for short circuit current ratings as shown on Drawings. The minimum ratings shall be 10,000 AIC for 120/208 volt equipment and 14,000 AIC for 277/480 volt equipment. Series ratings of protective devices shall not be acceptable.
- C. Enclosures: Cabinets, flush or surface mounted as shown on Drawings. NEMA Type 1 enclosure, except where the following enclosure requirements are shown on Drawings. Backboxes shall be made from galvanized steel. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. Provide at least four interior mounting studs with adjustable nuts.
- D. Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box except as otherwise specified.
- E. Directory Frame: Metal, mounted inside each panelboard door.
- F. Typed directory card completely filled out including "SPARE" and "SPACE" loads.
- G. Bus: Hard drawn, tin-plated copper of 98 percent conductivity.
- H. Main and Neutral Lugs: Compression type.
- I. Main Circuit Breaker (when scheduled): Mounted physically separate from branch breaker lineups (not in same row) to allow for full branch circuit pole quantity.
- J. Branch Circuit Devices: Arranged for double row construction.
- K. Equipment Ground Bus: Adequate for feeder and branch circuit equipment ground conductors. Bond to box with bolted or welded connection.
- L. Gutter: Generally, conform to UL 61.

- M. Extra Gutter Space: Arrangement as shown on Drawings or as required for installation.
- N. Auxiliary Gutter: Conform to UL 870, "Wireways, Auxiliary Gutters, and Associated Fittings."
- O. Service Equipment Approval: Listed for use as service equipment for panelboards having main service disconnect.
- P. Provision for Future Devices: Equip with mounting brackets, bus connections and extensions, and necessary appurtenances, for the OCPD ampere ratings shown on Drawing schedules for future installation of devices.
- Q. Special Features: Provide the following features for panelboards as scheduled and or shown on Drawings or as required to meet NEC:
 - 1. Skirt for Surface-Mounted Panels: Same gauge and finish as panelboard front with flanges for attachment to panel, wall, and floor.
 - 2. Contactors in Mains: Mechanically held, with current rating, poles, and connections as shown on Drawings. Conform to Division 26 Section "Motor Controllers."
 - 3. Shunt Trip Control Power Source: Shunt trips where shown on Drawings shall be 120 volt AC. Provide a 120 volt power supply from the main bus with a primary fuse protected, control power transformer, with terminals and wiring for the shunt trip connection to remote pushbutton station(s). Where specified for "emergency" shut-down, install pushbutton on the panel trim. Access to interior shall be without disturbing pushbutton and shall allow for wiring disconnection from pushbutton.
 - 4. Gutter Barrier: Arranged to isolate section of gutter as shown on Drawings.
 - 5. Column-Type Panelboard Configuration: Narrow cabinet extended as wireway to overhead junction box equipped with ground and neutral terminal buses.
 - 6. Subfeed (Double Lugs): OCPD or lug provisions sized to accommodate feeders shown on Drawings. Provide subfeed lugs for all multi section panelboards. Field install all required cross connection cables.
 - 7. Feed-Through Lugs: Sized to accommodate feeders shown on Drawings.
- R. Plug-in type load center type panelboards shall be used for residential applications only.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. General: Conform to above article "Panelboards, General Requirements" except as follows:
 - 1. Circuit Breakers for Switching Lights at Panelboards: Indicated type SWD.
 - 2. Interiors: Provide physical means to prevent installation of more OCPDs than the quantity for which the enclosure was listed.
 - 3. Circuit Breakers for Branch Circuits Serving Residential Unit Bedrooms: AFCI circuit breakers per Division 26 Section "Protective Devices."

4. Main, Neutral, and Ground Lugs and Buses: Have mechanical connectors for conductors.
5. Double-Width Panelboards: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards bussed together under single front or wired using serving feeder size between panelboards, at Division 26 discretion.
6. Doors: In panel front, with concealed hinges. Secure with flush catch and cylindrical tumbler lock, all keyed alike. The flush lock shall not protrude beyond the front of the door.

2.4 POWER DISTRIBUTION PANELBOARDS

- A. Doors: In panel front, omit single panelboard door in cabinet front for fusible switch panelboards except as shown on Drawings. Secure with vault-type cylindrical tumbler lock, all keyed alike. The flush lock shall not protrude beyond the front of the door. Doors over 48 inches high hinged, and shall be provided with a vault type handle, built-in locks, and three point latch (top, bottom and center).
- B. Branch-Circuit Breakers: Where OCPDs are shown on Drawings to be circuit breakers, use bolt-on breakers except circuit breakers 225-ampere frame size and greater may be plug-in type where individual positive locking device requires mechanical release for removal.
- C. Motor Starter Disconnects: Include overcurrent protection as shown on Drawings. Mount integral with or, in same panelboard, adjacent to motor starter. Mechanically interlock starter door with disconnect device. Provide auxiliary contacts on disconnect to reenergize control connections to starter.

2.5 ELECTRONIC GRADE PANELBOARDS SPD CHARACTERISTICS

- A. As defined in Division 26 Section "Surge Protection for Low Voltage Electrical Power Circuits" for panelboards.
- B. Conform to above article "Panelboards, General Requirements," except as follows:
 1. General:
 - a. 200 Percent Rated Copper Neutral Bus: The unit shall include a 200 percent rated all copper neutral bus designed for the peculiar current demands associated with non-linear loads. The neutral bus shall include AL/CU rated mechanical solderless-type lugs in sufficient quantity and capacity as shown on Drawings.
 - b. Safety Ground Bus: The unit shall include a safety ("equipment") ground bus bonded to the enclosure with connection points equal to the number of branch breaker positions. The safety ground bus shall include AL/CU rated mechanical solderless-type lugs in sufficient quantity and capacity.

- c. Insulated Isolated Ground Bus: The unit shall include an insulated isolated ground bus with connection points equal to the number of branch breaker positions. The insulated isolated ground bus shall include AL/CU rated mechanical solderless- type lugs in sufficient quantity and capacity.
- d. Wiring Gutters: The unit shall have an all-around interior perimeter wiring gutter. The cross sectional dimension of the gutter shall be as required by national/local electrical codes but not less than 16 square inches.
- e. Multiple Sections: For sub-feed or feed-thru lugged multiple section electronic panelboards, each panelboard unit contain all elements listed above except that a single SPD device shall protect the multiple assemblies.

2. Integral SPD Electronic Panelboard:

- a. SPD Boxes: The box shall be panelboard SPD extension barriered from panelboard components and formed of galvanized metal and chemically cleansed, and all breaks in galvanizing shall be painted with metallic paint. Minimum size shall be 20 inches wide by 5.75 inches deep unless otherwise shown on Drawings.
- b. Integral SPD Electronic Grade Panelboards shall be UL 67, UL 1283 and UL 1449, 3rd Edition listed by SPD manufacturer.

2.6 STAGE PANELBOARD CHARACTERISTICS

- A. The stage panelboard shall make provision for cam-lock plug connection for temporary power loads.
- B. Unit Operating Ratings: The nominal unit operating voltages, amperage and AIC ratings and configuration shall be as shown on Drawings.
- C. Main fused disconnect shall have a handle lock or lockable door cover to secure in off position when the unit is not in use.
- D. Output receptacles on bottom of panelboard shall be Cam-Lok E0305 series all rated to match ampere rating of main fused switch to which it shall be connected. Provide a set of matching double set screw plugs with each set of receptacles. Arrange receptacles left-to-right G-N-A-B-C. Mount in NEMA 3R cabinet per R5XX series details. Exterior cabinets shall be per Division 26 Section "Boxes and Cabinets."
- E. All cable access doors shall have protective edge stripping to guard against damage to cables.
- F. Provide nameplates per requirements of Division 26 Section "Electrical

Identification" including the following additional nameplate requirements:

1. "XXXX (ampere rating) – COMPANY SWITCH" mounted near the top of the front cover.

2.7 IDENTIFICATION

- A. General: Refer to Division 26 Section "Electrical Identification," for labeling materials and methods.
- B. Manufacturer's Nameplate Information:
 1. Voltage.
 2. Phase.
 3. Ampacity.
 4. Manufacturer.
 5. A.I.C. Symmetrical.
 6. UL Listing.
 7. Service Entrance Label (as applicable).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports" and "Vibration and Seismic Controls."
- C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mount large distribution panelboards minimum 1-foot above floor. When top and bottom dimensional requirements cannot be met, install on concrete bases.
 1. For distribution panelboards on concrete bases, anchor according to manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Sections "Hangers and Supports" and "Vibration and Seismic Controls".
- E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- F. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- G. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install filler plates in unused spaces and plug any unused, open cabinet knockouts.
- I. Install breaker handle clips in on position at breakers servicing fire alarm equipment.
- J. Stub four (4) 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four (4) 1-inch empty conduits into raised floor space or below slab not on grade.
- K. When a home run to an existing panelboard is shown, compatible circuit protectives of the indicated ratings shall be provided when they are not in the existing panel. Whenever circuits are removed from existing panels, the associated conduit and wire shall be removed in its entirety except leave horizontal studs at ceiling cavities and the protective device identified as a space. Adjust directories accordingly. Replace directory if over six (6) circuit changes.
- L. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
 1. Provide "Fire Alarm System" component identification label at breakers servicing fire alarm equipment.
- B. Create a typed directory to indicate installed circuit loads. Label circuit locations (not occupancy) and spares. Obtain typed approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.

B. Inspection and Tests:

1. Perform inspections and test procedures as required by Division 26 Section "Electrical Inspections and Testing", ANSI/NETA ATS Sections for associated panelboard components, "System Functional Tests", and "Thermographic Survey" requirements and the following additional requirements.
 - a. Follow-up thermographic survey shall not be required.
 - b. Prepare test and inspection reports.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make appropriate circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24 hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section provides requirements and specification criteria for wiring devices, wiring device accessories, and wiring device assemblies including:

1. AC Lighting Switches.
2. Receptacles.
3. Cord Style Plug Connectors.
4. Wall Box Dimmers.
5. Coverplates.
6. Special Purpose Devices.

1.2 REFERENCES

- A. Abbreviations and Definitions:

1. EMI: Electromagnetic Interference.
2. GFCI: Ground-Fault Circuit Interrupter.
3. Pigtail: Short lengths of conductors factory pre-wired to a modular, plug-in style connecting device, used for connecting plug-in style wiring devices to field supplied branch circuit conductors.
4. RFI: Radio Frequency Interference.
5. Coverplate: Metallic or non-metallic plates providing a finished closure between wall, floor or ceiling construction, electrical outlet box provisions, and wiring devices.
6. Wall Plates: Coverplate.

- B. Reference Standards:

1. Conform to execute, inspect and test, in accordance with code(s), standards, and governing rules and regulations of Federal, State, and Local governmental agencies having jurisdiction at the project locale.
2. Other reference which apply to this section include the enforced editions of:
 - a. IEC - International Electrotechnical Commissions:
 - 1) 309-1, Part 1: General Requirements (1988) Plugs, Socket-Outlets and Couplers for Industrial Purposes
 - b. NEMA - National Electrical Manufacturers Association:
 - 1) WD 1-83 (Reapproved 1989) General Requirements for Wiring

- Devices.
- 2) WD 6-88 Wiring Device – Dimensional Requirements.
- c. UL - Underwriters Laboratories:
 - 1) 486-91 (Rev. 95) Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- d. Fed. Spec. - Federal Specifications:
 - 1) WC-596 for receptacles.
 - 2) WS-896 for switches.

1.3 SUBMITTALS

- A. General: Submit in accordance with Conditions of Contract, Division 01 Specification Sections, and Division 26 Section "Basic Division 26 Requirements."

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include manufacturers' packaging instructions, labels, operating manuals, etc.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Service Outlet Assemblies: One for every 10, but no fewer than two.
 - 2. Surge Suppression Type Receptacles: One for every 10 of each type installed, but no fewer than two of each type.
 - 3. Tamperproof Tools: Provide not less than two (2) screwdrivers, wrenches, or other tools, required for the installation and removal of tamperproof devices provided under this Section.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Provide each type of wiring device and associated coverplates from a single manufacturer. Insofar as they are available, provide all wiring devices and associated coverplates from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
 - 2. Underwriters Laboratories Inc. (U.L.):
 - a. U.L. 20 General-Use Snap Switches
 - b. U.L. 498 Electrical Attachment Plugs and
 - c. U.L. 943 Ground-Fault Circuit Interrupters
- D. Comply with NEMA WD 1.
- E. Comply with NFPA 70.

1.8 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Verify and match Owner furnished equipment plug configurations.
 - 1. Cord and Plug Sets: Verify and match Owner furnished equipment requirements.

1.9 SEQUENCE AND SCHEDULING

- A. Protect wiring devices if installed prior to painting.
- B. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Except as otherwise noted, specified, or required, provide each type of wiring device and associated accessories, coverplates, etc., from a

single manufacturer.

B. Acceptable Manufacturers:

1. Bryant Wiring Device Division – Hubbell Incorporated (Bryant).
2. Cooper Wiring Devices Division – Cooper Industries (Cooper).
3. Hubbell Wiring Devices/Kellems Division – Hubbell Incorporated (Hubbell).
4. Leviton Manufacturing Co. Inc. (Leviton).
5. Pass & Seymour/Legrand (Pass & Seymour).

2.2 GENERAL REQUIREMENTS

A. Provide wiring devices, in types, characteristics, grades, finishes, colors, electrical ratings listed and labeled, etc., for applications indicated and in compliance with UL and other applicable ANSI and NEMA standards.

