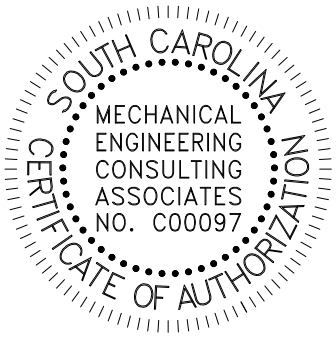
LAKE MURRAY ELEMENTARY SCHOOL
REPLACE HVAC, PHASE III

1531 Three Dog Road
Chapin, South Carolina 29036

PROJECT MANUAL

February 12, 2018



BID DOCUMENTS

BID NUMBER: 2018-028

MECA Project #114211.02

2330 Main Street
Columbia, SC 29201
(803) 765-9421
Fax: (803) 765-9848
meca@mecainc.com

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DIVISION 07 THERMAL AND MOISTURE PROTECTION ----- Dated February 12, 2018
Section 072100 Thermal Insulation

DIVISION 09 FINISHES ----- Dated February 12, 2018
Section 092116 Gypsum Board Assemblies
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Section 262000 Interior Wiring Systems
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DIVISION 28 ELECTRONIC SAFETY AND SECURITY ----- Dated February 12, 2018
Section 283110 Fire Alarm Systems

AIA Document A701- 1997,
"Instructions to Bidders"
Articles 1 through 8, Pages 1 through 6,

is hereby made part of these documents.

An Original is on file in the Engineer's Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201

NOTE: The District's "Instruction To Bidders", included in the Bid Invitation, amend or supplement Instructions to Bidders (AIA Document A701-1997) and other provisions of Bidding and Contract Documents. All provisions of the A701-1997, which are not so amended or supplemented, remain in full force and effect.

AIA Document A310 - 2010,
"Bid Bond"

is hereby made part of these documents.

An Original is on file in the Engineer's Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201

AIA Document A101- 2017
Standard Form of Agreement Between Owner and Contractor
Articles 1 through 10, Pages 1 through 8,

is hereby made part of these documents.

An Original is on file in the Engineer's Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina, 29201

AIA Document A201- 2017,
"General Conditions of the Contract for Construction"
Articles 1 through 15, Pages 1 through 38,

is hereby made part of these documents.

An Original is on file in the Engineer's Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201

NOTE: The District's "General Provisions", "General Conditions", and Special Conditions", included in the Bid Invitation, amend or supplement the General Conditions of the Contract for Construction (AIA Document A201-2017) and other provisions of Bidding and Contract Documents. All provisions of the A201-2017, which are not so amended or supplemented, remain in full force and effect.

AIA Document A312 - 2010
Performance Bond and Payment Bond,
Pages 1 through 5

is hereby made a part of these documents.

An original is on file in the Engineer's office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201

AIA Document G701 - 2001
Change Order
Page 1

is hereby made a part of these documents.

An original is on file in the Engineer's Office located at:

Engineer: Mechanical Engineering Consulting Associates, Inc.
2330 Main Street
Columbia, South Carolina 29201

SECTION 010100

SUMMARY OF WORK

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide in base bid all ductwork, air distribution, seismic roof curb, power wiring rough-in and EMS / controls rough-in as here-in specified and as indicated on drawings for a dedicated outside air conditioning unit (DOAU-4). The roof curb to be capped (insulated) for future DOAU installation. Provide temporary exhaust fan on curb cap as indicated with power and controls. In Alternate # 1: in lieu of the temporary exhaust fan and curb cap - provide and install DOAU-4.

B. Provide in Alternate # 2 kitchen exhaust fan and heated make-up air system as here-in specified and as indicated on drawings. Provide collapsible OSHA compliant roof edge guardrail system with roof surface protective pads.

C. Provide rooftop gas packs, seismic roof curbs, all distribution ductwork, and thermostatic controls as here-in specified and as indicated on drawings. Units serving the gymnasium, SPGP-48 and 49 are Alternate # 3.

D. Reference electrical documents for lighting alternate # 4

E. Provide ductless split heat pumps, seismic roof curbs, refrigerant piping and thermostatic controls as here-in specified and as indicated on drawings.

F. Provide demolition of portions of the existing HVAC system as indicated on plans.

G. Insulate all ductwork, piping, and equipment as herein specified and as indicated on mechanical drawings.

H. Control Management, Inc. is the only approved control vendor for this project. No other control contractors shall be approved.

I. Provide in bid all flashing and roof repairs required for curbs, rails, pipe penetrations, duct penetrations, etc. The roofing sub-contractor shall be a certified Johns Mansville installer. Roofing companies familiar with the District facilities are Aquaseal, Stanick and Watts.

J. Provide all power, control, interlock, and starting circuit wiring. Power wiring shall be voltages indicated on electrical plans and control wiring shall be 120 volts or less. Provide transformers and relays as required to comply with this requirement. Conduit shall be steel conforming to the requirements of the Electrical Specifications, except as otherwise specified.

K. Start, test, adjust, balance and place into operation all systems. The building air distribution systems are to be balanced to provide the quantity of air as shown on drawings. System air balance is to be accompanied with certified test forms as to obtained air quantities. Proper fan performance and coil discharge air temperature reading shall also be certified on test forms.

L. Provide seismic bracing and restraints as required by the International Building Code.

M. Provide gas piping and pressure regulators as herein specified and as indicated on mechanical drawings.

1.3 TIME OF COMPLETION AND LIQUIDATED DAMAGES

A. Time of completion: Unless an extension of time is granted, work under this contract shall be substantially complete **August 4, 2018.**

B. Liquidated Damages: Should the Contractor fail to substantially complete the work under this contract within the stipulated days plus any additional days that may result from extensions of time granted by the Owner, he agrees that the Owner may retain the sum of :

1. **Step One Liquidated Damages** will be assessed in the amount of $200.00 for each calendar day the actual Contract Time for Substantial Completion exceeds the specified Date of Substantial Completion.

2. **Step Two Liquidated Damages** will be assessed in the amount of $250.00 for each calendar day the actual Contract Time for Final Completion exceeds 30 days following Date of Substantial Completion.

1.4 SPECIAL INSPECTIONS REQUIRED BY THE OFFICE OF SCHOOL FACILITIES

A. The Chapter One and Chapter Seventeen Inspections are required by the Office of School Facilities. The Contractor will be required to provide notification to each inspector 48 hours prior to an inspection being needed.

B. The Chapter One Inspections and the Chapter Seventeen Inspections are hired by School District Five of Lexington and Richland Counties.

1.5 SCHEDULE OF VALUES

A. Before the first application for payment is issued, the Contractor shall furnish to the Engineer or his representative, a detail of the schedule of values in duplicate of quantities and prices of all materials, including sales tax and labor included in the Contract. Submit schedule on AIA Form G703.

1.6 APPLICATIONS FOR PAYMENT

A. After the Contract has been approved, certificates will be issued monthly or as may be later agreed upon, provided the work has progressed diligently and shall not exceed in the aggregate **ninety six point five percent (96.5%)** of the value of the labor and material furnished and set in the building. Application for payment shall be submitted to the Engineer on AIA G702 Application and Certificate for Payment" by the seventh of the month. Engineer will approve and forward to the School District for payment.

1.7 CHANGE ORDER

A. If a change order is required due to change in work, the contractor shall prepare an AIA Document G701 "Change Order" and submit to the Engineer for review. The Engineer will forward to the School District for review and final approval.

1.8 MANNER OF CONDUCT OF THE WORK

A. The existing building will be occupied during the "life of the contract". The work shall be done and temporary facilities provided so that daily operations and essential services are not interrupted except in the areas being renovated.

B. Noisy operations, such as drilling, hammering, etc. shall be restricted by the Owner to avoid disruption of daily activities. The Schedule of Operations shall be approved by the Owner.

C. No work shall be undertaken and no service shall be interrupted unless prior approval is received from the Owner at least five days prior to the interruption. Every request from the Contractor to begin work in a new area or to interrupt any service or function must be made to the Owner sufficiently far in advance to allow review (at least five days), approval, and concurrence by the Owner's Administrative Staff.

D. No jack-hammering will be allowed unless written permission is received from the Owner.

E. All holes will be core drilled using a diamond core drill.

F. Contractor has sole responsibility for enforcing coordination requirements to prevent interruptions and for adhering closely to the schedule.

1.9 SPECIAL SITE CONDITIONS

A. The work area is inside, on and beside the facility which is in daily use by the staff, faculty, and students. Contractors are specifically advised that storage and work space will be restricted. Encroachment beyond these limits by the Contractor shall be rigorously avoided. Material must be kept in a neat and orderly manner and work area must be kept clean.

B. Refer to specification Sections 017400 and 230200 for additional project cleaning and building protection provisions.

C. Construction Parking: Parking at the building site will be restricted to one (1) parking space. Contractor will be responsible for workers travel to and from the project site from a remote parking site. Deliveries of equipment and materials will be via the building loading dock where applicable and shall be limited to loading and unloading only. NO UNATTAENDED VEHICLES WILL BE ALLOWED. DRIVERS MUST REMAIN WITH THE VEHICLES.

1.10 ACCESS TO THE BUILDING AND STORAGE

A. The contractor will be permitted to bring workmen, material, equipment, etc., into the building only through the rear entrance of the Building.

B. Materials shall arrive on the site only as they are needed and immediately delivered to the limited construction area. Coordinate the construction site space needs with the Owner. Limited space may be available outside the construction area.

C. Supplies, equipment and materials to be delivered to the construction area in closed containers sized to be conveniently transported through existing corridors and door openings.

D. Remove all waste material from Owner's property and legally dispose of it.

E. Debris, trash and unused materials shall be removed from the construction area in closed containers that are sized to be conveniently transported through existing corridors and door openings.

1.11 WORK SCHEDULE

A. The Contractor will be permitted to carry out certain phases of this project during normal daily working hours, 7:00 a.m. to 5:00 p.m. on weekdays. Nothing in the above work schedule shall void the Contractor's option to perform work at other times if so desired. Also, some phases of the work can only be performed during off-hours, on weekends or at night. However, **the Contractor shall receive no additional compensation for work performed during off-hours, weekend, and nights.**

1. Contractor shall advise Owner of his intended work schedule and obtain their approval.

2. Contractor shall not do any electrical or mechanical work at any time which would interfere with the Owner's service or function without first advising Owner of the nature, proposed time, and duration of the interruption and obtaining approval for the work.

B. The contractor shall present all requests for approval to the Owner not less than five working days before proposed work is scheduled to be done.

C. Nothing in the above-mentioned work schedule shall void the Contractor's option to perform overtime work if he so desires and is so approved by the Owner. The Contractor is responsible for including all necessary cost to meet the schedule in the bid documents in the base bid. If the contractor requires overtime to meet the schedule in the bid documents, then the cost incurred are to be included in the base bid.

1.12 SAFETY COMPLIANCE

A. In addition to any detailed requirements of this specification, the contractor shall meet the requirements of federal and state standards referenced in Applicable Publications, whichever is more restrictive. Contractor must submit matters of interpretation of these standards to the respective administrative agency for resolution before starting work.

1.13 SEQUENCING OF CONSTRUCTION

A. It is the intent of these specifications that the work shall commence within ten (10) working days of the date of commencement as set forth in the “Notice to Proceed” and that all work shall be completed within the number of days specified.

B. The Contractor shall schedule the work in such a manner that will allow the Owner to fully occupy all spaces at all times. Scheduling of the work will be conducted with the contractor, the engineer and the School District prior to commencement of the work.

C. No time extension shall be granted for equipment delivery.

END OF SECTION 010100

SECTION 011400

CONTRACTOR'S USE OF PREMISES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section applies to situations in which the Contractor or his representatives including, but not necessarily limited to, suppliers, subcontractors, employees, and field engineers, entering upon the Owner's property.

B. Related Work: Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 01 of these Specifications.

1.2 QUALITY ASSURANCE

A. Promptly upon the award of the Contract, notify all pertinent personnel regarding requirements of this Section.

B. Require that all personnel who will enter upon the Owner's property certify their awareness of and familiarity with the requirements of this section.

1.3 TRANSPORTATION FACILITIES

A. Truck and equipment access:

1. To avoid traffic conflict with vehicles of the Owner's employees and customers, and to avoid over-loading of streets and driveways elsewhere on the Owner's property, limit the access of trucks and equipment to the designated "Contractor's Entrance".
2. Provide adequate protection for curbs and sidewalks over which trucks and equipment pass to reach the job site.

B. Contractor's vehicles:

1. Require contractor's vehicles, vehicles belonging to employees of the contractor, and all other vehicles entering the Owner's property in performance of the work of the contract, to use only the designated access route.
2. Do not permit such vehicles to park on any street or other area of the Owner's property except in the area to be designated.

1.4 SECURITY

A. Restrict the access of all persons entering upon the Owner's property in connection with the work to the contractor's entrance and to the actual site of the work.

1.5 PROTECTION OF EXISTING PROPERTY

A. This project involves work in and on the school property. The contractor will be responsible for protecting existing items from damage during construction. This effort will be coordinated during the preconstruction meetings.

B. After the completion of the construction, the condition of the area shall be restored to its original appearance at the contractor's expense.

1.6 MISCELLANEOUS

A. Confine operations at site to areas permitted by Owner and Contract Documents.

B. Do not unreasonably encumber site with materials or equipment.

C. Do not load structure with weight that will endanger structure.

D. Assume full responsibility for protection and safekeeping of products stored on premises.

E. Move any stored products which interfere with operations of Owner.

1.7 MANNER OF CONDUCTION OF WORK

A. The existing buildings will be occupied during the life of the contract. The work shall be done and such temporary facilities provided, so as not to interfere with the daily operation of the building or any essential service thereof.

B. Noisy operations, such as drilling, etc shall be restricted by the Owner to avoid disruption of daily activities. The schedule of operation shall be approved by the Owner. No work shall be undertaken and no service shall be interrupted, which does not have the prior approval of the Owner. Every request from the contractor to begin work in a new area to interrupt any service shall have approval and concurrence by the Owner’s Administrative Staff.

C. No jackhammering will be allowed unless written permission is received from the Owner. All holes will be core drilled using a diamond core drill.

D. Responsibility from enforcing coordination requirements and close adherence to time schedule rests solely with the general contractor.

1.8 SPECIAL SITE CONDITIONS

A. Trash and debris shall be removed by contractor daily. No food or drink will be allowed inside the existing buildings or any renovated areas.

B. On-site storage and parking will be allowed only in designated area and shall be totally maintained by the General Contractor. This area shall suffice for employee parking, construction trailers and general storage of materials. If additional space is required it shall be the responsibility of the General Contractor to locate and furnish at no additional cost to the Owner. The contractor shall fence and secure the storage area as he deems necessary to secure and protect the area.

END OF SECTION 011400

SECTION 012500

SUBSTITUTIONS (10 DAY PRIOR APPROVAL)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. To establish a mandatory method or system of submitting and approval or disapproval of various items, materials, equipment, products etc., in lieu of those specified or indicated.

B. Related Work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. The contract is based on the standards of quality established in the Contract Documents but specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition and the Contractor in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgement of the Engineer expressed in writing, is equal to that named.

B. Where quality and other characteristics are very nearly the same, the question of determining equal materials and readily available service sometime resolves itself to a matter of personal opinion and judgement and in these and all other cases involving the approval of materials, the opinion, judgement and decision of the Engineer and the Owner shall be final and bind all parties concerned.

C. The following products do not require further approval except for interface within the work:

1. Products specified by reference to standard specifications such as ASTM & similar standards.
2. Products specified by manufacturer's name and catalog model number.

1.3 REQUEST FOR APPROVAL

A. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified must have been submitted for approval ten (10) calendar days prior to bid opening date to the Engineer.

B. Format of Request:

1. Requests must be submitted to the Engineer in writing.

2. The written request must clearly identify the specification section (and paragraph if appropriate) along with any deviations from the specified product specification.
3. Identify compliance with pertinent standards of quality as listed under the "Quality Assurance" paragraph of part one of the specification section. Identify any deviations or alternate standards of quality.
4. Requests must be accompanied by samples, descriptive literature, and engineering information as necessary to fully identify and allow appraisal of the product.

C. Failure to comply with either the time frame for approval or format for the approval request (as identified in paragraphs A & B above) is in itself sufficient cause for rejection of the approval request.

1.4 APPROVED SUBSTITUTIONS

A. Approval of the Engineer to use materials and/or equipment, if granted, will have been in the form of a written addendum and will have been issued to all bidders of record. Approved substitutions may be used at Contractor's option.

B. Approval of an item submitted as a request for approval does not relieve that product from compliance with the specification section performance, quality, construction, material or warranty requirements.

C. No substitutions will be allowed, nor will an increase in Contract be allowed (for using materials specified) if substitutions have been requested later than ten (10) days prior to bid opening date.

END OF SECTION 012500

SECTION 012900

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the Work for each project, as specified herein and in other provisions of the contract documents.

1.2 RELATED WORK

A. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 01 of these specifications.

B. A “Schedule of Values” is required under the General Conditions. The minimum division of categories shall comply with requirements of this specification. The “Schedule of Values” is required to be compatible with the “Continuation Sheet” accompanying application for payment.

1.3 QUALITY ASSURANCE

A. Use required means to assure arithmetical accuracy of the sums described.

B. When so required by the Engineer, provide copies of the subcontracts or other data acceptable to the Engineer, substantiating the sums described.

1.4 SUBMITTALS

A. Prior to first application for payment, submit proposed schedule of values to the Engineer.

1. Meet with the Engineer and determine additional data, if any, required to be submitted.
2. Secure the Engineer’s approval of the schedule of values prior to submitting first application for payment.
3. A revised schedule of values shall be required after execution of a change order.

PART 2 - PRODUCTS

2.1 ORGANIZATION

A. The schedule of values shall be organized and titled under the standard CSI divisions. The contractor may provide additional sub-categories under these divisions as necessary for tracking of sub-contract costs, subject to approval by the Engineer. See example below:

Division 7 - Thermal and Moisture Protection

Roofs
- Roof Structure of Steel Frame
- Canopies
- Roof Covers
- Fireproofing

Division 8 - Doors and Windows

Doors
- Wood Doors
- Hollow Metal Doors
- Hardware

Division 9 - Finishes

Floors
- Quarry and Hard Tile
- Vinyl Tile
- Terrazzo and Resinous Flooring
- Carpet
- Ceramic Tile
- Hardwood

Division 22 - Plumbing
- Fixtures
- Piping
- Piping Insulation
- Water Heaters

Division 23 - Heating and AC
- Controls
- A/C Systems (over 20 tons)
- A/C Systems (over 5 less than 20 tons)
- A/C Systems (Less than 5 tons)
- Duct Work
- Piping
- Insulation
- Composite system-Heating, Ventilating and A/C
- Heat Pump System
- Chiller

Division 26 - Electrical

Conduit and Wiring
Fixtures
Switchgear

Division 28 - Electronic Safety and Security

Fire Alarm System
**If it is an alarm system - need to specify this and not just indicate fire protection

END OF SECTION 012900

SECTION 013100

PROJECT MEETINGS AND COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: To enable orderly review during progress of the work, and to provide for systematic discussion of problems, the Contractor shall conduct project meetings throughout the construction period. Meeting times and dates shall be set at the Pre-construction conference with the Owner's Representative and Engineer present.

B. Related Work:

1. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division One of these specifications.
2. The Contractor's relations with his subcontractors and material suppliers, and discussions relative thereto, are the Contractor's responsibility and normally are not part of the project meetings content.

1.2 QUALITY ASSURANCE

A. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority to commit the Contractor to solutions agreed upon in the project meetings.

1.3 SUBMITTALS

A. Agenda items: To the maximum extent practicable, advise the Owner's representative at least 24 hours in advance of project meetings regarding items to be added to the agenda.

B. Minutes:

1. The Contractor will compile minutes of each project meeting and will furnish copies to the Owner, Engineer, and Subcontractors.
2. Recipients of copies may make and distribute such other copies as they wish. Meeting minutes shall include a complete synopsis of all discussions, decisions, and/or problems being encountered on the project, as well as an update of the schedule.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 MEETING SCHEDULE

A. Except as noted below for Preconstruction Meeting, project meetings will be held weekly.

B. Coordinate as necessary to establish mutually acceptable schedule for meetings.

3.2 MEETING LOCATION

A. The Contractor will establish meeting location. To the maximum extent practicable, meetings will be held at the job site.

3.3 PRECONSTRUCTION MEETING

A. The pre-construction meeting shall be conducted by the agency's Project Representative and the Engineer. Other attendees should include the agency's construction project manager (if assigned), construction inspectors, the general contractor, major sub-contractors, and the OSF Project Manager. The Engineer shall take minutes of the meeting and provide all attendees with a copy of the items discussed.

B. The agency shall give the OSF Project Manager a minimum of seven (7) days notice of the date, time, and place of any pre-construction meeting.

3.4 PROJECT MEETINGS

A. Attendance

1. To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of work.
2. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the work is involved.

B. Minimum agenda:

1. Review, revise as necessary, and approve discussions, agreements and understanding of the previous meeting.
2. Review progress of the work since last meeting, including status of submittals for approval.
3. Identify problems that impede planned progress.
4. Develop corrective measures and procedures to regain planned schedule.
5. Complete other current business.

END OF SECTION 013100

SECTION 013200

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. To assure adequate planning and execution of the work and aid in completing construction within the number of calendar days allowed in the Contract, and to assist the Engineer in evaluating progress of the Work, prepare & maintain the schedules and reports described in this Section.

B. Documents affecting scheduling include, but are not limited to, General Conditions, Supplementary Conditions, and Sections in Division 01 of these specifications.

1.2 DEFINITIONS

A. "Day", as used throughout the Contract unless otherwise stated, means "calendar day".

1.3 QUALITY ASSURANCE

A. Employ a scheduler who is thoroughly trained and experienced in compiling construction schedule, and in preparing and issuing periodic updates and reports as required. The scheduler shall be actively and regularly engaged in the practice of scheduling construction projects. The cost of providing the initial schedule and biweekly updates shall be part of the base bid.

B. Perform data preparation, analysis, charting, and updating in accordance with standards approved by the Engineer.

1.4 SUBMITTALS

A. Comply with pertinent provisions of *Submittals*, section 013300.

B. Construction schedule: Within 30 calendar days after the Contractor has received the Notice to Proceed, submit one reproducible copy of a construction schedule.

C. Periodic revisions and reports: Submit one copy of the construction schedule updated along with the monthly payment request.

PART 2 - PRODUCTS

2.1 CONSTRUCTION ANALYSIS

A. Graphically show by bar-chart the order and interdependence of all activities necessary to complete the work, and the sequence in which each activity is to be accomplished, as planned by the Contractor and his project field superintendent in coordination with all subcontractors whose work is shown on the diagram.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. As soon as practicable after receipt of Notice to Proceed, complete the construction analysis in preliminary form, meet with the Engineer, review contents of the proposed construction schedule, and make all revisions agreed upon.

3.2 PERIODIC REVISIONS AND REPORTS

A. As required under Paragraph 1.04-C above, update the approved construction schedule along with each payment certificate. Indicate "actual" progress in percent completion for each activity in blank space provided below listed activity and provide written narrative summary of revisions causing delay in the program, and an explanation of corrective actions taken or proposed.

END OF SECTION 013200

SECTION 013300

SUBMITTALS

PART 1 - GENERAL

1.1 COORDINATION WITH OTHER SECTIONS OF CONTRACT

A. Refer to other sections of the contract specifications for detailed submittal requirements for each Section. At a minimum, submittals must meet the requirements in this Section. More detailed submittals may be required by other Sections. The submittal must meet the most stringent of the requirements.

1.2 SUBMITTALS

A. Submit shop drawings, product data as required to the Owner in sufficient number to allow the Owner to retain two copies. Make all submittals at one time. Make all submittals no later than two weeks after receipt of the "Notice to Proceed." Contact Engineer in advance if submittal will not be within two weeks of receipt of "Notice to Proceed."

B. Shop drawings shall be submitted in a clear and thorough manner. Details shall be identified by reference to sheets and details, schedules and room numbers shown on the Contract Drawings and Division of the specification and indexed accordingly.

C. Product Data shall clearly identify pertinent products and models on each copy. Show performance characteristics, capacities, dimensions, clearances, wiring, piping diagrams, and controls as required. Modify manufacturer's standard schematic drawings and diagrams to provide information specifically applicable to the work.

D. Samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product.

1.3 CONTRACTOR RESPONSIBILITIES

A. Review Shop Drawings, Product Data and Samples prior to submission.

B. Determine and Verify:

1. Field measurements
2. Field construction criteria
3. Catalog numbers and similar data
4. Conformance with specifications

C. Coordinate each item submitted with requirements of the work and of the Contract Documents.

D. Notify the Owner in writing, at time of submission, of any deviations in the submittals from requirements of the contract Documents.

E. Do not begin fabrication (or any work that requires submittals) until submittals are returned with the Owner's approval.

1.4 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor.

B. Number of submittals required:

1. Shop Drawings: Submit one reproducible transparency and one opaque reproduction.
2. Product Data: Submit the number of copies that the Contractor requires, plus two which will be retained by the Owner.
3. Samples: Submit the number stated in each specification Division.

C. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The project title and number.
3. Contract identification.
4. The names of:
   a. Contractor
   b. Supplier
   c. Manufacturer
5. Identification of the product, with the specification Division number.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on re-submittals.
11. An 8 in. x 3 in. Blank space for Contractor and Owner stamps.
12. Contractor's stamp, initialed or signed, certifying review of the submittal. Stamp and signature indicate that the following have been reviewed:
    - verification of products
    - field measurements
    - field construction criteria
    - coordination of the information within the submittal with requirements of the Work and Drawings
    - coordination of the information within the submittal with requirements of Contract Documents.

1.5 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in the submittals required by the Owner and resubmit until approved.

B. Shop Drawings and Product Data:

1. Revise initial drawings or data, and resubmit as specified for the initial submittal.

1.6 DISTRIBUTION: Distribute reproductions of Shop Drawings and copies of product Data that carry the Owner stamp of approval to:

A. Job site file.

B. Record Documents file.

C. Other affected contractors.

D. Subcontractors.

E. Supplier or Fabricator.

1.7 OWNER DUTIES

A. Review submittals with reasonable promptness and in accordance with approved schedule.

B. Affix stamp and initials or signature, and indicate requirements for re-submittal, or approval of submittals.

C. Return submittals to Contractor for distribution, or for resubmission.

END OF SECTION 013000

SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

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

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Engineer, Owner, or authorities have jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

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

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

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

1.4 SUBMITTALS

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

B. Reports: Prepare and submit certified written reports that include the following:

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

1.5 QUALITY ASSURANCE

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

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained an approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

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

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

F. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

1.6 QUALITY CONTROL

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

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

B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least [**24**] hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Document are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

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

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

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

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

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substances and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

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

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

END OF SECTION 014000

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contractor shall furnish, maintain and remove at completion of project, all temporary equipment that is required for the proper execution of work of all trades and is further described in this section of specifications.

B. Related Work: Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and sections in Division 1 of these specifications.

C. Inspect equipment furnished by subcontractors to insure that equipment complies with requirements of pertinent safety regulations.

D. Maintain temporary facilities and controls in proper and safe condition throughout progress of the work.

PART 2 - PRODUCTS

2.1 CONTRACTORS' TEMPORARY EQUIPMENT

A. Contractor shall furnish, maintain and remove at completion equipment such as temporary stairs, ladders, ramps, chutes, and like facilities, as required for proper execution of the work.

B. Contractor shall coordinate the provisions of exterior and interior scaffolding required for execution of this work. Such scaffolding shall conform to requirements of authorities having jurisdiction over such work and be maintained in safe condition at all times. Remove when no longer required.

2.2 LIFTING DEVICES AND HOISTING FACILITIES

A. Contractor shall provide, operate, and maintain construction elevators, or cranes as well as other type hoists and hoisting material as may be required for execution of all trades' work. Such apparatus, equipment and construction shall meet requirements of labor laws and other state or local laws.

2.3 BARRIERS

A. Comply with Federal, State, and Local codes and regulations.

B. Contractor shall provide and maintain bracing, shoring, sheeting, lights (warning and exit), guardrails, barricades, warning signs and other features necessary to adequately protect persons and property. When the need no longer exists remove such protective devices and/or procedures.

2.4 SECURITY ENCLOSURES AND PRECAUTIONS

A. Contractor shall provide all temporary enclosures required for protecting the project from the exterior, for providing passageways, for the protection of openings both exterior and interior and any other location where temporary enclosures and protection may be required.

B. Contractor shall take adequate precautions against fire, keep flammable material at an absolute minimum, and ensure that such material is properly handled and stored.

2.5 TELEPHONE SERVICE

A. Contractor shall provide and maintain a job telephone for the duration of the contract, and shall pay all costs in connection therewith. Toll calls shall be paid for by the party making the call.

2.6 TEMPORARY SANITARY FACILITIES

A. Permanent toilet facilities may be used by the construction personnel upon written permission of the Owner and subject to conditions mutually agreed to in writing.

2.7 TEMPORARY ELECTRICITY

A. The Contractor shall make the necessary arrangements and provide all temporary electrical services and lighting required during construction. Electricity at its source shall be furnished to Contractor by Owner.

2.8 TEMPORARY WATER DURING CONSTRUCTION

A. The contractor shall make arrangements to provide all water required during construction. Water, at source, to be furnished by the Owner.

2.9 ACCESS ROADS AND PARKING AREAS

A. Access to site for delivery of construction equipment and materials shall be made only from locations designated by Owner.

B. Parking of employee and Contractor vehicles on the site shall be limited to area or areas shown on drawings, or where not shown, as approved by Owner. Vehicles illegally parked will be removed from site at the expense of vehicle owner.

2.10 EXISTING BUILDING, NEW CONSTRUCTION SEPARATION

A. Contractor shall provide temporary enclosures to separate work areas from the areas of existing buildings occupied by Owner; to prevent penetration of dust or moisture into occupied areas, to prevent damage to existing equipment, and to protect Owner’s employees and operations from construction work.

B. Use framing and sheet materials which comply with structural and fire rating requirements of applicable codes and standard for temporary partition and ceiling enclosures.

C. Close joints between sheet materials and seal edges and intersections with exiting surfaces, to prevent penetration of dust or moisture.

D. In locations where painting is required, use fire-retardant paint providing a maximum flame spread of 25 when tested under ASTM E 84 or as required by local regulations.

E. Contractor shall provide HEPA filtered negative pressure fans for the purpose of negative pressure in all construction areas in the Hospital. The discharge of the negative pressure fans and filters shall to the outside of the facility and shall not be located within 25 feet of any outside air intakes for hospital HVAC systems. Construction space pressure shall be maintained at negative 0.01" w.c.

F. Contractor shall provide Plywood or equal to insure the proper protection of the existing roofing system and skylights.

G. All unused and stored gas cylinders shall be chained and secured.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES AND CONTROLS

A. Requirements of Regulatory Agencies: Comply with Federal, State and local codes and regulations and with utility company requirements.

B. Materials, General: Materials may be new or used suitable for the intended purpose, must be adequate in capacity for required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

C. The Contractor shall provide all weather protection and temporary cooling as necessary to carry on the work being conducted in the building. Contractor shall maintain properly conditioned working conditions except at specific times approved in advance by the Owner.