B. Wiring Device Face Colors:

1. General – Except as otherwise noted, provide white device face color – with matching color coverplates. Verify color selections with Architect.
2. Wiring device face colors for special application devices, except as otherwise indicated, specified, or required, shall be as follows:

a. Receptacles:

- 1) Connected to NEC Article 700, 701, and 702 Emergency/Standby Systems – Red.
- 2) Surge Protection Type – Blue face with industry standard TVSS graphic permanently embossed or engraved thereon.
- 3) Isolated Ground Type – Orange face with industry standard IG graphic permanently embossed or engraved thereon.

b. Switches (Toggle/Actuator Color):

- 1) Connected to NEC Article 700, 701 and 702 Emergency/Standby Systems – Red.

C. AC Lighting Switches: Quiet type. Comply with UL 20 and NEMA WD1.

D. Wall Box Dimmers: Solid state conforming to NEMA WD 1.

E. Receptacles: Comply with UL 498 and NEMA WD 1.

F. Ground-Fault Circuit Interrupter (GFCI) Receptacles: Provide "feed-thru" type ground-fault circuit interrupter, with integral heavy-duty duplex receptacles arranged to protect downstream receptacles connected to same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943.

- G. Cord Style Plug Connectors: 20 amperes, 125-volts, nylon body connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, cord hole. Match NEMA configuration to mating plug. Arrange as shown on Drawings.

2.3 WIRING DEVICE PIGTAIL CONNECTOR OPTION

- A. At Contractors option, but subject to other requirements of this Section, UL 2459 listed pigtail style modular connectors designed, fabricated, and tested for use with stranded branch circuit conductors may be provided to allow:
 - 1. Rough-in of pre-stripped six inch leads to a connector.
 - 2. Modular plug-in to the wiring device.
 - 3. Basis of Design:
 - a. Bryant - Quick-Tech™.
 - b. Cooper - ArrowLink™.
 - c. Leviton - LEV-LOK™.
 - d. Hubbell - Snap Connect™.
 - e. Pass & Seymour – Plug Tail™.

2.4 AC LIGHTING SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Standard toggle handle specification grade back and side wired: (* Indicates single pole, double pole, 3-way or 4-way, as required.)
 - 1. 20 amp, 120-277 volt:
 - a. Bryant – 490* Series.
 - b. Cooper – AH122* Series.
 - c. Hubbell – HBL122* Series.
 - d. Leviton – 122*-2 Series.
 - e. Pass and Seymour - PS20 AC* Series.
- C. Key operated, 20 amp, 120-277 volt, specification grade, back and side wired. (* Indicates single pole, double pole, 3-way or 4-way, as required.) Match school standard.
 - 1. Slotted face, with removable fork style key.
 - a. Bryant – 490* LI Series.
 - b. Cooper – AH122* L Series.
 - c. Hubbell – HBL122* L Series.
 - d. Leviton – 122* L Series.
 - e. Pass and Seymour – PS20AC* L Series.

2. Round, metallic, barrel lock style, face, with removable barrel style key.
 - a. Bryant – 490* RKL Series.
 - b. Cooper – N/A.
 - c. Hubbell – HBL122* RKL Series.
 - d. Leviton – N/A.
 - e. Pass and Seymour – PS20AC*-KL.

D. Linear, Slide Actuation Switches:

1. Shall be rated 20A @ 120VAC and 277VAC, provided as single pole, 3-way, or 4-way operating devices, as indicated.
2. Shall be provided with linear, slide operating actuators to match slide operating dimming style control devices.
3. Coverplate shall attach to device with no exposed fasteners.
4. Shall be designed, fabricated and tested for installation within a single, gang electrical outlet box opening and shall be specifically designed for multi-gang installations, matching the look, appearance and operating motion of adjacently installed dimming style control devices.
5. Acceptable Manufacturers:
 - a. Lutron Electronics, Inc. – Nova T Star – NT-*PS Series (*indicates single pole, 3- way or 4-way operation, as indicated.)
 - b. Or equivalent.

2.5 WALL BOX DIMMERS

A. LED:

1. 3-Wire Linear Slide Type:
 - a. Shall be solid state electronic, electro-mechanical devices, with linear slide style actuator, suitable for use, and compatible with the procured 3-wire LED drivers.
 - 1) UP movement of actuator turns connected load ON.
 - 2) UP/DN linear slide movement of actuator raises/lowers lighting intensity.
 - 3) DN slide movement to lowest position turns connected load OFF.
 - b. Shall be rated to control not less than the following dimmable LED lighting load:
 - 1) 16A @ 120VAC.
 - 2) 8A @ 277VAC.
 - c. Provide as single pole or 3-way multi-location control devices as indicated.
 - d. Shall be semi-flush, thin profile design, with no exposed heat sink fins,

- designed fabricated and tested for installation within a single gang electric box opening.
- e. Linear slide actuating device shall provide a positive mechanical air gap type branch circuit disconnecting means at the bottom travel OFF position.
 - f. Faceplate Finish/Color: Nylon/White. Actuator Finish/Color: Nylon/White.
 - 1) Faceplate shall attach to device with no exposed fasteners.
 - g. Acceptable Manufacturers:
 - 1) Lutron Electronics, Inc. - "Nova-T Star" NTF-10 Series.
 - 2) Or equivalent.
2. 0-10V Linear Slide Type:
- a. Shall be electronic, low voltage, solid state devices, with linear slide style dimming actuator, suitable for use and compatible with 0-10V LED drivers.
 - 1) UP/DN linear slide action raise/lower actuator.
 - 2) ON/OFF control shall be initiated by the device, via a remote, separately installed power supply/control unit with integral switching relay.
 - 3) Slide to lowest position shall initiate OFF command to separately installed power supply/control unit.
 - b. Shall, in combination with the remote power supply/control unit switching relay, control not less than 16A of dimmable LED driver lighting load @ either 120 or 277VAC.
 - c. Provide as single pole and electronic, multi-location control devices as indicated.
 - d. Faceplate Finish/Color: Nylon/White. Actuator Finish/Color: Nylon/White.
 - 1) Faceplate shall attach to device with no exposed fasteners.
 - e. Provide complete with separately installed power supply/control unit. Power supply/control unit shall be:
 - 1) A combination device providing 24VDC (100 mA) output from an input of either 120 or 277VAC input, to remotely connected devices.
 - 2) Provided with an integral switching duty relay, rated to interrupt not less than 16A @ either 120 or 277VAC.
 - 3) Enclosed in a high impact, molded, thermoplastic housing, designed for field installation within or to a standard electrical outlet box.
 - f. Acceptable Manufacturers:

- 1) Lutron Electronics, Inc. - "Nova-T Star" NTFTV Series Dimmer and PP-120/277H Power Supply/Control Unit.
 - 2) Or equivalent.
3. Electronic Low Voltage (ELV) Linear Slide Type:
- a. Shall be electronic, low voltage, solid state devices, with linear slide style dimming actuator, suitable for use, and compatible with, electronic low voltage (ELV) reverse phase LED drivers.
 - 1) UP/DN linear slide action raise/lower actuator.
 - 2) ON/OFF control shall be initiated by the device, via a remote, separately installed power supply/control unit with integral switching relay.
 - 3) Slide to lowest position shall initiate OFF command to power supply/control unit.
 - b. Shall, in combination with the remote power supply/control unit switching relay, control not less than 16A of dimmable LED driver load @ either 120 or 277VAC.
 - c. Provide as single pole or electronic, multi-location control devices as indicated.
 - d. Faceplate Finish/Color: Nylon/White. Actuator Finish/Color: Nylon/White.
 - 1) Faceplate shall attach to device with no exposed fasteners.
 - e. Provide complete with a separately installed power supply/control unit. Power supply/control unit shall be:
 - 1) A combination device providing 24VDC (100 mA) output from an input of either 120 or 277VAC input, to remotely connected devices.
 - 2) Provided with an integral switching duty relay, rated to interrupt not less than 16A @ either 120 or 277VAC.
 - 3) Enclosed in a high impact, molded, thermoplastic housing, designed for field installation within or to a standard electrical outlet box.
 - f. Acceptable Manufacturers:
 - 1) Lutron Electronics, Inc. - "Nova-T Star" NTFTV Series Dimmer and PP-120/277H Power Supply/Control Unit.
 - 2) Or equivalent.

2.6 GENERAL PURPOSE RECEPTACLES

- A. Standard face, 20 amp, 125 volt, straight blade, NEMA 5-20R, duplex grounding type:

1. General Purpose - Heavy duty, premium specification grade, with brass strap:
 - a. Bryant – N/A.
 - b. Cooper – AH5362 Series.
 - c. Hubbell - HBL5362 Series.
 - d. Leviton – 5362 Series.
 - e. Pass and Seymour – 5362A Series.
 2. Tamper Resistant – Commercial specification grade:
 - a. Bryant – CRS20 TR Series.
 - b. Cooper – TR5362 Series.
 - c. Hubbell – BR20 – TR Series.
 - d. Leviton – TBR20 Series.
 - e. Pass and Seymour – TR5362 Series.
 3. Isolated Ground Type – Heavy duty, premium specification grade, orange color face:
 - a. Bryant – BRY5462IG Series.
 - b. Cooper – IG5362 Series.
 - c. Hubbell – IG5362 Series.
 - d. Leviton – 5362IG Series.
 - e. Pass and Seymour – IG5362 Series.
- B. Decorator Face: 20 amp, 125 volt, straight blade, NEMA 5-20R, duplex, grounding type.
1. General Purpose – Heavy duty, premium specification grade with brass strap:
 - a. Bryant – N/A.
 - b. Cooper – 6362 Series.
 - c. Hubbell – HBL2162 Series.
 - d. Leviton – 16362 Series.
 - e. Pass and Seymour – 26352 Series.
 2. Tamper Resistant – Commercial specification grade:
 - a. Bryant – DRS20.
 - b. Cooper – TR6350 Series.
 - c. Hubbell – DR20TR Series.
 - d. Leviton – TDR20 Series.
 - e. Pass and Seymour – TR26362 Series.
 3. Ground Fault Circuit Interrupting Feed-Thru Type - Heavy duty premium specification grade, with LED "Protection Assurance" indicator on face:
 - a. Bryant – GF20LA Series.
 - b. Cooper – VGF20 Series.

- c. Hubbell – GF20 LA Series.
 - d. Leviton – 7899-HG Series.
 - e. Pass and Seymour – 2095 Series.
4. Isolated Ground - Heavy duty, premium specification grade, orange color face.
 - a. Bryant – BRY5362IG Series.
 - b. Cooper – IG8362 Series.
 - c. Hubbell – IG2162 Series.
 - d. Leviton – 16362-IG Series.
 - e. Pass and Seymour – IG5362_SP Series.
 5. Surge Protection - Heavy duty, premium specification grade, with audible alarm and visual LED "Protection Assurance" indicators on blue color:
 - a. Bryant – SP53 Series.
 - b. Cooper – 5362 S Series.
 - c. Hubbell – HBL5362SA Series.
 - d. Leviton – 7380 Series.
 - e. Pass and Seymour – 5362_SP Series.

2.7 SPECIAL PURPOSE WIRING DEVICES

- A. Blank Face Ground Fault Circuit Interrupting Device: 20 amp, 125 volt device designed for installation in single gang outlet box, providing no receptacles on face and integral, feed-thru GFCI protection to downstream devices. Provided with "TEST" and "RESET" buttons and LED "Protection Assurance" indicator on face.
 1. Bryant – GFSTBF20 Series.
 2. Cooper – VGFD20 Series.
 3. Hubbell – GFBF20 LA Series.
 4. Leviton – 7590 Series.
 5. Pass and Seymour – 2085 Series.
- B. Combination AC/DC USB Receptacles:
 1. Duplex NEMA 5-20R, 20 amp, 125 volts, tamper resistant, 3-wire grounding type AC receptacle, and two, 5 VDC USB 2.0 compatible Type A ports factory assembled on a common, single gang wiring device strap. Shall provide USB shutoff circuitry to automatically stop charging when the connected device is fully charged.
 - a. Cooper – TR7746 Series.
 - b. Hubbell - USB 20X2 Series.
 - c. Pass and Seymour – TR5361 USB Series.
- C. Electric Range Receptacles - 50 amp, 250 volt, 3 pole, 4 wire, heavy duty, straight blade, flush installation, NEMA 14-50R:

1. Hubbell – 7962.
 2. Leviton – HBL 5206.
 3. Pass and Seymour – 3890.
- D. Electric Dryer Receptacles - 30 amp, 125/250 volt, heavy duty specification grade, grounding straight blade type, NEMA 14-30 for flush installation:
1. Hubbell – HBL 9430.
 2. Leviton – 278.
 3. Pass and Seymour – 3864.
- E. Boiler/Chiller Emergency Shut Down Station:
1. One N.O. and one N.C. switched contact device, rated 3A per contact @ 600 VAC, and 1A per contact @ 250 VDC, factory installed on a stainless steel backplate assembly.
 2. Actuator shall be momentary contact mushroom head style, fabricated from polycarbonate material, red in color, regressed back from station cover, with the word "PUSH" permanently embossed in face, with white filled letters.
 3. Station cover shall be fabricated from molded polycarbonate material, red in color, with the words "BOILER SHUT DOWN", or "CHILLER SHUT DOWN", permanently embossed in face, with white filled letters.
 4. Referenced Product:
 - a. Safety Technology International, Inc. – STI Series 2000.
 - b. Or equivalent.
- F. Emergency Power Off (EPO) Station:
1. Heavy duty momentary contact red pushbutton with guard, flush stainless steel plate. Provide four (4) sets of contacts (minimum) allowing four (4) independent shunt trip panelboards per lab, and special backbox (as required). Nameplate per Division 26 Section "Electrical Identification" requirements.
 2. Allen Bradley, General Electric, Cutler Hammer - Westinghouse, Square D, or Siemens Allis.
- G. Fifteen (15) Minute Wind-Up Timer:
1. Paragon#SWP15M/SWPD15M.
 2. Mark-time #90005.

2.8 WIRING DEVICE ACCESSORIES

A. Indoor Coverplates:

1. General – Unless noted, shown, or otherwise indicated, provide to match the

associated wiring device(s) configuration, style, and ganging.

- a. Provide single, multi-gang, and combination coverplates as required, specified, or otherwise indicated, to match the installed wiring device(s) configurations, and ganging.
 2. Provide with metal screws for securing coverplates to device(s), with screw head color to match.
 3. Materials and Finishes:
 - a. Steel – Smooth face with factory applied prime painted finish only, suitable for field painting.
 - b. Stainless Steel – Type 302, satin smooth finish, square corners, beveled edges.
 - 1) Coverplates with rounded corners and no bevel do not meet this specification.
 4. Colors – Unless noted, shown, or otherwise indicated:
 - a. Coverplates for wiring devices connected to the "normal" power electrical distribution system shall be:
 - 1) Nylon - color to match wiring device.
 - 2) Stainless Steel – as specified above.
 - b. Coverplates for wiring devices connected to NEC Article 700, 701, and 702 Emergency System branch circuits shall:
 - 1) Match the coverplate color/finish previously specified for "normal" power system wiring devices, with ID per Division 26 Section "Electrical Identification."
 - c. Where multiple devices, potentially connected to multiple electrical distribution system branch circuits, with multiple wiring device face colors, are installed under a common coverplate, the coverplate color/finish shall be the color/finish specified for the "normal" power branch circuit wiring device color.
 5. Acceptable Manufacturers:
 - a. By wiring device manufacturer.
 - b. Mulberry Metal Products.
- B. Indoor High Abuse Coverplates (suffix HA):
1. Shall be a 2 part device consisting of a backplate/wall anchor and a heavy cast device coverplate.

- a. Backplate/wall anchor shall be fabricated from not less than 12 GA galvanized sheet steel, with threaded holes to accept device coverplate and for outlet box attachment.
 - b. Device coverplate shall be fabricated from heavy wall (not less than .125 inch thickness), corrosion resistant, die cast zinc.
 - c. Device coverplate shall be radius face design, with appropriate device cutout, such that installed device will be regressed back from face after installation.
 - d. Coverplate shall be fastened to backplate with tamper resistant, stainless steel screws regressed into face of coverplate.
2. Acceptable Manufacturers:
- a. Morelite – CSWP Series.

2.9 TWIST-LOCK RECEPTACLES

- A. Single Receptacles, 125 volt, 20 amp: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; CWL520R.
 - b. Hubbell; HBL2310.
 - c. Leviton; 2310.
 - d. Pass & Seymour; L520-R.

- B. Isolated-Ground Receptacles, 125 volt, 20 amp:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; IGL520R.
 - b. Hubbell; IG2310.
 - c. Leviton; 2310-IG.
 - d. Pass & Seymour; IG4700.
2. Description:
 - a. Comply with NEMA WD 1, NEMA WD 6, Configuration L5-20R, and UL 498.
 - b. Grounding contact shall be connected only to the grounding screw terminal of the device and shall be provided with inherent electrical isolation from the device mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.10 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.11 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.12 TESTER

- ### A.
- Provide two (2) receptacle circuit testers and two ground fault interrupter testers. Turn over to Owner upon completion.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
2. Provide wall box dimmers and their related accessories to match, and be compatible with the provided luminaire light sources, ballast, drivers, transformers and other lighting components and devices.
3. Receptacles shown outdoors, and in indoor wet locations and as otherwise indicated with suffix WP, shall be GFCI, weather resistant type, provided with outdoor weatherproof covers and shall be installed per outdoor, wet location weatherproof construction methods.

B. Coordination and Scheduling:

1. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.
2. Install wiring devices in electrical boxes that are clean; free from building materials, dirt, and debris.
3. Install wiring devices after roughing wiring work is completed.
4. Install coverplates after painting work is completed. Provide blank coverplates at unused and/or barred box locations unless otherwise directed by Owner.
5. Coordinate receptacles, shown within six feet of a sink or shown as exterior mounted, which shall be ground fault protected whether or not shown on Drawings.

C. Device Orientation:

1. In each instance where two or more devices are generally located in the same vicinity and at the same installation height, install these devices in multigang, barred boxes under a single common coverplate.
2. Combination devices (i.e. switch and receptacle) shall be installed in not less than a 2 gang box with barriers between gangs, under one common coverplate.
3. Combination receptacles and communications devices (i.e. telephone or television and receptacle) shall be installed in minimum 2 gang boxes with barriers to segregate the systems and shall be installed under one common wall plate.
4. Coordinate wiring device locations and heights with architectural elevations.
5. Unless noted otherwise, all wiring devices shall be installed in a vertical orientation.
6. Unless noted otherwise, lighting switches shall be installed such that the toggle handle "up" position turns the controlled lighting "ON".
7. Receptacle boxes provided for cabinetry and millwork shall be roughed 2 inches clear above counter backsplash or as otherwise shown on Drawings.
8. Receptacle boxes for water coolers shall be installed behind the cooler where recommended by manufacturer of the cooler.
9. Unless noted otherwise, duplex receptacles shall be installed in a vertical orientation with grounding pole up. Duplex receptacles installed 42 inches A.F.F. and above may be installed with grounding pole down.
10. Receptacles indicated or otherwise required to be installed horizontally, shall be installed with the neutral pole (grounded conductor) at the top uppermost position.

D. Device Conductor Terminations:

1. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated,

- tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.
2. Connect remote, maintained contact, emergency stop and test pushbutton devices ahead of all other motor control devices and to interrupt the motor control circuit in both the "Hand," and "Automatic" positions.
- E. Coverplates:
1. Do not install midsize, oversized or extra-deep coverplates to conceal poor workmanship. Repair wall finishes and re-install outlet box if standard device coverplates do not fit flush or do not cover rough wall openings.
 2. Install devices designated by suffix WP, with outdoor wet location coverplates, and associated outdoor, wet location installation methods.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification."

3.3 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 2. Test Instruments: Use instruments that comply with UL 1436.
 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop Under 15-A Load: A value of 6 percent or higher is not acceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- C. Test straight blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION 262726

SECTION 262800 – PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes circuit breakers, fusible disconnect devices and fuses rated 600 volts and less. Application, installation, and other related requirements for overcurrent protective device installations in other distribution equipment is specified in other Division 26 sections.

1.2 DEFINITIONS

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.
- B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.3 LEGEND

- A. AFCI = Arc fault circuit interrupter.
- B. AIC = Amperes interrupting capacity (K = 1000).
- C. BIL = Basic impulse level (K = 1000).
- D. Chg = Interchangeable.
- E. GFI = Ground fault interrupting.
- F. HID = Switching duty rated for HID or fluorescent fixtures.
- G. Non = Non-interchangeable.
- H. SWD = Switching duty rated at 20 ampere rating for fluorescent fixtures.
- I. ZSI = Zone Selective Interlocking.

1.4 COMPATIBILITY

- A. All protective devices in new assemblies shall be of the same manufacture except for special applications of proprietary types to maximize single-source responsibility.
- B. Protective devices added to existing assemblies shall have compatible interrupting ratings to the assembly and shall be of the original manufacture. If not available, modify or extend the assembly to accept compatible protective devices of same manufacturer as supplied in new assemblies.
- C. Series ratings of OCPDs are not acceptable.
- D. Provide compatible auxiliary solid-state functions as shown on Drawings for protective devices including:
 - 1. Communication Capability: Protective device communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Management Systems."
 - 2. Zone Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - 3. Arc Flash Protection System: Integral with electronic trip unit; for instantaneous trip function.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 Section "Basic Division 26 Requirements."

1.6 ACTION SUBMITTALS

- A. Product Data: For fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. Testing Agent Qualifications.
- B. Field Quality Control Test 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.

4. Manufacturer's field service report.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: 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 and circuit breakers.
 2. Time-current curves, including selectable ranges for each type of circuit breaker.
 3. Include "as-designed" and "as-left" OCPD adjustable settings list for all installations.
 4. Include key interlock sequence of operation per assembly.
- B. Record Documents.

1.9 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed protective devices, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Series rating of OCPDs is not acceptable.
- E. Field Testing: Refer to Division 26 Section "Electrical Inspections and Testing" for field inspections and testing requirements related to this Section including:
 1. Electrical Acceptance Testing Responsibilities.
 2. General Electrical Field Quality Control.
 3. Testing Agency Qualifications.
- F. Comply with ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems for field testing.

1.10 PROJECT CONDITIONS

- A. Environment 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).

1.11 COORDINATION

- A. Coordinate layout and installation of protective devices and their associated enclosures and components with other construction, including conduit, piping, equipment and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.12 REFERENCES AND STANDARDS

- A. Enclosures:

- 1. NEMA 250-85 - Enclosures for Electrical Equipment (1,000 Volts, maximum).

- B. Molded Case and Insulated Case Circuit Breakers:

- 1. UL 489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures.
- 2. NEMA AB1 - Molded Case Circuit Breakers.

- C. Disconnect Switches:

- 1. UL 98-87 - Enclosed and Dead Front Switches.
- 2. NEMA K-85 - Enclosed Switches.
- 3. UL 977-84 - Fused Power Circuit Devices.

- D. Bolted Pressure Switches:

- 1. UL 977 - Fused Power Circuit Devices.

PART 2 - PRODUCTS

2.1 THERMAL-MAGNETIC MOLDED CASE CIRCUIT BREAKERS

- A. Manufacturers:

- 1. Eaton Corporation; Cutler-Hammer Products.
- 2. General Electric Co.; Electrical Distribution & Control Division.
- 3. Siemens Energy & Automation, Inc.
- 4. Square D/Group Schneider.

- B. Construction:

1. Tripping Mechanisms: Inverse time delay thermal element for long-time overload tripping and an instantaneous magnetic trip element set to operate at 7 to 10 times the long-time trip setting for high fault current tripping in each phase. Common trip for multiple breakers without the use of handle ties. Trip-free over center quick-make, quick-break switching mechanism shall provide distinctive handle positions to self-indicate automatic tripping.
2. Enclosure: Bakelite, epoxy, glass-fibered reinforced polyester or similar material required to obtain interrupting rating.
3. Mounting: Plug-in for assembly rated 14,000 amperes interrupting capacity or below; bolt- in otherwise. Rating labels shall be visible when breaker is installed.
4. Terminal Lugs: Suitable for quantity of wire or bus to be attached; mechanical type for copper wire, compression type for aluminum wire, and bolted for bus connections.

C. Ratings:

1. Trip: As scheduled.
2. Frame: Provide as scheduled as minimum requirement.
3. AIC: Provide as scheduled as minimum requirement.

D. Special Features: Interchangeable trip settings, shunt trip, undervoltage trip, bell alarm, auxiliary switch, motor operator, etc., as shown on Drawings.

1. Molded case switch shall have manual only tripping mechanism.

2.2 SOLID-STATE MOLDED CASE CIRCUIT BREAKERS

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Construction:

1. Standard Tripping Mechanism: Solid-state tripping elements with associated current monitor and flux transfer shunt trip in two or three pole applications. Sensors shall be provided for each pole. Long-time trip settings shall be adjustable using rating plug and dials covering a minimum range of 50 – 100 percent of the specified rating. Hand held battery operated programmers are acceptable; however, provide a minimum of (2) programmers, a wall mountable galvanized steel storage box and provide a minimum of (2) 4 hour additional training sessions for the Owner. The magnetic trip unit

shall have adjustable short-time and instantaneous trip characteristics. Trip unit shall be common for all poles, trip-free, over center quick-make quick-break switching and consist of a manual trip button and trip indicators. The trip device shall be insensitive to temperature changes between minus 20 degrees C and plus 55 degrees C. The long-time delay, short-time pickup, short-time delay and instantaneous pickup shall be fully adjustable using dials[, **Electric Power Management System integration,**] or a hand held programmer, with the following minimum characteristics, based on the coordination study, settings and adjustments may override specification generalities:

- a. Long-time pickup (0.5 – 1) x plug rating.
 - b. Long-Time Delay:
 - 1) 600 amps and below (2-14 seconds).
 - 2) Above 600 amps (2-24 seconds).
 - c. Short-time pickup (2-8) x plug rating
 - d. Short-Time Delay:
 - 1) 600 amp frame and below (0.1 – 0.2 seconds) including $I^2 t$ out/in.
 - 2) 800 – 1600 amp frame (0.1 - 0.4 seconds) including $I^2 t$ out/in.
2. Ground Fault Protection Tripping: Shall utilize the flux transfer shunt trip. Utilize an internal sensor for breakers equal or under the 400 amp frame rating. Above 400 amps, the ground fault trip shall be a self-contained external relay and shunt trip, except for neutral sensor, and feature an adjustable pick-up and time delay range from 0 to 18 cycles. Sensing shall be by the residual current method. Provide trip indicator and test panel.
- a. Ground Fault Pickup:
 - 1) 1200A or Below: 0.2-0.7 times.
 - 2) Above 1200A: 500A-1200A.
 - b. Ground Fault Delay:
 - 1) 600 amp frame and below (0.1 – 0.2 seconds) $I^2 t$ on/off.
 - 2) 800 – 1600 amp frame (0.1 – 0.4 seconds) including $I^2 t$ on/off.
3. Enclosure: Bakelite, epoxy, glass-fibered reinforced polyester or similar material required to obtain interrupting rating. Provide sealable tamperproof cover over adjustment controls.
 4. Mounting: Bolt-in or drawout as indicated.
 5. Terminal Lugs: Suitable for quantity of wire or bus to be attached; mechanical type for copper wire, compression type for aluminum wire, and bolted for bus connection.