D. At completion of the work, when existing equipment has been utilized, the Contractor shall restore all equipment to "Original Condition." This shall include replacement of all filters, painting, and other servicing required.

3.2 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the work.

B. Remove such temporary facilities and controls as rapidly as progress of the work will permit, or as directed by the Engineer.

C. At the completion of contract, remove all temporary buildings, sheds and trailers from the site and leave the grounds in the condition specified in other sections.

END OF SECTION 015000

SECTION 017300

MISCELLANEOUS CUTTING & PATCHING

PART 1 - GENERAL

1.1 WORK INCLUDED: This Section establishes general requirements pertaining to cutting (including excavating), fitting, and patching of the Work required to:

A. Make the several parts fit properly.

B. Uncover Work to provide for installation, inspection, or both of ill-timed Work.

C. Remove and replace Work not conforming to requirements of the Contract Documents.

D. Remove and replace defective Work.

E. The work of this section shall include all patching of any existing substrate or finish material that is displaced, disturbed, marred or otherwise damaged by the operations of the work of this contract.

F. Patching is herein further understood to include replacement of certain materials that, by their nature, cannot be patched such as resilient base, resilient flooring, etc. This statement primarily concerns itself with finishes in existing areas indicated to remain as part of the finished project.

G. For alterations and additions the repair of all damages made by cutting shall include restoring those surfaces to their original state of finish, including surface texture, design color, etc., unless new finishes are called for. All such repairs shall be performed by personnel trained and proficient in the particular trades involved; i.e., plaster repairs by plasterers, masonry repairs by masons, tile repairs by tile setters, etc. Masonry and tile repairs shall be toothed to maintain bond or pattern. It is the intent of these specifications that all areas requiring repairs shall be restored to a completely finished condition, acceptable to the Owner.

1.2 INSPECTION

A. The contractor shall visit the building, inspect the areas in which work is to be performed and determine for himself the types and extent of finishing materials existing.

B. He shall determine which materials will probably require patching and which will probably require replacement and to what extent.

C. Failure to do so will not relieve him from this responsibility to conform to the requirements of this section.

1.3 RELATED WORK DESCRIBED ELSEWHERE

A. In addition to other requirements specified, upon the Owner's request, uncover Work to provide for inspection by the Owner of covered Work; and remove samples of installed materials for testing.

B. Do not cut or alter work performed under separate contract without the Owner's written permission.

1.4 QUALITY ASSURANCE

A. Perform all cutting and patching in strict accordance with pertinent requirements of these Specifications and, in the event no such requirements are determined, in conformance with the Owner's written direction.

1.5 SUBMITTALS

A. Request for the Owner's consent:

1. Prior to cutting which affects structural safety, submit written request to the Owner for permission to proceed with cutting.
2. Should conditions of the Work, or schedule, indicate a required change of materials or methods for cutting and patching, so notify the Owner and secure his written permission prior to proceeding.

B. Notices to the Owner

1. Prior to cutting and patching pursuant to the Owner's instructions, submit cost estimate to the Owner. Secure the Owner's approval of cost estimate and type of cost reimbursement before proceeding with cutting and patching.
2. Submit written notice to the Owner designating time the work will be uncovered, to provide for the Owner's observation.

PART 2 - PRODUCTS

2.1 MATERIALS: For replacement of Work removed, use materials which comply with the pertinent sections of these specifications.

2.2 PAYMENT FOR COSTS: The Owner will reimburse the contractor for cutting and patching performed pursuant the Owner's written request after claim for such reimbursement is submitted by the Contractor. Perform all other cutting and patching needed to comply with the Contract Documents at no additional cost to the Owner.

2.3 EXISTING ADJACENT FINISHES

A. The intent of this specification is that all finished surfaces shall present an unblemished finished appearance conforming to existing adjoining materials and colors.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Inspection:

1. Inspect existing conditions, including elements subject to movement or damage during cutting and patching.
2. After uncovering the Work, inspect conditions affecting installation of new Work.

B. Discrepancies:

1. If uncovered conditions are not as anticipated, immediately notify the Owner and secure needed directions.

3.2 PREPARATION PRIOR TO CUTTING: Provide all required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the Work.

3.3 PERFORMANCE: Perform cutting and demolition by methods which will prevent damage to other portions of the Work and will provide proper surfaces to receive installation of repair and new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.

3.4 CONCRETE

A. Concrete shall be patched by cutting out old concrete to remove loose aggregate cement with rectangular sides. Apply approved bonding agent to old concrete to insure firm juncture of new and old.

3.5 CLEAN UP

A. Remove all debris and excess material from the site and legally dispose of it.

END OF SECTION 017300

SECTION 017400

CLEANING

SCHOOL DISTRICT FIVE CLEANING SPECIFICATIONS FOR CONSTRUCTION PROJECTS

PART 1 - CLEANING

1.1 There has been confusion among contractors as to what is required for keeping jobsites clean and preparing the site to be turned over to the owner at the end of the project. This document will note the expectations of the School District as to what is expected. The district expects to get the school building turned over to them in the same condition of cleanliness as before the contractor arrived to begin work. Simple broom cleaning or gathering up of debris once per week is not acceptable. Daily cleaning will be required. Floor protection and poly over shelves and sensitive equipment is mandatory.

A. The district expects the floor of any school to be protected by using a floor covering to protect all floors. The floor covering specified by the District is shown as follows:

1. Materials to be supplied: 3 mil polyethylene floor covering with adhesive backing.
2. Manufacturer: Surface Shield, Inc. supplied by Floor Protection Resources
3. Available from: Lowe's or Home Depot

B. Project cleanup is expected to occur on a daily basis. During the last 30 minutes of each day, the all construction debris is expected to be removed from the jobsite and placed in dumpsters provided by the contractor. Daily cleanup is mandatory. No exceptions. If daily cleaning does not occur, the District may hire the cleaning done and deduct the cleaning amount from the Contractor's invoices.

C. Protection of shelves: Shelves must be covered by poly (3mil) and taped to protect dust from getting under the shelves. The day prior to the building being turned over will be the time to remove the shelves covering.

D. Protection of Computers/Printers: At the beginning of the project, computer labs and individual computers will be covered with plastic trash bags and labeled as computer equipment.

E. Desks & Chairs: Desk and chairs must be moved to either the center of the room or to the edge of the walls and be covered with poly (3mil) to protect them.

F. Final cleaning prior to the project being turned over to the Owner: Remove all poly from the floors, shelves, furniture protection, etc. Broom clean or vacuum the flooring. Prior to wet mopping, provide dusting of all horizontal surfaces. Wet mop the floors.

END OF SECTION 017400

SECTION 017700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. To provide an orderly and efficient transfer of the building and building component information to the Owner. Closeout submittals shall consist of the following items:

- Closeout, Warranty and Operation and Maintenance Documents
- Record (as-built) Drawings and Specifications

1.2 QUALITY ASSURANCE

A. One copy of all project closeout submittals shall be forwarded to the Engineer for review and approval prior to forwarding the information required by this section to the Owner. Approval of these documents shall be considered as a pre-requisite for certification of Final Completion.

1.3 MATERIALS LIST

A. Furnish the Owner, three identical copies of a typewritten list showing every manufactured item / material used on the job. Include catalog number, manufacturer's name and address, distributor's name and address. Type the lists neatly and index them according to respective sections of specifications.

1.4 CLOSEOUT, WARRANTY, OPERATION AND MEAINTENANCE DOCUMENTS

A. Prepare two 3-ring binder titled with the name of the project and date. The binder shall contain, in order, the following information:

1. The Contractor's name, address, telephone number, fax number and the name of the project manager. Provide contact information for the Contractor's representative that includes telephone and beeper numbers where the person can be reached for emergency service at all times including nights, weekends, and holidays.
2. The names, addresses, telephone numbers for each major subcontractor.
3. Evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to Certificate of Inspection for Plumbing, Mechanical and Electrical.
4. Certificate of Insurance for products and completed operations.
5. Evidence of payment and release of liens.
6. In order of division, following the order of the section of this specification, all warranty information specifically required by the sections of this specification.
7. In order of division -- following the order of the sections of this specification – catalogs, wiring and control diagrams, manufacturer's data, maintenance and operation instructions, parts lists on all devices, fixtures, machines, appliances, mechanical and electrical equipment, etc., for permanent maintenance records.

8. Electronic copy of all of the above materials and information in PDF format on CD.

B. Arrange to instruct operating and maintenance personnel of Owner in use and maintenance of mechanical systems and associated control systems and specialty equipment provided under this contract. Submit letter showing when training was held and who attended.

1.5 COMPLETE AND SUBMIT AIA Document G704 Certificate of Substantial Completion.

1.6 COMPLETE AND SUBMIT AIA Documents G706 Contractor's Affidavit of Payment of Debts and Claims.

1.7 COMPLETE AND SUBMIT AIA Documents G706A Contractor's Affidavit of Release of Liens.

1.8 PROVIDE a clean and readable set of project Record Documents showing all deviations or changes in routing, location, or installation procedures made during the course of construction. Deliver Record Documents to Engineer for Owner. Refer to Section 017839 for details. Accompany this submittal with a transmittal letter, in duplicate, containing:

- Date
- Project Title and commission number
- Contractor's name and address
- Title and number of each Record Document
- Signature of contractor or his authorized representative

1.9 COMPLETE AND SUBMIT the Consent of Surety to Final Payment on AIA Document G-707, latest edition.

1.10 PROVIDE AIA Documents G715 Instruction Sheet and Attachment for Acord Certificate of Insurance issued by an authorized representative of the contractor's insurance company certifying completed project insurance coverage as required by the contract documents.

1.11 A STATEMENT that the Contractor knows of no reason that the completed project insurance will not be renewable to cover the period required by the contract documents.

1.12 RETURN ALL CONTRACTOR'S Identification Badges prior to receipt of final payment.

END OF SECTION 017000

SECTION 017800

PROJECT CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. To provide an orderly and efficient transfer of the building and building component information to the Owner. Closeout submittals shall consist of:

1. Closeout, Warranty & Operation and Maintenance Documents
2. Record (as-built) Drawings

1.2 QUALITY ASSURANCE

A. One copy of all project closeout submittals shall be forwarded to the Engineer for review and approval prior to forwarding the information required by this section to the Owner. Approval of these documents shall be considered as a pre-requisite for certification of Final Completion.

1.3 CLOSEOUT, WARRANTY & OPERATION AND MAINTENANCE DOCUMENTS

A. At the Final Completion of the project the General Contractor shall prepare one 3 ring binder titled with the name of the project and date. The binder shall contain, in order, the following:

1. The General Contractor's name, address, telephone number, fax number and the name of the project manager or contact person representing the General Contractor, including addresses and telephone numbers where that person can be reached for emergency service at all times including nights, weekends, and holidays.
2. The names, addresses, telephone numbers for each major subcontractors including:
   a. Plumbing sub-contractor
   b. Mechanical sub-contractor
   c. Electrical sub-contractor
   d. Roofing sub-contractor
3. When applicable evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to:
   a. Certificates of Inspection for Plumbing, Mechanical and Electrical.
   b. Certificates of Occupancy.
4. Certificates of Insurance for products and completed operations.
5. Evidence of payment and release of liens.
   a. Consent of Surety to Final Payment: Submit on AIA Document G707, latest edition.

b. Contractor's Release of Liens: Conditioned upon receipt of final payment. Submit in letter form on Contractor's letterhead and on AIA Document G706A, latest edition.

6. Contractor's Affidavit of Payment of Debts and Claims: Submit on AIA document G706, latest edition.
7. In order of division, following the order of the sections of this specification, all warranty information specifically required by the sections of this specification.
8. In order of division, following the order of the sections of this specification, catalogs, wiring and control diagrams, manufacturer's data, maintenance and operation instructions, parts lists on all devices, fixtures, machines, appliances, mechanical and electrical equipment, etc., for permanent maintenance records.

1.4 RECORD DOCUMENTS

A. Throughout progress of the work, the contractor shall maintain an accurate record of actual construction and changes of the contract documents.

B. The purpose of the Record Documents is to provide factual information regarding all aspects of the work, both concealed and visible, to enable future modification of the work to proceed without lengthy and expensive site measurement, investigation, and examination.

C. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications as to actual products used and each sheet of drawings and other documents where such entry is required to show the change properly.

D. Accuracy of records shall be such that future search for items shown in the Contract Documents may rely reasonably on information obtained from the Project Record Documents.

E. The Record Documents shall be made available to the Engineer for review upon request, and the Engineer's approval of the current status of Project Record Documents may be a prerequisite to the Engineer’s approval of requests for progress payment and request for final payment under the contract.

F. Record Document Handling:

1. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work.
2. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

G. Content: Promptly following receipt of the Owner's Notice to Proceed, secure from the Engineer at no charge to the contractor one complete set of all documents comprising the contract. Immediately upon receipt of the job set described in Paragraph 2.01(A) above, identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET". Maintain at site for Owner one Record Copy of:

1. Drawings
2. Specifications
3. Addenda
4. Change Orders and other Modifications to Contract
5. Engineer Field Orders or written instructions
6. Approved shop drawings, product data and samples
7. Field Test Reports

H. Making entries on Drawings:

1. Using an erasable colored pencil, clearly describe the change by note or drawing.
2. Call attention to the entry by a "cloud" drawn around the area or areas affected.
3. In the event of overlapping changes use different colors for the overlapping changes.
4. Legibly mark drawings to record actual construction such as:
   a. Depths of various elements of foundation in relation to finish first floor datum.
   b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the structure.
   d. Field changes of dimension and detail.
   e. Changes made by Field Order or by Change Order.
   f. Details not on original contract drawings.

I. Make entries in the specifications, addenda and other pertinent documents by legibly marking each section to record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed. Indicate changes made by Field Order or by Change Order.

J. Show on the job set of Record Drawings, by dimension accurate to within one inch, the centerline, etc., of each run of items such as are described above. Clearly identify the item by accurate note such as "cast iron drain", "galv. water", and the like. Show, by symbol or note, the vertical location of the item ("under slab", "in ceiling plenum", "exposed", and the like).

K. At Contract closeout, deliver Record Documents to Engineer for Owner. Accompany this submittal with a transmittal letter in duplicate containing:

1. Date
2. Project title, and commission number
3. Contractor's name and address
4. Title and number of each Record Document
5. Signature of contractor or his authorized representative

END OF SECTION 017800

SECTION 017839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Throughout progress of the Work of this Contract, maintain an accurate record of all changes in the Contract Documents, as described in Article 3.01 below.

B. Upon completion of the Work of this Contract, transfer the recorded changes to a set of Record Documents, as described in Article 3.02 below.

1.2 RELATED WORK DESCRIBED ELSEWHERE

A. Submittals: Section 013300

1.3 QUALITY ASSURANCE

A. General: Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved in advance by the Owner.

B. Accuracy of records: Thoroughly coordinate all changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the contract Documents may reasonably rely on information obtained from the approved Record Documents.

C. Timing of entries: Make all entries within 24 hours after receipt of information.

1.4 SUBMITTALS

A. The Owner's approval of the current status of Record Documents will be a prerequisite to the approval of requests for progress payment and request for final inspection and final payment under the Contract.

1.5 PRODUCT HANDLING

A. Use all means necessary to maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the Work and transfer of the recorded data to the final Record Documents. In the event of loss of recorded data, use all means necessary to secure data to the Owner's approval; such means include, if necessary in the opinion of the Owner, removal and replacement of concealing materials and, in such case, all replacements shall be to the standards originally specified in the Contract Documents at no cost to the Owner.

PART 2 - PRODUCTS

2.1 RECORD DOCUMENTS

A. Job Set: Promptly following award of contract, secure from the Owner, at no charge to the contractor, one complete set of all Documents comprising the Contract.

B. Final Record Documents: At a time near the completion of the Work, but prior to final inspection and final payment, secure from the Owner at no charge to the Contractor, one complete set of all Drawings included in the Contract.

PART 3 - EXECUTION

3.1 MAINTENANCE OF JOB SET

A. Identification: Immediately upon receipt of the job set described in Paragraph 2.01 above, identify each of the Documents with the title "RECORD DOCUMENTS - JOB SET." Maintain the following on site: of:

- Drawings
- Specifications
- Addenda
- Change Orders and other Modifications to Contract
- Engineer Field Orders or written instructions
- Field Test Reports

B. Preservation:

1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set to the approval of the Owner.
2. Do not use the job set for any purpose except entry of new data and for review by the Owner, until start of transfer of data to final Record Documents.
3. Maintain the job set at the site of Work as the Engineer designates that site.

C. Making entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by note and by graphic line, as required. Date all entries. Call attention to the entry by a "cloud" around the area or areas affected. In the event of overlapping changes, different colors may be used for each of the changes.

D. Making entries on other Documents:

1. Where directives issued by the Owner cause changes, clearly indicate the change by note in ink, colored pencil, or rubber stamp.
2. When changes are caused by Contractor originated proposals approved by the Owner, including inadvertent errors by the Contractor which have been accepted by the Owner, clearly indicate the change by note in erasable colored pencil.

3. Make entries in the specifications, addenda and other pertinent documents by legibly marking each section to record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed. Indicate changes made by Field Order or by Change Order.
4. Make entries in the pertinent Documents as approved by the Owner.

E. Conversion of schematic layouts:

1. In most cases on the Drawings, arrangements of conduits and circuits, piping, duct, and other similar items, is shown schematically and is not intended to portray precise physical layout. The contractor, subject to the Owner's approval determines final physical arrangement. However, design of future modifications of the facility may require accurate information as to the final physical arrangement of items that are shown only schematically on the Drawings.
2. Shown on the job set of Record Drawings, by dimension accurate to within 24 mm (1"), the center line of each run of items such as conduits and circuits, piping, duct, and other similar items. Clearly identify each item by accurate note. Show, by symbol or note, the vertical location of the item to indicate if it is under slab, in ceiling, exposed, etc. Make all identification sufficiently descriptive that it may be related reliably to the Specifications.
3. The Owner may waive the requirements for conversion of schematic data where, in the Owner's judgment such conversion serves no beneficial purpose. However, do not rely upon waivers being issued except as specifically issued in writing by the Owner.
4. Timing of entries: Be alert to changes in the Work from how it is shown in the Contract Documents. Promptly, and in no case later than 24 hours after the change has occurred and been made known to the Contractor, make the entry or entries required.

F. Accuracy of entries: Use all means necessary, including the proper tools for measurement, to determine actual locations of the installed items.

3.2 FINAL RECORD DOCUMENTS

A. General: The purpose of the final Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of design to proceed without lengthy and expensive site measurement, investigation, and examination. Provide a single bookmarked PDF file with bookmarks for each section and part. Provide one CD and 2 complete drawing sets of record drawings.

B. Approval of recorded data prior to transfer: Following receipt of the Final Record Documents described in Paragraph 2.01.B above, and prior to start of transfer of recorded data thereto, secure a review by the Engineer and Owner of all recorded data. Make all required revisions.

C. Approval of recorded data prior to transfer: Carefully transfer all change data shown on the job set of Record Drawings to the Final Record Document. Coordinate the changes as required and clearly indicate at each affected detail and other drawing the actual location of items. Call attention to each entry by drawing a “cloud” around the area or areas affected. Make all change entries on the drawings neatly, consistently, and in ink or crisp black pencil.

D. Transfer of data to other Documents: If the Documents (other than Drawings) have been kept clean successfully during progress of the Work, and if entries have been sufficiently orderly thereon to the approval of the Engineer, the job set of those Documents (other than Drawings) will be accepted by the Owner as final Record Documents for those Documents. If any such document is not approved by the Engineer, secure a new copy of that Document from the Owner and carefully transfer the change data to the new copy.

E. Review and approval: Submit the completed total set of Record Documents to the Owner. Participate in review meeting(s) as required by Engineer or Owner. Make all required changes in the Record Documents and promptly deliver the final Record Documents to the Engineer prior to requesting a final inspection and final payment under the contract.

3.3 CHANGES SUBSEQUENT TO ACCEPTANCE

A. The Contractor shall have no responsibility for recording changes in the Work subsequent to acceptance of the Work by the Owner, except for changes resulting from replacements, repairs, and alterations made by the Contractor as part of this guarantee.

END OF SECTION 017839

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

PART 3 EXECUTION

2.01 SCOPE

A. Remove portions of existing buildings in the following sequence:
   1. See Mechanical Drawings for Units to be removed.
   2. Existing speakers, wi-fi devices and other items noted on plans to be re-installed in new ceiling system in current locations or as close to current locations as possible..

B. Remove other items indicated, for salvage and re-installation in new ceiling system..

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Provide, erect, and maintain temporary barriers and security devices.
   2. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   3. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   4. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements that are not to be removed.

2.03 EXISTING UTILITIES

A. Protect existing utilities to remain from damage.

B. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

C. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

C. Services (Including but not limited to Fire Protection and Electrical): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

2.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

END OF SECTION

SECTION 04 2000
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Common Brick.

B. Mortar and Grout.

C. Reinforcement and Anchorage.

D. Flashings.

E. Accessories.

1.02 REFERENCE STANDARDS

A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale); 2013.

D. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.

E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.

F. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.

G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

H. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2013.

I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2012.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 BRICK UNITS

A. Facing Brick: ASTM C216, Type FBS, Grade SW.
   1. Color and texture: To match existing brick on building.
   2. Nominal size: As indicated on drawings.
   3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

B. Building (Common) Brick: ASTM C62, Grade SW; solid units.
   1. Nominal size: As indicated on drawings.

2.02 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91, Type N.

B. Portland Cement: ASTM C150, Type I.
   1. Not more than 0.60 percent alkali.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

A. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch (4.8 mm) thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in (32 mm).

B. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
   3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

2.04 FLASHINGS

A. Plastic Flashings: Sheet polyvinyl chloride; 40 mil (1mm) thick.

2.05 ACCESSORIES

A. Weeps: Cotton rope.

B. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR AND GROUT MIXES

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Exterior, non-loadbearing masonry: Type N.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio. Match existing mortar colors if required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

3.02 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Match existing vertical coursing. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Brick Units:
   1. Bond: Running.
   2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
   3. Mortar Joints: Concave.

3.04 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

C. Remove excess mortar and mortar smears as work progresses.

D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally at bottom of walls.

3.06 REINFORCEMENT AND ANCHORAGE - GENERAL

3.07 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 1.77 sq ft (0.16 sq m) of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

3.08 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

B. Extend PVC flashings to within 1/4 inch (6 mm) of exterior face of masonry.

C. Lap end joints of flashings at least 6 inches (152 mm) and seal watertight with mastic or elastic sealant.

3.09 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

3.10 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation and integral vapor retarder at cavity wall construction.

B. Batt insulation in exterior wall construction.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2013.

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

E. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene Board Insulation: ASTM C578, Type X; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Board Size: 48 x 96 inch.
   4. Board Thickness: 1 inch and 1 1/2 inch.
   5. Board Edges: Square.
   6. Compressive Resistance: 15 psi.
   7. Board to have R-5.0 per inch of thickness.
   8. Manufacturers:
      a. Owens Corning Corp: www.owenscorning.com.
   9. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BATT INSULATION MATERIALS

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   2. Thickness: 4 inch.
   3. Insulation to have R-15 value.
   4. Manufacturers:
      a. CertainTeed Corporation: www.certainteed.com.
      b. Johns Manville Corporation: www.jm.com.
      c. Owens Corning Corp: www.owenscorning.com.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

3.02 BOARD INSTALLATION AT CAVITY WALLS

A. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.
   4. Place impale fastener locking discs.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal stud wall framing.

B. Acoustic insulation.

C. Gypsum sheathing.

D. Gypsum wallboard.

E. Joint treatment and accessories.

F. Water-resistive barrier over exterior wall sheathing.

1.02 REFERENCE STANDARDS

A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2012.

B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2013.

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.

E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.

F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2011.

G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007 (Reapproved 2013).

H. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing; 2013.

I. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2013.

J. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.

K. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2013.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on metal framing, gypsum board, accessories, joint finishing system, and insulated sheathing and regular sheathing.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (240 Pa).
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.

2.03 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces, unless otherwise indicated.
   2. Thickness: 5/8 inch.

B. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Fiberglass-Mat Faced Gypsum Sheathing: Fiberglass mat on face, back and long edges. Mold Resistance – 10.
   3. Regular Board Thickness: 1/2 inch.
   4. Edges: Square, for vertical application.
   5. DensGlass Sheathing by Georgia-Pacific Gypsum LLC or approved equal.

2.04 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 4 inch.

B. Water-Resistive Barrier: Plastic sheet complying with ICC-ES AC38.

C. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Ready-mixed vinyl-based joint compound.

D. Screws for Attachment to Steel Members Less Than 0.03 inch (0.7 mm) In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium-plated for exterior locations.

E. Screws for Attachment to Steel Members From 0.033 to 0.112 inch (0.8 to 2.8 mm) in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Studs: Space studs as permitted by standard.
   1. Extend partition framing to extent of opening..

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.

3.04 BOARD INSTALLATION

A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
   1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.06 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 RELATED REQUIREMENTS

A. Section 23 3700 - Air Outlets and Inlets: Air diffusion devices in ceiling.

B. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system.

C. Section 27 5117 - Public Address Systems: Speakers in ceiling system.

1.03 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2008.

C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2008e1.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

A. Standards for Suspension Systems: Comply with ASTM C 635 for materials; and with the **International Building Code 2012 Edition, Seismic Design Category "D"** for installation.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Manufacturers:
   1. USG; Product Radar ClimaPlus High-CAC panels: www.usg.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustical Units - General: ASTM E1264, Class A.

C. Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
   1. Size: 24 x 24 inches.
   2. Thickness: 3/4 inches.
   3. NRC Range:.70, determined as specified in ASTM E1264.
   4. Ceiling Attenuation Class (CAC): 40, determined as specified in ASTM E1264.
   5. Edge: Square.

6. Surface Color: White.
7. Provide 30 year written warranty against growth of mold and mildew and show 0% growth when tested and scaled according to ASTM D-3273.
8. Surface Pattern: Non-directional fissured.

2.02 SUSPENSION SYSTEM(S)

A. Manufacturers:
   1. Same as for acoustical units.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required. To meet **International Building Code 2012 Edition, Seismic Design Category "D"** requirements.

C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   3. Finish: White painted.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid. To meet International Building Code 2012 Edition, Seismic Design Category "D" or per approved ESR by ICC.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
   1. Height: 4 inch.
   2. Thickness: 0.125 inch thick.
   3. Finish: Satin.
   4. Color: Color as selected from manufacturer's standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.02 RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

END OF SECTION

SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Removal of existing carpet tile.

1.02 REFERENCE STANDARDS

A. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2009.

B. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Shaw; Product Pattern - Chrisma Tile - 59561. Field Verify color and match existing.
   1. Tile to be 24" x 24", Color to be Aloft 61400. Tile to match existing and be placed in location of HVAC unit being removed. Co-ordinate joints to align with existing pattern in each location.

2.02 ACCESSORIES

A. Rubber base to match existing base in color and type on either side of new wall. Remove existing on either side to make a non conspicuous joint where new base meets existing base.

B. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive rubber base.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

D. Verify that required floor-mounted utilities have been removed and properly prepared for carpet tile.

3.02 PREPARATION

A. Remove existing carpet tile in order to have full tile continue where HVAC unit has been removed if carpet tile were cut to fit around units.

B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI Carpet Installation Standard.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile to match existing pattern.

F. Fully adhere carpet tile to substrate.

G. Trim carpet tile neatly at walls.

H. Resilent Base - Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

I. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 9000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.03 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.

B. Provide all paint and coating products from the same manufacturer.

C. Paints:
   1. Sherwin-Williams Company: www.sherwin-williams.com.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each coating material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Colors: To match adjacent surfaces at all locations. Color may vary from room to room. Verify on job site with color samples on 8 1/2" x 11" painted sample.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board and concrete masonry.
   1. Two top coats and one coat primer.

2. Primer(s): As recommended by manufacturer of top coats.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

I. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Touch-up damaged coatings after Substantial Completion.

END OF SECTION

SECTION 230200

GENERAL REQUIREMENTS MECHANICAL

PART 1 - GENERAL

1.1 SPECIAL NOTES

A. Work under this section of the specifications shall be governed by requirements there under.

B. The use of the word "PROVIDE" in the specifications and on drawings for work under this section shall mean: Furnish and install complete, supplying all necessary labor and materials.

C. This section applies to all sections of Division 23 of this project except as specified otherwise in the individual sections and here-in. Work described in this section includes general requirements common to all mechanical systems. Provisions of this section apply to all mechanical specification sections.

D. References: Refer to the General Conditions for the Contract, the Supplementary General Conditions for the Contract, and the Subdivisions of Division 01; all of which are contained in or referenced as a part of this Project Manual. Instructions relating to the overall operations of the Contractor, as they may apply and as contained in the referenced Subdivisions, will be equally applicable to his subcontractors, equipment and material suppliers and/or installers, and other persons or companies having work requirements, this project.

E. The contractor’s attention is directed to the intention of the specifications to provide domestic manufactured products only for this project. Where non-domestic products will only be considered on an individual product basis and will only be accepted if prior approval is received before the project is bid.

1.2 GENERAL REQUIREMENTS

A. Provide necessary labor, material, plant and equipment including materials not specifically mentioned, but necessary to complete the job in a neat, correct and workmanlike manner.

B. The drawings and specifications shall be considered as supplementary, one to the other, so that materials and labor indicated, called for or implied by the one and not the other, shall be supplied and installed as though specifically called for by both.

C. All electrical equipment shall be UL listed and all gas equipment is to be AGA certified.

D. All items shall be properly lubricated and in perfect operation upon completion of the project and prior to final acceptance by owner.

E. Contractor shall be held responsible for having visited job site and having familiarized himself with existing conditions prior to submitting bid. If any existing problems are identified, notify Architect in writing prior to submitting bid.

1.3 SCOPE

A. See spec section 010100 Summary of Work.

1.4 SPACE CONDITIONS

A. All work shall fit the spaces available. Verify all dimensions of the work before commencing fabrication and/or installation. Minor deviations from the drawings required to conform to space conditions and to provide the required accessibility shall be made at no additional cost to Owner.

B. Only base manufacturer's equipment has been investigated and determined to meet necessary space conditions. It shall be the responsibility of the approved equal manufacturer and contractor to verify their suitability for use on this project.

1.5 DRAWINGS

A. The Plans are not intended to show all ductwork, pipes, valves, fittings, connections, and details of the work to be done. The piping, duct, and equipment locations shall be adhered to as closely as possible; however, any changes necessary to avoid columns, beams, lighting fixtures, ductwork, sprinkler piping, etc., shall be made at no additional cost to the Owner.

B. Conflicts in the plans and specifications where changes and alterations are necessary, or where exceptions are taken by the Contractor with regard to sizes, locations, and other details indicated on the drawings, they shall be discussed with the Architect and have his consent in writing before any changes are made. The Contractor shall confer with the Architect for the exact location of all openings into finished areas and all equipment and piping locations before proceeding with the work.

C. The drawings of this work were prepared in conjunction with the other trades and plans of the project and it shall be the Contractor's responsibility to provide himself with drawings of the other trades as required and to coordinate and schedule the work with the other trades.