C. Ratings:

1. Trip: As scheduled.
 2. Frame: Provide as scheduled as minimum requirement.
 3. Sensor-Clip shall match frame size.
 4. AIC: Provide as scheduled as minimum requirement.
- D. Special Features: Interchangeable trip settings, shunt trip, undervoltage trip, bell alarm, auxiliary switch, motor operator, etc., as shown on Drawings.
1. Molded case switch shall have manual only tripping mechanism.

2.3 ARC FAULT CIRCUIT INTERRUPTER (AFCI) CIRCUIT BREAKERS

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

- B. Definition - Arc Fault Circuit Interrupter: A device intended to provide protection against the effects of arcing faults by recognizing characteristics that are unique to arcing fault conditions and by functioning to de-energize a circuit when an arcing fault occurs.

C. Construction:

1. Standard tripping mechanism per UL 1699:
 - a. Single pole AFCI breaker for 120 VAC, single phase applications.
 - b. Two pole, AFCI breaker with common trip is applied in 3 wire, 120/240 VAC and 240 VAC applications.
 - c. Two pole independent trip for 120 VAC multi-wire applications with a shared neutral.
 - d. A combination AFCI/GFCI breaker shall be utilized for applications where AFCI protection and 5 ma GFCI protection are required.
 - e. All AFCI breakers shall be HACR rated and SWD rated for 15 and 20 amperes.

2.4 SEPARATELY ENCLOSED CIRCUIT BREAKERS

A. Enclosure:

1. Flush or surface as shown on Drawings.
2. Type shall suit area per NEMA requirements.

3. Ground wire lug of suitable size shall be brazed to the enclosure. Neutral bar on four wire systems shall be ungrounded.
 4. Nameplate centered on front shall identify load served.
- B. Breaker characteristics shall be as previously specified.

2.5 DISCONNECT SWITCHES

A. General:

1. Disconnect switches for 120 VAC equipment shall be manual fractional horsepower motor controllers, as specified in Section "Motor Controllers," with engraved coverplate identifying load served.
2. Other disconnect switching shall be as specified below.

B. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

C. Construction:

1. Heavy duty type, fused and/or non-fusible as shown on Drawings.
2. Interior Construction: Switch blades fully visible in the off position when the enclosure door is open. Fuseholders for specified fuse, rejection type.
3. Switch Mechanism: Quick make, quick break with positive interlock to prevent opening of enclosure door when operating handle is in the on position and to prevent closing of the switch mechanism with the door open. Operating handle shall be an integral part of enclosure base, have provisions for three padlocks in the off position, and the means to indicate whether the switch is on or off by its position. Vertical operating handles shall be up in the on position.
4. Terminal Lugs: Suitable for quantity of wire to be attached, front removable with terminal shields; mechanical type for copper wire, compression type for aluminum wire.

D. Ratings:

1. Amperes - 30-1200.
1. Voltage - 240 or 600.
2. Poles - 2, 3 or 6.
3. AIC - Match fuse or upstream protective device.
4. Horsepower rated - 30 - 600 amps.

E. Enclosure:

1. Surface mounted type.
 2. Type shall suit area per NEMA requirements.
 3. Ground wire lug of suitable size shall be brazed to the enclosure. Neutral bar on four wire systems shall be ungrounded.
 4. Nameplates on front shall identify load service as well as proper fuse application warning.
- F. Special Features: Service entrance rated, control circuit interlock, etc., as shown on Drawings.
1. Label each safety switch per Division 26 Section "Electrical Identification," with the following legend in capital lettering at least 3/8 inch high: "DANGER, DO NOT START OR STOP MOTOR WITH THIS SWITCH. USE FOR ISOLATION ONLY."
 2. Where indicated (by subscript "AUX") provide not less than one set of Form C (1 N.O & 1 N.C) auxiliary contacts, mechanically interlocked to the switch operating handle, such that the N.C. contact opens prior to the switch blades closing, of the N.O. contact closes prior to the switch blades opening.
 - a. Contacts shall be rated not less than 15A continuous, @ 240 V AC.

2.6 ACCESSORIES

- A. Provide breaker accessories for general operation and maintenance of specified breakers. Include items listed below and items recommended by manufacturer:
1. Three (3) spare adjustable trip plugs for each rating specified.
 2. Special adjustment tools.
- B. Provide quantities of circuit protective accessories in locations necessary for effective general operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install circuit protective devices in assemblies at or above the minimum interrupting rating and frame size shown on Drawings. Circuit breaker frame size shall be the largest ampere rating if not specified in the rating schedules.
- B. Add new circuit protectives to existing assemblies when shown on Drawings. Rearrange existing circuit protective and provide bus extensions, hardware, enclosure modifications, etc., to accomplish the installations. Modify assemblies directories or add nameplates to match existing.
- C. Install separately enclosed circuit breakers and disconnect switches at five feet

above floor unless otherwise noted. Support independent of stud partitions.

- D. Install fused disconnect switches as shown on Drawings and Schedules, complete with fuses recommended by the manufacturer of the equipment served. Ensure proper AIC ratings for protection of the switch and equipment. Submit final fuse ratings as part of O&M Manual submission. Series ratings of OCPD are not acceptable.
- E. Install distribution equipment circuit protective devices at factory.
- F. Leave all spare devices in the off position.
- G. Coordinate factory or field installation of key interlocks and associated sequence of operation nameplate per assembly per Division 26 Section "Electrical Identification."
- H. Install spare fuse cabinet at location shown on Drawings.
- I. Install key interlock spares cabinet at Owner designated location.

3.2 IDENTIFICATION

- A. Identify components in accordance with Division 26 Section "Electrical Identification."

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between OCPDs and control/indication devices as specified in Division 26 Section "Low Voltage Electrical Power Conductors and Cables" for hard wired connections.

3.4 CONNECTIONS

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.5 GROUNDING

- A. Provide equipment grounding connections for individually mounted OCPD units as indicated, as required by NEC, and per Division 26 Section "Grounding and Bonding." Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL

- A. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
- B. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.
- C. Pretesting: Upon completing installation of the system, perform the following preparations for independent tests:
 - 1. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
 - 2. Make continuity tests of circuits.
 - 3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
 - 4. Provide manufacturer's instructions for installation and testing of OCPDs to test personnel.
- D. Test and Inspections:
 - 1. Perform inspections and test procedures as required by Division 26 Section "Electrical Inspections and Testing", ANSI/NETA "Air, Low Voltage", Circuit Breakers, Air Insulated Case/Molded Case", "Circuit Breakers Air, Low Voltage Power", "Ground-Fault Protection System", and "System Functional Tests" requirements including optional requirements and the following additional requirements:
 - a. Prepare test and inspection reports.

END OF SECTION 262800

SECTION 262913 – MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes motor controllers rated 600 V and less that are not supplied with equipment furnished by other Divisions.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 26 "Basic Division 26 Requirements."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings:
 - 1. Layout Drawings: Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Field quality control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers 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 enclosed controllers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- B. Record Documents:
 - 1. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full- load currents.
 - 2. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.
- E. Field Testing: Refer to Division 26 Section "Electrical Inspections and Testing" for field inspections and testing requirements related to this Section including:
 - 1. Electrical Acceptance Testing Responsibilities.
 - 2. General Electrical Field Quality Control.
 - 3. Testing Agency Qualifications.
- F. Comply with ANSI/NETA ATS – Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems for field testing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt,

fumes, water, corrosive substances, and physical damage.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than three days in advance of proposed interruption of electrical service.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
 - 2. Eaton Corporation; Cutler-Hammer Products.
 - 3. General Electrical Company; GE Industrial Systems.
 - 4. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
 - 5. Siemens/Furnas Controls.

6. Square D.

2.2 MOTOR CONTROLLERS, GENERAL

- A. Controller shall be manual type for motors 1/3 HP and smaller and magnetic type for motors 1/2 HP and larger.
- B. Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, (power factor correction), the motor, the required control sequence, the duty cycle of the motor, drive, and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled.
- C. Contacts shall open each ungrounded connection to the motor.
- D. Controller contacts shall be twin-break, silver-to-silver, renewable contacts with one set of contacts for each phase.
- E. Overload Relays: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of the specific motor to which connected with appropriate adjustment for duty cycle.
- F. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)." Provide enclosures suitable for the environmental conditions at the controller location. Provide NEMA Type 1 enclosures except as otherwise indicated.
- G. The coverplate shall have a lock-off tab for a padlock.

2.3 MANUAL FRACTIONAL HORSEPOWER MOTOR CONTROLLERS

- A. Description: Quick-make, quick-break toggle action.
- B. Single-phase motor control switches (thermal switches) for fractional horsepower motors. Single pole for 120 volt, two pole for 208 volt operation. Mount flush in finished areas and surface otherwise.
- C. Trip-free, toggle operated with on-off-reset position clearly indicated with neon pilot light for run indication.
- D. Thermal overload shall be ambient compensated, plug-in type element with heater rating clearly indicated. Provide one overload for single pole switch and two overloads for two pole switch.
- E. Where the motor is interlocked and controlled by another device, the motor controller shall be marked "Hand-Off-Auto."

2.4 COMBINATION MAGNETIC MOTOR CONTROLLERS

- A. Description: Provide full-voltage, nonreversing, across-the-line, magnetic controller, except where another type is indicated.
- B. Control Circuit: 120 V. Provide control power transformer integral with controller where no other supply of 120 V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity
- C. Combination Controller: Switch type; fused or nonfused as indicated; quick-make, quick-break switch; factory assembled with controller, and arranged to disconnect it. For fused switches, provide rejection-type fuse clips and fuses rated as indicated. Switches and fuses are specified in Division 26 Section "Protective Devices." Interlock switch with unit cover or door.
- D. Combination Controller: Motor Circuit Protector (MCP); molded-case circuit-breaker type with magnetic-only trip element calibrated to coordinate with the actual locked-rotor current of the connected motor and the controller overload relays. Provide breakers that are factory assembled with the controller, interlocked with unit cover or door, and arranged to disconnect the controller. Provide lockable disconnect device.
- E. Enhanced-Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics. Select to protect motor against voltage unbalance and single phasing.
- F. Enclosure door shall be interlocked with the operating handle to prevent opening of doors with handle in the on position.
- G. Shall be provided with the following pilot lights:
 - 1. Green light to indicate motor running.
 - 2. Red light to indicate motor off.
- H. Provide Type 2 coordination (no damage protection) for motor starter per UL 508E requirements.

2.5 COMBINATION 2-SPEED MAGNETIC MOTOR CONTROLLERS

- A. General: Match controller to motor type, application, and to number of speeds. Conform to Article "Magnetic Motor Controllers" above. Provide auxiliary devices as indicated herein and on Drawings. Provide all required relays factory installed in controller enclosure.
- B. Combination starters shall be across-the line full voltage, non-reversing type with undervoltage release for 2 speed motors. Be factory assembled and include magnetic type controllers and motor circuit protector.

- C. The controller shall serve the purpose of starting a 2-speed motor at the pre-selected speed and to provide complete overload, overcurrent, and undervoltage protection at each speed.
- D. The 2-speed controller shall basically be an assembly of two magnetic across-the-line controllers, one for each motor speed, mechanically and electrically interlocked and wired for automatic control through a cover mounted control switch. Include single phase protection and voltage unbalance trip relays.
- E. Controller shall be provided with the following pilot lights:
 - 1. Green light to indicate motor high speed.
 - 2. Amber light to indicate motor low speed.
 - 3. Red light to indicate motor off.
- F. Decelerating Relay: Provide selection of lower than current operating speed by pushbutton or pilot device as indicated with deceleration automatically timed through any intervening speeds.

2.6 REDUCED-VOLTAGE MOTOR CONTROLLERS

- A. Star-Delta Magnetic Type: Closed transition with adjustable time delay.
- B. Part Winding Magnetic Type: Closed transition with separate overload relays for starting and running sequences.
- C. Auto transformer Magnetic Type: Closed transition.
- D. Solid-State Type: Suitable for use with standard NEMA MG 1 Design B, 3-phase induction motors, providing adjustable acceleration rate control using voltage or current ramp. Provide adjustable starting torque control with up to 500 percent current limitation for 20 seconds. Provide surge suppressor in solid-state power circuits to provide 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage. Provide snubbers to prevent malfunction due to system voltage transients. Provide overload protection for NEMA Class 10 or better. Provide LEDs to indicate motor and control status including control power available, controller on, overload trip, loss of phase, and shorted SCR.
- E. Provide automatic voltage reduction controls to reduce voltage when motor is running at light load.
 - 1. Provide a motor running contactor to operate automatically when full voltage is applied to motor. Controller shall operate as a magnetic motor controller except during starting of motor.