D. Should any difficulties prevent the installation of the work as indicated, the proposed changes shall be submitted to the Engineer in detail and must be approved in writing before the work may be performed.

E. All inverts, locations, and elevations on all piping, equipment, trenches, etc. shall be verified on the job site prior to the performance of any work that may be affected in any manner by said inverts, locations, and elevations. Before construction of project starts, check location of proposed equipment and ductwork. Review other drawings for project, checking locations of structural elements, locations and sizes of chases, type and method of construction of roof, ceilings, walls, and partitions. Report to Engineers before start of construction any conflicts or unsatisfactory conditions. In no case shall Contractor proceed in uncertainty. No extra charge will be approved after start of construction for work resulting from failure to follow these instructions.

F. Where connections and drains are provided to serve specific pieces of equipment, it shall be the Contractor's responsibility to verify the exact location of the equipment connections and drains and no installation shall be attempted until exact locations have been established. This applies to all equipment regardless of who furnishes said equipment.

1.6 PERMITS, LICENSES, AND FEES

A. The installation of the systems covered by these specifications shall conform in strict accordance to all ordinances, codes and regulations of the City, County, State, and/or all other authorities having jurisdiction and shall conform to all applicable requirements and recommendations of the N.F.P.A. These requirements are minimums and shall be complied with at no additional cost to the Owner.

B. In the absence of local regulation and codes, on heating, ventilating, or air conditioning, or in items or circumstances not covered by local regulation and codes, all recommendations and requirements of the ASHRAE, as set forth in the current edition of the ASHRAE Guide, shall be met as well as all requirements and recommendations of NFPA 90A and the International Building Code.

C. Where requirements of the drawings and specifications exceed code requirements, the work shall be provided in accordance with the drawings and specifications. Any work provided contrary to these requirements shall be removed and replaced at the Contractor's expense.

D. The Contractor shall obtain and pay for all necessary permits and inspections required for the installation of this work and shall pay all charges incident thereto. The Contractor shall deliver to the Engineer all certificates of said inspections issued by the authorities having jurisdiction.

1.7 BID BASIS

A. Basis of Design: The design is based on equipment data furnished by a listed "Base" manufacturer. Only this base listed equipment has been verified by the A/E for compliance with the documents. There is no intent in these documents to necessarily use only "standard" products of the "Base" supplier nor any other supplier. Modifications and alterations of standard products may be required.

1.8 MATERIALS AND WORKMANSHIP

A. All materials and equipment shall be new and free from flaws and defects of any nature. Materials called for are to be considered as standard of quality; which however, implies no right on part of Contractor to substitute other materials and methods without written authority from Engineer.

B. All work shall be performed by skilled mechanics, under competent supervision, employing latest and best practices of the trade. Work shall be installed in accordance with recommendations of ASHRAE Guide, and equipment manufacturer's installation instructions. In the event there is any conflict or doubt, consult Engineer for clarification and approval.

1.9 SUBSTITUTIONS

A. Specific reference in the specifications to any article, device, product, material, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal" shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor in such cases may at his option, use any article, device, product, material, fixture, form or type of construction, which in the judgment of the Architect, expressed in writing prior to bidding as specified below, is equal to that herein named.

B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified, shall be submitted for approval to the Engineer ten days before bids are taken. Requests shall be accompanied by samples, descriptive literature, and engineering information, as necessary to fully identify and appraise the product. No increase in the contract sum will be considered when requests are not approved. If the item is found to be equal, the Architect will issue an Addendum making it a part of the Contract Documents prior to bidding. After bidding, no further changes will be considered.

C. Contractor shall be responsible for determining that all products submitted for approval meet given space limitations and maintain all required clearances for proper access and service.

D. Being listed as an approved equal manufacturer means only that the listed manufacturer is basically a reputable supplier whose equipment will receive consideration if in accordance with all document requirements including space limitations and deliver. Being listed is not to be construed as indicating nor implying that the supplier's product is assured of being acceptable for the project. The burden of developing a product to comply with the documents and of obtaining approval of the product rests solely with the Contractor.

1.10 SUBMITTAL

A. The Engineer will review and take appropriate action on shop drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be for general compliance with the design and with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviation from the Contract Documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been made.

B. Prior to submittal of shop drawings to the Engineer, the Contractor shall review and approve shop drawings. Shop drawings which have not been reviewed and approved in writing by the contractor will not be reviewed by the Engineer. Contractor shall state in writing on shop drawings, any proposed deviations from contract documents. Such deviations, if not stated in shop drawing submittals, shall be the sole responsibility of the contractor. **Note: The first page of each shop drawing submittal must contain the words "APPROVED" or "APPROVED AS NOTED" and must be signed and dated by the contractor before the Engineer will review them.**

C. Review rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are reviewed, said review does not mean that drawings have been checked in detail; said review does not in any way relieve this contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.

D. Shop Drawings: After award of Contract, and before any materials of this Section are delivered to the job site, submit twelve (12) complete sets of Shop Drawings to Architect in accordance with the requirements listed below and in accordance with the provisions of these Specifications and the General Conditions of the Contract.

1. After securing tentative approval on all items pending shop drawing submission, the contractor shall submit for approval manufacturer's shop drawings of all equipment, and shop drawings to scale of all fabricated work furnished under this Section of the specifications including piping, ductwork, equipment layouts, supports and equipment foundation pad layout. Shop drawings shall be of scale large enough to clearly indicate all details of work. Mechanical rooms, boiler rooms, refrigeration plants, and fan rooms shall be submitted on a scale of not less than 1/4-inch equals one foot.
2. Where colors or finishes are specified for products, a sample showing the color or finish shall be submitted with the shop drawings.
3. Where high efficiency motors have been specified, submit certification of motor efficiency with shop drawings for each motor of one horsepower or greater.

E. Material List: Accompanying the shop drawings, submit a complete list of all materials proposed to be furnished and installed under this Section, giving manufacturer's name and catalog number, sizes, capacities, model numbers, accessories and other pertinent information for each item to indicate full compliance with drawings and specifications; this shall in no way be construed as permitting substitution except as specifically provided in these specifications. Every device or piece of equipment herein specified by model and manufacturer shall be submitted for approval. Partial lists submitted from time-to-time will not be permitted.

F. Mechanical/Electrical Coordination: Before equipment is ordered and after all motors, loads, controls, and other characteristics of equipment are known, the Contractor shall review the data shown on the Electrical drawings. Special attention shall be given to motor size, starters, means of disconnect, control wiring, etc. that are being furnished under the electrical section of the specifications. At the time of shop drawing submittal, the contractor shall by letter to the Engineer point out any discrepancies and describe the proposed corrective action.

1. Prior to start of construction, contractor shall submit a starter schedule for review by Engineers. This schedule shall contain equipment description, starter manufacturer and model number, starter accessories, control voltage and source of starter power and control circuitry.
2. No extra charge will be approved after start of construction for work resulting from failure of contractor to follow these instructions.

G. As-Built Drawings: Contractor shall maintain on the job site one complete set of the mechanical drawings for this project. All changes authorized by the Engineer as to the location, sizes, etc., of piping, ductwork, and other mechanical equipment shall be indicated in red ink on the mechanical drawings as the work progresses. At the completion of the project, Contractor shall deliver a complete set of "As-Built" prints of the mechanical drawings to the Engineer.

H. Control Drawings:

1. Before installation of controls, copies of complete submittal data, including equipment specifications, control diagrams, schematic diagrams, internal connections, and sequence of operation to the Engineer for his approval. Diagrams shall show all instruments, devices, tubing, etc. Set points and actions of instruments, operating ranges, and normal position of controlled devices shall be indicated. Operating sequence describing each system shall appear on the same drawing as the system's control diagram.
2. Wiring diagrams shall show conduit and wire sizes, transformers, fuses and correct schematic diagrams for each motor starter and magnetic contractor. Diagram shall be coordinated with the equipment manufacturers involved and shall show the terminal designations for all connections to the equipment and the manufacturer's approval obtained.

I. Manual: Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the Owner through the Engineer two copies each of a Manual compiled in accordance with the provisions of these specifications; and also include in each copy of the Manual a copy of the As-Built Drawings, operating and maintenance instructions, approved control drawings, spare parts lists, name and address of local service representatives and all warranty certificates for new equipment.

J. Contractor to provide two (2) copies of O&M manuals on CD in .PDF format. CD shall contain all warranty and service data on each piece of equipment and CD shall be indexed to allow direct access to all data associated with any piece of equipment.

1.11 ELECTRIC WORK

A. Contractor will provide the following for the mechanical equipment:

1. A source of power as required for each electric motor and for each electrical heating and cooling item of equipment installed under the contract, including final wiring connections to motor terminals or to terminals in a control panel mounted on each respective unit.
2. Circuit breaker protection as required for each electric heating and cooling item of equipment installed under the contract.
3. Wiring each electric motor and each electrical heating and cooling item of equipment (where applicable) through a magnetic starter or a magnetic contactor furnished by the Contractor.
4. Wiring of each constant speed ceiling exhaust fan through a wall switch furnished by the contractor.

B. All motors shall be provided with thermal overload protection either internally or at the starter and all electrical equipment shall be U.L. listed.

C. In the event Contractor proposes to use any items of equipment which have sizes, numbers of electrical meters, or other electrical requirements different from those specified on schedules, drawing or elsewhere, Contractor shall be responsible for coordinating these changes and shall bear all additional costs necessitated by these changes.

D. In general, the Contractor will do all power wiring for the equipment as described above, and the Contractor shall do all control and interlock wiring, unless otherwise specified or indicated on drawings.

E. Consult electrical drawings for extent of electrical work provided for the equipment. Verify current characteristics before ordering any equipment for this project.

F. Contractor shall provide all other wiring not covered above, that is necessary for complete and operating heating and air conditioning systems for the building, including all control wiring, interlock wiring, conduit, relays, controls, starters, disconnect switches, circuit breakers, control conduit and outlet boxes, wiring of all applicable control items of equipment, and other electrical work as required.

G. All wiring shall be run in galvanized or sherardized rigid electrical conduit or E.M.T. where allowed under the electrical section of the specifications, and shall be concealed in finished areas and occupied spaces. All conduits shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation. NO PLENUM RATED CABLE WILL BE ALLOWED ON THIS PROJECT.

H. The Contractor shall provide power wiring from the breaker panel to all control devices including but not limited to control panels, valves, thermostats, dampers, flow switches and other devices requiring power for a complete and operating mechanical system.

I. All electrical work required under this Contract shall comply with the National Electrical Code, and shall meet all local requirements. All electric equipment shall bear UL labels.

1.12 GUARANTEES

A. The Contractor agrees:

1. To correct defects in workmanship, new materials, new equipment, and the operation of system for a period of one year from date of acceptance. Equipment and materials, repaired or replaced are guaranteed for one year following date of correction.
2. To repair any damage to building and equipment resulting from defects in workmanship, materials, equipment, and system operation.
3. To remove any item not specified or given approval and replace it with specified or approved item.
4. Any item submitted for approval that does not conform to these specifications shall have accompanying note of exception.
5. That the system as installed shall comply with code requirements.
6. The contractor acknowledges these guarantee provision are in addition to the guarantee and warranty clauses in the General Conditions of the contract. These are supplemental and additional requirements for the Division 23 portion of the project.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials provided under this section of the specifications shall be new and of the best grade and quality. Materials and equipment manufactured outside of the United States will not be acceptable.

B. The approval of the Engineer shall be obtained by the Contractor on all equipment and materials before any installation is made.

C. Equipment that is installed and then does not perform as represented by selection data or shop drawings shall be replaced with equipment that meets the job requirements and specifications at no additional cost to the Owner.

D. All equipment, materials, and work indicated on the drawings or as specified hereinafter is intended to be installed in a manner conforming to the best engineering practices and all equipment is intended to be complete in every respect to satisfy the job requirements and this specification. In the event any material or equipment is indicated to be used or installed contrary to the manufacturer's recommendations, or if any part, control accessory or auxiliary item required for satisfactory and proper operation and performance of the material and/or equipment is not indicated or specified, it shall be the Contractor's responsibility to notify the Engineer in writing prior to installation. In the event the Contractor fails to give such notice, he will be required to correct the work and/or furnish items omitted (in the performance of his work) at no increase in the contract sum.

E. Upon request from the Engineer, the Contractor shall furnish to the Engineer a certification on all materials and equipment so designated by the Engineer. The certification shall be made by the manufacturer of the material and/or equipment; shall be signed by an official of the manufacturing concern; and shall state that the drawings, specifications, and project requirements have been thoroughly studied by the manufacturer and that the proposed material and/or equipment is unconditionally guaranteed to operate and/or perform properly as applied.

PART 3 - EXECUTION

3.1 UTILITY CONNECTION AND MODIFICATIONS

A. It shall be the Contractor's responsibility to determine all requirements regarding utility services to the building. The Contractor shall verify the exact locations of stubs provided.

3.2 PROTECTION

A. The Contractor shall provide adequate protection to all materials, equipments, fixtures, etc. provided under this section of the specifications to prevent damage of any nature. The Contractor shall be required to remove and replace, at no additional cost to Owner, any item showing any sign of damage of any nature that cannot be restored to its new condition and appearance. Grinding and polishing may be used in the restoration of damaged equipment and materials when approved by the Engineer.

3.3 EXCAVATION AND BACKFILLING

A. Contractor shall do all excavating and backfilling for installation of work included under this contract and he shall promptly remove from the premises all excess earth, debris, and trash for which he is responsible. Coordinate all cutting and patching excavation conditions. All work shall comply with section 230500 of these specifications.

3.4 CUTTING AND PATCHING

A. The Contractor will do all cutting and patching and construction of chases within building for this installation.

3.5 PENETRATIONS AND CURBING

A. Contractor shall provide framed openings in roof and walls as required for all equipment, ductwork, and louvers. Contractor shall coordinate sizes and locations of these and all other necessary penetrations well in advance with all trades.

B. Contractor shall provide all roof curbs for this installation and will flash all roof curbs and penetrations per roofing manufacturer’s requirements. Contractor shall utilize the Owner’s Bonded roofing contractor for all roof work.

3.6 MECHANICAL - ELECTRICAL COORDINATION

A. Equipment, piping, and ductwork shall be installed with clearances to electrical switchboards, panelboards, power panels, motor control centers, and transformers. The clearances shall be the greater of the requirements of the latest editions of NEC or 3'-6" in front of the equipment. Equipment, ductwork or piping shall not be installed directly over the electrical gear and not less than 3'-0" horizontally from the top of the electrical gear.

3.7 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall acquaint and instruct the Owner's representative with all details of performance, operation, and maintenance of the systems. In addition, the contractor shall furnish two copies of a brochure to the Owner through the Engineer, which shall contain printed operating and maintenance instructions, parts list, control diagram, etc., including a list of spare parts and any special tools recommended by the equipment manufacturers to be stocked by the Owner. The manuals shall include a complete set of all approved shop drawings furnished under this section of the specifications. Contractor shall also provide a CD-ROM with PDF files containing all data submitted in the O and M manuals.

B. The basis of Owner's instructions shall be written for inclusion in the maintenance and operating instructions data specified above. Obtain certificates, signed by the Owner's representative, that these instructions have been received and understood.

3.8 CLEANING

A. The Contractor shall keep the job site clean, removing all debris and unused material as they occur. At the completion of the work, the Contractor shall thoroughly clean all materials and equipment provided as part of the work.

B. Prior to testing and adjusting, all piping systems, including all components of systems, shall be thoroughly cleaned inside and out.

C. All soil, waste, drain and rainwater lines shall be rodded out in the presence of the Owner's representative. All cleanout plugs shall be removed, lubricated and replaced.

D. Painting of the equipment shall be as specified here-in. Removing loose scale, rust, drippings, dirt, etc. in preparation for painting shall be done under this section of the specifications.

E. Prior to acceptance of the building, thoroughly clean all exposed portions of the HVAC installation, removing all labels and all traces of foreign substances, using only a cleaning solution approved by the manufacturer of the item being cleaned. Caution should be taken to avoid damage to all finished surfaces.

3.9 ALL EQUIPMENT shall be protected from dust at all times. Mechanical units shall not be run during construction installation periods that create dust such as sheetrock finishing, cabinetry, terrazzo, etc. When mechanical units are in operation during construction, filters must be in place in the units and over the return air grilles to protect equipment and return air path from construction debris and dust. Filters shall be changed by the contractor as frequently as necessary to insure protection of equipment and ductwork. If filters are not in place equipment shall not be operated. Failure of the contractor to comply with these conditions will result in the contractor bearing any and all costs associated with cleaning of ductwork and equipment prior to final acceptance of systems.

3.10 START-UP

A. The Contractor shall place the systems in full operation before testing begins. The Contractor shall make corrections in the system, including furnishing and installing drives, motors, dampers, valves, etc., if required to balance the systems. All such corrections shall be included in the Contractor's base bid and shall be accomplished at no additional cost to the Owner. All piping shall be tested before covered with insulation or being concealed.

B. All equipment installed under this contract shall be started by a Factory authorized personnel from the manufacturer of the equipment installed.

END OF SECTION 230200

SECTION 230300

PRESSURE TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section includes the pressure testing of all air conditioning systems and includes requirements common to all the mechanical systems. Provide all labor, tools instruments, etc. as required to completely test the systems.

B. Other sections of these specifications are a part of this section. Refer to all other sections for a complete description of the work. Work, conditions, and materials specified in other sections and not duplicated in this section includes, but is not limited to the following:

1. Mechanical General Provisions.
2. Basic Materials and Methods.
3. Adjusting Balancing HVAC Systems.

C. All work provided under these specifications shall be subject to constant inspection and final approval of the Architect and all Code authorities having jurisdiction. Tests, in addition to these specified herein, required to prove Code compliance shall be provided as required by the Authorities without additional cost to the Owner. All work found to be defective or indicating leakage shall be repaired or replaced with new materials, as directed by the Engineer. Tests shall be repeated until all work is proven tight.

1.2 QUALITY CONTROL

A. All tests shall be conducted by qualified personnel. When requested the qualifications of individuals shall be submitted to the Engineer for approval.

1.3 NOTIFICATION

A. The Engineer shall be notified prior to all tests.

B. The Code Authorities having jurisdiction shall be notified prior to all tests.

PART 2 - PRODUCTS

2.1 PROVIDING EQUIPMENT

A. Provide all material, test equipment, instruments, and labor required for the tests. All instruments shall be properly calibrated and shall have records on calibration.

PART 3 - EXECUTION

3.1 DUCTWORK

A. Supply ducts shall be tested with a calibrated orifice and fan before grilles, registers, diffusers, and ceiling are installed. Low pressure sheet metal duct losses shall not exceed 10% of the design system CFM at 2" W.G. Seal if required. Medium pressure ducts shall be tested as recommended by SMACNA Manual. Fiberglass ductwork does not require pressure testing.

3.2 GAS PIPING

A. In the absence of local pressure testing procedures, test the assembled pipe system with compressed air at 175 psi for four hours.

3.3 REFRIGERANT PIPING PRESSURE TESTING

B. After Freon piping has been completed and before insulating pipe and enclosing chases, the field installed piping shall be pressure tested at a pressure of 300 psi (high side) and 150 psi (low side). While the system is being pressure tested, an electronic leak detector shall be used to check for leaks.

C. Pressure shall be maintained on piping for a minimum of 12 hours. All field installed piping shall be evacuated when surrounding ambient air is not less than 60 degrees F. A minimum vacuum of 2.0 mm of mercury shall be pulled on piping system and maintained for 12 hours. The vacuum pressure displacement shall be not less than 5 CFM. The vacuum shall be checked with an electronic gauge.

END OF SECTION 230300

SECTION 230500

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The use of the word "PROVIDE" in the specifications and on drawings for work under this section shall mean: Furnish and install complete, supplying all necessary labor and materials.

B. This section applies to all sections of Division 23 of this project except as specified otherwise in the individual sections and here-in. Work described in this section includes general requirements common to all mechanical systems. Provisions of this section apply to all mechanical specification sections. Work described in this section includes construction materials and methods of installing equipment common to all mechanical systems. Provisions of the section apply to all Division 23 specifications sections.

C. Mechanical General Provisions apply to work specified in this section.

PART 2 - PRODUCTS AND METHODS

2.1 FLASHING

A. Ductwork and HVAC Equipment: Cap flashing for all ducts and other types of ventilating equipment which pass through or mount on the roof shall be furnished and installed under this section of the specifications. The material shall be of the same materials as the ducts, etc. to which it shall be fastened unless otherwise noted. The cap flashing shall be made tight to the duct, waterproofed, and extended over the base flashing and down the side for not less than 4 inches. The cap flashing shall be formed to provide a spring action against the base flashings. In cases of dissimilar metals between the cap and base flashings, an isolation membrane shall be installed to prevent electrolysis.

B. Flashing for pipes passing through the roof shall be provided as indicated on the drawings or as approved by the Engineer.

2.2 PIPE SLEEVES

A. All pipes passing through walls, floors, ceilings, all fire rated partitions, etc. shall be provided with pipe sleeves made of galvanized steel pipe unless specifically noted otherwise. Sleeves through partitions and walls shall be of the same length as the wall thickness. Sleeves set in concrete slabs shall be set flush with the underside of the slab and shall extend 1/2 inch above the finish on top of the slab. Where sleeves are in fire rated construction, the voids between the sleeves and the piping passing through insulated piping shall be of sufficient size to allow insulation to pass through the sleeve freely. Where pipes pass through walls below grade or through any floor slabs, the space between the pipe and sleeve shall be finished caulked water tight with G.E. Silicone caulking.

B. At the Contractor's option sleeves 8 inches in diameter and larger may be formed of 16 gauge galvanized steel with welded butt joints. The metal finish shall be restored after welding.

2.3 FIRESTOPPING MATERIALS

A. Where pipe, ducts, conduit, wiring, or other mechanical equipment passes through fire rated walls, floors, or partitions with ratings of one-hour or greater, firestopping materials shall be placed in the voids between the equipment and the rated building material. Sleeves in rated construction shall have voids between sleeves and duct or pipe filled with firestopping materials.

B. Firestopping Materials shall have a fire rating equal to or greater than the construction penetrated. Firestopping material shall not produce toxic smoke when exposed to flame. Firestopping shall be unaffected by vibration, normal usage, and shall not deteriorate with time.

C. Firestopping materials shall be Chase-Foam as manufactured by Chase Technology Corp. or Silicone RTV Foam (3-6548 Silicone) as manufactured by Dow Corning or 3M "CP-25" caulk system. Where permitted by Code, fire rated mineral wool may be used for applications approved by the Architect. All fir stopping systems shall be installed in strict compliance with manufacturer's instructions for compliance with UL listings. acoustical sealant.

2.4 PENETRATIONS AND CURBING

A. Contractor shall provide framed openings in roof and walls as required for equipment, ductwork, and louvers. Contractor shall coordinate sizes and locations of these and all other necessary penetrations well in advance.

B. Contractor shall provide all roof curbs for this installation will flash all roof curbs and penetrations. Contractor shall utilize Owner’s approved roofing contractor for all roof work on this project.

C. Contractor shall provide all roof equipment support rails for this installation will flash all support rails and penetrations as detailed on drawings.

D. Curbs shall be seismic rated welded galvanized steel construction minimum 18 ga. with wood nailer, 1-1/2" rigid insulation on interior, counter flashing cap, and damper shelf as required. Unless specified elsewhere curbs shall be a minimum of 12" high with interior dimensions as required by unit dimensions. Curbs shall be compatible roof system. Verify roof construction and pitch prior to ordering curbs. Provisions shall be made within curbing penetrations for routing of power wiring and control wiring to equipment to prevent the necessity of a second roof penetration for this purpose. Curb shop drawings shall include stamped and sealed seismic and wind calculations proving compliance with current IBC. Contractor shall provide all supplemental structural steel modifications as indicated on plans and as indicated by seismic and wind load calculations to accommodate the installation of curb systems.

E. Equipment Support Rails shall be welded galvanized steel construction minimum 18 ga. with wood nailer, 1-1/2" rigid insulation on interior, counter flashing cap, and damper shelf as required. Unless specified elsewhere curbs shall be a minimum of 12" high with interior dimensions as required by unit dimensions. Curbs shall be Creative Metals, Inc. Series ESSSF, Conn-Fab, or approved equal. Support Rails shall be compatible roof system. Verify roof construction and pitch prior to ordering rails.

F. Where walls are penetrated for louvers, ducts, or vents, appropriate lintels shall be provided to support structure and shall comply with the requirements of the structural drawings and specifications.

2.5 FLOOR, WALL AND CEILING PLATES

A. General:

1. Where exposed to view, all piping or duct passing through or into floors, walls, partitions, and ceilings shall be provided with escutcheon plates of flanges. The Plates or flanges shall fit snugly around the pipe, or the pipe insulation for insulated lines, and shall cover completely the pipe opening and sleeves. Plates shall be fabricated of minimum 16 gauge galvanneal as appropriate to allow field painting. All plates shall be painted to match surrounding finish.

B. Unfinished Areas:

1. In unfinished areas, the plates or flanges shall be constructed of not less than 16 gauge galvanized sheet metal. Equipment rooms with furred ceilings will be considered as unfinished areas.

2.6 ACCESS PANELS

A. Access panels shall be provided for access to all equipment, valves, piping, dampers, etc. furnished under this section of the specifications and requiring access. Dampers with operating control through the ceiling will not require access. The panels shall be located as indicated on the drawings and/or as required for adequate access. The exact locations of the access panels shall be as approved by the Architect.

B. Walls and Ceilings: Furnish and install steel doors in sidewalls, in walls of chases, in inaccessible ceiling, and other locations as indicated or required for ready access to service valves, balancing valves, automatic air vents, balancing dampers, and other items as applicable. Access doors shall be a minimum of 24" x 24" in size where applicable, and shall be furnished with screwdriver operated cam lock doors and a gray prime coat finish. Access doors shall have the same fire rating as the walls, floors, or ceilings in which they are installed. Access doors shall be Miami-Carey Co. Model HP and (as applicable) or approved equal.

C. All panels located in fire rated walls or partitions shall be 1-1/2 hour B rated doors.

D. Ductwork: Furnish and install steel access doors where indicated and/or required for access to motor operated dampers, controls, filters, louvers, fire dampers, and any other operable devices. Access doors shall be minimum 18" x 18" in size and shall be fabricated of minimum 24 gauge galvanized steel hinged to a fastening device to give an air tight closure on neoprene or felt gasket. Doors for insulated duct shall be double panel construction with 1" rigid insulation material between metal panels. Access doors shall be Ruskin AD-1275, Series ADH-22 or approved equal.

E. Suppliers of Comparable Products: Krueger, Miami-Carey, Ruskin.

2.7 PAINTING AND LABELLING

A. All factory applied finishes on equipment and materials that are damaged in any fashion shall be restored to their original finish in a manner as approved by the Engineer.

B. Where the Interior of any duct is exposed to view or can reflect light as viewed from a habitable space the interior surfaces shall be primed and painted flat black or as otherwise approved by the Engineer.

C. Where colors or finishes are specified in this section of the specifications to match adjacent surfaces and the colors or finishes of the product installed do not match the contractor shall repaint or refinish as required to accomplish the desired effect, as approved by the Engineer.

D. Contractor shall paint all exposed ductwork, piping, both insulated and uninsulated that is installed under this contract.

E. Paint and label all piping or insulation around piping according to existing color scheme. If no existing color scheme exists, use standard colors as indicated in Chapter 34 (PIPING SYSTEM IDENTIFICATION) of 1997 ASHRAE.FUNDEMENTALS. Submit proposed colors and markings to A/E for approval.

F. Engraved plastic nameplates shall be provided for each piece of equipment installed on this project. Lettering shall not be less than one-quarter inch high. Mechanically fasten nameplates to fixed surface on equipment or on walls immediately adjacent to each piece of equipment. Label all equipment with tag indicated on mechanical schedules and details, i.e., HP-1, AHU-1, CP-1, etc. in addition to this minimum information, where a piece of equipment is dedicated to and individual room or area, the device label shall include the area designation/room number. Prior to fabricating labels, contractor shall obtain room/area designations from Engineers for compliance with final building signage. Refer to Sections 230503, 233000, and 230900 for additional labeling requirement for system components.

2.8 STRUCTURAL ATTACHMENTS

A. Concrete fasteners shall be self-drilling type, Locke Mfg. Co. "Bull Dog", Phillips "Red Head", or Diamond "Blue-Cut".

B. Contractor shall provide all supplementary steel, framing members, beam clamps, hanger rods, etc., as required to properly support equipment and ductwork.

C. Hanger rods shall be selected to safely carry the load to be supported and shall not be less than the diameter listed by the hanger manufacturers for the specific size hanger used.

D. Attachment:

1. Piping and equipment suspended from steel construction shall be suspended from beams from the panel points of the bar joist only. When the hanger point is not directly below a structural member of a joist panel point, supplementary supporting steel shall be provided to receive the bridge across the structural member of a joist as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.
2. Hangers and supporting steel shall be attached to new concrete construction with continuous metal inserts designed to be used in ceilings, walls, or floors. In no case shall the load imposed on an insert exceed the manufacturer's recommended loading.
3. Hangers and supporting steel shall be attached to existing concrete structure, using concrete drill anchors at locations and in a manner as approved by the Architect. Anchors shall not be loaded beyond their published ratings.

E. Support ducts from building structure with galvanized steel hangers to each side of duct. Hangers for ducts up to 60 inches maximum side dimension shall be 1" X 1/8" galvanized steel band. Hangers for larger ducts shall be 1-3/8" X 1/8" galvanized steel band. Space hangers on 8 foot centers with three hangers at each branch or take-off.

2.9 FOUNDATIONS, HANGERS, AND SUPPORTS

A. The Contractor shall provide all necessary hangers, supports, bracing, accessories, etc. required for proper installation of the work. Pipe hangers shall be spaced close enough to maintain proper grade and prevent sagging, but in no case shall the hanger spacing be greater than specified hereinafter. Special care shall be taken in supporting piping subject to expansion and contraction so that the piping does not become improperly aligned or anchored.

B. Unless specifically indicated otherwise, all concrete foundations and all structural steel, other than the building structure or special supports provided under another section of the specifications, required for proper support of piping, equipment, and materials provided under this section of the specifications and shall be furnished and installed under this section of the specifications and shall comply in strict accordance with all requirements of the Structural and/or Concrete Sections.

C. All supplementary steel exposed to the weather shall be hot-dipped galvanized.

D. Unless otherwise indicated, all floor mounted equipment located in the Equipment Room and spaces shall be mounted on 4" high concrete bases extending 6" beyond the bases of the equipment in each direction. Concrete shall be reinforced with No. 4 steel rods spaced 12" on center in both directions, except that steel in pump bases shall be on 6" centers.

2.10 ELECTRICAL

A. All motors required for all equipment furnished under this section of the specifications shall be provided under this section of the work. Two speed motors shall be two winding type unless otherwise indicated. Unless otherwise indicated under the Electrical work or on the Mechanical Drawing, motors smaller than 1/2 HP shall be for 115 volts, single phase, 60 cycle power, and motors 1/2 HP and larger shall be single or three phase 60 cycle power as indicated on equipment schedules.