2.7 AUXILIARY CONTROL DEVICES

- A. General: Factory installed in controller enclosure except as otherwise indicated. Where separately mounted, provide NEMA 1 enclosure except as otherwise indicated.
 - 1. Control circuit shall be a maximum of 120 volts with individual control power transformer having Class CC dual primary and single secondary fused protection. Provide terminal lugs for connection to wiring from external remote located controls. Where indicating lights, solenoid valves and additional control components are energized from the control transformer, the control power transformer will be increased in size to handle its normal load plus the other indicated loads.
- B. Control devices such as pushbuttons and selector switches shall be heavy-duty, oil-tight, and be key operated or lockable where shown on Drawings.
- C. Control selector switches shall be as shown on Drawings and shall be one of the following:
 - 1. Start-Stop.
 - 2. Off-Auto (O-A).
 - 3. Hand-Off-Auto (H-O-A).
- D. Provide each H-O-A switch with momentary stop and start push buttons located in the "H" leg to prevent accidental starting when the switch is turned to the "H" position.
- E. Control devices shall be mounted in starter cover and be labeled with the motor or assembly which they service.
- F. Pilot lights shall be transformer type, heavy-duty, oil tight.
- G. Provide 1 "NO" and 1 "NC" isolated auxiliary contacts in addition to the normal hold-in contact and auxiliary contacts required for interlocks and pilot lights.
- H. Provide Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- I. Provide Ground Fault Relays: With sensing circuit and adjustable trip settings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Coordinate motor control equipment with the motor being supplied. Refer to motor controller schedules on Drawings. Note that scheduled motor circuit protectors are based on continuous duty ratings.
- B. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- C. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Location: Locate controllers as indicated and within sight of motors controlled approximately where shown on Drawings.
- B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports."
 1. Individually mounted magnetic and manual controllers mounted in finished areas shall be flush. Flush coverplates shall be stain finish, stainless steel for manual starters or painted finish for magnetic controllers. Manufacturer's nameplates or holes resulting there from will not be permitted.
- C. Install freestanding controllers on concrete bases.
 1. Anchor secondary unit substations to concrete bases according to manufacturer's written instructions, seismic codes at Project and requirement in Division 26 Sections "Hangers and Supports" and Vibration and Seismic Controls".
 2. Bolt freestanding controllers to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.
- D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- E. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Protective Devices."
- F. For magnetic controller/controllers, combination fused or motor circuit protector type shall be used. If fuses are indicated, the motor circuit protector shall be

equipped with current limiters.

- G. Where interlocking or sequence starting of motors is shown on Drawings, it shall be done such that when the circuit feeding a starter is open, no part of the controller/controllers shall be energized. Furnish any relays, auxiliary contacts or disconnect switches necessary to implement the indicated sequences and interlocks.
- H. Provide permanent wiring diagrams as approved by the Engineer showing all internal starter controller within each motor controller/controllers compartment. Glued-on blue-line prints are not acceptable. Also provide interlock wiring diagrams between controller/controllers.
- I. Overloads shall be of NEMA size required to match the specified motor nameplate (and power factor capacitor data).
- J. Minimum controller/controllers size shall be NEMA 1.
- K. Provide wiring from the controller to the motor. For 2-speed, 3-phase controller/controllers, provide three or six wires as required by the controller/controllers type.

3.4 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Hangers and Supports," and concrete materials and installation requirements are specified in Division 03.

3.5 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.6 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.

3.7 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.8 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:

- 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
- 2. Test continuity of each circuit.

- B. Tests and Inspections:

- 1. Perform inspections and test procedures as required by Division 26 Section "Electrical Inspections and Testing", ANSI/NETA ATS "Motor Control, Motor Starters, Low-Voltage", "System Functional Tests", and "Thermographic Survey" requirements and the following additional requirements.
 - a. Follow-up 12 month thermographic survey shall not be required.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - c. Prepare test and inspection reports.

3.9 ADJUSTING

- A. Set field adjustable switches and circuit-breaker trip ranges.

END OF SECTION 262913

SECTION 265100 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section provides requirements and specification criteria for the provision of the following:
 - 1. Interior luminaires, ballasts, lamps and related accessories.
 - 2. Emergency lighting products.
 - 3. Illuminated "EXIT" signs.
 - 4. Luminaire supports.

1.2 DEFINITIONS AND ABBREVIATIONS

- A. CCT: Correlated Color Temperature.
- B. CFL: Compact Fluorescent Lamp.
- C. CRI: Color Rendering Index.
- D. CU: Coefficient of Utilization.
- E. HL: High Lumen - As related to compact fluorescent lamp descriptors. Also referred to as "Biax".
- F. LED: Light Emitting Diode.
- G. LER: Luminaire Efficacy Rating.
- H. Luminaire: A complete lighting assembly or product consisting of; not less than a light source(s) and related device(s) to position the light source(s), housing or enclosure, light source control, optics and shielding, and light source power supply/control device(s).
- I. NRTL: Nationally Recognized Testing Laboratory.
- J. RCR: Room Cavity Ratio.
- K. RoHS: Restriction of the Use of Hazardous Substances in Electrical and Electronic Equipment. As used herein, compliance shall be defined as meeting or exceeding the requirements set forth in European Union Directive 2002/95/EC.
- L. Solid State Lighting/Luminaires: Light sources and their associated luminaires that produce light (radiant energy) without the use of electrical filaments, excited gas

or plasma, such as LED, OLED, or PLED.

- M. TCLP: Toxicity Characteristic Leaching Procedure.
- N. UV: Ultra Violet.
- O. VCP: Visual Comfort Probability.

1.3 ACTION SUBMITTALS

- A. Product Data: Submitted as a complete package, in loose-leaf 3 ring binders, notebooks, or folders, in quantities specified in Division 01, for the products specified herein, and in the Luminaire Schedule. Not less than the following product data shall be submitted:
 - 1. A product data sheet, literature, drawing, etc., for each luminaire specified.
 - a. The product data sheets shall be specific to the particular luminaire, lamp, ballast, and accessories specified.
 - b. The luminaires standard features, and conformance with the specified options, features, performance criteria, etc.
 - c. The manufacturer's standard luminaire description, drawing, photo and fabrication specifications indicating conformance with the Luminaire Schedule and this specification section.
 - d. Luminaire dimensional data.
 - e. Photometric performance data, based on laboratory testing, specific to the particular lamp, ballasts, and accessories specified for this project.
 - f. Efficiency Data: Provide both lumen performance efficiency, and luminaire efficiency rating (LER).
 - 1) Where specifically stated, photometric performance data shall be certified by an independent testing service regularly engaged in the testing and certification of luminaire photometric performance.
 - 2) Where not specifically stated, the photometric performance data provided by the manufacturer will be acceptable.
 - g. Environmental air handling performance data: Where environmental air handling types of luminaires have been specified, provide the following data:
 - 1) Vertical and horizontal air distribution data.
 - 2) CFM capacity.
 - 3) Data and information required to calculate and/or evaluate termination velocity.
 - 4) Data and information required to calculate and/or evaluate noise criteria.
 - 5) Compatibility with 2nd party air supply diffusers.
 - 6) Data and information required to calculate and/or evaluate static

- a. For continuous row and continuous length (including wall-to-wall) luminaires, provide scaled drawings indicating luminaire lengths and lamping requirements for each separate, individual length and row. Indicate layouts and quantities of individual luminaire housings, corners, transition components, spacers, etc.
2. Wiring Diagrams: Provide ballast quantities and wiring to provide conformance with switching, life safety, and other control requirements.
3. Lighting products that are slight variations of standard products, and/or continuous row/length versions of standard products, shall bear labeling from a NRTL.
4. Custom fabricated lighting products shall be tested in accordance with the appropriate standard(s), and shall bear labeling from a NRTL.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality Control Test Reports:

1. Indicate and interpret test reports for compliance with performance requirements.

B. Coordination Drawings: Submit reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Structural members to which suspension systems for luminaires will be attached.
4. Other items in finished ceiling including, but not limited to, the following:
 - a. HVAC system diffusers, registers, grilles, and other environmental air handling outlets, inlets, and devices.
 - b. Speakers.
 - c. Sprinklers.
 - d. Smoke and fire detectors.
 - e. Occupancy sensors.
 - f. Access panels.
5. Perimeter soffits, moldings, and similar architectural features.

C. Warranties: Provide special warranties as specified in this Section, otherwise refer to Division 01.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Provide not less than three (3) sets of

submittals of the following items, to the Owner, in loose leaf 3-ring binders.

1. Three (3) copies of each approved action and informational submittal processed as part of the Work.
2. Copies of product warrant statements.
3. Copies of product installation and maintenance materials furnished with the equipment.
4. Provide complete sets (quantity as defined in Division 01) of product data sheets, reflected ceiling plans, wiring diagrams for project specific applications of each luminaire type for each application throughout the project.
5. Include date of installation, date of initial lamping and replacement parts order information. Include lamp and ballast re-ordering information, and re-lamping schedule for luminaires appropriate for group re-lamping. Include basic maintenance requirements, including luminaire and component cleaning.
6. Provide copies of spare lamp, luminaire and ballast, and other accessories delivery receipts.

1.6 QUALITY ASSURANCE

A. Provide luminaires factory designed, built and tested per the following standards:

1. Fluorescent Luminaires – UL 1598. Where a specific LER value is specified, test according to NEMA LE 5 and LE 5A, as applicable.
2. Recessed Luminaires – In compliance with NEMA LE 4, for ceiling system material, type, and design compatibility.
3. Solid State Lighting/Luminaires – UL 8750, 1598, 1574 and 2108.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing and Calculations Guides.

D. Solid State Lighting/Luminaires:

1. Luminous flux, luminaire efficiency and chromaticity shall be tested, measured and reported in accordance with the most current versions of IES documents LM-79 and LM-80.
2. Chromaticity ranges for "white light" products, with various correlated color temperatures, shall be provided in accordance with ANSI/NEMA-C78.377.
3. Drivers and power supplies shall be provided in accordance with the requirements of ANSI/NEMA-C82.SSL1 and their maximum allowable harmonic emission limits shall be in accordance with ANSI/NEMA-C82.77.
4. Shall be provided with a U.S. Department of Energy (DOE) "Lighting Facts" label indicating their specific performance characteristics, tested and reported in accordance with the requirements of the most current version of

IES LM-79.

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Except as otherwise specified herein, provide installation in accordance with the requirements of NECA/IESNA 500 – Standard for Installing Indoor Lighting Systems (ANSI).
- G. Provide in compliance with NFPA 70.

1.7 COORDINATION

- A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate installation of luminaires to prevent the possibility of damage.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Provide for the coordination of luminaire procurement, delivery, expediting, ceiling material/luminaire compatibility, etc.
- B. Deliver luminaires in factory fabricated containers or wrappings which properly protect luminaires from damage. When possible, arrange for manufacturer to take back packaging materials to be recycled or reused.
- C. Store luminaires and accessories in a secure, dry, heated location, protected from construction dust, dirt and debris, in their factory shipped cartons, pallets, packaging, etc., until ready for installation.
- D. Handle luminaires carefully to prevent damage, breakage or scoring of finishes.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate with other work including ceiling type, wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of interior luminaires with other work.
- B. Sequence luminaire installation with other work to minimize possibility of damage and soiling during remainder of construction.
- C. Schedule the installation of luminaires and lamps, to allow for the specified lamp "burn-in" period.

1.10 CONTROLS PROGRAMMING, SETUP AND COMMISSIONING

- A. Provide on-site construction personnel for the purpose of aiding outside vendors, factory technicians and other duly authorized representatives of lighting equipment manufacturers, during their required controls programming, setup and commissioning of systems and equipment.

- 1. Provide not less than 2 on-site hours for this activity.

1.11 WARRANTIES

- A. Warranties specified in this Article shall be provided and shall run concurrent with other warranties required of the Contractor under the requirements of the Contract Documents. Warranty requirements being at time of Substantial Completion of project.

- B. Warranties for Electronic Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts, including labor, that fail in materials or workmanship within five (5) years.

- C. Warranties for LED luminaires: Written warranty, executed by manufacturer agreeing to replace luminaires, including labor, exhibiting a failure of LED modules or LED drivers within five (5) years.

- D. Warranties for luminaire finishes: Written warranty, executed by manufacturer agreeing to replace luminaires, including labor, exhibiting a failure of finish as specified below within five (5) years.

- 1. Protection from Corrosion: Warranty against perforation or erosion of finish.
 - 2. Color Retention: Warranty against fading, staining, and chalking.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (ANY SUBSTITUTIONS TO THE SELECTED LIGHT FIXTURES IN THE SCHEDULES LOCATED ON THE DRAWING MUST BE PRE-APPROVED BY THE ARCHITECT PRIOR TO SUBMITTING BIDS).

- A. Luminaire Manufacturers must be as noted in the schedules on the drawings. Subject to compliance with the requirements of this section and the design criteria specified in the Luminaire Schedule, provide products by the manufacturers listed in the Luminaire Schedule.

- B. Reference to specific luminaire manufacturers and their respective model or series numbers, are included in the Luminaire Schedule to provide a guide as to the

level of quality, performance, and overall physical appearance of the specified product, which shall be met, in accordance with the Luminaire Schedule's design criteria, and as written herein.

- C. Listed luminaire manufacturers and their series or model numbers shall not imply unconditional specification approval. The listed manufacturers and their respective products have been included as acceptable manufacturers of products which shall comply with the Luminaire Schedule design criteria, luminaire descriptions, and these specifications. Modification to a given manufacturer's standard product may be required to make the model or series numbers listed comply with the Luminaire Schedule design criteria, and these Specifications.
 - 1. The preceding paragraph shall in no way suggest or indicate that a manufacturer's UL listing be voided or otherwise compromised, in order to comply with the specified luminaire design criteria, descriptions or these Specifications.
- D. Luminaire Products and Accessory Manufacturers: Subject to compliance with the requirements of this section, provide products from the manufacturers included herein.

2.2 LUMINAIRES AND ACCESSORIES

A. General Requirements:

- 1. Provide luminaires complete with the required and specified features, options, accessories, etc. Luminaires shall be provided as complete assemblies, ready for installation, including lamps, ballasts, transformers, reflectors, shielding media, wiring and all other components required for a complete installation.
- 2. Luminaires provided shall be constructed, wired, and installed in compliance with appropriate NRTL standards and applicable codes.
 - a. Provide luminaires that are listed or approved for use in their application and location.
 - b. All products provided shall be listed, labeled, or otherwise approved by a NRTL, and shall be provided with the appropriate listing ID label(s) permanently affixed to the luminaire, concealed from normal view.
- 3. Except as otherwise noted, luminaires and their related accessories, lamps, ballasts, etc., shall be new, unused, factory tested, and ready for field installation.
- 4. Refer to Luminaire Schedule for additional luminaire specifications, descriptions, features and functions, color and finish selections, etc.
- 5. Recessed luminaires provided for installation in ceiling spaces known, or presumed, to be installed in direct contact with combustible materials within the ceiling cavity, shall be IR tested, rated, and so labeled.
- 6. Recessed luminaires provided for installation in known, or presumed air tight ceiling spaces, shall be designed to restrict airflow to under two cubic

- feet per minute, from the controlled environmental space to the ceiling space (or plenum), and shall be listed and labeled "Air-Tight."
7. Recessed luminaires provided for installation in known, or presumed fire rated ceiling assemblies, shall be UL classified, listed, and so labeled for use in fire rated ceiling assemblies.
 8. Luminaires provided for recessed installation in false ceiling materials shall be designed and built for full access to concealed electrical components from below the finished ceiling material. Luminaire designs that require destruction, or removal of installed ceiling system components to allow access to concealed electrical components, do not meet this specification.
 9. In general, luminaires shall be fabricated from sheet metal, or extruded metal parts. Except as otherwise specifically specified, noted, or indicated, non-metallic parts shall not be used in luminaire construction.
 10. Lampholders shall be factory supplied, by the respective luminaire manufacturers, and shall be provided according to the luminaires designated lamping requirements.
 - a. Lampholders supplied for fluorescent luminaires shall be compatible with and match their associated lamp requirements.
 11. Luminaires shall be constructed for safe installation. Luminaires shall be provided free from burrs, sharp edges and corners, and fabrication/tooling marks.
 12. Provide luminaires complete with ceiling trims and similar materials to coordinate with ceiling construction materials.
 13. Provide luminaires complete with their full complement of required installation hardware, T-bar hangers, wood joist hangers, "C" channel bar hangers, outlet box canopies, pendant suspension kits, etc. The Contractor shall bear the responsibility for ceiling/luminaire installation coordination and procurement.
- B. Recessed Luminaires: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- C. Fluorescent Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. Solid State Lighting Luminaires: Comply with UL 8750 and previously stated standards.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.

- b. Lamp diameter code (T4, T5, T8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Ballast starting type (preheat, rapid start, instant start, programmed start, etc.) for fluorescent and compact fluorescent luminaires.
 - d. CCT and CRI for all lamps.
2. Provide DOE "Lighting Facts" label on all solid state lighting products.
- H. Fluorescent Luminaires:
1. Shall be provided with factory installed disconnecting means, in compliance with Article 410.130(G) of NFPA 70 - National Electrical Code.
 2. Except as otherwise indicated, luminaires shall be constructed of not less than 22 gauge, pre-treated and pre-finished cold rolled steel (CRS), die-cut, formed, welded and tabbed to form a rigid housing. Housings and exposed surfaces shall be painted after fabrication in the specified finish coating(s).
 3. Provide multiple ballast/lamp wiring to facilitate the switching arrangements indicated on the drawings. Unless otherwise indicated, 3 and 4 lamp fluorescent luminaires shall be factory wired to multiple ballasts, to allow inboard/outboard switching of the respective lamps.
 4. Lampholders supplied shall be compatible with, and shall match the configuration of the associated luminaire lamping requirements.
 - a. Lampholders supplied for linear, bi-pin fluorescent lamps, required to be dimmed, shall be rapid start type, with knife edge style contact points, and shall be factory wired in parallel, not series, not shunted and not jumpered.
 5. Luminaire wiring compartments shall be listed and labeled for feed-thru wiring.
 6. Continuous Row, Long Linear Length Luminaires:
 - a. Luminaires provided for continuous row, and long linear length installation, shall be factory designed, fabricated, and provided utilizing the longest single length luminaire housing, lens, and lamp configurations available. Except as otherwise noted or indicated, luminaire manufacturers shall not indiscriminately butt short housing/lens/lamp lengths together, to form long continuous luminaire lengths.
 - b. Except as otherwise indicated, continuous row and long length luminaires shall be limited to 3 and 4-foot-long lamp lengths.
 - 1) Luminaires/lamp lengths fabricated to provide the emergency lighting requirement indicated shall be limited to 4-foot lamp lengths. Two foot and 3-foot-long luminaires and lamp lengths shall not be utilized to provide the indicated emergency lighting.
 - c. Where staggered lamping is specified, luminaire manufacturer and contractor shall coordinate the nominal luminaire lengths indicated, with the manufactured housing components, to provide a uniform, unbroken,

lighting appearance along the entire length of continuous row indicated.

- 1) Manufacturer shall provide luminaire and lamp lengths (limited to 3 and 4-foot-long lamps only) as required, to provide the end-to-end lengths indicated. A single 2-foot-long lamp may be utilized, with approval from the Architect, if required, to provide the continuous lighted length required.
- 2) Where luminaire continuous lengths are shown indicated, or otherwise specified as extending wall-to-wall, the luminaire housings and lenses shall extend wall-to-wall, to match the architectural wall/ceiling construction.
- 3) The overall staggered lamp length may fall within 6 inch maximum of the housing/lens length, and shall be equally and symmetrically spaced at both ends.
- 4) Lenses, louvers, and other shielding media, where specified, shall be provided in the longest lengths available, to limit the number of joints and seams.

d. Luminaires shall be factory supplied with spine type splicing, alignment, and installation components, to allow luminaires to be field installed in long, linear, continuous rows, with no discernible deflection along the entire row length.

I. Doors, Frames, and Other Access Components:

1. Doors, lens frames, access compartments, latches, etc., shall be smooth operating; designed and fabricated to trap produced light within the luminaire housing proper. No visible light leaks.
2. Luminaires shall be designed, built, and tested to allow for lamp replacement without having to remove or disassemble luminaire components.
3. Lenses, louvers, diffusers, door frames, access covers, etc., shall be held captive, and shall be designed to limit the potential for accidental droppage during lamp replacement, luminaire cleaning, maintenance, etc.

J. Luminaire Coatings and Finishes:

1. Luminaire surfaces, components, trims, housings, etc., shall be factory pre-treated, rust proofed, primed, and otherwise prepared, to inhibit rust and corrosion. Exposed luminaire surfaces shall be factory pre-treated, primed, and finish coated with a suitable rust and corrosion inhibiting product.
2. Luminaire reflective surface coatings shall provide not less than the following minimum reflectance values:

a.	White Paint	85
b.	Specular Surfaces	83
c.	Semi-Specular Surfaces	75
d.	Laminated Silver Metalized Film	90
		percent

3. Except as otherwise indicated, the luminaire manufacturer's standard factory finishes shall be acceptable. The finish color shall be as specified or otherwise indicated.
4. Where specifically specified, or otherwise indicated, custom finishes or color selections shall require written approval from the Architect prior to application. A sample of the custom finish or color shall be submitted, to the Architect, for approval.
5. Where a specific finish, or color, is specified, or otherwise indicated, the luminaire manufacturer shall factory apply the stated finish or color product to all visible luminaire surfaces, except those surfaces affecting luminaire performance. Except as otherwise indicated, luminaire finishes shall not be field applied.
6. Cast and extruded luminaire components and housings, specified with a natural or clear finish shall be factory coated with a baked-on, clear, methacrylate lacquer, transparent epoxy, or other suitable clear protective coating.

K. Reflectors, Cones, and Baffles:

1. Shall be fabricated free from spinning lines, ripples, and other surface imperfections.
2. Shall be designed for invisible and secure attachment and installation to luminaire housing. Shall be free from visible or exposed hardware.
3. Shall be provided in the finish, color, material, and optical design properties specified in the Luminaire Schedule.

2.3 LENSES, DIFFUSERS, LOUVERS, AND LAMP SHIELDING MEDIA

A. General - Acrylic Lenses and Diffusers:

1. Lenses shall be specifically designed, fabricated, and tested for the purpose of providing optically correct, measurable, and predictable light distribution results. Lenses shall facilitate light refraction, distribution, lamp shielding and glare control for artificial light source luminaires.
2. Shall be fabricated from 100 percent clear, UV stabilized, virgin acrylic, material, specifically designed and tested for use with artificial illuminating light sources, and shall be non-yellowing as a result of aging, exposure to heat, and UV radiation.
3. Lens Thickness: Except as otherwise indicated, shall be fabricated and factory tooled to not less than 0.125 inch overall thickness.
4. Shall be designed, fabricated, and tested to maintain a maximum smoke development rating of 450 as required by ASTM-E84, and a maximum burning rate of 2-1/2 inches per minute as required by ASTM D635.
5. Deflection, measured at the center of a 24" x 48" lens or diffuser, from its edge, shall be not greater than 3/32" (0.094)" below luminaire door/trim assembly. Negative cambers, molded into the lens or diffuser material, designed to arch the material upward, shall be acceptable.

B. Pattern 12 Lens – Shall be:

1. Not less than .125 in. overall panel thickness.
 2. Not greater than .080 in. prism penetration depth.
 3. Female (inverted) conical prisms, 3/16 in. square at penetration depth, straight flat-sided prism shape (concave sided, radiused prisms do not meet this specification), configured on a 45° axis layout, across the entire panel.
 4. Acceptable Manufacturers: By luminaire manufacturer.
- C. Overlay Panel – Shall be:
1. Milk white, translucent acrylic material, nom. 0.040" thick, with a matte finish on the surface away from the lamp(s).
 2. Acceptable Manufacturers: By luminaire manufacturer.
- D. Glass Lenses and Diffusers: Annealed crystal glass unless noted otherwise.

2.4 ILLUMINATED "EXIT" LUMINAIRES

- A. Shall be factory designed, built, and tested in accordance with UL 924, and with ordinances and codes applicable in the project locale.
- B. Unless indicated otherwise, shall be provided for AC operation, with multiple LEDs as the light source for internal illumination.
- C. Except as otherwise indicated, shall be stencil cut, solid full face, with red acrylic sheet backing.
- D. Shall, under normal operating conditions, consume 5 watts of AC power, or less, per face.

2.5 LIGHT SOURCES

- A. Acceptable Manufacturers:
1. Basis of Design – Products manufactured by the Philips Lighting Company, hereinafter referred to as Philips, have been specified as the Basis of Design. Products from the following listed manufacturers may be considered equivalent, providing their product specifications meet or exceed the Basis of Design specification.
 2. Fluorescent Lamps:
 - a. GE Lighting.
 - b. Osram/Sylvania.
 - c. Philips Lighting.
- B. Fluorescent Lamps:

1. General – Except as otherwise noted, requirements apply to the specified linear and compact fluorescent lamp products.
 - a. Shall be designed, fabricated, and tested to comply with the requirements of the Federal Toxicity Characteristic Leaching Procedure (TCLP) criteria, for classification as a non-hazardous waste material.
 - b. Mercury Content: Lamps provided, shall be fabricated with reduced/low mercury content, yielding less than 0.2 mg of soluble mercury per liter, when tested in accordance with ANSI/NEMA C78.LL1. In addition, the following mercury content limits per lamps shall apply:
 - 1) HL CFL (18 – 55 watt) – 4.4 mg or less.
 - c. Phosphor: Except as otherwise noted – RE 8.
 - d. Specified lamp life is based on 3 hours ON/OFF time interval.
 - e. Specified lamp lumens are based on published data, measured at 25 deg. C (77 deg. F).
 - f. Unless otherwise specified, lamp correlated color temperature (CCT) shall be 3500K.