B. All motor starters, both manual and magnetic, and pushbutton stations required for motors furnished under this section of the specifications shall be provided under this section of the work. All starters shall have "HAND-OFF-ON" switches and auxiliary contactors. Control transformers shall be provided as needed to meet control requirements. All two-speed starters shall be for two winding motors and shall have decelerating relay between high speed and low speed. All starters shall have compelling low speed start relay. All starters shall be installed under this section of the specifications, unless furnished as an integral part of the equipment. All starters shall be of the same manufacturer, except starters for water chillers may be of a different manufacturer.

C. Motors one horsepower and larger, including those used for pumps, air units, fans, etc. shall be designed in accordance with NEMA Standard MGI, Design B, Class B or F insulation for 40 degrees C temperature rise. The motor power factor at full load and rated voltage for motors with greater than 1 HP output shall be at least 0.85 power factor shall be as determined by IEEE Standard 112A Method B. Apparent efficiency shall meet or exceed current ASHRAE 90 requirements

D. All power wiring shall be provided under the Electrical Section of the specifications, unless specifically noted otherwise in this section of the work. Power wiring between starters and applied equipment motors shall be provided under this Section. Power wiring that is furnished to Packaged Equipment such as rooftop units, condensing units, electric heating equipment, packaged house pumping systems, etc. shall consist of a single point connection and shall terminate with the connection to the units. Single point power connection shall be furnished as part of the package.

E. All electrical devices and equipment including, but not limited to, all motors, starters, relays, pushbuttons, wiring, etc. provided under this section of the work shall comply in all respects with all requirements of the Electrical Specifications.

F. Identification labels shall be provided for each starter, control device, etc. showing the instruments function. Labels shall be in accordance with the requirements for labels as specified under the Electrical specifications.

G. All control wiring shall be provided under this section of the work, unless specifically indicated otherwise under the Electrical specifications.

H. Each manufacturer shall certify in writing to the Engineer that the equipment furnished has high efficiency motors as specified hereinbefore. The certification shall state motor HP, motor manufacturer, power factor and efficiency.

2.11 EXCAVATION AND BACKFILLING

A. The Contractor shall carefully plan the excavations to avoid existing trees and plants and shall not approach too close to footings and foundation. Exact locations of excavations to be approved by the Architect before performing work. The excavation shall be only wide and deep enough to provide for the piping, and other subgrade construction. All piping shall be installed with a minimum of 24” cover. For piping located in traffic areas cover shall comply with minimum coverage dictated by Division 2 Site Work. Shoring shall be provided and used when the ground and/or the depth of the excavation warrants same.

B. The piping shall rest on a continuous and firm grade. Holes shall be cut in the bottom of the excavation for pipe bells.

C. Where rock is encountered the rock shall be removed to a depth of 6" below the desired depth and replaced with suitable earth.

D. Backfilling shall be started only after the piping has been completed, tested and inspected. The backfill shall be free of rocks and debris and shall compacted as the excavation is filled. The Contractor shall take ample precaution to prevent damage to the piping. The compaction of the backfill shall be the same as the adjacent area as approved by the Architect, unless otherwise indicated. All backfill shall meet minimum requirements of Division 2 Site Work. Where Division 2 is not specific, the backfill material shall meet ASTM D 2487 Soil Classifications Groups CW, GP, SM, SW, SP, and SM and shall be free of rocks, gravel, debris, waste, frozen material, vegetation, or other deleterious matter. Fill soil shall have a liquid limit less than 50 and a plasticity index less than 20.

E. Compaction of backfill shall not be less than 98 percent of maximum dry unit weight according to ASTM D 689. Place and compact backfill in layers, maximum depth of each layers shall be 4”. Where approved by Architect and heavy compaction equipment is utilized layer depth may be increased to 8”.

END OF SECTION 230500

SECTION 230503

PIPE & PIPE FITTINGS

PART 1 - GENERAL

1.1 THE WORK under this section includes furnishing and installing all pipe and fittings required for the project.

1.2 ALL PIPING AND MATERIAL for this project shall be domestic manufactured only. No foreign product will be given consideration or approval.

1.3 Refer to other sections for all additional pipe and fittings specifications:

A. Refrigerant Piping

B. Valves

C. Pressure Testing

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING

A. All low pressure gas piping will be provided by the Mechanical Contractor from the last cut-off valve or regulator as provided by the gas vendor to all end users, including final connection to all furnaces, hot water heaters, boilers, and emergency generator.

B. Contractor shall coordinate installation of new gas meter with gas vendor. Owner shall pay any tap fee associated with new meter and service.

C. Pipe material and design:

1. 2 inch and smaller pipe: Schedule 40 black steel with malleable threaded fittings.
2. 2-1/2 inch and larger size pipe: Schedule 40 black steel with welded fittings.
3. At Contractor’s option piping less than 2” diameter may be type "K" copper tubing. Where transition from steel to copper made a dielectric coupling or union is to be provided.
4. A minimum of 6 inch drip leg to be provided at each rise in piping.
5. All underground service piping shall rise above ground immediately before entering into building.

D. In the absence of local pressure testing procedures, test the assembled pipe system with compressed air at 175 psi for four hours.

E. Underground gas piping shall be factory wrapped and coated. All joints between lengths of wrapped and coated pipe shall be compression coupling wrapped with two coats of felt paper and painted with asphalt after pressure test is completed. Pipe trench to be a minimum of 24" deep and gas pipes shall never be installed underground within building.

2.2 PIPE FITTINGS

A. Copper Pipe: Wrought copper, solder type fittings, suitable for the temperature and pressures to be encountered and for the solder or brazing specified. Ells shall be long radius pattern. Flare connections to equipment will be allowed only where required. Unions shall be Nibco No. 633 wrought copper with copper-to-copper solder joints.

B. Steel and Iron Alloy Pipe (Screw Fittings):

1. Unless otherwise indicated, fittings shall be malleable iron in accordance with American Standard for Malleable Iron Screwed Fittings. Fittings shall be black or galvanized to match piping.
2. Eccentric reducing fittings shall be cast iron, black or galvanized to match piping. Screwed fittings used in drainage piping shall be cast iron, drainage pattern fittings.
3. Unions in steel alloy piping shall be Grinnell Fig. 463 ground joint bronze-to-iron-unions.

C. Steel and Iron Allow Pipe (Weld Fittings):

1. Fittings and rings shall be "Tube Turns", or approved equal by Taylor Forge or Ladish.
2. Steel butt fittings shall be in accordance with ASTM A-234 and ASA B16, Material A-106, Grade B. All elbows shall be long radius fittings.
3. Weldolet or Threadolet Fittings will be acceptable only when the branch size take-off is not less than two sizes smaller than the main run of pipe.
4. Unions shall be welding neck or slip-on companion flanges.

D. SILVER SOLDER shall be Sil-Phos as manufactured by United Wire, or an approved equal high temperature solder.

E. GASKETS shall be as recommended by the manufacturer for the service, temperatures and pressures to be encountered.

G. Pipe Joints:

1. Copper Pipe & Tubing: Copper joints shall be made with a wire type solder applied in accordance with the manufacturer's recommendations. No paste solder or flux solder will be allowed. Copper joints underground, under floors on grade, or concealed in chases shall be brazed with silver solder. Copper joints exposed above the floors on grade or readily accessible above removable ceilings shall be made with 95-5 wire solder or brazed with silver solder. Connections of copper to ferrous piping or equipment shall be made with dielectric couplings and proper adapters. Solder joints at valves shall be made with 95-5 solder only. Flare connections to equipment will be allowed where required. Ends of all pipe and tubing shall be cut square and reamed smooth. Ends of tubing and pipe and cups of fittings shall be cleaned of oxides by mechanical means and lightly fluxed as soon as possible with a non-corrosive paste type flux. When inserting pipe or tubing into fitting a slight twisting motion shall be applied to spread flux.

2. Steel and Iron Allow Piping: All piping connections to and near all coils and equipment, regardless of size, shall be screwed joints except when the equipment requires a flanged connection. Sufficient screwed fittings shall be provided near connection points to equipment to absorb piping movement without putting stress on equipment connection.
3. Screw Joints: Joints shall have American Standard tapered pipe threaded properly formed. Joint compound consisting of graphite and oil may be used in making up joints. Joint compounds containing lead or lead oxides shall not be used. All pipe shall be cut square, reamed, threaded and thoroughly cleaned before installation.
4. Welded Joints:
   a. All piping systems or portions of systems containing welded joints shall be constructed in accordance with all provisions and recommendations of ANSI B31.1, current edition, except as modified herein.
   b. Butt weld joints shall be complete full penetration welds made with a single vee, double vee, or other suitable type of groove, and shall be made with backing rings.
   c. The Contractor shall verify in writing to the Owner prior to construction that all welding procedures, welding operators and welders to be used on this project are qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, current edition.
   d. A copy of each welder's or welding operator's qualification record shall be filed in the job office.
   e. All welds shall be clean and shall be free of "icicles", loose metal or other obstructions that result from welding.
   f. The Architect reserves the right to require the Contractor to cut open the pipe along side of any welds for the purpose of inspection. In each case, the Owner will pay for such cutting and rewelding if the work is correct, but in case the inspected work is incorrect, the Contractor shall bear the cost of cutting, inspecting, and rewelding.
   g. The types and extent of non-destructive examinations required for pipe welds shall be in accordance with ANSI Code for Pressure Piping, B31.1 - Power Piping.

2.3 PIPE HANGERS AND SUPPORTS

A. The contractor shall furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for all piping. Pipe hangers shall meet the seismic requirements outlined in Section 230548.

B. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate strength of the support. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the contractor shall submit a certification stating that such requirements have been complied with.

C. Submit to the Engineer for approval shop drawings of all items to be furnished under this section.

D. Submit to the Engineer samples of all materials specified herein if requested. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such a equipment, pipe and personnel contact.

E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.

F. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.

G. Pipe hangers and supports shall be as manufactured by B-Line Systems, Inc. or equal by PHD, Grinnell, or Fee and Mason. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.

H. Hanger rods, nuts, and bolts shall be cadmium plated in mechanical rooms and elsewhere where exposed. Hardware concealed above ceilings may be standard black steel.

I. Supports outside of building shall be galvanized construction.

J. Pipe Hangers and Supports for Metal Pipe:

1. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clamps, or ceiling mounting bolts.

K. Hangers:

1. All hangers and supports shall have some form of adjustment available after installation. Hanger material shall be compatible with the pipe material.
2. Hangers for steel pipe shall be B-Line Systems, Inc. figures B3100, B3102, B3170, and B3173 or equal. B-Line Systems, Inc. figures B3174 and B3198 or equal are acceptable for use on piping 2 inch and smaller.
3. Hangers for copper tubing shall be B-Line Systems, Inc. figures B3104CT, B3170CT, B3173CT, and B3198CT or equal. Felt isolator pads may be used on carbon steel hangers supporting stainless steel pipe or copper tubing.
4. Piping hangers shall be installed around the outside of the insulation with protective shields. Vapor barrier jackets shall not be broken by hanger rods.
5. Support long horizontal runs of insulated steel piping subject to 1/2" or more longitudinal thermal expansion with B-Line Systems, Inc., figures B3110 or B3114 roller hangers with a figure B3160 series protection saddle or equal. Cast iron rollers shall not be subjected to temperatures above 450 degrees F.

L. Hanger Rods:

1. Hanger rods shall be B-Line Systems, Inc. figures B3205 and ATR or equal.
2. Hanger rods shall be subjected to tension only. Lateral and axial movement shall be accommodated by proper linkage in the rod assemble.
3. Hanger rod diameters shall be based on MSS SP-69 Table 4.

M. Concrete Inserts:

1. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls, or floors, spot inserts for individual pipe hangers and shall be as manufactured by B-Line Systems, Inc. or equal and shall be as follows:
   a. Continuous concrete inserts shall be used where applicable and shall be used for hanger rod sizes up to and including 3/4" diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be B221, B321, or B521 by B-Line Systems, Inc. or equal.
   b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8" diameter. Inserts shall be figures B2505 thru B2508, B2500, or B3014 by B-Line Systems, Inc. or equal.

N. Welded Steel Brackets:

1. Wall or column supported pipes shall be supported by welded steel brackets equal to B-Line Systems, Inc. figures B3063, B3066, and B3067 or equal as required for pipe sizes up to and including 20" diameter.

O. Stanchions:

1. Floor supported pipes 3" and larger in diameter shall be supported by either cast-in-place concrete supports or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where lateral displacement of the pipes is not probable.
2. Each adjustable pipe saddle support shall be screwed of welded to the corresponding size base stand. Supporting pipe shall be of schedule 40 steel pipe construction. Each base stand shall be secured to the concrete floor by expansion bolts. Adjustable saddle supports shall be equal to B-Line Systems, Inc. figure B3093 with B3088T or B3090 with B3088.

P. Riser Clamps:

1. Riser piping shall be supported independently of any connected horizontal piping of possible. Provide supplementary steel or concrete supports for clamps. The clamps shall not be supported by the sleeves.
2. Support all vertical runs of ambient piping at each floor or as specified with B-Line Systems, Inc. figures B3373, B3131, B3373CT as required or equal.

Q. Pipe Clamps:

1. Where flexibility in the hanger assembly is required due to horizontal pipe movement, use pipe clamps. For non-insulated pipe use B-Line Systems, Inc. figures B3140 or B3142 or equal. For insulated pipe use B-Line Systems, Inc. figures B3144 or B3146 or equal.

R. Trapeze Hangers:

1. Strut channel trapeze hangers shall be used to support parallel piping. Pipe racks or stanchions fabricated with strut channel shall be used in areas of multiple pipe runs. Strut clamps, straps, and rollers will be used to maintain proper alignment. Strut shall be B22 or heavier as required as manufactured by B-Line systems, Inc. or equal. Clamps and straps shall be B2000 series or B2400 series by B-Line Systems, Inc. or equal. Rollers shall be B-Line Systems, Inc. figures B218, B219, B379, B479, or B3126 or equal.

2.4 IDENTIFICATION OF PIPING

A. Label all piping in Equipment Rooms, above "Lay-In" type ceilings and all other accessible locations. Pipe markers shall conform with Scheme for Identification of Piping Systems (ANSI A13.1-1956).

B. Each marker shall show the name of the fluid in the pipe and a directional flow arrow, both superimposed on one of the five basic background colors. Pipe markers shall be installed at each service valve, at each mechanical item of equipment, at 20 foot intervals on horizontal runs of piping, and at midpoints of risers on vertical piping.

C. The identifiers shall be plastic strips on which the name of the service shall be printed. The identifiers shall be installed with an adhesive which will adhere to the pipe or insulation without deteriorating. Each piping system shall have a different color code marking. Colors shall be submitted for approval. Identification markers shall be applied over the insulation on insulated pipe. The identifiers shall be Brady or Seton self-sticking pipe markers and combination arrow tape meeting the requirements of ANSI standards. Where approved by Engineers stenciled labels may be accepted.

Pipe Contents	**Color**	**Text Color**
Natural Gas	Yellow	Black

PART 3 - EXECUTION

3.1 PIPING shall be installed and connected to the equipment essentially as indicated on the drawings, in a neat and workmanlike manner. Unless specifically noted otherwise, all piping shall be concealed above ceilings and in chases.

3.2 ALL PIPING and equipment shall be supported by the building structure. Unless specifically noted otherwise, no piping or equipment shall be supported from ductwork, other piping, plenum construction or other equipment.

3.3 ALL PIPING shall be installed and arranged to allow free movement to the piping due to expansion, contraction, building movement, etc. without putting excessive stress or strain into the piping or equipment. All piping, risers, runouts, etc. subject to deflection by expansion and contraction shall be cold-sprung 50% of the deflection required to be absorbed. All sleeves and other openings in the construction shall be of sufficient size and spaced so as to allow for the necessary pipe movement without undue stress on piping. Risers shall be free to travel as required with the horizontal piping. Piping runouts to and from risers shall be absorbed and still maintain the specified pitch for the runouts and piping to and from the risers.

3.4 PIPING and equipment suspended from steel construction shall be suspended from beams or from the panel points of the bar joist only. When the hanger point is not directly below a structural member or a joist panel point, supplementary supporting steel shall be provided across the structural members or bridge joists as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.

3.5 ALL VERTICAL PIPING shall be installed plum and true. Horizontal piping specified to be graded shall be installed at a straight and uniform grade without pockets. Horizontal piping not specified to be graded, shall be installed in a straight and true manner.

3.6 ALL PIPING SYSTEMS shall be arranged to drain to one or more low points. Each low point shall be equipped with a hose and valve drain connection.

3.7 UNIONS and/or companion flanges shall be provided at all equipment connections and elsewhere as indicated on the drawings or as required for easy removal of equipment.

3.8 UNDERGROUND PIPING

A. All piping below grade or below slabs on grade, except cast iron pipe, shall be double wrapped with Tape-Coat 20 applied and primed in accordance with the manufacturer's recommendations or equal factory coated piping. Factory coated piping shall have all joints wrapped with Tape-Coat 20 as specified above. All underground piping shall be tested for breaks and bare spots in the protective coating by an electronic device designed for the purpose, in the presence of the Architect.

B. Unless indicated otherwise all underground piping shall have a minimum of 24” of cover. Where piping is installed in traffic areas the depth of coverage shall comply with the minimum requirements of the Site Work Division 2. All underground piping shall be provided with an underground marking tape identifying pipe location, identifier tape shall be located a minimum of 6” above the top of the pipe.

3.9 DRAINS

A. Condensate and equipment drains shall be graded downward in the direction of flow not less than 1/4" per foot. Unless otherwise indicated, the drains shall spill into floor drains, hub drains, or on grade in a manner as approved by the Engineer. Provide drain valves on piping system at low points and at interval required for proper system drainage.

3.10 RELIEF VALVE DISCHARGE LINES

A. Lines shall be installed to drain the entire relief line. Relief lines shall be supported in a manner to prevent any weight being placed on the relief valve. All relief lines shall have a plain section of pipe at the discharge point without threads.

3.11 PAINTING

A. All HVAC piping above grade shall be prime painted with two coats black Rustoleum. All piping exposed in mechanical rooms shall finished painted with one coat black enamel.

B. All gas piping above grade shall be painted with two coats black rustoleum and finished with one coat Yellow enamel. Gas service and pressure shall be stenciled in black on all lines at each regulator and at 20' intervals.

END OF SECTION 230503

SECTION 230548

VIBRATION ISOLATION AND SEISMIC RESTRAINT

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section consists of furnishing engineering and materials necessary for vibration isolation and seismic restraints for equipment contained herein for the project.

B. All mechanical equipment 3/4 HP and over listed in the Vibration Isolation / Seismic schedule shall be mounted on vibration isolators to prevent the transmission of objectionable vibration and vibration induced sound to the building structure.

1. All isolation materials, flexible connectors and seismic restraints shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner at no cost to the Owner.
2. The contractor and manufacturer of the isolation and seismic equipment shall refer to the isolator and seismic restraint schedule that lists isolator types, isolator deflections and seismic restraint type. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections.

C. Unless otherwise specified, **all mechanical, and plumbing equipment, pipe, and duct shall be restrained to resist seismic forces**. Restraints shall maintain equipment, piping, and duct work in a captive position. Restraint devices shall be designed and selected to meet the seismic requirements as defined in the latest issue of the IBC or local jurisdiction building code.

1.2 SEISMIC RESTRAINT SHALL NOT BE REQUIRED FOR THE FOLLOWING**:**

A. Hanging, wall mounted, and flexibly supported mechanical, plumbing and components that weigh 20 pounds (89 N) or less, where I_p = 1.0 and flexible connections are provided between the components and associated duct work, piping and conduit.

B. Piping supported by individual clevis hangers where the distance, as measured from the top of the pipe to the supporting structure, is less than 12 inches (305mm) for the entire pipe run and the pipe can accommodate the expected deflections. Trapeze or double rod hangers where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolation hanger connection to structure).

C. High deformability piping (steel, copper, aluminum with welded, brazed, grooved, or screwed connections) designated as having an Ip = 1.5 and a nominal pipe size of 1 inch (25 mm) or less where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment. Note, any combination of piping supported on a trapeze where the total weight exceeds 10 lb/ ft. must be braced.

D. High deformability piping (steel, copper, aluminum with welded, brazed, grooved, or screwed connections) and limited deformability piping (cast iron, FRP, PVC) designated with an Ip = 1.0 and a nominal pipe size of 1 inch and less in the mechanical equipment room, or 2" and less outside the mechanical equipment room.

E. PVC or other plastic or fiberglass vent piping.

F. HVAC ducts suspended from hangers that are 12 inches (305 mm) or less in length from the top of the duct to the supporting structure and the hangers are detailed to avoid significant bending of the hangers and their connections. Duct must be positively attached to hanger with minimum #10 screws within 2" from the top of the duct.

G. HVAC duct with an $I_p = 1.5$ that have a cross-section area less than 4 square feet. HVAC ducts with an $I_P = 1.0$ that have a cross sectional area of less than 6 square feet (0.557 m2).

H. Equipment items installed in-line with the duct system (e.g, fans, heat exchangers and humidifiers) with an operating weight less than 76 pounds (334 N). Equipment must be rigidly attached to duct at inlet and outlet.

1.3 MANUFACTURER'S RESPONSIBILITIES: MANUFACTURER OF VIBRATION AND SEISMIC CONTROL PRODUCTS SHALL HAVE THE FOLLOWING RESPONSIBILITIES:

A. Determine vibration isolation and seismic restraint sizes and locations.

B. Provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified.

C. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.

D. Provide calculations to determine restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified & stamped by an engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience and licensed in the project's jurisdiction. Provide calculations for all floor or roof- mounted equipment, all suspended or wall mounted equipment 20lbs (89 N) or greater, and vibration isolated equipment 20lbs (89 N)or greater.

E. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer.

F. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.

1.4 QUALITY CONTROL

A. The isolators and seismic restraint systems listed herein are as manufactured by Amber / Booth, Mason Industries, Kinetics, or approved equals which meet all the requirements of the specifications, are acceptable. Manufacturer must be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

B. Steel components shall be cleaned and painted with industrial enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

C. All isolators, bases and seismic restraints exposed to the weather shall utilize cadmium-plated, epoxy coat or PVC coated springs and hot dipped galvanized steel components. Nuts, bolts and washers may be zinc-electroplated. Isolators for outdoor mounted equipment shall provide adequate restraint for the greater of either wind loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.

1.5 SUBMITTALS

A. Submit shop drawings of all isolators, seismic restraints and calculations provided (para 1.3).

B. The manufacturer of vibration isolation products shall submit the following data for each piece of isolated equipment: clearly identified equipment tag, quantity and size of vibration isolators and seismic restraints for each piece of rotating isolated equipment. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated deflections, and solid load. Submittals for bases shall clearly identify locations for all mountings as well as all locations for attachment points of the equipment to the mounting base. Submittals shall include seismic calculations signed and checked by a qualified licensed engineer in the employ of the manufacturer of the vibration isolators. Catalog cut sheets and installation instructions shall be included for each type of isolation mounting or seismic restraint used on equipment being isolated.

C. Provide shop drawings indicating location of all specification SC cable restraints (section 2.3.2) required for pipe and ductwork. Drawings must be stamped by manufacturer's registered professional engineer.

D. Mechanical, electrical and plumbing equipment manufacturers shall provide certification that their equipment is capable of resisting expected seismic loads without failure. Equipment manufacturers shall provide suitable attachment points and/or instructions for attaching seismic restraints.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Specification W: a pad type mounting consisting of two layers of ribbed elastomeric pads with a ½" poro-elastic vibration absorptive material bonded between them. Pads shall be sized for approximate deflection of 0.10" to 0.18". Pads shall be Amber / Booth Type NRC.

B. Specification A: an elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at the top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately 1/2" deflection, and incorporate a steel seismic snubber with all directional restraint. Mountings shall be Amber/Booth Type SRVD.

C. Specification B: an adjustable, freestanding, open spring mounting with combination leveling and equipment fastening bolt. The spring shall be welded to the spring mounting baseplate and compression plate for stability. The isolator shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. An elastomeric pad having a minimum thickness of 1/4" shall be bonded to the baseplate. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. This type isolator must be used with specification SL seismic restraint (section 2.3.1). Isolators shall be Amber/Booth Type SW.

D. Specification C: a unitized adjustable, stable open spring isolator with a seismic restraint housing which serves as a blocking device during equipment installation. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. The springs shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. The spring assembly shall be removable with equipment in place and shall fit within a welded steel enclosure consisting of a top plate and rigid lower housing. Isolated seismic restraint bolts shall connect top plate to lower housing to resist seismic and wind forces in all directions and limit motion to a maximum of 1/4" movement before engaging. Surfaces that engage under seismic motion shall be cushioned with a resilient elastomeric pad or grommet to protect equipment. Top plate shall have adequate means for fastening to the equipment, and baseplate shall have adequate means for bolting to structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3). Seismic isolator shall be Amber/Booth Type CTER.

E. Specification D: an elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment and an elastomeric isolation element designed for approximately 1/2" deflection. Hangers shall be Amber/Booth Type BRD.

F. Specification E: a combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment, coil spring, spring retainers and elastomeric element designed for approximately 1/2" deflection. The spring shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. Spring hangers shall be Amber/Booth Type BSRA.

G. Specification F: a set (two or more) of spring thrust resisting assemblies, which consist of coil springs, spring retainer, isolation washer, angle mounting brackets, and elastomeric tubing for isolating thrust resister rod from fan discharge. Thrust restraints shall be Amber / Booth Type TRK.

H. Specification SB: a unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer to protect equipment. Restraints shall allow a maximum of 1/4" movement before engaging and shall allow for the spring to be changed if required. Isolator shall be a stable spring with a minimum kx/ky of 1.0. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. Nuts and bolts shall be zinc-electroplated to prevent corrosion. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed. Baseplate shall provide means for bolting to the structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3.). Mountings shall be Amber/Booth Type SWSR.

2.2 BASES

A. Specification G: a welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. The steel members shall be adequately sized to prevent distortion and misalignment of the drive, and specifically, shall be sized to limit deflection of the beam on the drive side to 0.05" due to starting torque. Snubbers to prevent excessive motion on starting or stopping shall be furnished if required; however, the snubbers shall not be engaged under steady running conditions. Bases shall be Amber/Booth Type SFB.

B. Specification H: a welded WF (main member) structural steel base for increasing rigidity of equipment mounted thereon or for unitizing belt driven fans. Fan bases shall have holes drilled to match fan and located to provide required center distance between fan and supplied NEMA standard motor slide rails. The steel members shall have minimum depth of 1/12 of the longest span, but not less than 6" deep. Junior beams and junior channels shall not be used. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. Where height restrictions prevent the use of members having a depth of 1/12 of the longest span, beams of less depth may be used provided they have equal rigidity. Provide height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Bases shall be Amber/Booth Type WSB.

C. Specification J: a concrete inertia base consisting of perimeter structural steel concrete pouring form (CPF), reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. The perimeter steel members shall have a minimum depth of 1/12 of the longest span, but not less than 6" deep. The base shall be sized with a minimum overlap of 4" around the base of the equipment and, in the case of belt-driven equipment, 4" beyond the end of the drive shaft. Fan bases are to be supplied with NEMA standard motor slide rails. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space. Inertia bases shall be Amber/Booth Type CPF.

2.3 SEISMIC RESTRAINTS:

A. Specification SL: a restraint assembly for floor mounted equipment consisting of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and to the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a minimum ¼" thick resilient elastomeric pad to protect equipment. Restraints shall be field adjustable and be positioned for 1/4" clearance as required to prevent interference during normal operation. Restraint assembly shall have minimum rating of 2 times the catalog rating at 1 G as certified by independent laboratory test. Restraint shall be Amber/Booth Type ER.

B. Specification SC: a restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable must have Underwriters Laboratories listed certified break strength, and shall be color-coded for easy field verification. Secure cable to structure and to brace component through bracket or stake eye specifically designed to exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per AISI Manual for structural applications of steel cables and ASTM A630. Break strengths must be per ASTM E-8 procedures. Safety factor of 1.5 may be used when prestretched cable is used with end connections designed to meet the cable break strength. Otherwise safety factor 3.76 must be used. Cables shall be sized for a force as listed in section 1.3. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be Amber/Booth Type LRC.

2.4 ROOFTOP UNIT CURBS AND ISOLATION SYSTEMS

A. Specification X: Non isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchor to concrete deck, or bolt or weld directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch and contractor is to verify roof pitch before ordering. Curb shall use minimum 16 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.) or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Seismic curbs shall be Amber/Booth Type RTC.

B. Specification Y: An extruded aluminum rail base for roof top air conditioning units consisting of top and bottom weatherproofed aluminum rails for mounting between equipment and roof curb, incorporating wind/seismic restraints and a continuous air and water seal which is protected from accidental puncture and direct sunlight by an aluminum weather shield. Rails shall incorporate free standing, open spring isolators (minimum kx/ky of 1.0) properly spaced and sized around perimeter for the deflection listed in the isolation schedule. To prevent leaks, rails shall be factory assembled (to the limits of freight carriers) and shipped as a one-piece unit. Where spliced, corners to be factory assembled. Specification X rails may only be used where wind/seismic restraint are capable of withstanding seismic forces per paragraph 1.3. Seismic design of the curb supporting the isolation rail shall be provided by the roof curb manufacturer. Rails shall be Amber/Booth Type RTIR.

C. Specification Z: Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. The upper curb shall be supported by type C isolators welded or bolted to continuous structural support which is positively anchored to concrete deck or bolted or welded to the structure to withstand seismic loading. An EPDM nylon reinforced air-tight weatherproof seal shall consolidate the upper and lower curbs. Weatherproof access panel shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor-supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch and contractor is to verify roof pitch before ordering. Isolation curb shall use minimum 16 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.) or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Isolation curbs shall be Amber/Booth Type RTIC.

2.5 FLEXIBLE PIPE CONNECTIONS

A. Specification K: Water Service: For flanged connection – a double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 degrees F. Connectors shall have minimum movement capabilities of 1.77” compression, 1.18” lateral and 1.18” extension. Connectors shall provide a minimum 35 degree angular movement up to 6”, minimum 30 degree up to 12” and minimum 20 degree up to 24”. Spring loaded control units shall be furnished to limit movement to within allowables. Flex connector shall be Amber/Booth Type 2600.

1. Water Service: For threaded type – A double spherical rubber hose connector, minimum 8” long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8” compression, 7/8” lateral, ¼” extension and 20 degree angular through 1-1/4”, 13 degree through 2”, and 9 degree through 3”. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to ¼”. Flex connector shall be Amber/Booth Type 2655.

B. Specification L: Steam and Condensate Service:

1. For flanged connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Flex connector shall be Amber/Booth Type SS-FP or SS-FW.
2. For threaded connections - a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Flex connector shall be Amber/Booth Type SS-PM.

C. Air Compressor Service:

1. For flanged connection – a flanged metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Connector shall be double braided with a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-FP (Special).
2. For threaded connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Connector shall be double braided and have a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-PM (special).

PART 3 - EXECUTION

3.1 ISOLATOR AND SEISMIC RESTRAINTS shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 3/4 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

A. Natural Gas Pipe: All piping shall be isolated with specification E hangers or specification SB or SX floor mounts with the same deflection as equipment isolators (max 2”).

B. Pipe Riser Isolation: All piping risers shall be fully supported by specification B mounts with precompression plates. Pipe risers shall be supported at intervals of every third floor of the building. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed. Riser supports shall be Amber/Booth Type SWP.

3.3 DUCT ISOLATION

A. Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type E hangers or type SB (SX) floor mounts.

3.4 INSTALLATION

A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary support during installation or shipping.

B. Locate isolation hangers as near the overhead support structure as possible.

C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

D. Seismic Rated roof curbs shall be installed directly to building structural steel or concrete roof deck. Installation on top of steel deck or roofing material is not acceptable. Shimming of seismic rated curbs is not allowed.

3.5 APPLICATION OF SEISMIC RESTRAINTS

A. ISOLATED EQUIPMENT

1. All floor mounted isolated equipment shall be protected with type SB or type C unitized isolator and restraint or with separate type SL restraints (minimum of 4) in conjunction with type B isolators. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
2. All suspended isolated equipment and vessels shall be protected with specification SC restraints. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

B. ROOFTOP CURBS

1. All rooftop equipment shall be mounted on Specification X seismic rated roof curbs.

3.6 DUCTWORK

A. Duct work 6 square feet and larger in cross sectional area shall be protected in all planes by type SC restraints. Locations shall be determined by the isolator supplier and shall include, but not be limited to: (1) at equipment connections as required to protect the connections. (2) at all duct runs and duct run ends (transverse bracing and longitudinal bracing not to exceed spacing specified in Amber/Booth design criteria, or SMACNA guidelines).

END OF SECTION 230548

SECTION 230593

BALANCING, ADJUSTING, AND TESTS

PART 1 - GENERAL

1.1 SCOPE

A. Work in this section includes the adjusting and balancing of all heating, air conditioning, and ventilating systems. The results of all tests, adjustments, and balancing shall be submitted to the Architect for approval.

B. Provide all labor, supervision, tools, equipment, instruments, additional materials, report forms, etc. as required to complete an accurate balance of the system.

C. Belts, drives, impellers, and motors shall be adjusted and/or changed as required to obtain the required air and water quantities against the developed system pressure.

D. The building air distribution is to be balanced to provide the quantity of air as shown on drawings. System air balance is to be accompanied with certified test forms as to obtained air quantities. Proper fan performance and coil discharge air temperature reading shall also be certified on test forms.

E. Mechanical Contractor shall furnish competent personnel and necessary testing instruments and equipment to check, test, operate, and adjust all mechanical equipment and systems as installed. Tests shall be as required to ensure that all equipment is operating in accordance with manufacturer's recommendations, and requirements of this specification. Tests shall be of sufficient duration to prove adequacy and satisfactory performances of all items of equipment.

F. Mechanical contractor shall supply upon request without additional charge, instrumentation and personnel to spot check system balance in presence of Engineers and Owner.

G. All tests, balancing, and adjusting shall be performed as many times as required to prove project requirements have been met.

H. Control Contractor shall adjust and set all thermostats, program clock, and other control items of equipment as required. Contractor shall submit to the Architect and Engineers record copies of Control Contractor's certification that all specified control items of equipment have been installed, calibrated, and are operating properly.

1.2 QUALITY CONTROL

A. All testing and balancing work shall be performed by an approved and suitable contractor.

B. Testing and balancing instruments shall have been calibrated within a period of six months prior to use in this work. Instruments used shall be of high quality and as recommended by their applications.

1.3 SUBMITTALS

A. Prior to acceptance of the system by the Owner, submit for approval a written report in triplicate. The reports shall be complete showing all quantities, velocities, pressure drops, and sizes.

PART 2 - PRODUCTS

2.1 PROVIDE ALL MATERIALS, test equipment and instruments required for the tests.

2.2 BELTS, DRIVES, IMPELLERS AND MOTORS shall be as specified in other sections of this specification for the equipment being adjusted.

PART 3 - EXECUTION

3.1 ADJUSTMENTS

A. Thoroughly clean, flush, fill and test all systems as specifically recommended by the various equipment manufacturers and as required. Check all safety relief valves, high limit controls, freeze protection controls, and all other safety devices to determine if they are functioning properly.

B. Mechanical systems are intended to operate without objectionable noise and vibration. Make all reasonable adjustments to the installed materials and equipment to remove abnormal noise and vibration. Report, in writing, any condition that such adjustments do not correct.

C. Three sets of filters shall be provided. One set shall be installed for operation during construction and testing. The second set of filters shall be installed at time of final inspection and the third set of air filters shall be delivered to Owner prior to final acceptance of the project.

3.2 TESTING AND BALANCING

A. Balance and test Contractor shall provide personnel and instrumentation to adjust, balance, record, and submit not less than two test results (including final test) for each of the following:

1. Air Handling Units

a. Total CFM
b. Return Air CFM
c. Outside Air CFM
d. Total Static Pressure
e. Fan Suction Pressure
f. Fan Discharge Pressure
g. Motor Amperage and Voltage
h. Fan RPM

2. Outside Air Unit (In addition to Fan data above)

a. Outside Air Entering temperature db/wb

b. Return Air Entering temperature db/wb
c. Wheel entering Air temperature db/wb
d. Wheel leaving Air Temperature db/wb
e. DX coil entering Air Temperature db/wb
f. DX coil leaving Air Temperature db/wb

3. Gas Pack Units

a. Air temperature entering coil, db and wb temperature in cooling mode
b. Air temperature leaving coil, db and wb temperature in cooling mode
c. Air temperature entering heater db in heating mode
d. Air temperature leaving heatrer db in heating mode
e. All data for Fans in Item 1
f. Compressor amps and voltage at full load

4. Adjust and record air quantities for all air distribution equipment in accordance with CFM's specified on drawings.

B. Submit record copies of all testing and balancing reports to the Architect and Engineers.

C. Test results shall be presented on approved forms, Submit three (3) copies of these reports to the Owner for approval prior to final building acceptance.

END OF SECTION 230593

SECTION 230700

INSULATION OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Trained personnel regularly engaged in the installation of insulation and approved by the insulation manufacturer shall install the insulation in a neat and professional manner.

B. Except where specifically specified otherwise, all insulation, adhesives, coverings and coatings shall be applied in strict accordance with its respective manufacturer's recommendations.

C. No wheat paste or organic materials that breed or sustain mold shall be used in conjunction with the insulation work.

D. The Contractor shall verify that all tests and inspections of the work to be insulated have been completed and approved before the insulation is applied.

E. Adequate provisions shall be made to protect the premises, equipment, and the work of other trades against all droppings, adhesives and coatings used in the installation.

F. Pipe unions, strainers and flanges on hot lines shall not be insulated; starting and stopping points for the insulation on hot lines shall be 1 inch on either side and shall be neatly tapered and tightly sealed. Cold lines subject to sweating shall be insulated throughout, including unions, flanges and strainers.

G. Ample provisions shall be made at hanger and support points to prevent the compression of insulation beyond that recommended by the insulation manufacturer for the application.

H. All insulation shall have a composite insulation, jacket, binders, and adhesives fire and smoke hazard rating as tested by procedure ASTM E84, NFPA 255, and UL 723, not exceeding the following values and shall be so listed by UL:

1. Flame Spread 25
2. Smoke Developed 50

I. All accessories, including but not limited to, adhesives, mastics, tapes, shall have the same component ratings. All materials shall be labeled indicating compliance with the above requirements. All treatments used to obtain the required ratings shall be permanent; water-soluble treatments will not be acceptable. Flexible elastomeric insulation with smoke developed exceeding 50 is prohibited in ceiling plenums, return air plenums, or ductwork.

1.2 SUBMITTALS

A. Submit shop drawings and data to prove complete compliance with these specifications on all products and methods of installation.

1.3 SCOPE

A. Includes but not limited to insulation of the following items:

1. All supply, return, exhaust and outside air ductwork inside the building.
2. All exposed supply, return, exhaust and outside air ductwork.
3. All refrigerant piping

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

A. The mastics, adhesives, and any other product used with the insulation shall be compatible with, and approved by, the insulation manufacturer.

B. The insulation shall be as specified in each section. Suppliers of comparable products: Arabol, Armstrong, Benjamin-Foster, Forty-Eight Insulations, Insul-Coustics, Koppers, Owens-Corning, Vimasco, and Webers

2.2 DUCTWORK INSULATION

A. Insulate all supply, return, and outside air ducts inside of building with 2-1/2" thick (¾ lb/ft^3 density) fiberglass duct insulation Ultralite, or equal. Insulation shall have .29 maximum K factor (BTU-in.)/(h-ft3-°F) at 75°F mean temperature and shall be supplied with reinforced foil-faced vapor barrier. Insulation as installed shall meet the minimum requirements of the current edition of the International Energy Conservation Code.

B. Insulate all exterior ductwork with 2" thick elastomeric insulation to achieve a minimum R value of 8. Foam rubber insulation shall have a maximum k factor of .27 and shall have an operating temperature range of -40 degrees F to 220 degrees F. Insulation shall comply with ASTM C-534 and UL 94-5v. Insulation shall be rated for use in return air plenum and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

C. Approved Manufacturers: Armaflex, Rubatex, GSG " Ultrafoam", Halstead, Manville, Imcolock, or Imcoaflex. Approved adhesives are Armaflex 520, Manville Micro-Lok 650, BFG Construction adhesive #105.

2.3 AIR CONDITIONING CONDENSATE DRAIN LINES

A. Insulate condensate lines with 3/4" foamed rubber pipe insulation. Foam rubber insulation shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as tested by ASTM E 84-75. Seal all seams and joints with adhesive equal to Armstrong 520.

B. Insulation shall be Armaflex "AP", or equal product by Rubatex, or Manville

2.4 REFRIGERANT LINE INSULATION

A. Flexible foamed pipe insulation. Foam rubber insulation shall have a maximum k factor of .27 and shall have an operating temperature range of -40 degrees F to 220 degrees F. Insulation shall comply with ASTM C-534 and UL 94-5v. Insulation shall be rated for use in return air plenum and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less. Insulation as installed shall meet the minimum requirements of the current edition of the International Energy Conservation Code.

B. Thickness:

1. 1" thick for 1-1/2” outside diameter and smaller pipe.
2. 1-1/2" thick for pipes larger than 1-1/2” outside diameter pipe.

C. Approved Manufacturers: Armaflex, Rubatex, GSG " Ultrafoam", Halstead "Insul-tube", Manville Aerotube II, Imcolock, or Imcoaflex. Approved adhesives are Armaflex 520, Manville Micro-Lok 650, BFG Construction adhesive #105, Imcoa fuse seal joining system, or Imcoa Leaktite.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all insulation in strict accordance with the manufacturer's recommendations, using approved type laggings, adhesives, mastics, and other materials as applicable

3.2 INSULATION OF SHEETMETAL DUCTWORK

A. Insulate all supply, return, and outside air ducts inside of building including lined ductwork with 2" thick duct wrap.

1. Install duct wrap in accordance with manufacturer's recommendations.
2. Do not compress insulation except in areas of structural interference.
3. Secure to duct with stic-clips, overlap all seams and joints and staple. All seams, joints, and punctures in vapor barrier shall be sealed with waterproof mastic.
4. The insulation shall be installed with all joints tightly butted or lapped and with the foil vapor barrier lapped at least 2" and taped with glass fabric tape and vapor barrier mastic. Duct tape is not acceptable.

5. The insulation shall be held in place with No. 18 gauge stainless steel wire not greater than 12" on centers.
6. Welded pins shall be used on the bottom and sides of ducts as required to prevent sagging of insulation, but in no case greater than 12" on centers.
7. The insulation shall be applied to the duct in a manner so that standing seams, bracing, etc. will not be exposed.
8. After the insulation is installed, all punctures in the vapor barrier shall be patched with glass fabric and mastic.
9. Repair of minor punctures in return air vapor barrier is not required.

3.3 EXTERIOR EXPOSED DUCTWORK

A. Exterior ductwork shall be insulated with 2" thick elastomeric insulation.

1. Install insulation in accordance with manufacturer's recommendations.
2. After insulating is complete, an exterior sleeve shall be provided to encase exposed insulation. Exterior sleeve shall be constructed of 0.016” aluminum. All seams and joints in exterior sleeve shall be sealed water tight by soldering or welding. Where sleeve attaches to building and unit the seal shall be caulked with a high quality urethane caulk.
3. After installation and inspection of exterior sleeve, the sleeve shall be primed and painted and identified with a color selected by the Engineer.

3.4 CONDENSATE DRAIN LINES

A. Seal all seams and joints with adhesive.

B. Where possible, slip insulation on piping without splitting.

3.5 REFRIGERANT PIPING

A. Insulation shall fit in snug contact with pipe and be installed in accordance with manufacturer's recommendations.

B. Stagger joints on layered insulation.

C. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.

D. Seal joints in insulation with Manufacturer's approved adhesive.

E. Provide six inch long, 20 gauge galvanized steel sleeve around pipe insulation at each support.

F. Extend insulation through pipe support clamps.

G. Insulation exposed outside building shall have any required slit joints and seams placed on bottom of pipe and given two coats of gray adhesive finish.

H. Insulate fittings with sheet insulation and as recommended by Manufacturer.

I. Paint exterior exposed insulation with two coats of gray finish recommended by Insulation Manufacturer, then finish with a .016" thick aluminum jacket secured with stainless steel bands.

J. Underground refrigerant lines shall be run in rigid PVC conduit. Each line shall be run in a separate conduit of sufficient size to accommodate pipe and insulation. Where conduit penetrates exterior wall and interior floor slab, it shall be sealed with a waterproof mastic.

END OF SECTION 230700

SECTION 230900

CONTROLS

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install a complete system of direct digital automatic temperature and energy management controls as specified below and as manufactured by NOVAR Controls, or approved equal. All approved equal systems shall be compatible with and be capable of total integration with the existing Campus-wide NOVAR control system.

B. All control wiring shall conform to Electrical Section of these specifications, National Electrical Code, and unit manufacturer's recommendations.

C. New controls shall be compatible with existing Host Computer system and all points added as a part of this project shall be added to the Computer's data base along with new graphic displays for all new systems and equipment. All adjustable setpoints and monitored points shall also be available at the Host Computer. Provide all necessary hardware and software required.

1.2 GUARANTEE

A. After completion of the installation, the Contractor shall adjust all sensors, control valves, motors and other equipment provided under this contract with trained personnel in the direct employ of the manufacturer. He shall place them in complete operating condition subject to the approval of the Owner and instruct the operating personnel in the proper use of the equipment.

B. The control system as specified herein shall be guaranteed free from defects in workmanship and materials under normal use and service for a period of one year from date of acceptance by the Owner. Any equipment proven to be defective in workmanship or materials during the guarantee period shall be adjusted, repaired, or replaced by the Controls manufacturer at no charge to the Owner.

1.3 OPERATING AND MAINTENANCE INSTRUCTIONS.

A. Three bound and indexed Operating and Maintenance Manuals shall be prepared and submitted to OWNER’S operating personnel.

B. Each manual shall contain the following information, data and drawings:

1. List of contents. Insert under front cover.
2. Copy of approved submittals, shop drawings and control diagrams.
3. Installation, operating and maintenance instructions for each item of equipment.
4. Manufacturer's list of renewal parts for each item of equipment with recommended stock items and quantities indicated.

1.4 QUALITY ASSURANCE.

A. Materials and equipment shall be the cataloged products of Controls Manufacturer.

B. Install system using competent workmen who are fully trained in the installation of proper operation of the Facilities Management and Control System.

C. Single source responsibility of supplier shall be the complete installation and proper operation of the FMCS and shall include debugging and proper calibration of each component in the entire system.

D. Factory Quality Certification:

1. The manufacturer of the Facilities Management and Control System shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). The intent of this specification requirement is to assure that the products from the Temperature Control System Manufacturer are delivered through a Quality System and Framework that will assure consistent quality in the products delivered for this project.
2. Product literature provided by the Facilities Management and Control System Manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.5 SUBMITTALS

A. Before installation of controls, submit twelve copies of complete submittal data, including equipment specifications, control diagrams, schematic diagrams, internal connections, and sequence of operation to the Architect for approval. Diagrams shall show all instruments, devices, tubing, etc. Set points and actions of instruments, operating ranges, and normal position of controlled devices shall be indicated. Operating sequence describing each system shall appear on the same drawing as the system's control diagram.

B. Wiring diagrams shall show conduit and wire sizes, transformers, fuses, and correct schematic diagrams for each motor starter and magnetic contactor. Diagram shall be coordinated with the equipment manufacturers involved and shall show the terminal designations for all connections to the equipment and the manufacturer's approval obtained.

C. Control submittal shall include a list of all graphic screens to be provided. Include in the submittal a flow chart of how the graphics will be interlinked. A schematic of each graphic shall be provided with all display data clearly identified.

D. Upon completion of the work, provide a complete set of drawings and application software on magnetic floppy disk media. Drawings shall be provided as AutoCAD compatible files.

PART 2 - PRODUCTS

2.1 ELECTRICAL WIRING

A. All electrical wiring, both control and interlock, shall be provided under this section of the specifications unless specifically indicated otherwise hereinafter or under the Electrical Section of the specifications.

B. Under this section of the specifications, control and interlock circuits required to enter a motor control center shall be extended to a junction box in the immediate vicinity of the motor control center. Each circuit shall be provided with a minimum of 15 feet of properly tagged wire for extension to and termination in the Motor Control center under the Electrical Section of this specification. The control manufacturer shall coordinate the wiring with the electrical equipment furnished and shall be responsible for proper terminations.

C. Unless otherwise indicated, the control power for each system shall be taken from the 115 volt circuit at each panel, with a control voltage transformer, circuit breaker, and disconnect switch.

D. Refer to the Electrical Section of the specifications regarding motor starters. Only one source of power will be allowed in a starter enclosure, unless specifically noted otherwise, and relays will be used to control starter coils; however, interlock circuits may be run through auxiliary contacts of starters without additional relays unless same are required by the control functions.

E. All wiring shall be run in galvanized or sherardized rigid electrical conduit or E.M.T. where allowed under the electrical section of the specifications, and shall be concealed in finished areas and occupied spaces. All conduit shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation. NO PLENUM RATED CABLE WILL BE ALLOWED ON THIS PROJECT.

F. Unless specifically indicated elsewhere, all power wiring from the breaker panel to all control devices including but not limited to control panels, valves, thermostats, dampers, flow switches, control dampers, and other devices requiring power for a complete and operating system shall be provided under this Section of the work.

G. Conductors

1. 50 to 600 volts:

a. Use solid copper, 75 °C type THW, THWN or XHHW for conductors No. 10 AWG and smaller unless otherwise indicated on the drawings, required by the National Electrical Code, or specified elsewhere. Where fixtures are used as raceway use 90 °C type THHN or XHHN conductors.

b. Use No. 12 AWG stranded type THHN/THWN for control conductors on 120 volt control wiring systems unless indicated otherwise on the drawings.

c. Splices and taps (No. 10 AWG and smaller) - Connectors for solid conductors shall be solderless, screw-on, spring pressure cabled type, 600 volt, 105 degrees C with integral insulation and UL approved for aluminum and copper conductors. Use crimp-on type connectors with integral insulating cover on stranded conductors.

d. Electrical insulating tape shall be 600 volt, flame retardant, cold and weather resistant, minimally .85 mil thick plastic vinyl material; Scotch No. 88, Tomic No. 85, Permacel No. 295.

2. Below 50 volts:

a. Minimum size for individual conductors is AWG No. 18. Minimum conductor sizes for multiconductor cables is AWG No. 22. Low voltage conductors are allowed to be run in above ceiling space and in walls except where space if defined as a plenum such as above furred ceilings. In plenums, (including mechanical rooms) conductors shall be run in raceway per NEC Article 300-22 or shall be covered with Teflon FEP insulation approved for plenum applications. All other wiring (e.g., wiring run outside or exposed) shall be run in conduit.

b. Taps and Joints: Mechanically and electrically sound.

c. Color Code: All low voltage control conductors shall be color coded by factory.

d. Conductor Insulation: "TFFN", unless noted otherwise.

e. Manufacturers: Some approved manufacturers are Anaconda, Belden, Brand Rex, Continental, General Cable, Phelps Dodge, Simplex and Triangle.

H. Control Voltage

1. 120 volt or less control is required and may be accomplished either by individual control transformers or use of internal panel transformer where available. Where panel transformers are utilized, circuits shall be increased as necessary. In either, fuses shall be provided in each ungrounded primary leg.

2.2 CONTROL DEVICES AND ACCESSORIES

A. Positive positioning devices shall be provided for all control motors and valve operators used for proportioning or sequencing control, to make available the full power of the motor in both directions.

B. Pressure switches shall be complete with mercury or otherwise totally enclosed switching action. The pressure switches shall be suitable for the service and shall be of the adjustable type with ranges as required.

2.3 CONTROL VALVES

A. Valves shall be of the modulating or two-position, three-way or two-way as required and/or indicated and shall be suitable for the pressures, temperatures, and operating conditions to be encountered. Valves 2 inches and smaller shall have bronze bodies with screwed ends, and valves 2-1/2 inches and larger shall have iron bodies with flanged ends. Modulating valves shall have renewable seats and V-port or equal percentage plug.

Three-way modulation valves shall have linear inner valves. All two-way valves shall have single-seal and shall be for "dead-end" service.

B. Three-way valves for modulating use on water service shall be semi-balanced, all metal, double-seated valves.

C. All control valves larger than 2-1/2" shall be provided with pneumatic actuators, valve position feedback, and pilot postioners. Electronic valve actuators with position feedback may be used for valve 2" and smaller.

2.4 MOTOR OPERATED DAMPERS

A. Motor operated dampers shall be as specified under the "Air Distribution" Section of the specifications.

B. All actuators for motor operated control dampers shall be provided under this Section unless specifically noted otherwise.

2.5 THERMOSTATIC DEVICES

A. Thermostats, electronic remote bulb type, shall be functionally similar to room type with adjustable throttling range and shall have remote bulbs of the rigid stem or with flexible capillary tubes as required. Capillaries shall be liquid-filled compensated or other approved type. Elements installed in pipe lines shall have union connected separable wells and elements installed in duct systems shall have averaging elements with the sensing portion not less than 6 feet long, unless otherwise noted. Submaster thermostats shall have field adjustable readjustment range.

B. Thermostats, electric room type, shall be low voltage type, 2-position or modulating as required, with lock type cover, concealed temperature adjustment, less thermometer, and shall have mercury type or other totally enclosed contacts. No room thermostat shall operate on a voltage in excess of 24 volts, unless specifically noted otherwise.

C. Firestats shall be electric, or the rigid element or remote bulb type as required, but shall be manually reset. Firestats shall have a fixed setpoint, and shall be set at 125°F, unless otherwise noted. All firestats shall have 2 circuit contact blocks for 4 wires.

D. Freezestats shall be as described heretofore for remote bulb thermostats, except shall be equipped with a capillary sensing element with an active length of not less than 20 feet, 1 foot of which, at any point along the element, shall be capable of activating the control instrument. All freezestats shall have 2 circuit contact blocks for 4 wires. One contact to be used for monitoring.

E. Electronic temperature sensors shall consist of nickel wire windings which varies its resistance with temperature changes. The elements shall be precision wound to a resistance tolerance of .25% at 70°F. Insertion elements other than for air shall be wound on a rigid tube and used with immersion wells. Duct insertion elements shall be protected type. Elements used outdoors shall be encased in a waterproof conduit fitting. Elements used for room sensing shall be encased in thermostat covers matching other room thermostats.

2.6 FIELD SENSORS AND DEVICES

A. ANALOG INPUT DEVICES

1. Resistor Temperature Detector (RTD): RTD's shall have a range of minus 50 to plus 250°F, with a resistance tolerance of .25% at 70°F. The RTD shall be encapsulated in epoxy, series 300 stainless steel, or a copper sheath. The RTD's shall be provided in either probe mounting, averaging element, or for mounting in a separable well for liquid sensing applications.
2. Humidity Sensors: Humidity sensors shall be solid state with a range of 10 to 80 % RH with an accuracy of plus or minus 4% at 70°F. The sensing element shall be of the non-saturating type. Provide either duct or wall mounted versions based on the application required.
3. Pressure to Electric Transducers: For sensing applications where a pneumatic control signal exists, provide a pressure to electric transducer that develops a 1 to 5 VDC signal in response to a 3 to 15 psi input. The transducer shall be designed for operation at 24 VDC with a maximum current draw of 4 mA maximum. The transducer shall be rated for 150 percent of the normal input pressure.
4. Differential Pressure Transmitters: Provide electronic static pressure transmitters for the appropriate ranges as indicated on the plans or in the specifications. The device shall provide for ranges of from 0 to .1 inches of water column up to 0 to 10 inches of water column. Accuracy at any range shall be plus or minus 2 percent full scale. Units shall be rated for ten times normal input pressure. Unit shall operate from the panel 24 Volt DC supply.

B. BINARY INPUT DEVICES

1. Differential Pressure Switches: Provide a differential pressure switch with single pole double throw contacts. Switch operation shall be adjustable over the operating range. The switch shall have a snap-acting Form C contact rated for the application. The switch contacts shall be rated for 5 amps at 120 volts as a minimum.
2. Pressure Switches: Pressure switches shall have a repetitive accuracy of plus or minus one percent of their operating range and shall withstand up to 150 percent of rated pressure. Sensors shall be diaphragm or bourdon tube. Switch operation shall have a snap-acting Form C contact rated for the application. Switch contacts shall be self-wiping contacts of platinum alloy, silver alloy, or gold plated, and shall have an adjustable differential setting.

C. OUTPUT DEVICES

1. Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall have silver alloy contact material. Relay operation shall be in 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression (limiting transients to non-damaging levels). All control relays shall be of the plug-in style with a separate base. All wiring shall be terminated to the base and not the relay itself.

D. DAMPER OR VALVE OPERATORS

1. Damper or valve operators shall be provided for each automatic damper of valve and shall be of sufficient capacity to operate the damper of valve under all conditions, and to guarantee tight close-off of valves, as specified, against system temperatures and pressure encountered. Each operator shall be full-proportioning or two-position type as required, indicated or specified, and shall be provided with spring return for normally closed or normally open position for fire, freeze, or moisture protection on power interruption as required.
2. Provide operators with proper linkages and brackets for mounting and attaching to devices.
3. Electronic Actuators: Actuators shall be sized and adjusted to provide tight close-off as required by the sequence of operation. Actuators found not to have enough torque for positive close-off shall be replaced with actuators and accessories required to make controlled device meet its intended purpose.

E. LOCAL CONTROL PANELS

1. Local control panels shall be constructed of steel or extruded aluminum with hinged door and keyed lock, with baked enamel finish of manufacturer's standard color. All controlling instruments, temperature indicators, relays, switches and gauges shall be factory installed and permanently labeled and located inside or face of the panel. Unless otherwise indicated, mount control and adjusting switches, temperature indicators, and other indicating or manually operated devices on the front face of the panel with suitable engraved nameplates.
2. Approved AS-BUILT control diagrams shall be mounted inside of each panel.

2.7 ENERGY MANAGEMENT SYSTEM

A. The existing energy management system shall be upgraded for the new equipment. New equipment shall have the ability to maintain operation even if communication is lost from the central control facility.

B. Energy Management Functions

1. Each controller shall be capable of performing the following energy management routines as a minimum.

a. Time of day scheduling (365 day Clock)
b. Timed overrides of daily programs
c. Start/stop time optimization
d. Peak demand limiting
e. Duty cycling (temperature compensated)
f. Economizer control
g. Enthalpy changeover
h. Supply air reset
i. Chilled water reset
j. Outdoor air reset
k. Event initiated programs
l. Occupied/unoccupied modes

C. Control Functions

1. Each controller within the Building Control System shall perform both temperature control functions and energy management routines as defined by the operator.
2. All temperature control functions shall be executed within the DDC unit Loop control shall be executed via direct digital control algorithms. the user shall be able to customize control strategies and appropriate control loop algorithms and choose the optimum loop parameters for loop control. Control loops shall support any of the control modes:

    a. Two-position (on-off, slow-fast, etc.)
    b. Proportional (P)
    c. Proportional plus integral (PI)
    d. Proportional, integral, plus derivative (PID)

3. It shall be possible to fully create, modify or remove control algorithms within a specific DDC unit while it is operating and performing other control functions. Each control loop shall be fully user definable in terms of:

    a. Control mode
    b. Gain
    c. Control action
    d. Sampling time

4. In order to minimize wiring and sensor costs, provide DDC units that are able to share point information such that control sequences or control loops executed at one control unit may receive input signals from sensors connected to other DDC units.
5. The system shall permit the generation of job-specific control strategies that can be activated in any of the following ways:

    a. Continuously
    b. At a particular time-of-day
    c. On a pre-defined date
    d. When a specific measured or controlled variable reads a selected value or state.
    e. When a piece of equipment has run for a certain period of time

D. Battery Backup

1. Upon a loss of commercial power to any DDC unit, other units shall not be affected, and the loss of operation of that unit shall be reported at the designated operator's terminal. All control strategies and energy management routines defined for the DDC unit shall be retained during a power failure via the battery with the unit for a minimum of thirty (30) hours. Upon resumption of commercial power, the control unit shall resume full operation without operator intervention. The unit shall also automatically reset its clock such that proper operation of timed sequences is possible without the need for manual reset of the clock. Controller provided with non-volitile EEPROM memory for control parameters shall be except from battery back up system.

E. User Specified Programs

1. The library of routines available in firmware must be capable of generating programs specified by the user. These shall include but are not limited to

   a. Intermediate season control (dead Zone)
   b. Trending of variable
   c. Historical data storage
   d. Totalizing
   e. Holiday programming

F. Operator Interface

1. The operator interface shall be capable of providing digital displays of all points addressed within the particular level two and level three controllers.
2. Each addressable hardware and software point shall be capable of being manually displayed and overridden through the operator interface.
3. In addition to local display on controller, one laptop computer for connection to system LAN and second and third level controller shall be provided as a part of this contract.

G. Field Programmable

1. The controller shall contain al necessary mathematic, logic, utility functions and all standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include but not be limited to:

   Math Routines:
   a. Basic Arithmetic
   b. Binary Logic
   c. Relational Logic
   d. Fixed Formulas for Psychometric Calculations

   Utility Routines For:
   a. Process Entry and Exit
   b. Keyboard Functions
   c. Variable Adjustments and Output
   d. Alarm Indication
   e. Restart

   Control Routines For:
   a. Signal Compensation
   b. Loop Control
   c. Energy conservation
   d. Timed Programming

2. Final field programs shall be stored in battery backed-up RAM or non-volatile EEPROM.

H. Expandability

1. The unit shall be expandable by adding additional field interface units that operate through the processor of the controller. The processor in the DDC shall be able to manage remote field interface units thereby expanding its control loop and energy management point capacity.

I. Calibration Compensation

1. To maintain long term analog accuracy in the controller sensing circuits, the unit shall sense the voltage being supplied to the resistance sensing element and through firmware, and compensate for power supply changes due to long term drift or drift due to ambient temperature changes at the power supply.