2.6 FLUORESCENT LAMP BALLASTS

A. Acceptable Manufacturers:

1. Reference herein, to specific ballast manufacturers and their respective product model or series, have been included to provide the listed luminaire and ballast manufacturers a guide as to the level of quality and ballast/lamp performance that shall be met by the supplied ballast products.
 - a. Basis of Design Product: The design, performance, and specification criteria for any given ballast designation is based on those products listed herein as the Referenced Product.
 - b. Acceptable Equivalent Manufacturers:
 - 1) Advance Transformer.
 - 2) GE Lighting.
 - 3) Lutron Electronics Co., Inc.
 - 4) Osram/Sylvania.
 - 5) Universal Lighting Technologies.

B. General – Ballasts shall:

1. Be factory provided by the respective luminaire manufacturers, and shall be suitable for their intended use, to operate the designated lamps listed in the

- Luminaire Schedule, and as specified herein, to their full light output unless another ballast factor, dimming style, or bi-level ballast is indicated.
2. Separate ballast submittal required as part of the product data submittal package. Refer to Part 1 for submittal requirements.
 3. Be supplied and factory installed, by the respective luminaire manufacturer, suitable for the luminaire's respective lamp requirement, physical space restraints, operating environment, etc. The luminaire manufacturer shall be responsible for supplying the appropriate ballast given the criteria listed in the Luminaire Schedule, and as specified herein.
 4. Identical luminaires shall be factory supplied with identical ballasts.
 5. Be lamp quantity specific. Luminaire manufacturer shall not indiscriminately provide multi-lamp ballasts to operate single lamp luminaires, or provide 3 or 4 lamp ballasts to operate 2 lamp luminaires.
 - a. Except as otherwise indicated:
 - 1) Single lamp luminaires shall be factory provided with a single lamp ballast.
 - 2) Two lamp luminaires shall be factory provided with a single, 2 lamp ballast.
 - 3) Three lamp luminaires shall be factory provided with (1) one lamp and (1) two lamp ballast, factory wired to provide inboard/outboard lamp operation.
 - 4) Four lamp luminaires shall be factory provided with (2) two lamp ballasts, factory wired to provide inboard/outboard lamp operation.
 - 5) Six lamp luminaires shall be factory provided with (3) two lamp ballasts, factory wired to provide inboard-to-outboard lamp operation.
 6. Where specified, or otherwise indicated may be multi-lamp, tandem wired type, to provide master/slave style wiring/lamp operation arrangement, to comply with governing energy codes, legislation and regulation.
 - a. Luminaire/ballast manufacturer shall provide, as part of the shop drawing submittal documentation that the use of singular multi-lamp ballasts in this arrangement utilizes equal, or less, energy consumption than the use of multiple one or two lamp ballasts.
 7. Be listed and labeled per UL - 935 (2005) - Fluorescent Ballasts, and shall be Class P, Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
 8. Comply with ANSI C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits, Category A for transient protection.
 9. Comply with ANSI C82.11 where applicable.
 10. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
 11. Be designed, tested, fabricated, and so labeled, to be in compliance with RoHS.
 12. Be physically interchangeable with standard electromagnetic and standard electronic ballasts, where applicable.

13. Be totally enclosed within a metallic enclosure, and shall be provided with integral leads color coded per ANSI C82.11, or with poke-in style wire retaining connectors.

C. Warranty:

1. Except as otherwise noted, ballast products procured, shall be provided with a five year, manufactures standard, full replacement, limited warranty against defects in materials or workmanship, beginning at date of product manufacture.

D. Electronic Ballasts for Compact Fluorescent Lamps:

1. DIM/CFL/5% - Shall be electronic, solid-state, 3-wire, line voltage, dimming type ballast, provided with the following performance specifications, features, and requirements:
 - a. Shall provide for a continuous dimming range from 100 percent full light output, to 5 percent light output.
 - b. Shall be programmed rapid start type, designed, built, and tested for operating the various CFL type lamps and wattages specified.
 - c. Shall be factory wired in parallel to rapid start style lampholders.
 - d. Shall be provided with auto restart circuitry to allow lamps to restart without interrupting or resetting power to the ballast.
 - e. Ballasts provided shall be multi-voltage (120VAC or 277VAC) type, for operation on 60 Hz AC systems, with +/- 2 percent change in light output with a line voltage variation of +/- 10 percent
 - f. Shall be high frequency electronic type. Designed, built, and tested in conformance with ANSI C82.11 High Frequency Ballast Standard. Shall operate their respective HL/CFL lamps at a frequency range between 25 – 38 kHz, and their respective DT/TT/CFL lamps at not less than 42 kHz.
 - g. Operating Power Factor – Not less than 0.95.
 - h. Ballast Factor – Not less than 1.0 for HL/CFL lamp/ballast, and not less than 0.95 for DT/TT/CFL lamp/ballast).
 - i. Lamp Current Crest Factor – Less than 1.7 throughout the dimming range.
 - j. Total Harmonic Distortion (THD) – Less than 10 percent.
 - k. Sound Rating - Class A.
 - l. Min. Starting Temperature - 50°F (10C°).
 - m. Shall be designed, built, and tested to withstand electrostatic discharges up to 15,000 V, without impairment, per IEC 801-2, and shall be provided with integral fault protection to prevent ballast failure due to faulty wiring.
 - n. Warranty – 5 year, full replacement, limited warranty. Provide field service commissioning.
 - o. Referenced Product:
 - 1) Lutron – EC3 Series.

2. DIM/CFL/HL/0-10V - Shall be electronic, solid-state, 0-10VDC, 4-wire, line and low- voltage, dimming type ballast, provided with the following performance specifications, features, and requirements:
 - a. Shall provide for a continuous dimming range from 100 percent full light output, to 3 percent light output for CFL/HL lamps.
 - b. Shall be programmed rapid start type, designed, built, and tested for operating CFL/HL fluorescent lamps of the various wattages specified.
 - c. Shall be factory wired, in parallel, to rapid start style lampholders.
 - d. Shall be provided with auto restart circuitry to allow lamps to restart without interrupting or resetting power to the ballast.
 - e. Ballasts provided shall be universal voltage (120-277 VAC), for operation on 60 Hz AC systems, with an allowable line voltage variation of +/- 10 percent
 - f. Shall be high frequency electronic type. Designed, built, and tested in conformance with ANSI C82.11 High Frequency Ballast Standard. Shall operate at a frequency range greater than 42 kHz.
 - g. Operating Power Factor – Not less than 0.98, at full light output, and not less than 0.90 throughout the dimming range.
 - h. Ballast Factor – Not less than 0.90.
 - i. Lamp Current Crest Factor – Less than 1.7 throughout the dimming range.
 - j. Total Harmonic Distortion (THD) – Less than 10 percent.
 - k. Sound Rating - Class A.
 - l. Min. Starting Temperature - 50°F (10°C).
 - m. Shall be designed, built, and tested to withstand electrostatic discharges up to 15,000 V, without impairment, per IEC 801-2, and shall be provided with integral fault protection to prevent ballast failure due to faulty wiring.
 - n. Warranty – 5 year, full replacement, limited warranty. Provide field service commissioning.
 - o. Referenced Product:
 - 1) Advance – Mark 7 Series.

2.7 LED LIGHTING PRODUCTS

A. Luminaires:

1. Refer to Luminaire Schedule for specified parameters such as correlated color temperature (CCT) value(s), lumen output, efficiency, etc.
2. Products shall be fabricated to be Reduction of Hazardous Substances (RoHS)- compliant.
3. Must maintain their warrantied life while operating within the manufacturers' specified environmental parameters.
4. The lumen maintenance specification of any assembled LED based chip, array, module, driver, and luminaire combination shall be a minimum of L70, at 50,000 hours, as tested and measured in compliance with IES documents LM-79 and LM-80.

5. Except as otherwise stated in the Luminaire Schedule, the light source shall provide a minimum CRI of 80.
 6. Acceptable Manufacturers:
 - a. Refer to the Luminaire Schedule.
- B. Drivers: Listed and so labeled per UL 8750 and UL 1310, and shall meet or exceed the following general specification criteria:
1. Designed and tested to be compatible with the luminaire light source operating current, voltage, and output power requirements.
 2. Inaudible above 27 dBA ambient sound level.
 3. Designed, fabricated, and tested to operate at an input voltage of 120 – 277VAC, ± 10 percent, at 60 Hz, with no perceptible change in light source output.
 4. Contribute less than 20 percent total harmonic distortion, operating at full rated load, and shall not exceed the maximum allowable THD requirements allowed per standard ANSI C82.11.
 5. Provided with integral short circuit, open circuit, and overload protection.
 6. Have an operating power factor ≥ 0.9 .
 7. Limit conducted and radiated interference in compliance with FCC 47 CFR Part 15.
 8. Housed in a UL compliant and listed enclosure, suitable for remote installation where required, and listed for installation within spaces used for environmental air (plenum), as defined in NFPA-70 – *the National Electrical Code*.
 9. Acceptable Manufacturers:
 - a. Cree.
 - b. EldoLED.
 - c. Philips/Advance.
 - d. Thomas Research Products.
 - e. Or as supplied by the luminaire manufacturer, in compliance with these Specifications.
- C. Dimmable Drivers - In addition to the general specification criteria specified above:
1. Have an operating power factor of ≥ 0.9 at full load, and not less than 0.8 at dimmed level.
 2. Provide smooth, flicker-free, dimmable light output from 100 to less than 1 percent.
 3. 0-10V dimming control protocol compatible, unless noted otherwise.
 4. Acceptable Manufacturers:
 - a. Cree.
 - b. EldoLED.
 - c. Philips/Advance.
 - d. Thomas Research Products.
 - e. Or as supplied by the luminaire manufacturer, in compliance with these Specifications.

2.8 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as luminaire.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge (2.68 mm).
- E. Luminaire Support Chains: Not less than #12 chain link style, provided with "S" hooks for linking chain lengths together, and fastening devices to allow for independent attachment and anchoring to building structure.
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.9 EXTRA MATERIALS

- A. Above and beyond the quantities of material required to execute the contract, provide the following extra materials:
 - 1. Spare Luminaires:
 - a. 10% of the quantity ordered for each scheduled luminaire, minimum of one unit.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to the Luminaire Schedule for additional installation information.
- B. Refer to the Contract Drawings for quantities and intended locations of luminaires.
- C. Provide for the coordination of ceiling material/luminaire construction and installation, coordination with the work of this Division, and the work of other

Divisions.

- D. Coordinate lamping, ballast, and control system requirements with the respective luminaire manufacturers and suppliers, prior to procurement, to provide the specified performance.
- E. Coordinate the installation of the various interior lighting system components with field construction. Verify that the various luminaires provided are compatible and coordinate with the various ceiling types, materials, and their construction restraints.
- F. Refer to the contract documents and coordinate the installation of interior lighting equipment with respect to luminaire quantities, luminaire construction with respect to their installation into a particular surface or material, luminaire quantities, etc.
- G. Be responsible for continuous row quantities and lengths. Provide field dimensions to the luminaire manufacture, for luminaires specified and designed for continuous, wall-to-wall installation.

3.2 INSTALLATION – LUMINAIRES

- A. Install luminaires and their related accessories at locations and heights, as shown on Drawings, in accordance with the respective luminaire manufacturer's instructions, and the applicable requirements of the NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices.
- B. Provide luminaires and their associated outlet boxes, with hangers, supports, fasteners, etc., to properly support their weight. Refer to Division 26 Section "Hangers and Supports." Submit design of hangers, method of fastening, other than indicated or specified herein, for review by the Architect.
- C. Except for luminaires designed to be installed and secured directly to their associated outlet box only, luminaires shall be independently supported and fastened to/from the building structure and not to the work of any other construction trade.
- D. Provide luminaires of the same type indicated, in any given room or space, except as otherwise indicated.
- E. Provide, for luminaires not factory pre-wired to integral outlet box, an outlet box, installed not less than 12 inches from the luminaire wiring terminals, with not more than 72 inches of tap conductor length, installed in accordance with NEC Article 410, between the outlet box and the luminaire wiring terminals.
- F. Luminaire Arrangements:
 - 1. General:
 - a. Install plumb, square, and true to building construction. Where indicated by dimension, or shown on the Drawings, maintain indicated arrangement.
 - 2. Flush/Recessed:

- a. Roughed In a concealed wiring method, with concealed outlet box(s), backbox(s) installed flush to the face of their respective wall, floor, or ceiling material.
3. Surface:
 - a. Roughed in a concealed wiring method with concealed outlet box(s), installed flush to the surface of their respective wall, floor, or ceiling material.
4. Exposed:
 - a. Install utilizing an exposed wiring method, roughed to either exposed electrical outlet box(s), or roughed directly into the exposed luminaire.
 - b. Installed directly over said outlet box(s), or wired directly to the exposed wiring method, and shall be securely fastened to building surfaces or appurtenances, plumb, square, and true to building construction.
5. Lamp Orientation:
 - a. Install lamps such that, in any given space, all lamps orient in the same direction. Verify lamp orientation with Architect.
6. Continuous Length Installations:
 - a. Where individual length luminaires are indicated, noted, or otherwise directed to be installed in end-to-end, continuous lengths, provide additional supports, fastening means, wiring method(s), hardware provisions, etc., to facilitate the installation without gaps or openings between adjacent luminaires.
 - b. Luminaires shall be designed, fabricated, and listed for feed-thru wiring.
 - 1) Luminaires not designed, fabricated, or listed for feed-thru wiring shall be installed in a concealed wiring method, connecting adjacent luminaires.
- G. Flush/Recessed Luminaire Installation:
 1. Verify construction of wall, floor, or ceiling, and its finished surface material, prior to luminaire installation.
 2. Provide luminaires complete with factory supplied plaster flanges, frames, etc., to facilitate the installation of recessed luminaires in wet plaster and drywall type ceilings.
 3. Provide, in concert with the luminaire manufacturers, the required installation hardware, mounting clips, rails, hangers, and related luminaire accessories, to facilitate flush luminaire installations.