J. Diagnostics

1. Each unit shall contain self diagnostics that continuously monitors the proper operation of the unit. A malfunction of the unit will be reported, and will inform the operator of the nature of the malfunction, and the control unit affected. It shall be possible to annunciate malfunctions as well as other control unit alarms at a selected central operator's terminal.
2. The system shall allow on-line diagnosis via telephone modem from a remote location (vendor's headquarters or local branch office).

K. Default Operating Procedure Alarms

1. All variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated), which is identified as being unreliable, the unreliable data value will flash. The calculation will use a default value programmed into the unit. All alarms shall be displayed at the controller. A scan can then identify all alarm conditions and their identifier.

L. Adaptive Control

1. The system shall be provided with an adaptive control setup to monitor indoor/outdoor temperatures and respond automatically to changing conditions to provide:

    a. Optimize morning start-up time to provide minimum warm-up or cool-down.
    b. Temporarily increase on-time of duty-cycled loads to correct indoor temperature variances during occupied hours.
    c. Provide night setback by automatically starting "normally off" equipment at night to keep building temperature above field adjustable low limit.
    d. Provide minimum on-time of HVAC equipment through multiple-zone control.
    e. All set points and programs shall be easily adjusted to suit individual building characteristics.

M. Demand Limiting

1. The ability to set demand control record KW setpoint level and automatically shed building loads to maintain demand setpoints shall be provided.

N. Smart Serial Interface

1. A serial interface shall be provided to allow all data and programming information to be either uploaded or downloaded from a remote location.

O. Cabinet

1. The controller shall be enclosed in a metal cabinet. The cabinet shall be constructed such that it can be mounted and electrical terminations made during the construction phase of the project.
2. The unit cabinet shall be provided with a key lock. All cabinets on each installation shall utilize one master key.

2.8 MONITOR AND ALARMS

A. Monitor and alarm the following points when "off normal" conditions exist. An alarm shall cause an audible alarm and display at the remote personal computer furnished by Owner.

1. Temperature drift in any temperature controlled device.
2. Entering temperature for each coil. (Global point acceptable)
3. Leaving temperature for each coil.

PART 3 - EXECUTION

3.1 INSTALLATION OF INSTRUMENTS

A. Install all room thermostats and fan switches 5' AFF unless otherwise specified on plans. All room thermostats shall be furnished by unit manufacturer and wired in accordance with equipment manufacturer's recommendations for proper unit control. All control wiring shall conform to Electrical Section of these specifications, National Electrical Code, and unit manufacturer's recommendations.

B. All controls mounted outside building shall have weatherproof enclosures.

C. Control Panels shall be located in mechanical rooms and shall be installed 5' AFF and shall be anodized aluminum or steel with baked enamel finish and designed for wall mounting. All devices on panel cover and inside panel shall be identified by plastic nameplates. Provide hinged locking door for access to devices inside panel. All enclosures and cabinets housing electrical apparatus and the secondary side of all transformers shall be grounded.

3.2 WIRING

A. All conduit shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation. Wiring shall be run parallel and at right angles to the building construction.

3.3 RECORD DRAWING

A. A copy of the complete reviewed control diagram shall be framed under glass in each Mechanical Equipment Room. Copies shall be black line photostat.

3.4 IDENTIFICATION

A. Engraved plastic nameplates shall be provided for all control equipment. Lettering shall not be less than one-quarter inch high. Attach to fixed surface adjacent to each instrument. Label all devices on monitoring panel and room instruments. Label shall indicate device's operating range, normal setting (or reading), and function of device.

PART 4 - OPERATING SEQUENCES

4.1 GAS PACKS

A. Furnish and install electric DDC controllers with room temperature sensor. Sensor shall have communication port for interrogation of local controller and interface with building control system network, programmable occupancy override button, and programmable setpoint adjustment.

1. Each unit shall be wired to provide the control sequence recommended by unit manufacturer.
2. Unit controller shall be provided with necessary hardware and software to provide the following information back to the building central energy management system. This data shall also be available at the handheld unit by plugging into the controller’s space sensor.

a. Room temperature.
b. Active room set points Heating & Cooling.
c. Compressor commanded state
d. Gas Heat commanded state
e. Room scheduled state (occupied/unoccupied)
g. Unit discharge air temperature
h. Fan commanded state
i. Fan status via current sensing relay
j. Unit alarm status

4.2 OUTSIDE AIR CONDITIONING UNITS

A. Each unit shall be provided with a factory mounted direct digital controller compatible with the existing Siemens controls system. Control contractor shall coordinate with unit manufacture to insure controller version is compatible with field installed network.

B. In the occupied mode the unit controller shall energize supply fan. The controller shall monitor discharge air temperature and humidity and cycle the compressors, modulate compressor capacity and modulate heat wheel speeds to maintain active discharge air temperature dew point temperature. If dew point rises above active space setpoint, the active discharge dewpoint temperature shall be reset down. In winter mode the scr controlled auxiliary electric heat shall be cycle on to maintain active discharge air temperature setpoint.

C. In the unoccupied mode the unit controller shall be de-energized. If space relative humidity rises above 60% unit shall be energized to lower space RH to 50%.

D. Each air handling unit shall be provided with a smoke detector in the supply air. Duct smoke detectors shall be wired to shut down system when products of combustion are sensed.

E. The following points shall be available at the central control computer for each unit:

1. Fan commanded state
2. Fan status
3. VFD speed for each energy wheel
4. Unit discharge air temperature, humidity and calculated dewpoint
5. Return/exhaust air temperature, humidity, and calculated dewpoint
6. Temperature and humidity downstream of each wheel and coil on supply air side
7. Outside air damper position, proven with end switches
8. Discharge air dewpoint active setpoint
9. Compressor status
10. Electric heat SCR output (% of full output)
11. Unit alarms
12. Outside air temperature
13. Outside air humidity
14. Smoke detector status
15. Fan CFM from unit fan sensor

END OF SECTION 230900

SECTION 232300

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SPECIAL NOTE

A. Piping shown on drawings shall be installed complete and shall be of the size shown. When a size is not indicated, the Mechanical Contractor shall request the pipe size from the Architect through the General Contractor. All piping shall be installed parallel or perpendicular to the building construction.

B. Some refrigerant line lengths and/or vertical lifts may exceed manufacturer's recommendations. Mechanical contractor is responsible for insuring the equipment manufacturer sizes all refrigerant lines for these pieces of equipment. Provide suction line accumulators and solenoid valves near the expansion valve if necessary.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. All refrigerant piping shall be type "L-ACR " copper tubing, hard drawn with wrought copper solder type fittings suitable for connection with silver solder.

B. Refrigerant suction piping shall be trapped at each indoor unit. Each liquid line shall be provided with a dryer as specified in the Equipment section of these specifications. Provide all necessary valves to isolate dryer to allow service without losing entire system charge.

PART 3 - EXECUTION

3.1 REFRIGERANT PIPING JOINTS

A. All joints in piping shall be silver soldered. The piping shall be charged with dry nitrogen while constructing the joints. Piping within chases in building shall be one piece, no joints will be allowed in hidden or inaccessible areas.

3.2 PRESSURE TESTING

A. All refrigerant piping shall be tested in accordance with equipment manufacturer's recommendations and in compliance with Section 232300.

3.3 PIPE HANGERS AND SUPPORTS

A. The contractor shall furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

B. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate strength of the support. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the contractor shall submit a certification stating that such requirements have been complied with.

C. Submit to the Engineer for approval shop drawings of all items to be furnished under this section.

D. Submit to the Engineer samples of all materials specified herein if requested. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such a equipment, pipe and personnel contact.

E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.

F. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.

G. Pipe hangers and supports shall be as manufactured by B-Line Systems, Inc. or equal by PHD, Grinnell, or Fee and Mason. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.

H. Hanger rods, nuts, and bolts shall be galvanized steel.

I. All supports outside of building shall be galvanized construction.

J. Pipe Hangers and Supports for Refrigerant piping shall be equal to B-Line galvanized steel strut system.

1. All hangers and supports shall have some form of adjustment available after installation. Hanger material shall be compatible with the pipe material.
2. Hangers for copper tubing shall be B-Line Systems, Inc. Strut system with Vibra Cushion isolators and pipe clamps.
3. Piping hangers shall be installed around the outside of the insulation with protective shields.

K. Hanger Rods:

1. Hanger rods shall be B-Line Systems, Inc. figures B3205 and ATR or equal.
2. Hanger rods shall be subjected to tension only. Lateral and axial movement shall be accommodated by proper linkage in the rod assemble.

3. Hanger rod diameters shall be based on MSS SP-69 Table 4.

L. Concrete Inserts:

1. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls, or floors, spot inserts for individual pipe hangers and shall be as manufactured by B-Line Systems, Inc. or equal and shall be as follows:
   a. Continuous concrete inserts shall be used where applicable and shall be used for hanger rod sizes up to and including 3/4" diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be B221, B321, or B521 by B-Line Systems, Inc. or equal.
   b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8" diameter. Inserts shall be figures B2505 thru B2508, B2500, or B3014 by B-Line Systems, Inc. or equal.

M. Riser Clamps:

1. Riser piping shall be supported independently of any connected horizontal piping of possible. Provide supplementary steel or concrete supports for clamps. The clamps shall not be supported by the sleeves.
2. Support all vertical runs of ambient piping at each floor or as specified with B-Line Systems, Inc. figures B3373, B3131, B3373CT as required or equal.

N. Saddles:

1. Pipe covering protection saddles shall be used in conjunction with all insulated cold pipe lines. All saddles shall be centered on the piping and in the hangers.
2. Saddles for all insulated piping shall be galvanized sheet metal saddle shields of adequate size to cover the bottom 120 degrees of the pipe insulation. The shields shall be properly curved to evenly contact the outside circumference of the insulation and shall have rounded corners (1/2" radius). The length of the shields shall be as recommended by the pipe insulation manufacturer for the pipe size, insulation thickness and hanger spacing, but in shields shall be constructed of sheet metal of gauges not less than that listed below:

Pipe Size	Min. Gauge	Min. Length
Up thru 3"	18 gauge	12" long
3-1/2 thru 5"	16 gauge	16" long
6" and 8"	14 gauge	20" long
10" and 12"	12 gauge	24" long

3.4 PIPING shall be installed and connected to the equipment essentially as indicated on the drawings, in a neat and workmanlike manner. Unless specifically noted otherwise, all piping shall be concealed above ceilings and in chases.

3.5 ALL PIPING and equipment shall be supported by the building structure. Unless specifically noted otherwise, no piping or equipment shall be supported from ductwork, other piping, plenum construction or other equipment.

3.6 ALL PIPING shall be installed and arranged to allow free movement to the piping due to expansion, contraction, building movement, etc. without putting excessive stress or strain into the piping or equipment. All piping, risers, runouts, etc. subject to deflection by expansion and contraction shall be cold-sprung 50% of the deflection required to be absorbed. All sleeves and other openings in the construction shall be of sufficient size and spaced so as to allow for the necessary pipe movement without undue stress on piping. Risers shall be free to travel as required with the horizontal piping. Piping runouts to and from risers shall be absorbed and still maintain the specified pitch for the runouts and piping to and from the risers.

3.7 PIPING and equipment suspended from steel construction shall be suspended from beams or from the panel points of the bar joist only. When the hanger point is not directly below a structural member or a joist panel point, supplementary supporting steel shall be provided across the structural members or bridge joists as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.

3.8 ALL VERTICAL PIPING shall be installed plum and true. Horizontal piping specified to be graded shall be installed at a straight and uniform grade without pockets. Horizontal piping not specified to be graded, shall be installed in a straight and true manner.

3.9 All piping suspended from structure, where the distance from the top of the duct or equipment to the bottom of the structure is more than six (6) inches, shall be provided with siesmic cable restraints as detailed in Vibration Mounting and Control, Inc. Drawing # 33557 or 33558 as appropriate. Cabling system shall be sized and installed in strict accordance with manufacturer's recommendations for compliance with Standard Building Code Section 1206.

3.10 ALL PIPING SYSTEMS shall be arranged to drain to one or more low points. Each low point shall be equipped with a hose and valve drain connection.

3.11 UNIONS and/or companion flanges shall be provided at all equipment connections and elsewhere as indicated on the drawings or as required for easy removal of equipment.

3.12 INSULATION

A. Insulate refrigerant piping as specified in section 230700 of these specifications.

END OF SECTION 232300

SECTION 233000

AIR DISTRIBUTION

PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS

2.1 SUPPLY DIFFUSERS AND RETURN GRILLES

A. Material and Finishes: Construct diffusers, registers, and grilles of aluminum as indicated on drawing schedules. No steel construction will be allowed on this project. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Diffusers and grilles located in fire rated ceilings shall be steel construction. Colors shall be as specified on schedules or as approved by Owner.

B. Sound Pressure Level: The inlets and outlets shall be sound rated and certified in accordance with ADC 1062 R4, in db of noise criterion (NC) based on sound power level minus 10 db in each octave band. All devices shall have a sound power level no greater than 35.

C. Throw: Defined as distance from the diffuser, register, or grille to the point which the air velocity falls below 50 feet per minute. Throw shall not exceed 1.5 times the outlet mounting height.

D. Drop: Maximum drop of air stream shall not be so great that it is within 6 feet of the floor at the end of the throw.

E. Ceiling Diffusers: Equip with baffles or other devices required to provide proper air distribution patterns indicated on drawings. Provide factory-fabricated, single key, volume dampers. Diffuser internal parts shall be removable through the diffuser-neck for access to the duct and without the use of special tools.

F. Each grille shall be provided with two tabs on diagonal corners for connection of suspension wires. Contractor shall provide suspension cables from tabs to building structure in compliance with the International Building Code.

G. Air distribution devices shall be by Metal Aire or Krueger as indicated on grille and diffuser schedule, Price, Nailer, Titus, or approved equals.

2.2 DUCTWORK

A. Duct to be air tight, smooth on inside and neatly finished on the outside. Details on construction and materials not specified herein shall be in accordance with recommendations of latest ASHRAE Guide, or Duct Manual published by the Sheet Metal and Air Conditioning Contractors National Association, and shall comply with the International Building Code.

B. Drawings show general arrangement of ducts, but do not necessarily show all offsets, etc., required to avoid interferences. Where shape of duct is varied, alter dimensions to provide equal static pressure drop per unit of length.

C. Turning vanes must be installed in all square elbows. Radius elbows are to have a centerline radius of 2-1/2 diameters for round duct. Radius elbows in rectangular duct are to have a centerline radius of two duct widths.

D. Provide splitter dampers for adjustment of distribution to branches where indicated on drawings and elsewhere as required to properly balance system. Splitters shall be the same thickness galvanized steel as duct where used but in no case shall the splitter by less than 22 gauge. Splitter shall be hinged at leaving edge and shall have a rounded nose at air entering edge. Length of splitter shall be at least 1-1/2 times the width of smaller branch duct but in no case less than 12". Splitter shall have a 3/8" steel rod hinged to air entering edge and passing through a suitable clamp on the side of duct to permit position adjustment and rigid anchor in final position. Where size of splitter dictates multiple anchors shall be used.

E. Provide duct air extractors (DAE) for adjustment of distribution to branches where indicated on drawings and elsewhere as required to properly balance system. Extractors shall be equal to MetalAire Model 101 or 102 Airtrol. Extractor shall have a remote operator passing through a suitable clamp on the side of duct to permit position adjustment and rigid anchor in final position.

F. Except as specified, all rectangular ductwork shall be galvanized steel fabricated in accordance with latest SMACNA Duct Manual for low pressure ductwork.

G. All exposed ductwork shall be constructed of "paint grip" or galvanneal steel and shall be field painted to match ceiling structure.

H. Round flexible duct runouts to diffusers shall be Flexmaster Type 8M acoustical low pressure, flexible duct with galvanized steel helix core, CPE inside liner, 1" insulation minimum R-6, and fire retardant reinforced aluminum vapor barrier jacket (.05 perm per ASTM E96), minimum working pressure 6.0” w.g. positive and -4.0” w.g. negative, or approved equal by Thermaflex. Flexible duct length shall not exceed 8'. Take off connections from rectangular ducts to flexible round ducts shall be made with Flexmaster Type FLDE spin-in fittings with extractor and damper or approved equal.

I. Medium Pressure:

1. Duct to be air tight, smooth on inside and neatly finished on the outside. Details on construction and materials not specified herein shall be in accordance with recommendations of latest ASHRAE Guide, or latest Sheet Metal and Air Conditioning Contractors National Association's manual for medium pressure ductwork.
2. All supply ductwork from the air unit outlet to all variable air volume terminals, including powered mixing boxes, shall be medium pressure fabricated in accordance with SMACNA pressure, velocity, and seal class indicated below.
3. Medium pressure round sheet metal duct shall be formed with lock type spiral seams. Provide not less that 24 inches of straight sheet metal ductwork at each variable volume terminal inlet.

4. Medium pressure round branch take-offs shall be conical type.
5. Spiral duct shall be standardized factory machine formed spiral duct and fittings by Monroe Metals, Inc. Install all spiral ductwork in strict accordance with manufacturer's recommendations utilizing factory fabricated fittings and couplings.
6. Seams and transverse joints of medium pressure rectangular duct and transverse joints of round duct shall be sealed with Benjamin Foster 32-14, Insul-Coustic IC450 or Minnesota Mining EC800.
7. Provide medium pressure duct listed to UL Class 1 flexible air duct for final connection to the inlets of variable volume terminals. Inter duct shall be of smooth airtight polymer film laminated to a galvanized steel wire helix. Ducts shall have nominal 1" fiberglass blanket with metallized film laminate vapor barrier. Vinyl vapor barrier not allowed. Flexible duct shall be Flexmaster, Clevafles Type KQA, Anaconda Metal Hose, ATCO Rubber Products, Automation Industries, Inc., Certainteed Corp., Garlock, General Environmental Corp., Johns-Manville, Krauf Fiberglass, Metalflex Corp., Owens-Corning Fiberglas Corp., Porter Co., and Wiremold Co.

J. Medium Pressure Ductwork Tests: Test for air leakage conforming to SMACNA HPDCS, Chapter 10 "Testing for Leakage." Run tests of ductwork, including duct main, duct risers, branch ducts, and flexible duct runouts.

K. All ductwork shall be constructed to the following SMACNA seal, velocity, and pressure classifications:

Duct construction & classification:

Application	Presure Class	Velocity Class FPM	SMACNA Seal Class
EXHAUST FANS	-2.00	2500	B
MISC.LOW PRESS LOW PRESSURE	+2.00	2500	B
DOWNSTREAM OF VAV	+1.00	2500	B
FROM A/C UNIT TO VAV BOXES	+5.0	4000	A

L. Ductwork from outside air unit to individual devices shall be constructed to a SMACNA “A” seal classification.

2.3 FIRE DAMPERS

A. Fire dampers shall be installed where indicated on drawings and shall conform to the latest edition of the Standard Building Code. All fire dampers shall have UL label. Rectangular fire dampers shall be Ruskin No. IBD-2, Style A, B, C, CR, or CO as shown on schedule or as required. Dampers should be for horizontal and vertical installation as indicated on drawings.

B. Dampers shall be Ruskin Manufacturing Company, National Controlled Air, or American Warming and Ventilating, Safe-Aire, Nailer., or approved equals.

2.4 CONTROL DAMPERS

A. Furnish and install opposed blade type airfoil control dampers of size indicated on drawings. Dampers frame shall be constructed of minimum 16 gauge galvanized steel with blade and jamb seals. Airfoil blades shall be aluminum construction. Blade seals shall be vinyl and jamb seals shall be flexible metal. All seals shall be mechanically fastened to damper, glued in place foal rubber seals are not acceptable. Damper leakage shall be less than 6 cfm/sq. ft. of damper area at 1" w.g. when tested in accordance with AMCA standard 500.

B. Dampers shall be Ruskin model specified on drawings, Air Control Products, Louvers and Dampers, Inc., Safe-Aire, Air Balance, Inc., Nailer or approved equals.

2.5 MANUAL DAMPERS

A. Volume control dampers in ductwork shall be Ruskin No. MD-35, or equal opposed blade type, galvanized steel, with heavy duty locking quadrant. Equal products by National Controlled Air, Air Control Products, Louvers and Dampers, Inc., Safe-Aire, Nailer, Air Balance, Inc., or approved equals.

2.6 ACCESS DOORS

A. Ductwork: Furnish and install steel access doors where indicated and/or required for access to motor operated dampers, controls, filters, louvers, fire dampers and any other operable devices. Access doors shall be minimum 12" X 12" in size and shall be fabricated of minimum 24 gauge galvanized steel hinged to a mounting frame of equal or greater gauge and provided with a fastening device to give an air tight closure on neoprene or felt gasket. Doors for insulated duct shall be double panel construction with 1" rigid insulation material between metal panels. Access doors shall be Ruskin AD-1275, Series ADH1-1, Nailer or approved equal.

2.7 COMBINATION FIRE/SMOKE DAMPER

A. Combination fire smoke dampers shall be furnished and installed as shown on plans or as described in schedules. Dampers shall meet the requirements of NFPA90A, 92A and 92B. Dampers shall have a fire rating of 1 ½ hours in accordance with the latest edition of UL555 and shall be classified as Leakage Class I Smoke Dampers in accordance with the latest version of UL555S. Dampers shall be FM approved and labeled as Specification Tested Products and shall be warranted to be free from defects in material and workmanship for a period of 5 years after date of shipment.

B. Each fire smoke damper shall be AMCA licensed and shall bear the AMCA Certified Ratings Seal for Air Performance.

C. The dampers and their actuators shall have a UL555SS elevated temperature rating of 250°F. Actuators shall be installed by the damper manufacturer at time of damper fabrication.

D. Each smoke damper shall be equipped with a “control closure” quick detect heat-actuated release device to prevent duct and HVAC component damage. Instantaneous damper closure through the use of fusible links is unacceptable.

E. Damper frame shall be constructed from roll-formed structural hat channel, reinforced at the corners, and formed from a single piece of minimum 16 gage galvanized steel. Damper blades shall be airfoil shaped with 13 gage equivalent thickness formed from a single piece of galvanized steel. Bearings shall be stainless steel. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked in to the blade edge. Each damper shall be supplied with a factory mounted sleeve of 17” (432) minimum length. Each sleeve shall include a factory mounted access door. Dampers shall be Ruskin model FSD60, or approved equal.

2.8 KITCHEN EXHAUST FAN

A. Provide where shown on drawings, centrifugal belt driven, up blast, vertical discharge type roof exhaust fans of size and capacity specified in schedules on drawings. Motor and drives shall be isolated from exhaust air stream. The motor shall be heavy duty type with permanently lubricated, sealed ball bearings and air for cooling motor shall be taken into motor chamber from a location free of discharge contaminants. Pulleys shall be adjustable cast iron type and the entire drive assembly shall be mounted on vibration isolators. Unit is to be furnished complete with aluminum housing, aluminum mesh bird screen, single speed motor, disconnect switch mounted under ventilator cover, heat baffle, high limit thermostat (firestat) set at 350 degrees F, and pre-fabricated roof curb with treated wood nailer and counter flashing. Fan shall be UL approved for grease removal in accordance with UL #762, shall meet the requirement of NFPA96, NFPA17, and fan performance shall be AMCA certified.

B. Curb shall be internally insulated with both thermal and sound insulation and shall meet the requirements of Section 230500 of these specifications. In additions to the requirement of Section 230500, the curb shall be of sufficient height to provide a minimum fan discharge height of 40" above the finished roof surface. Curb shall be compatible with roofing system. Verify roof pitch and construction prior to ordering curb.

C. Units shall be controlled by a manual ON/OFF switch. The switch shall be mounted on side of kitchen exhaust hood and shall be provided with a stainless steel nameplate identifying its function. Switch shall be provided with a status light to indicate fan operation. Fan shall be provided with a magnetic starter.

D. All conduit from switch to magnetic starter shall be concealed, no exposed conduit on side of hood, along walls, or on ceiling will be allowed. Magnetic starter shall be furnished under Division 22 and installed under Division 23. Magnetic starter will be installed in Remote Electrical Room. It shall not be located within finished Kitchen area.

E. Fans shall be Greenheck model specified on drawings, Loren Cook, Acme, Jenn-Aire, or approved equals.

2.9 KITCHEN SUPPLY AIR FAN

A. The supply fan unit shall be of the belt driven, double width, double inlet, forward curved centrifugal blower type. The blower assembly shall be mounted on vibration isolators. Drives shall be sized for a minimum 165% of the driven horsepower. Fan shall be provided with a magnetic starter. All exterior housing components of the supply unit shall be constructed of minimum 18 gauge galvanneal steel, painted with a weatherproof finish that has been baked for durability. Heavy gauge adjustable angle iron support legs shall be furnished as required. The inlet of the unit shall contain birdscreen and a bank of washable, removable air filters. Filters shall be of one-inch aluminum mesh type, coated with filter adhesive compound, and shall be UL Classified.

B. Furnish a motorized backdraft damper as an integralpart of supply fan unit. Damper shall open upon energization of supply fan and close upon shut-off of supply fan.

C. Furnish pre-fabricated roof curb. Curb shall be internally insulated with both thermal and sound insulation and shall meet the requirements of Section 230500 of these specifications. Curb shall be compatible with roofing system. Verify roof pitch and construction prior to ordering curb.

D. Unit shall be controlled by a manual ON/OFF switch. The switch shall be mounted on the side of the kitchen exhaust hood and shall be provided with a stainless steel nameplate identifying its function. Each fan shall be controlled by a separate switch. Switches shall be identified by function. Fan switch shall be provided with a status light indicating fan operation.

E. All conduit from switch to magnetic starter shall be concealed, no exposed conduit on side of hood, along walls, or on ceiling will be allowed. Magnetic starter shall be furnished under Division 22 and installed under Division 23. Magnetic starter will be installed in Remote Electrical Room. It shall not be located within finished Kitchen area.

F. Fan shall be Exhaust fans shall be Greenheck model specified, Acme, Cook, Jenn-Aire, or approved equal.

END OF SECTION 233000

HEATING AND COOLING SYSTEMS

SECTION 237413

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install where shown on drawings single package gas packs with associated ductwork, supply and return grilles, and thermostats as indicated for each area of the building.

PART 2 - PRODUCTS

2.1 ALL EQUIPMENT

A. All electrical equipment shall be UL listed and all gas equipment shall be AGA certified.

2.2 SINGLE PACKAGE GAS PACK

A. Furnish and install single package gas packs of model and capacity shown on drawings. Units are to be furnished complete with all controls and accessories as specified and required for complete and operating systems. Unit shall be furnished complete with filters, fan and drives, starters, and evaporator coil, hermetic type compressor with crankcase heater, condensing coil, outside air economizer with barometric relief, refrigerant metering device, and condenser fan and drive. Compressor motor shall be covered by a five-year protection plan. Unit shall be UL approved and certified by AGA.

B. Protection devices shall include: liquid line low-pressure switch, suction line accumulator and pressure relief device, thermal and current sensitive overload protection, start assist as required, and rapid recycling protection for compressor.

C. Thermostatic controls shall be provided under controls section 230900.

D. Each unit is to be supplied with a smoke detector in return duct to shut system down when products of combustion are sensed, except as noted in the control section of these specifications.

E. Units shall be Trane Models specified on drawings or approved equals by Lennox, or York.

2.3 FILTERS

A. Furnish and install three sets of filters for each air handler as provided under the Balancing and Testing portion of these specifications.

B. Filter shall be UL listed Class 2, filter media shall have an average efficiency of 30-35% when tested in accordance with ASHRAE Test Standard 52-68.

C. Filters shall be Farr 30/30, American Air Filter, Continental Filter, or approved equals.

D. Three sets of filters shall be provided. One set shall be installed for operation during construction and testing. The second set of filters shall be installed at time of final inspection and the third set of air filters shall be delivered to Owner prior to final acceptance of the project.

PART 3 - EXECUTION

3.1 CONDENSATE DRAINS

A. Provide a trapped condensate line from each gas pack to location indicated on roof plan on drawings. Where no termination point is indicated on drawings, route condensate line to nearest existing roof drain of building and terminate.

END OF SECTION 237413

SECTION 237433

OUTSIDE AIR PRE-CONDITIONING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this section of the specifications shall consist of furnishing and installing factory assembled single package rooftop mounted or indoor mounted outside air pre-conditioning units. Units shall be configured as here-in specified and as scheduled on plans to achieve the specified capacities.

B. Other sections of these specifications are a part of this Section. Refer to all sections for a complete description of the work.

1.2 SUBMITTAL

A. Shop drawings shall be submitted as specified in Section 230200. Shop drawings shall include sufficient information to prove compete compliance with the contract documents. Shop drawings on all system components and assemblies are required.

B. Submittals shall clearly outline the compliance to or deviation from any specified item including but not limited to unit construction details, capacities, and performance characteristics.

C. Shop drawings on all packaged units shall consist of manufacturer's literature and other information as may be required to establish contract compliance. Wiring diagrams especially prepared for this project and showing all modifications required to interlock the unit as specified shall be submitted. The sensible and total cooling capacity of each unit when operating at the specified conditions shall be clearly indicated.

D. Submit drawings indicating components, dimensions, weights required service clearances, and location and sizes of field connections. Indicate equipment, piping and connections and valves required for complete system.

1.3 QUALITY CONTROL

A. All cooling and/or heating coils shall be ARI certified.

B. Units shall be UL or ETL-US labeled.

C. All packaged units shall be tested for noise in a sound laboratory conforming to ASHRAE Std. 36 B 63. Published sound data shall be submitted with the shop drawings and shall be based on ASHRAE methods.

D. All units shall be factory run tested prior to shipment. Results of factory run test shall be provided for each unit and shall be included in the project O&M manuals. At a minimum the factory run test shall include: dynamic fan balance of entire fan assembly over the entire fan variable speed range; compressor run check of each compressor; leak and pressure checks of refrigerant circuits and components; factory mounted controller sequence functionality; and run test of all electrical components.

E. Fan shall be dynamically balanced at the factory at design RPM to less than 3 mils peak-to-peak. Manufacturer shall provide certified data. If vibration data is not supplied by manufacturer, contractor shall conduct vibration tests on fan and unit in the field and submit certified report to engineer for review.

1.4 REFERENCES

A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.

D. ANSI/ASHRAE/IES 90 A - Energy Conservation in New Building Design Standard provides performance requirements to improve the utilization of energy in new buildings.

E. ARI 410 - Forced Circulation Air-Cooling and Air- Heating Coils Standard for establishing requirements for testing, rating and certification of ratings.

F. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements.

G. California Administrative Code - Title 24 - Establishes the minimum efficiency requirements for HVAC equipment installed in new buildings in the State of California.

H. AMCA 300 - Reverberant room method for sound testing of fans.

I. ANS S1.32 - Precision methods for the determination of sound power levels of discrete frequency and narrow band noise sources in reverberation rooms.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation data.

B. Include start-up instructions, maintenance data, controls, and accessories.

C. Submit maintenance data.

D. Submit manufacturer's installation instructions.

1.6 ACOUSTICS

A. SOUND DATA - Manufacturer shall provide certified sound power data for Self Contained including unit discharge sound power and inlet + cabinet radiated sound power. Sound power shall not exceed the values listed in "a" below. All ratings shall be in accordance with AMCA 300 and ANS S1.32 testing and rating standards.

B. Manufacturer shall furnish detail on unit size, configuration and test procedure used for arriving at sound power in "A".

C. In the event that the unit does not meet the required sound power, the contractor shall install attenuation to the unit to meet the required space acoustics specification, and shall not be paid until such attenuation is tested and meets the sound criteria.

1.7 HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

B. Protect units from physical damage. Factory shipping covers and skids shall be kept in place until installation.

1.8 WARRANTY

A. Provide a full parts warranty for one year from substantial completion date of project.

B. Provide five year warranty for compressors and refrigerant circuit materials only.

C. Desiccant wheel shall have a 10 year non-prorated warranty of the entire assembly parts and labor.

PART 2 - PRODUCTS

2.1 SUMMARY

A. Furnish and install outside air conditioning units of size arrangements, capacities and performance as indicated here-in and/or on plans and schedules. Unit manufacturer shall be registered under ISO 9001. Cooling performance shall be rated in accordance with ARI standards. Unit shall be ETL or UL listed. Packaged condensing units shall be factory pre-assembled, tested and shipped complete with all components necessary to maintain humidity and temperature control levels independent of load variations within design limits. Unit(s) shall be designed for year-round 24 hr/day service.

B. Units shall be Novelaire, model specified, or Munters.

2.2 DESICCANT WHEEL

A. The desiccant wheel media shall be a monolithic, extended-surface contact medium, fabricated entirely of inert, inorganic binders and glass fibers formed into narrow passages in the direction of airflow. The wheel shall be non-toxic. The process and reactivation air streams shall be separated by air seals and internal partitions so that the humid reactivation air does not mix with the dry process air. Acceptable manufacturers must be able to procure replacement wheels within 24 hours or provide a spare stock for each unit size.

B. Wheel Face Seals: The dehumidifier shall have full-face seals on both the process air entering and the process air leaving sides of the wheel. These shall seal the entire perimeter of both air streams as they enter and leave the wheel. Partial seals shall not be acceptable. The seals shall be the silicone rubber bulb-type, with a protective strip of low-friction, abrasive-resistant surface to extend seal life and reduce the force needed to turn the desiccant wheel. Neither wiper-type seals nor brush-type nor any non-contact-type seal shall be acceptable. The seals shall be documented to have a minimum working life of 25,000 hours of normal operation.

C. Materials: The glass fibers which form the support matrix shall be made from uniform continuous strands larger than five microns in diameter which are non-respirable and are not considered a possible health risk by the International Agency for Research on Cancer (IARC).

D. The wheel shall be tested according to ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials) and shall achieve the following results:

1. Flame spread index = 0
2. Smoke developed index = 10

E. Desiccant impregnation: The desiccant shall be evenly impregnated throughout the structure for predictable, consistent performance and for maximum wheel life. Coatings applied on top of the contact medium shall not be acceptable unless the manufacturer can provide independent life tests demonstrating less than a 5% decline in desiccant capacity over a five year period of normal operation.

F. Desiccant type: The desiccant impregnated into the contact medium shall be a titanium-reinforced silica gel. The HoneyCombe® desiccant wheel shall be a fabricated extended surface contact media with a multitude of small passages parallel to the airflow. The rotary structure shall be a monolithic composite consisting of inert silicates with microscopic pores designed to remove water in a vapor phase. The desiccant shall be hydro thermally -stabilized silica gel reinforced with titanium for maximum strength and stability over time. The fabricated structure shall be smooth and continuous having a depth of between 95 and 200 millimeters in the direction of airflow without interruptions or sandwich layers which restrict air flow or create a leakage path at joining surfaces. Nominal face velocity shall not exceed 1100 fpm. The HoneyCombe® wheel shall be manufactured in the United States. The manufacturer shall provide documentation to establish that:

1. The desiccant retains more than 90% of its original capacity after ten years of continuous operation in clean air, with inlet air conditions up to an including 100% relative humidity.
2. The wheel as impregnated with silica gel is capable of withstanding five complete water immersion cleaning cycles while retaining more than 95% of its original adsorption capacity.

2.3 Desiccant Wheel Support and Drive Assembly

A. Desiccant wheels 60” in diameter and smaller shall be a single piece for fast removal and simple handling. Belt-driven desiccant wheels shall be supported by four rollers at the base of the unit so the wheel can be easily removed by lifting it over the rollers using the drive belt. In addition, the wheel drive assembly shall provide:

1. Rotation speed: To avoid excessive heat carryover from reactivation to the process air, the wheel rotation speed shall not exceed 8 rph while achieving the required moisture removal rate at the specified conditions.
2. Drive belt: Flat, toothed type belt with aramid fiber reinforcement. Direct-drive wheels assemblies are acceptable.
3. Drive motor: The drive motor shall be fractional horsepower and rated for continuous duty for a period of 20,000 hours under the load conditions imposed by the drive assembly.
4. Rotation detection: The drive assembly shall be equipped with a rotation detection circuit which shuts down the dehumidifier and signals the operator through an alarm if the wheel is not rotating.

2.4 DIRECT EXPANSION (DX) COOLING COILS

A. Coils shall be sized to provide the full capacity scheduled. Coils shall be arranged to condition the full volume of process air. Refrigerant pressure drop to be between 1.5 psi and 5 psi, and air face velocities shall be 450 fpm or less. Coil circuiting provides for optimum performance with minimum pressure loss. Coil shall be designed for 250 PSI working pressure and factory tested under water at 300 PSI air pressure.

B. Direct expansion cooling coils are fin and tube type constructed of 3/8” O.D. x 0.012” or 1/2” O.D. x 0.016” wall rifled copper tubes and .006 inch thickness aluminum fins mechanically bonded to tubes. Casing and tube support sheets are 16 gauge galvanized steel formed to provide mounting flanges and structural support for the fin-tube assembly. Supply headers consist of an expansion valve and distributor to feed liquid refrigerant through copper tubing to all circuits in the coil equally. Tubes are circuited to insure minimum refrigerant pressure drop and maximum heat transfer. Fin spacing of up to 12 FPI provides adequate transfer area to minimum air pressure drop. Direct expansion coils conform to ARI Standard 410 and are compatible with all other components of the same refrigeration circuit.

2.5 DRAIN PANS

A. The drain pan is to be constructed of welded 304 SS and bolted in place. The cooling coil drain pan shall extend the entire length of the coil and extend a minimum of 4 inches beyond the air leaving side of the coil. The drain pan shall be a minimum of 2 inches deep and have a minimum pitch of 1 inch. The drain pan shall be sloped to ensure zero standing water. Drain connection shall extend through unit base. Connection to be 1 inch male NPT.

2.6 PACKAGED REFRIGERATION CIRCUIT

A. Refrigeration circuit is complete with compressor(s), condenser heat exchanger, and all controls and accessories required to regulate refrigerant pressure, flow rates and temperatures. The condensing unit is piped together with evaporator coil(s) and is sized and controlled to operate at all conditions required. Condensing units manufactured by a separate company and then mounted and piped and a single skid are not acceptable. The refrigeration equipment shall be capable of operation down to an ambient temperature of 50°F.

B. Condenser coils shall be sized to reject the heat absorbed by the evaporator coil and the work of compression at a low delta T relative to ambient to enhance efficiency. Coil circuiting provides for optimum performance with minimum pressure loss. Coil shall be round tube, plate-fin, or microchannel design. Coil shall be designed for 400 PSI working pressure and factory tested under water at 600 PSI air pressure.

C. Compressors are scroll type. Service Access shall be provided around the entire compressor for maintenance. Isolation valves shall be provided in the refrigeration circuit to allow removal of pressure sensors and other control instruments. Each compressor shall have its own refrigeration circuit and expansion valve. Tandem compressors sets are not acceptable.

D. All piping connections are brazed using a filler material with not less than 15% silver content for copper to brass joint. Brazing flux is used on all joints and all interior surfaces of brazed assemblies are exposed only to dry nitrogen during heating and cool down periods. All refrigeration tubing is copper, type "L", cleaned and capped, designed specifically for refrigeration service. All piping circuits contain thermostatic expansion valve with external equalization, liquid line solenoid valve, and filter/dryer. All components are completely installed in piping circuit and all joints leak tested with refrigerant charge and electronic leak detector prior to evacuation, final charging and complete factory testing and set-up. All assembly and testing work is performed at the factory prior to shipping. All refrigeration circuits are pumped down, valved off and shipped with the full refrigerant charge ready for on site start-up.

2.7 WEATHER PROTECTION

A. The dehumidification system shall be capable of continuous outdoor operation. The air inlets shall be protected from water entry by hoods, louvers, mist eliminators or connected ductwork. Consequently, all access panels shall be weather tight, as shall all joints between casing and electrical conduits and between the unit casing and any components mounted in separate enclosures. The roof shall be fabricated using a capped standing seam or single piece style construction.

2.8 FANS

A. Supply and exhaust blowers provide the specified air volume through the system with adequate static pressure to overcome duct and distribution losses specified. Supply and exhaust blowers are belt-drive forward curve or direct-drive backward inclined, air foil blade type. Direct-drive blower fan speed shall not exceed 80% of the fan shaft critical speed. Access shall be provided to the supply blower for inspection and servicing. All fans shall be rated in accordance with AMCA Standard 210. Reactivation fans shall be direct-driven backward inclined, air foil blade type with VFD control.

2.9 FAN BALANCING

A. Fans shall be balanced such that the maximum displacement in any plane does not exceed 1.5 mils for fans operating at or below 2000 rpm or 1.0 mils for fans operating above 2000 rpm.

2.10 FAN MOTORS

A. Supply, exhaust, and reactivation fan motors shall be the totally-enclosed fan-cooled (TEFC), high-efficiency type with a minimum of Class B insulation.

2.11 FILTERS

A. The unit shall include disposable filters with 25% to 30% minimum efficiency with 90% to 92% arrestance minimum as rated by ASHRAE Test Standard 52-76. The filters shall be removable at the inlet of both supply and reactivation air streams. These filters shall be mounted on sliding or lift racks and accessible through access or doors. The entire supply, return, and reactivation air stream shall be filtered.

2.12 ELECTRICAL CONTROL CABINET

A. The electrical control cabinet shall be weather tight to NEMA 3R standards.

B. Wiring to comply with the current National Electrical Code with further fuse and wiring sizing to meet or exceed UL 508A Industrial Control Panel.

C. Wires shall be color-coded or numbered at both ends and all terminal block connection points shall be numbered. These markings shall correspond with the electrical diagram provided in the operating and maintenance manual.

D. Components shall be UL, ETL or CSA approved where possible.

E. The control cabinet shall include a copy of the O & M manual, mounted in a separate compartment or pocket to allow access to critical information by maintenance personnel after installation.

2.13 CONTROLS

A. The unit shall have the option factory mounted microprocessor control. The microprocessor shall be capable of communicating with a building management system (BMS) through Modbus, Lonworks or BACnet protocol, field selectable. Control shall include the ability to determine stages of heating, cooling and dehumidification required to maintain space conditions when an “enable” command is given via the BMS, or direct control via commands issued from the BMS. Unit shall also respond to an occupied unoccupied signal from the BMS. In unoccupied mode unit shall enter the circulation mode to provide space humidity and temperature control without introduction of outside air.

2.14 UNIT BASE

A. Unit base shall be bolted steel construction with formed heavy gauge galvanized steel channels around the outside perimeter and reinforced with galvanized steel cross members bolted on centers not exceeding 31 inches. Base shall have a minimum of four lifting brackets.

2.15 UNIT STRUCTURE

A. The unit casing shall be constructed using a double wall panel and frame system for torsional rigidity. This includes walls, floors and ceilings. This system shall not contain any through metal. The unit casing shall also meet the following criteria based on ASTM E84-90 (Standard Test Method for Surface Burning of Building Materials), flame spread = 25, smoke index = 50.

B. The frame system components shall be constructed of fiberglass reinforced plastic (FRP) pultruded members. Horizontal frame members shall be supported along their length by intermediate supports and internal partitions. Through metal systems shall not be allowed. To avoid condensation, heat loss or loss of cooling capacity, each panel shall be 2 inches thick and constructed such that there are no through metal connections between the exterior surface and the interior surface. The interior casing shall be 22-gauge galvanized steel. The exterior casing shall be 22-gauge corrosion resistant galvalume. Manufacturers not providing exterior galvalume construction must provide painted galvanized exterior panels. Painted coating must be corrosion resistant exceeding ANSI 2000 hour salt spray standards. Panels shall be foam injected into individual panels with a density of 2-1/2 lb/ft^3. The heat transfer rate through casing walls shall be less than 0.0625 Btu/sq. ft./°F equivalent to an R-value of 14. This construction shall be suitable for a 50°F difference as tested between process air dry bulb temperature and the dew point of the air surrounding the plenum. The unit casing shall be manufactured as an air and vapor tight system. There shall be a gasket system which seals the panels to the structure. Fixed panels shall be provided with flat closed cell neoprene and be sealed in place with FDA approved silicon. Doors and plug panels shall be provided with polyvinyl chloride seals.

2.16 ACCESS DOORS AND PANELS

A. Access doors or plug panel doors will be provided as indicated on the drawings. Doors shall be rigid double wall construction and shall use heavy-duty hinges with lockable latches on each door. Doors shall be a minimum of 15" in width. Doors shall be of the same construction as panels. Door latches shall be capable of being fully tightened against gasket surfaces. All major components such as coils, filters, blowers, etc., within the air handling structure shall be easily removable through access panels without dismantling plenums or distributing ductwork. Equipment that requires disassembly of components rather than access through removable or hinged panels shall not be acceptable. The unit casing shall include access panels for inspection and for any maintenance required by the operating and maintenance manual. Panels without gaskets shall not be acceptable.

2.17 INDIRECT FIRED POST HEATERS

A. Heater shall conform to ANSI Z83.8. Unit shall be suitable for operation on natural gas as specified. Unit shall be of down blast or horizontal configuration. Unit shall have an input rating of 100, 150, 200, 250, 300 or 400 MBH on high firing rate and 55, 80, 110, 135,160, or 220 MBH on low firing rate, respectively, or shall be 4:1 turndown modulating output. Where input is greater than 400 MBH multiple heaters shall be used. It shall contain tube type heated exchangers, flue gas collector with vent fan, in shot burners, and controls for high and low fire. Unit shall be un-housed and fit within the unit housing envelope dimensions.

B. Burners shall be die formed in shot type. Burners must be individually removable for cleaning or service. Entire burner assembly must be easily removable as an assembly.

C. Unit shall have a powered venting system consisting of a collection box, direct drive vent fan and an air proving switch. The collection box shall be made of the same material as the heat exchanger bulkhead plate and shall be removable. The venting fan bearings shall have a minimum L10 bearing life of 24000 hrs. The vent fan shall exhaust the flue gas horizontally out the side of the unit. The unit fan shall operate on 120/1/60 and not exceed 2 FLA.

D. Tubes shall be permanently attached to a bulkhead plate to form an airtight seal between combustion byproducts and heated air system. Heat exchanger shall be constructed of 18 gauge aluminized tubes with 14 gauge aluminized steel bulkhead plate. Heat exchanger shall be rated for a minimum lifespan of 100,000 cycles.

E. Gas train shall utilize components certified by AGA. Gas train shall consist of a 24 VAC two stage combination valve (manual on-off, automatic safety shutoff, regulation to handle 0.5 psig input pressure and adjustable pilot valve). The combination valve shall be rated at a flow of 400 MBH. The valve shall feed in shot burners through a manifold with screw in brass orifices sized for either natural gas or propane, as required by unit schedule. The flame controllers shall be solid state module that operates on 24 VAC. It shall have a built in spark igniter and flame sensor with 100% gas shutoff. The pilot shall be ignited during each cycle of operation. After the pilot is proven, the main burner valve shall open. Pilot and main burners shall be extinguished during the off cycle. The thermal disc type high temperature limit switch shall shut off the main and pilot valves if an overheat occurs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in strict accordance with manufacturer's requirements, shop drawings, and Contract Documents.

B. Adjust in alignment on concrete foundations, sole plates or other supporting structure. Level, grout, and bolt in place.

C. Coordinate electrical installation with electrical contractor.

D. Coordinate controls with control contractor.

E. Provide all appurtenances required ensuring a fully operational and functional system.

3.2 START-UP

A. Factory Start-Up Services: Start-up is to be supervised by the unit manufacturer or a manufacturer-certified service organization. Provide for as long a period of time as is necessary to ensure proper operation of the unit but in no case for less than 2 full working days. The start-up engineer shall conduct such operating tests as required to ensure that the unit is operating in accordance with design. Complete testing of all safety and emergency control devices shall be made. The start-up engineer shall submit a written report to the owner and manufacturer containing all test data recorded as required above and a letter certifying that the unit is operating properly.

B. Operation and Maintenance Manuals: Provide complete with descriptive literature, model, and serial number of all equipment, performance data, manufacturer's instructions for operating and maintenance, lubrication recommendation and schedule, and winter shutdown procedure.

END OF SECTION 237433

SECTION 238143

AIR TO AIR HEAT PUMPS

PART 1 - GENERAL

1.1 SCOPE

A. Provide split system heat pumps together with all necessary ductwork, supply and return grilles, and thermostats for each area of the building as specified and indicated on drawings.

PART 2 - PRODUCTS

2.1 ALL EQUIPMENT

A. All electrical equipment shall be UL listed.

2.2 SPLIT SYSTEM HEAT PUMPS

A. Furnish and install split system heat pumps of model and capacity shown on drawings. Units are to be furnished complete with all controls and accessories as specified and required for complete and operating systems. Each unit shall consist of one (1) indoor fan unit and one (1) outdoor condensing unit. Indoor unit shall be furnished complete with filters, fan and drives, starters, and evaporator coil. Outdoor unit shall be furnished complete with hermetic type compressor with crankcase heater, condensing coil, refrigerant metering device, and condenser fan and drive. Compressor motor shall be covered by a five-year protection plan.

B. Protection devices shall include: liquid line low-pressure switch, suction line accumulator and pressure relief device, automatic defrosting cycle, thermal and current sensitive overload protection, start assist as required, and rapid recycling protection for compressor.

C. Thermostats shall be automatic changeover type supplied by unit manufacturer with supplementary electric heat lockout, fan switch, compressor short cycle protection, and emergency heat switch. Wire thermostats for control sequence recommended by unit manufacturer.

D. Each air handler is to be supplied with a firestat in return duct to shut system down when firestats sense temperature in excess of 125 desgrees F.

E Units installed using field fabricated and installed refrigerant piping will require additional charge of Freon and oil. This should be done after all leak tests have been completed in accordance with Refrigerant Piping section of these specifications.

G. Each unit shall be provided with a field fabricated auxiliary condensate drain pan. The drain pan shall be constructed of galvanized steel as detailed on drawings. All joints and seams in drain pan shall be welded or soldered and shall be painted with galvanneal paint to prevent rust. Pan shall be equipped with a float switch or moisture sensor to deactivate unit when pan fills with 1" of water.

H. Units shall be Mitsubishi Models specified on drawings or approved equals.

2.3 FILTERS

A. Furnish and install three sets of filters for each air handler as provided under the Balancing and Testing portion of these specifications.

B. Filter shall be UL listed Class 2, filter media shall have an average efficiency of 30-35% when tested in accordance with ASHRAE Test Standard 52-68.

C. Filters shall be Farr 30/30, American Air Filter, Continental Filter, or approved equals.

D. Three sets of filters shall be provided. One set shall be installed for operation during construction and testing. The second set of filters shall be installed at time of final inspection and the third set of air filters shall be delivered to Owner prior to final acceptance of the project.

PART 3 - EXECUTION

3.1 OUTDOOR UNIT SUPPORT

A. Units on grade: Outdoor units shall be located where indicated on drawings. Minor adjustments to exact location shall be coordinated with Architect. Locate, size, furnish, and install a concrete pad for each unit located on grade.

B. Units on roof: Provide equipment support rails for all units located on roof. Equipment support rails shall be as specified in Section 230500 and exact placement shall be coordinated with General Contractor to insure proper support and installation.

3.2 INDOOR UNIT SUPPORTS AND VIBRATION ISOLATORS

A. Furnish and install neoprene-in-shear type vibration isolators for all indoor units. Isolator shall be Vibration Mountings and Controls, Inc. Type "R" or "RD" for floor mounted units and Type "RH" or "RHD" for suspended units, or equal by Mason Industries, Inc. Korfund, or Amber Booth. Isolators shall be sized and installed according to manufacturers recommendations for load and deflection. Furnish and install all supplementary steel, framing members, beam clamps, hanger rods, etc. as required to properly support units.

END OF SECTION 238143

SECTION 260500

ELECTRICAL, GENERAL

PART 1 - GENERAL

1.1 SITE VISIT

A. Prior to bidding, this Contractor shall visit the job site and shall familiarize himself with all conditions under which work is to be performed and shall include in his bid all labor, material and operations required for a complete job.

1.2 DRAWINGS AND SPECIFICATIONS

A. Drawings do not indicate all hardware and fittings. Examine all plans and specifications for the project and conditions at site and arrange work accordingly, furnishing required fittings and hardware without extra charge. If a conflict exists, the greater quantity or better quality, in the opinion of the Engineer, governs.

B. Drawings and specifications are complementary; work called for in either shall be provided as if called for by both.

1.3 CODES AND STANDARDS

A. Materials, equipment and installation shall conform to the requirements of the codes and standards (latest editions) listed below. In addition, all materials, equipment, and devices shall meet the requirements of the Underwriters' Laboratories, Inc. The label of, or listing by, the Underwriters' Laboratories, Inc. will be accepted as conforming with this requirement. In lieu of the label or listing, the Contractor may submit independent proof satisfactory to the Engineer that the materials, equipment or devices conform to the published standards, including methods of tests, of the Underwriters' Laboratories, Inc. (UL), National Electrical Code (NEC), National Electrical Safety Code, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Manufacturers Association (NEMA), Illuminating Engineering Society (IES), National Fire Protection Association (NFPA), National Electrical Contractors Association Standard Practices for Good Workmanship in Electrical Contracting (NECA 1), International Building Code (IBC) and Americans with Disabilities Act (ADA), and SC Office of School Facilities Planning and Construction Guide.

1.4 BASIC MATERIALS AND METHODS

A. All materials installed shall be new, clean, in good condition and shall meet applicable provisions of codes and standards listed above.

B. Workmanship shall be in accordance with best practice.

1.5 SCOPE

A. Provide all labor, equipment, material, and operations required for complete, safe and quietly-operating electrical systems in accordance with specifications and drawings and subject to terms and conditions of the contract.

B. The work includes:

1. Grounding in accordance with specifications, drawings and codes;
2. Complete distribution for lighting including feeders, distribution panelboards, branch circuits, lighting fixtures, power supplies,lamps, controls, switches, outlets and switching circuits;
3. Complete distribution system for power including feeders, branch circuits, and connections to outlets and devices for power utilization;
4 Fire alarm system extension;
5. Power supply connections to mechanical equipment;
6. Cutting, patching, trenching and backfilling as required for provision of the work;
7. Fireproofing and caulking as indicated;
8. Seismic restraint for electrical system components;
9. Partial demolition of existing electrical system.

1.6 CUTTING AND PATCHING

A. Provide under this contract all cutting and patching of walls, floors, partitions, ceilings, etc. required for proper installation of the new system.

B. Provide patching to match the existing finish of the building. Do not cut joists, beams, girders, columns, or other structural members without written permission from Owner.

C. Ceiling tile shall be removed and reinstalled by a qualified franchised acoustical tile contractor regularly engaged in this type of work. Replace damaged tile with new tile of color and pattern to match existing tile. Submit samples for approval.

D. Relocation of existing conduit, equipment, wiring, etc. as required for installation of new system is included in this work. Perform all work in accordance with specifications for new work of the particular type involved.

1.7 EXCAVATING AND BACKFILLING

A. Provide under this contract all excavating and backfilling required for the installation of electrical work.

B. Contractor shall notify Engineer prior to backfilling. Do not begin backfilling until Owner’s representative has observed the work. Excavations shall be filled as soon as possible and not left open for prolonged periods.

C. Provide safety (warning) barricades around all open trenches and holes before leaving unattended. Do not leave exposed wiring in a trench unattended.

D. Backfilled shall be done in layers of 6 inches fill, wetted down and tamped for each consecutive layer up to grade to a compaction of at least 95 percent of AASHTO T-99-49 Proctor Curve.

E. Whenever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored to original conditions to the full satisfaction of the Engineer.

1.8 ROOF PENETRATIONS

A. Contractor shall coordinate roof penetrations with other trades and shall provide all work required for complete raceways and raceway supports for electrical work for roof-mounted equipment and devices.

B. Provide flashing devices not included under other divisions of these specifications. All work shall comply with requirements for roof construction and shall in no way alter any specified roof performance or warranties.

C. Where several services (e.g., electrical and refrigeration) are connected to a single equipment, coordinate with other trades involved to minimize roof penetrations and to perform work in a workmanlike manner.

D. Lay out work in advance and locate raceway penetrations as near equipment connection points as possible. Where more than one raceway serves equipment, extend all raceways through a common flashing device with one roof penetration and leave sufficient space between raceways to affect a leakproof seal.

E. Contractor shall examine other divisions of these specifications and shall comply with all requirements for a complete project.

1.9 SEISMIC RESTRAINTS

A. Provide seismic restraint of new electrical systems and equipment as required by 2015 International Building Code (IBC). Seismic restraint products shall be by Cooper/B-line, Mason Industries, Unistrut Corporation, Grinnell Corporation, Amber Booth, Peabody or approved equal.

1.10 DAMAGES

A. Cost of repairing damage to building, building contents, and site during construction and guarantee period resulting from this work is a part of this contract.

1.11 MATERIAL AND EQUIPMENT

A. New and as specified, or approved equal.

B. Where several units of one type of equipment are used, all units shall be products of the same manufacturer.

C. Any increase in the cost of this work, resulting from substitution of any product or products for those specified is part of this contract. Such work shall be accomplished in an approved manner at no extra cost to the Owner.

1.12 REQUESTS FOR PRIOR APPROVAL

A. Requests for prior approval shall comply with AIA A701, Instructions to Bidders, Article 3.3.

B. Submit requests for prior approval to Engineer no fewer than ten working days prior to bid time. Requests shall be approved in writing by Engineer.

C. Requests for prior approval shall provide the following information:

1. Dated list of items for which approval is requested. Include project name and requesting company's name on request. For lighting fixtures, summary shall include same information required on shop drawing submittals.
2. Identification of equipment for which approval is requested, e.g., fixture symbol, etc.
3. Descriptive literature, catalog cuts, etc. which describe equipment or devices for which approval is requested.

D. Approval of the A/E to use materials and/or equipment, if granted, will be in the form of a written addendum. Approved prior approvals may be used at Contractor's option. No substitutions will be allowed, nor will an increase in contract price or time be allowed (for using materials specified) if prior approvals have been requested later than ten (10) days prior to bid opening date.

1.13 OPERATING INSTRUCTIONS, PANELBOARD DIRECTORIES AND NAMEPLATES

A. Instruct owner in operation of all systems.

B. Install in each panelboard a single-sided plastic-covered, typewritten circuit directory in metal frame. Indicate name, address and service telephone number of installer. Directory shall list the load served and the location of the load for each breaker.

C. Nameplates Provided by Contractor: On all panelboards, disconnect switches, transformers and enclosures, provide engraved plastic laminate nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Attach nameplates with epoxy cement or screws. On main switchboard/panelboard and feeder distribution panelboards, provide nameplate for each circuit breaker.

D. Nameplates Provided by Equipment Manufacturers: All switchboards, panelboards, transformers, safety switches and the like shall be provided with engraved metal nameplates which state all industry-standard required data about the labeled equipment. Nameplates shall be affixed with screws or rivets. The use of paper nameplates only will not be accepted.

1.14 SHOP DRAWINGS

A. The Engineer will review and take appropriate action on shop drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be only for general compliance with the design and with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Engineer's review shall be conducted with reasonable promptness consistent with sound professional practice. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Engineer shall not be required to review and shall not be responsible for any deviations from the Contract Documents not clearly noted by the Contractor, nor shall the Engineer be required to review partial submissions or those for which submissions for correlated items have not been made.

B. Prior to submittal of shop drawings to the Engineer, the General Contractor and the Electrical Subcontractor shall review and approve shop drawings. Shop drawings which have not been reviewed and approved in writing by the Electrical Subcontractor will not be reviewed by the Engineer. Electrical Subcontractor shall state in writing on shop drawings, any proposed deviations from contract documents. Such deviations, if not stated in shop drawings submittal, shall be the sole responsibility of the Electrical Subcontractor.

NOTE: IN ADDITION TO THE GENERAL CONTRACTOR’S APPROVAL AND STAMP, THE FIRST PAGE OF EACH SHOP DRAWING SUBMITTAL SHALL CONTAIN THE WORDS "APPROVED" OR "APPROVED AS NOTED," AND SHALL BE SIGNED, AND DATED BY THE ELECTRICAL SUBCONTRACTOR BEFORE THE ENGINEER WILL REVIEW THEM.

C. Lighting fixture submittal shall contain a cover sheet listing:

1. Project name;
2. All proposed fixtures by symbol, manufacturer, and catalog number;
3. Contractor's approval stamp and signature as noted above.
4. Attach fixture catalog pages (cuts) to cover sheet.

D. Electrical subcontractor shall submit for review by the Engineer detailed shop drawings of all equipment and all material listed below. All submittal data shall be submitted at one time. Partial submittals will not be reviewed by the Engineer. No material or equipment for which Engineer's review is required shall be delivered to the job site or installed until this contractor has in his possession the reviewed shop drawings for the particular material or equipment. The shop drawings shall be complete as described herein. This Contractor shall furnish the number of copies specified by the Architect or six (6) copies of shop drawings if no number is specified by the Architect.

E. Shop drawings submitted for review shall be detailed, dimensioned drawings or catalog pages showing construction, size, arrangement, operating clearances, performance characteristics and capacity.

F. Samples, drawings, specifications, catalogs, submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, contractor's name, and project name.

G. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

H. Review rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. WHERE DRAWINGS ARE REVIEWED, SAID REVIEW DOES NOT MEAN THAT DRAWINGS HAVE BEEN CHECKED IN DETAIL; SAID REVIEW DOES NOT IN ANY WAY RELIEVE THIS CONTRACTOR FROM HIS RESPONSIBILITY OR NECESSITY OF FURNISHING MATERIAL OR PERFORMING WORK AS REQUIRED BY THE CONTRACT DRAWINGS AND SPECIFICATIONS.

I. Failure of contractor to submit shop drawings in time for review by Engineer with reasonable promptness consistent with sound professional practice shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.

J. The Contractor shall submit shop drawings for the following materials and equipment for review by Engineer: See “Note” in paragraph B, above.

1. Lighting fixtures
2. LED retrofit lamps (base bid only)
3. Lighting controls
4. Fire alarm system extension
5. Safety switches
6. Basic materials: circuit breakers, wire, conduit, fittings, wiring devices

1.15 RECORD DATA

A. Preserve one set of approved shop drawings and deliver to Owner prior to substantial completion of the work. Owner's shop drawings shall be bound in a 3-ring binder of good quality, with stiff vinyl or cloth front and back. Number of copies shall be as directed by Architect.