4. Provide gaskets, flanges, etc., to prevent "light leaks" around luminaires.
5. Provide field or factory supplied T-bar suspension bars, rails, etc., and hold down clips or devices, designed for compliance with NEC Article 410.
6. Provide not less than two, independently fastened (not to the ceiling system), suspension attachments for each luminaire installed.
 - a. For geometrically-shaped luminaires (1x4s, 2x2s, 2x4s, etc.), designed for installation within suspended ceiling systems (grid, drywall, wet plaster, or otherwise), provide not less than two inverted "Y" style suspension means, per luminaire, with four attachment points per luminaire housing, or four separate suspension means, each attached to luminaire housing.
 - b. For downlight style luminaires installed in suspended ceiling systems (grid, drywall, wet plaster, or otherwise), provide not less than one inverted "Y" style suspension means, per luminaire, with two attachment points per luminaire housing, or two separate suspension means, each attached to luminaire housing.
 - c. Each supporting means shall be fastened and secured to the building structure and shall have a breaking strength of not less than the weight of the luminaire, plus a safety factor of 3.
 - d. The suspension means shall be attached to the luminaires at their designated factory established attachment points.

H. Stem/Pendant Style Luminaire Installation:

1. Provide hang-straight, swivel style canopies for stem/pendant hung luminaires, such that the luminaires hang plumb and level (unless otherwise indicated). Security attach outlet box feed points and intermediate supports to the building structure, to support not less than twice the weight of the suspended luminaire.
2. Outlet boxes and electrical feed points shall be installed above the luminaire(s) with branch circuit wiring/cord drop(s) extended down to luminaire housing concealed inside rigid raceway pendants; or exposed, attached to, and following length of cable suspension points.
3. Coordinate feed point and intermediate support canopy locations with the Architect, prior to roughing. In general, canopy locations shall be either centered at a grid intersection, or centered within a ceiling tile. Verify exact locations with Architect prior to roughing.
4. Install canopies, and their associated electric work, provided for continuous row luminaire applications in straight, rows, with no discernible deflections.
5. Provide stems and pendants, by the luminaire manufacturer, in quantities as recommended by the luminaire manufacturer, to provide a straight, level, installation, with no discernible luminaire deflection.
6. Provide individual stem/pendant mounted luminaires with not less than 2 stems or pendants per luminaire.

I. Surface Installation:

1. Install tight to surface without distorting surface or luminaire. Supports shall be provided on 4 foot centers max., with a minimum of two hangers per

- individual four foot luminaire and three hangers per individual eight foot luminaires.
2. Space luminaires in continuous rows to correspond to ceiling joint intersections. Continuous row luminaires may be fed from a single outlet where luminaires are listed as approved wireways and suitable wiring is used.
 3. Provide hangers for each luminaire, each rated to support not less than four times the luminaire weight.
 4. Provide offset or trapeze hangers where required. Hangers shall be securely attached to the building structure and independently supported from ceiling system or other building appurtenances.
 5. Provide factory supplied surface luminaire collar where outlet box serving luminaire cannot be (or is not) roughed flush to face of installation surface.
 - a. If collar assembly is not available from luminaire manufacturer, contractor shall fabricate same, or shall have collar fabricated by others.
 - b. Surface collar shall match luminaire's attachment points and raceway entries into and out of collar/outlet box.
 - c. Limit collar depth to depth of outlet box or raceway size servicing luminaire.
 6. Surface Wall Installation:
 - a. Unless otherwise specifically noted, install luminaires true, square and plumb to building construction.
 - b. Except for luminaires specifically designed, fabricated, and instructed, for canopy style installation directly over outlet box, provide additional supporting means.
- L. Relocated Luminaires:
1. Refer to Division 26 Section "Selective Removals, Relocations, and Rearrangements," for additional relocated luminaire requirements.
 2. Remove luminaires from existing locations and store as for new luminaires. Reinstall as shown on Drawings. Before reinstalling, luminaires shall be cleaned, provided with new lamps and ballasts and repaired. The following shall be performed:
 - a. Replace ballast.
 - b. Replace broken, damaged, worn or faulty lamp sockets.
 - c. Provide new luminaire wire.
 - d. Replace lenses.
 - e. Provide new lamps.
 - f. Completely damp clean lens and interior.
 - g. Mount as required for new luminaires.
- M. Fasten luminaires securely to supports provided.
- N. Emergency Lighting Products Installation:
1. Unless noted, shown, or otherwise indicated, refer to manufacturers published instructions for field installation directions.

2. Luminaires provided for "EXIT" and other directional signage, shall:
 - a. Be connected unswitched to their designated branch circuit wiring.
 - b. Be installed at locations indicated, at heights and elevations providing maximum visibility and readability, in accordance with Section 7.10 of NFPA-101, Life Safety Code.
3. Unless noted or shown otherwise, luminaires provided for emergency lighting purposes shall be connected unswitched to their designated emergency lighting branch circuit wiring.
 - a. Provide an unswitched normal power branch circuit conductor for normal voltage sensing to emergency lighting devices that are controlled by other equipment and devices.
4. Unless noted or shown otherwise, ELBDs shall be factory installed within, or integral to luminaire housings as the preferred installation method. Installation of these products remote from a given luminaire's housing may be provided, if:
 - a. The device is an ELBD2 or ELBD3.
 - b. Authorized and permitted by the Architect.
 - c. Installation is performed per equipment manufacturer's direction.
 - d. Allowed by the authority having jurisdiction.
 - e. Installation complies with the equipment's listing and labeling requirements.
 - f. Installation within, or integral to, a given luminaire's housing is not possible or practical.
5. ELBDs shown, noted, or otherwise indicated to be installed remote from their associated emergency lighting luminaires, shall be installed in readily accessible locations, allowing devices to be serviced, maintained, and tested.
6. Securely fasten emergency lighting battery units to intended surface. Provide suitable anchors and backing to secure unit to surface. Provide anchored metal shelves for the installation of emergency lighting battery units, too large and too heavy to install directly over outlet boxes.
7. Install remote test/pilot light component within direct viewing field of luminaires equipped with emergency lighting devices, and within the maximum distance limitation stated in the manufacturer's installation instructions.
 - a. Verify exact locations with Architect, prior to roughing.
 - b. Unless otherwise specifically noted or indicated, remote test/pilot light devices shall be installed flush to wall or ceiling construction, utilizing concealed construction means and methods.
 - c. Provide field wiring between remote test/pilot light device locations and the emergency lighting devices.
8. Emergency Lighting ID: Provide a means of permanently identifying luminaires connected to NEC 700, 701 or 702 lighting branch circuit.

- a. The means shall be an obvious physical, unique ID marker, red in color, of a size and shape that is readably identifiable from floor level.
 - b. The means shall be permanently applied to the luminaire housing (only in utilitarian, industrial spaces) or to the ceiling or wall construction, immediately adjacent to the luminaire location.
 - c. Verify exact ID locations with architect prior to installing in architecturally significant spaces.
 - d. Luminaires with AC pilot light and test stations installed integral to the luminaire housings shall not require additional ID.
 - e. Luminaires with remote AC pilot light and test stations installed immediately adjacent to, or in close proximity to the luminaire housing, shall not require additional ID.
- O. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.
- P. Provide complete electrical connection(s) to luminaires furnished and installed under other Divisions, such as:
1. Film Illuminators:
 - a. Recessed units shall be direct connected.
 - b. Provide a duplex receptacle, under right hand corner of surface mounted units, as indicated on Drawings.
 2. Pre-Fabricated Shower Modules:
 - a. Provide branch circuit and switch control wiring to luminaire factory installed in shower enclosure.
- Q. Provide complete electrical connection(s) to luminaires furnished under other Divisions, such as:
1. Surgical luminaires
 2. Under cabinet and under counter luminaires.
 - a. Connect through remote switch control, as shown on Drawings. Connect multiple units to common switch control. Coordinate number of luminaires per cabinet or counter length with other Divisions.
 3. Exam lights.

3.3 LIGHT SOURCES

- A. Install lamps in luminaires. Lamps shall be new and unused.
- B. If permanent lighting system is used for temporary construction lighting, lamps shall

be replaced upon turn over to Owner.

- C. Replace lamps that have failed in temporary luminaires provided for lighting during construction.
- D. Replace lamps that have failed in permanently installed luminaires that have been allowed to be used for lighting during construction.
- E. Replace lamps that have failed within their published warranty period, if so stated, or within their published average life span, during the Contractor's warranty period.
- F. Provide, to the Owner, lamp replacement warranty information for their use in resolving lamp replacement issued with the lamp manufacturers.

3.4 LED DRIVERS

- A. Provide complete connection to LED type luminaires thru both integrally installed and remote electronic drivers.
- B. Remote drivers are specifically not shown on the drawings. Contractor shall install remote drivers in a readily accessible, dry, indoor, concealed location, in accordance with the manufacturer's instructions.
- C. Provide ventilated metal enclosures for remote drivers furnished as loose equipment. All wiring to/from remote drivers and their associated LED luminaires shall be installed in raceway.
- D. Verify and comply with remote distance limitations specified by the luminaire/driver manufacturer.

3.5 DIGITAL LIGHTING CONTROL EQUIPMENT

- A. Provide for the services of a duly authorized factory representative of the Digital Lighting Control Equipment manufacturer, for not less than 16 on-site hours to perform not less than the following tasks:
 - 1. Meet with the Owner's representative(s) and the contractor(s) responsible for the installation of the lighting equipment and the Digital Lighting Control Equipment for the purposes of:
 - a. Verify exact locations of the Digital Lighting Controls Equipment.
 - b. Verify delivery of the components required to make the system operational and review installation requirements of the control equipment and devices.
 - c. Review wiring requirements and component installation procedures with the contractor(s).
 - 2. Upon completion of system wiring and component installation:

- a. Verify that the components are installed and wired per manufacturer's requirements and instructions.
- b. Verify with Owner's representative, the Owner's desired control schemes and hours of operation. Provide for not less than 4 schemes, scenes, and/or shows.
- c. Program the installed system components to implement the Owner's desired control schemes, scenes and shows and hours of operation.
- d. Train the Owner's personnel in how to operate and change system settings and how to maintain the installed equipment.
- e. Turn over Operations and Maintenance materials to the Owner's representative.

3.6 LENSES, DIFFUSERS, LOUVERS AND LAMP SHIELDING MEDIA

- A. Install specified products for luminaires.
- B. Clean lighting equipment and luminaires of dirt and construction debris upon completion of installation. Clean fingerprints, smudges, wrapping, etc., from lenses, baffles, louvers, reflectors, etc.
- C. Protect installed luminaires from damage during remainder of construction activity. Replace lenses, baffles, louvers, reflectors, etc., damaged or broken prior to, during, or after installation.

3.7 ADJUSTMENTS AND RELOCATIONS

- A. Provide for field directed adjustments to lighting equipment, luminaires, etc., and their previously installed roughing, as follows, under contract:
 1. It is intended that field directed adjustments be limited to relocation of lighting equipment, luminaires, etc., to directed locations within 10 feet of their presently installed location.
 2. Provide for not less than 24 hours of workman's time to disconnect, remove, relocate and re-connect lighting equipment, luminaires, etc., presently installed, to new location(s) directed.
 3. Provide for required tools, equipment, ladders, scaffolding, etc., to facilitate the directed adjustments.
 4. Provide for the electrical construction work, means and methods required to disconnect, remove, relocate and re-connect lighting equipment, luminaires, etc.
- B. Provide, after the lighting installation is substantially complete, preliminary aiming of adjustable luminaires. Provide preliminary control settings for luminaires. Verify that luminaires are fully operational.
 1. After the lighting installation is complete, provide two (2) electricians, tools,

and equipment, for not less than 16 hours total, to access and adjust luminaires with Architect and Lighting Designer after dark. Schedule through appropriate correspondence channels.

- C. Occupancy Adjustments: When requested, within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide for not less than two visits to Project site, at other-than-normal occupancy hours, for this purpose. Some of this work may be required after dark.

- 1. Adjust aimable luminaires in the presence of Architect and Lighting Designer.

3.8 BONDING

- A. Provide bonding of all luminaires and their associated controls, to the equipment ground system. Tighten connections to comply with tightening torques specified in UL Standard 486A to provide a permanent and effective bonding path to ground.

3.9 DEMONSTRATION

- A. Apply electrical energy to luminaires, upon completion of their installation, and after building circuitry has been energized to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.10 FIELD QUALITY CONTROL

- A. Inspections and Tests:
 - 1. Perform inspection and test procedures as specified in Division 26 Section "Electrical Inspections and Testing", and the following additional requirements:
 - a. Prepare test and inspection reports.
- B. Prepare, and deliver to the Architect, at substantial completion, a written report of all conducted tests, inspections, observations, and verifications, indicating and interpreting results. If adjustments are made to the previously tested installation, retest to demonstrate compliance with the project requirements or indicated standards.

3.11 DISPOSAL OF REMOVED LIGHTING EQUIPMENT

- A. Refer to Division 26 Section "Selective Removals, Relocations, and Rearrangements" for requirements.

END OF SECTION 265100