1.16 RECORD DRAWINGS

A. Contractor shall maintain on the job site one complete set of drawings for this project. All changes authorized by the Engineers and/or the Owner as to the locations, sizes, etc. of equipment, conduit, fixtures, and/or other material and equipment shall be indicated in red pencil on the drawings as the work progresses. At the completion of the project, Contractor shall obtain a complete set of reproducibles of the drawings, and shall transfer all changes to these reproducibles. The number of record prints specified by the Architect shall be delivered to the Architect.

1.17 COORDINATION WITH OTHER TRADES

A. Coordinate with other trades to conceal electrical work and provide electrical work in correct locations for each piece of mechanical or electrical equipment connected.

B. Conceal outlets for all mechanical equipment, etc., in finished areas. Obtain roughing diagrams for all devices and install electrical work according to diagrams.

C. Locate all outlets at uniform heights to suit block coursing. Heights shown in drawings may be varied to suit coursing, but shall in all cases comply with codes.

1.18 ELECTRICAL WORK FOR MECHANICAL SYSTEMS

A. Provide complete power wiring and connections for mechanical systems specified under Division 23. This work includes all raceways, conductors, outlet and pull boxes, line voltage on-off switches where indicated and disconnecting means as indicated and required by applicable codes. Where magnetic motor starters, variable frequency drives or other controllers are furnished by others, install and wire complete; where controllers are provided already mounted on equipment, wire complete. In all cases provide power wiring through controller to load; do not reduce. Make all connections and color code per this division. Unless noted otherwise, safety switch enclosures shall be NEMA Type 3R outdoors and in wet locations; NEMA Type 1, elsewhere. Not included in this division is temperature control wiring, equipment control wiring, and interlock wiring required to operate the mechanical system, except as specified below for water heaters. Refer to Division 23 for equipment provided under that Division.

1.19 EQUIPMENT FOUNDATIONS AND MOUNTING

A. Unless otherwise noted, set all floor and ground mounted equipment on minimum 6” high concrete pads reinforced with 6 x 6, 10/10 WWM. Epoxy dowel #4 rebar 12” on center along entire perimeter of pad as required to tie pad into base slab. Pads to be approximately 6" larger than equipment base and have 1" x 1" chamfer on all edges. Pads to have carborundum brick rubbed finish. Surface finish to be uniformly smooth.

B. For transformers, provide isolating pads between equipment and foundation or structural support. Pads shall be formed by a minimum of two layers of 1/4"-5/16" thick neoprene, ribbed or waffled on both sides. Connect circuits through flexible conduit of 24" length to prevent transmission of vibration to structure or raceway system.

C. Provide all required mounting devices, hardware, supplementary steel and other materials to mount equipment. Mountings shall be secured to structure and seismically braced to comply with codes. Where additional structural members such as columns, beams, and the like are required to mount equipment, they shall be provided at no additional cost to the Owner.

1.20 TESTS, PERFORMANCE

A. Upon completion of work, the system shall be free of faults, including short circuits, grounds and open circuits and loads shall be balanced across phases to obtain minimum neutral current in all feeders and branch circuits. Test systems as required in the presence

of the Engineer or his representative, and operate to comply with applicable codes and contract documents.

B. For all fire safety systems, test systems completely and exercise all user stations, initiation/activation stations and warning/output devices prior to substantial completion by the Engineer. Furnish certificate to Engineer stating that systems are complete and operational and have been operated by the Contractor as specified above.

C. All costs associated with correction of deficiencies in the work shall be borne by the Contractor. Defective material and equipment shall be replaced; do not repair.

D. All devices which must be adjusted or set to operate on a schedule (time clocks, program mechanisms, etc.) shall be set prior to substantial completion to operate on schedules directed by the Owner.

1.21 WARRANTIES

A. The Contractor Agrees:

1. To correct defects in workmanship, materials, equipment, and operation of all systems for a period of one year from the date of Substantial Completion.
2. To remove any item not specified or given written approval and replace it with an approved item.
3. That all systems provided will safely, quietly, and efficiently operate in accordance with the design.

B. This does not supersede manufacturer’s warranties which may extend beyond one year.

1.22 CONSTRUCTION SEQUENCE

A. The Contractor is cautioned that the project may be constructed in stages to accommodate the owner's use of the building. This contractor shall verify requirements prior to bidding and shall cooperate in all respects with other contractors and trades on the job to carry out the work with minimum disruption of both the owner's requirements and construction of the project.

1.23 DETAILS

A. The details and sketches in the drawings are construction standards applicable to this project.

B. The contractor shall comply with details as applicable to the work indicated and shall retain on the job site at all times, a complete set of drawings and specifications.

1.24 DEFINITIONS

A. In this division of the specifications and accompanying drawings, the following definitions apply:

1. Provide: To purchase, pay for, transport to the job site, unpack, install and connect complete and ready for operation; to include all permits, inspections, equipment, material, labor, hardware and operations required for completion.
2. Install: To receive from another contractor, the owner or another entity and install complete and ready for operation. Unless otherwise indicated, receipt is assumed to be at the job site.
3. Furnish: To purchase, pay for and deliver to the job site for installation by others.
4. The contractor is cautioned that "furnish" and "install" require coordination with others. Such coordination shall be accomplished prior to bidding and bid amounts shall include all required labor, material and operations for completion of all items and systems specified and indicated.
5. As Indicated: As shown in drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260500

SECTION 260510

ELECTRICAL, DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this Section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems

1.2 SCOPE

A. Provide all labor, material and operation required for removal of existing electrical systems as indicated.

B. Bidders shall visit the site of the work prior to bidding and shall include in bid all work required to provide new work and to modify existing work as required to continue in operation.

C. Contractor shall examine demolition and new work plans for all trades and include in bid all rework and/or relocation of existing raceway, junction boxes, panelboards, safety switches, devices, wiring systems and all other related electrical equipment as required to accommodate new construction.

D. Electrical demolition work generally includes:

1. Existing circuit breakers, safety switches and other electrical equipment as indicated;
2. Partial fire alarm;
3. Exposed conduits, surface metal raceways and exposed outlet boxes and devices as indicated;
4. Conductors, exposed and concealed as indicated;
5. Existing wiring devices as indicated. Where new wiring devices are shown in existing locations, the Contractor may re-use the existing opening and outlet box for new device;
6. Lighting fixtures, their supports, outlet boxes, appurtenances and lamps as indicated.
7. Dimmer system and associated controls (alternate only)
8. Existing electrical work for mechanical equipment being removed by others.
9. Where indicated on drawings, existing raceways may be reused for new circuits. Contractor shall mandrel brush and swab existing feeder conduits prior to pulling new conductors.

E. Include in bid all work required for temporary wiring and associated electrical work required to maintain existing systems in service during demolition phase.

F. All interruptions in electrical systems (power, lighting, communication, fire alarm and

other systems) as required for this work shall be coordinated with and approved by Owner prior to performing work. Notice shall be provided to Owner in writing a minimum of 48 hours in advance, but not less than the time specified in other portions of Contract Documents.

G. The intent of this specification is to obtain removal of the existing electrical system to the extent required to enable the Owner to identify, service, repair or modify the new wiring system efficiently and safely.

1.3 STANDARDS

A. Demolition work shall comply with ANSI A10.6, NFPA 241 and all applicable local, state and federal standards and guidelines.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities in work area have been disconnected and capped as required.

B. Survey existing conditions and correlate with demolition and new work indicated in Contract Documents to determine extent of demolition required.

C. When unanticipated mechanical, electrical, environmental or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Provide prompt written notice to Engineer of any conflicts.

3.2 DEMOLITION

A. Owner shall retain first right of refusal on all electrical equipment being demolished. Prior to beginning demolition work, contractor shall walk through demolition area with Owner's representative and identify items to be removed and turned over to Owner. Contractor shall carefully remove, protect and store items to be turned over to Owner and deliver to Owner at location on site as directed by Owner.

B. Maintain services and systems indicated to remain and protect them against damage during demolition process.

C. For all lighting being relocated, remove, clean, re-lamp and reinstall complete as indicated on new work plans.

D. All devices indicated as to remain or to be relocated shall be protected against damage during demolition process and cleaned prior to being restored into service.

E. Contractor shall patch all locations resulting from demolition at which new work is not installed, as required under Section 260500, Electrical, General.

F. Provide temporary barricades, dust barriers and other protection required to prevent injury to people and damage to building contents, adjacent area of building and facilities

to remain.

3.3 DISPOSAL OF DEMOLISHED MATERIALS

A. Demolished material shall be promptly removed from site.

B. Remove and transport materials in a manner that will prevent contamination or damage to adjacent surfaces and areas.

C. Burning of demolished materials will not be permitted on site.

D. All materials shall be properly and legally disposed of. Contractor is responsible for all handling, storage, transportation and disposal fees.

3.4 CLEANING

A. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations.

B. Return adjacent areas to condition existing before demolition operations began.

END OF SECTION 260510

SECTION 260923

OCCUPANCY SENSOR LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems
3. Section 260943, Relay Lighting Control System

1.2 SCOPE

A. Provide complete a complete occupancy sensor lighting control system system, including power packs, relays, sensors (wall and ceiling type), override switches and related components. Also provide all cable, conduit, connections, programming, testing and documentation for a complete and operating system.

B. Carefully examine plans and provide required quantity of power packs, relays, sensors and other required material for a complete and operable system.

1.3 CODES AND STANDARDS

A. The installed system and equipment shall comply with NFPA-70, NEMA Standards as applicable, ASHRAE 90.1, IBC Energy Code, SC Office of School Facilities and Planning Guide, UL 508 and UL 916 (Energy Management Equipment). Additionally, system components shall comply with FCC Emissions Standards under Part 15, Subpart J for Class A application.

1.4 QUALITY ASSURANCE

A. Manufacturers: Equipment shall be by firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. System Checkout: Factory-trained technicians shall be available to functionally test each component in system after installation to verify proper operation and confirm that the locations, aiming, settings, and wiring conform to manufacturer documentation.

C. System Support: Factory applications engineers shall be available for on-site training and telephone support.

1.5 SUBMITTALS

A. Submit in accordance with Section 260500. The following are required:

1. Product Data: Lighting control system and components.

2. Shop Drawings: Dimensioned drawings of all lighting control system components, wiring and accessories.
3. Lighting plan with actual locations of each sensor, including sensor type, model, mounting, orientation and aiming requirements.
4. Typical Wiring Diagrams: Typical wiring diagrams for all components including power packs, relays, sensors and override switches. Include any interconnection diagrams as required for connection between components and with other control systems. Plan shall be on same size media as design documents, shall be scalable and shall show all required work. Schematic diagrams only will not be accepted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Occupancy Sensor System shall be by Leviton, Wattstopper, Sensor Switch, Novitas, Hubbell or approved equal.

2.2 SYSTEM DESCRIPTION

A. Operation: Unless otherwise noted, turn lights on when coverage area is occupied and off when unoccupied. Integral time delay shall turn lights off after preset time, which shall be adjustable with a minimum 1-15 minute range. All controls in sleeping areas shall be configured for manual ON and automatic OFF (vacancy mode).

B. Sensor relay unit shall consist of dry contacts with 20 ampere rating at 277 VAC unless noted otherwise. Relay shall be rated for load type served including tungsten, ballast, HID and motor loads.

C. All sensors shall have integral LED indicator light, which shall illuminate when motion is detected during both testing and normal operating modes.

D. All sensors shall be provided with manual bypass override switch. Override switches shall be wall mounted and may be integral with wall-mounted sensors.

E. All sensors shall utilize Digital Signal Processing (DSP) to minimize false triggering and respond only to those signals caused by human motion.

F. Sensitivity adjustment shall be provided for each type sensing technology in sensor.

G. Controls shall be of fail-safe design and shall fail to the ON position.

H. Interior Wall-Mounted Sensors

1. Shall accommodate load served, with a minimum rating of 800 watts at 120 volts and 1200 watts at 277V. Provide with external power pack and relay modules where required.
2. Shall be PIR type with the exception of toilet rooms, sleeping quarters and other areas with obstructions to the occupant’s workspace, where sensor shall be dual-technology (PIR/Ultrasonic) type.
3. Controls shall be recessed or covered to minimize tampering.
4. Shall utilize multi-segmented fresnel lens for PIR.

I. Interior Ceiling-Mounted Sensors

1. Shall utilize power pack and relay modules as required for quantity of sensors and loads served.
2. Shall be PIR type with the exception of toilet rooms and other areas with obstructions to the occupant's workspace, where sensor shall be dual-technology (PIR/Ultrasonic) type.
3. Shall utilize multi-segmented fresnel lens for PIR.

J. Outdoor Sensors

1. UL 773A rated for raintight application.
2. Rated operating temperature of -40°F to 130°F
3. Automatic light-level sensor shall prevent operation during daylight hours.

K. Power Packs

1. 120 or 277 volt rated, to suit loads served.
2. Plenum rated.
3. Shall mount to or in junction box, dependant on local code.
4. Shall control quantity of circuits as required for lighting loads served as well as for switching scheme indicated.
5. Provide slave packs and relays as required for loads served.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall be responsible for the installation and start-up of the equipment covered by this specification.

B. Plans are diagrammatic and only generally indicate rooms requiring coverage. Provide final quantity of sensors as required to achieve a minimum of 90% coverage unless higher coverage is required by local codes. Locate and aim sensors as required for complete and proper volumetric coverage of each area per the manufacturer's recommendations. Do not exceed coverage limits specified by manufacturer.

C. Contractor is responsible for all settings. Set each device for proper sensitivity and time delay per the manufacturer's recommendations. Verify time delay settings with owner prior to adjustment.

D. All ultrasonic detectors shall be located a minimum of six (6) feet from HVAC supply/return grills.

3.2 RACEWAY SYSTEM

A. Comply with requirements of Section 262000.

3.3 QUALITY CONTROL

A. After installation of sensors and all associated electrical work, energize circuits make all

adjustments and test for compliance with requirements and manufacturer instructions.

B. Verify proper operation of each lighting control device, including sensor activation, override function, sensitivity and time delay.

3.4 DOCUMENTATION AND RECORD DRAWINGS

A. Drawings: Comply with requirements of Section 260500 and this section (submittals).

3.5 TRAINING

A. Provide two hours on-site training of owner's personnel in system operation, adjustment and maintenance. Training shall be by manufacturer authorized technician or service provider at a time as directed by owner.

END OF SECTION 260923

SECTION 260943

NETWORK LIGHTING CONTROL SYSTEM

(ALTERNATE ONLY)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems

1.2 SCOPE

A. Provide complete digital (networked) type lighting control system including time-based, sensor-based and manual lighting controls. The system shall be capable of turning lighting loads on/off as well as providing multiple lighting levels and dimming where indicated.

B. Contractor shall carefully examine plans and specifications and provide a complete and operable lighting control system for all lighting indicated. All lighting shall be controlled thru building lighting control system. Provide all relay panels/packs, power packs, dimmer controls, occupancy sensors, wall control stations, gateways, routers, repeaters, bridges, interfaces, wiring, mounts, hardware, programming and associated electrical work as required for a complete system.

C. System shall be capable of turning lighting on-off as well as providing multiple level lighting control and dimming where indicated.

D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost. The system shall not require any centrally hardwired switching equipment.

E. The system architecture shall facilitate remote operation via a computer connection.

F. System shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

G. Lighting control system manufacturer is responsible for providing a complete system design, to be presented to the Engineer in the form of Submittals as indicated below. Design shall include all required devices, components, wiring, sensor layout and the like for a complete system.

1.3 CODES AND STANDARDS

A. The installed system and equipment shall comply with NFPA-70, NEMA Standards as applicable, ASHRAE 90.1, IBC Energy Code, UL 508 and UL 916 (Energy Management

Equipment). Additionally, system components shall comply with FCC Emissions Standards under Part 15, Subpart J for Class A application.

1.4 QUALITY ASSURANCE

A. Manufacturers: Equipment shall be by firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Component Pretesting: All components and assemblies shall be factory pretested and burned-in prior to installation.

C. System Checkout: Factory-trained technicians shall be available to functionally test each component in system after installation to verify proper operation and confirm that panel wiring and addressing conform to wiring documentation.

D. System Support: Factory applications engineers shall be available for on-site training and telephone support.

E. All components and the manufacturing facility where product was manufactured must be ROHS compliant.

F. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.5 SUBMITTALS

A. Submit in accordance with Section 260500. The following are required:

1. Product Data: Lighting control system and components including general device descriptions, wiring details and nomenclature.
2. Shop Drawings: Dimensioned drawings of all lighting control system components, wiring and accessories.
3. One-Line Diagram: One-line diagram of the system configuration proposed.
4. Typical Wiring Diagrams: Typical wiring diagrams for all components including power packs, sensors, relay panels, relays, low voltage switches, line voltage switches, and programmable panel master switches. Diagrams shall be typical per room type and shall indicate device interconnectivity of devices.
5. Overall plan with actual locations, types, models, aiming and orientation of each sensor, relay panels, controller, keypad, interface, wiring and components. Plan shall be on same size media as design documents, shall be scalable and shall show all required work. Schematic diagrams only will not be accepted.
6. Contractor Startup/Commissioning Worksheet.

1.6 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Lighting Control System shall be Sensor Switch nLight series. Other manufacturers acceptable by prior approval only.

B. This specification is based on Sensor Switch nLight system and specific components indicated are for clarity only and included to establish design intent, quality and function, but not to limit competition.

2.2 SYSTEM DESCRIPTION

A. System shall have an architecture that is based upon three main concepts: Intelligent lighting control devices, standalone lighting control zones and network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components: occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. Intelligent lighting control devices shall communicate digitally, utilizing at least two RJ-45 connectors.

D. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

E. Devices within a lighting control zone shall be connected with CAT-5 low voltage cabling, in a daisy-chain fashion, and in any order.

F. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

G. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

H. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

I. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

J. System shall have a primary wall mounted network control “gateway” device that is capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

K. System shall use “bridge” devices that route communication and distribute power for up to 8 lighting zones together for purposes of decreasing system wiring requirements.

L. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

M. Individual lighting zones shall be capable of being segmented into several channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

N. System shall be capable of operating a lighting control zone according to several sequences of operation. Note operating modes should be utilized only in manners consistent with local energy codes.

1. Auto-On / Auto-Off (via occupancy sensors)
2. Manual-On / Auto-Off
3. Auto-to-Override On
4. Manual-to-Override On
5. Auto On/Predictive Off
6. Multi-Level On (multiple lighting levels per manual button press)

O. A taskbar style desktop application shall be available for personal lighting control.

P. An application that runs on "smart" handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.

Q. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.

R. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)

1. Module shall be a wall mounted user accessible device that is capable of communicating and controlling downstream system control devices and linking into an Ethernet.
2. Devices shall be powered by low voltage, fit within a two gang switch box (or mounting ring), and have a backlit LCD panel.
3. User control shall be made available via finger-touch buttons with no moving parts. Buttons shall be capable of being locked for security.
4. Device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to a lighting control zones device.
5. Device shall automatically detect all devices downstream of it.
6. Device shall have a standard and astronomical internal time clock.
7. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
8. Each control gateway device shall be capable of linking 400 devices to the management software.
9. Device shall be capable of using a dedicated or DHCP assigned IP address.

B. Networked System Occupancy Sensors

1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in toilet rooms or rooms with obstructions), a sensor with an additional "dual" technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two RJ-45 ports.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
17. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray). Sensor color shall be as directed by Architect to match receptacles.

19. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
20. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
21. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

C. Networked System Daylight (Photocell and or Dimming) Sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching 120 VAC. Load ratings shall be 800 W @ 120 VAC and ¼ HP motor load. Relays shall be dry contacts.

D. Networked System Power (Relay) Packs

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 VAC, be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically

meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
7. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all load types, and be rated for 400,000 cycles.
8. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
9. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.

E. Networked System Relay & Dimming Panels

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120 VAC or up to 2 Dual Phase relays capable of switching 208 VAC loads.
2. Relays shall be rated to switch up to a 20A ballast load at 120 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection

F. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. All sensors shall have two RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four colors (Ivory, White, Light Almond, and Gray).
7. Devices with dimming control outputs can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling
11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

G. Networked System Graphic Wall Station

1. Device shall have a 3.5” full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
3. Device shall enable user supplied .jpg screen saver image to be uploaded.
4. Device shall surface mount to single-gang switch box
5. Device shall have a micro-USB style connector for local computer connectivity.
6. Device shall have two RJ-45 ports for communication

H. Networked System Scene Controllers

1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Device shall recess into single-gang switch box and fit a standard GFI opening.
3. Devices shall provide LED user feedback.
4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
5. All sensors shall have two RJ-45 ports.
6. Device shall have four touch sensitive buttons for selecting programmable lighting control scenes/profiles.
7. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
8. Device shall be capable of selecting a lighting profile be run by the system’s upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
9. Device shall have LEDs indicating current selection.

I. Communication Bridges

1. Device shall surface mount to a standard 4” x 4” square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.4 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5 MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software

B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

D. A printable network inventory report shall be available via the software.

E. A printable report detailing all system profiles shall be available via the software.

F. Software shall require all users to login with a User Name and Password.

G. Software shall provide at least three permission levels for users.

H. All sensitive stored information and privileged communication by the software shall be encrypted.

I. All device firmware and system software updates must be available for automatic download and installation via the internet.

J. Software shall be capable of managing systems interconnected via a WAN (wide area network).

2.6 SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.

B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.

C. An “Energy Scorecard” shall be display that shows calculated energy savings in dollars, KWHr, or CO2.

D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).

E. Energy savings data shall be calculated for the system as a whole or for individual zones.

F. A time scaled graph showing all relay transitions shall be presented.

G. A time scaled graph showing a zones occupancy time delay shall be presented

H. A time scaled graph showing the total light level shall be presented.

I. User shall be able to customize the baseline run-time hours for a space.

J. User shall be able to customize up to four time-of-day billing rates and schedules.

K. Data shall be made available via a .CSV file

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall be responsible for the installation and start-up of the equipment covered by this specification.

B. Plans are diagrammatic and only generally indicate rooms requiring coverage. Provide final quantity of sensors as required to achieve a minimum of 90% coverage unless higher coverage is required by local codes. Locate and aim sensors as required for complete and proper volumetric coverage of each area per the manufacturer’s recommendations. Do not exceed coverage limits specified by manufacturer.

C. Contractor is responsible for all settings. Set each device for proper sensitivity and time delay per the manufacturer’s recommendations. Verify time delay settings with owner prior to adjustment.

D. Coordinate with Owner prior to programming. Provide programming and scheduling in accordance with Owner requirements and allow for a minimum of two “sweeps” of relays after-hours. Allow for override as required for after-hours operation.

E. All ultrasonic detectors shall be located a minimum of six (6) feet from HVAC supply/return grills.

3.2 RACEWAY SYSTEM

A. Provide raceways for all conductors and cables. See drawings for raceway types approved for various locations and applications in the project.

B. Comply with requirements of Section 262000.

3.3 QUALITY CONTROL

A. After installation of system and all associated electrical work, energize circuits and make all adjustments and test for compliance with requirements and manufacturer instructions.

B. Verify proper operation of each lighting control device, sensor activation, override function, flash time delay and the like and ensure that all programming is in accordance with owner requirements.

3.4 COMMISIONING AND TRAINING

A. Prior to commissioning, contractor and factory-authorized technician shall have a meeting with Owner and Owner's representatives (Engineer reserves right to be in attendance – Contractor shall coordinate with Engineer prior to scheduling meeting). System functionality, programming, scheduling and operation shall be discussed with Owner and commissioning worksheets completed in accordance with Owner's desired functions and schedules. Meeting minutes shall be taken by contractor, approved by Owner and provided to Engineer prior to system programming/settings. This meeting is independent of Owner training and shall not count towards training requirements listed herein.

B. Provide six (6) hours on-site training of owner's personnel in system operation, adjustment and maintenance. Training shall be manufacturer authorized technician or service provider at a time as directed by owner. Allow in bid for training to be provided on two (2) separate non-consecutive days as directed by Owner.

3.5 DOCUMENTATION AND RECORD DRAWINGS

A. Drawings: Comply with requirements of Section 260500 and this section (submittals).

3.6 WARRANTY

A. All devices and components in lighting control system shall be covered by manufacturer 5-year warranty. Include warranty certificate and contact information in closeout documents.

END OF SECTION 260943

SECTION 262000

INTERIOR WIRING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Section 260500, Electrical, General, applies to the work under this section.

1.2 SCOPE

A. Provide interior wiring systems complete and ready for operation, as indicated, specified herein and in compliance with applicable codes and standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A Materials of like type shall be manufactured by the same company with the exception of lighting fixtures.

B. Circuit breakers, safety switches, motor starters, contactors and the like: General Electric, Siemens-ITE, Square D, Cutler-Hammer, or approved equal.

C. Fittings, Condulets, Boxes and the like: Steel City, Thomas and Betts, O-Z Electrical Manufacturing Company, Appleton, Efcor, Crouse-Hinds, Garvin Industries, or approved equal.

D. Conductors and Cables: Alpha Wire Company, Belden, Cerro Wire, Southwire Company, General Cable or approved equal.

E. Cable Markers: 3M Company, E-Z Code, Brady, or approved equal.

F. Connectors, Lugs and Terminals and the like: 3M Company, Ideal, Thomas and Betts, O-Z Electrical Manufacturing Company, or approved equal.

G. Wiring Devices and the like: Best Specification Grade; Arrow Hart/Cooper, Hubbell, Legrand/P&S, Leviton, or approved equal.

H. Fuses: Bussman, Gould, Littelfuse, or approved equal.

I. Surface Metal Raceway: Wiremold, Hubbell, Panduit, or approved equal.

J. Grounding Devices, Rods and the like: Cadweld, Thomas and Betts, Appleton, Erico, O-Z Electrical Manufacturing Company, or approved equal.

K. AC and MC Cable: Only permitted for fixture “whips”, maximum 6’ length.

2.2 CONDUIT AND FITTINGS

A. Rigid Steel Conduit (Zinc-Coated): ANSI C80.1.

B. Rigid Nonmetallic Conduit: Not Permitted.

C. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.

D. Electrical Metallic Tubing (EMT): ANSI C80.3.

E. Flexible Metal Conduit: UL 1.

1. Liquid-Tight Flexible Metal Conduit (Steel): UL 360.

F. Fittings for Metal Conduit, Electrical Metallic Tubing, and Flexible Metal Conduit: UL 514. All ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514.

1. Fittings for rigid metal conduit and IMC shall be threaded type. Split couplings are not acceptable.
2. Fittings for electrical metallic tubing (EMT) shall be the compression type.

G. Electrical Nonmetallic Tubing (ENT): Not permitted.

2.3 SURFACE METAL RACEWAY AND FITTINGS

A. UL 5, two-piece painted-steel, totally-enclosed snap-cover type. Provide multiple-outlet type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified in this section of the specifications and shall be spaced as indicated. Alternate receptacles shall be wired on different circuits.

B. Where surface metal raceway without receptacles is required, provide type, color, and wire capacity as indicated. Secure covers with two-hole straps of the same design and color as raceway. Straps shall be a product of the surface metal raceway manufacturer and intended for use with the installed surface metal raceway.

2.4 OUTLET BOXES AND COVERS

A. UL 514, cadmium- or zinc-coated if of ferrous metal.

B. Provide outlet boxes of size and type required by NEC, and in no case smaller than the following:

1. Boxes for lighting fixtures: 4" octagonal x 1-1/2" deep, or 4" x 4" x 1-1/2"
2. Boxes for Switches and Receptacles: 3" x 2" x 2-3/4" or 4" x 4" x 1-1/2" with plaster ring to suit construction

C. Provide suitable extensions, rings or subcovers set to come flush with the finished surface in which boxes are mounted.

D. Boxes for exposed raceway shall be threaded-hub cast metal, sizes as specified above.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

A. UL 50, hot-dip zinc-coated, code gauge sheet steel, screw cover unless indicated otherwise.

2.6 WIRES AND CABLES

A. Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. All wire and cable shall be new, with size, grade of insulation, voltage and manufacturer's name permanently imprinted on outer covering at regular intervals, and delivered to the job site in complete coils and reels.

B. Conductors: Conductors No. 10 AWG and smaller shall be solid, and those No. 8 AWG and larger shall be stranded. Unless indicated otherwise, conductor sizes shown are based on copper. All conductors shall be copper.

C. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 low-energy remote-control and signal circuits, No. 16 AWG. All 120 v. branch circuits exceeding 100' in length and all 277 v. branch circuits exceeding 250' in length shall be No. 10 AWG, minimum.

D. Color Coding: Provide for all service, feeder, branch, control and signaling circuit conductors. Color shall be green for grounding conductors, and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the neutral of the higher-voltage system shall be white with a yellow stripe, or shall be gray. The color of the ungrounded conductors in different voltage systems shall match existing.

E. Color coding for fire alarm conductors shall be the manufacturer’s standard and shall be consistent throughout the system. Include color coding key with record data.

F. Insulation: Unless specified or indicated otherwise, or required to be otherwise by NFPA 70, all power and lighting wires shall be 600-volt, Type THHN, THWN, or XHHW; remote-control and signal circuits shall be Type TW, THHN, TF, THWN or XHHW.

G. Bonding Conductors: ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger.

H. Variable Frequency Drive (VFD) Cable:

1. Provide VFD Cable for connection between all variable frequency drives and motors.
2. Cable shall comply with ICEA Standard S-73-532, UL 1685 and IEEE 1202/383 Flame Test. TC-ER cables shall comply with UL 44 and UL1277; stranded copper conductors with ASTM B-3 and B-8.
3. Cable shall be designed and manufactured specifically for application with variable frequency drives, shall be copper and include appropriate ground and symmetrical shielding conductors.

I. Nonmetallic-Sheathed Cable: Not permitted.

2.7 ELECTRICAL CONNECTIONS

A. Comply with NEC Article 110-14.

B. All termination devices, such as connectors, splicing devices, equipment terminals, device terminals and the like shall be rated and listed for operation at 75 degrees C.

2.8 SPLICES AND TERMINATION COMPONENTS

A. UL 486A and UL 486B, as applicable for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 AWG and smaller shall be insulated pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

B. Splices and/or taps for #8 and larger conductors shall be crimp type by T&B, Burndy, Oz, or approved equal; or Ilsco KUP-L-Tap®, ClearTap, or approved equal.

2.9 DEVICE PLATES

A. Provide UL listed, one-piece device plates for outlets and fittings to suit the devices installed. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls be satin finish stainless steel. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed. All plates shall be oversize type.

2.10 SWITCHES

A. Toggle Switches: Fed. Spec. W-S-896, totally enclosed with bodies of thermosetting plastic and a mounting strap. Handles shall be white, gray, brown or ivory. Wiring terminals shall be of the screw type, side wired. Switches shall be rated quiet-type ac only, 120/277 volts, with the current rating and number of poles indicated. Colors shall be as directed by Architect.

B. Disconnect Switches: NEMA KS1. Provide heavy duty, fusible type. General duty and non-fusible switches are not permitted.

1. Operating mechanisms shall be of the quick-make, quick-break type, with arc-suppressing characteristics.
2. Enclosures shall be NEMA 1 indoors and NEMA 3R outdoors and in wet locations unless otherwise indicated, equipped with cover interlock and provisions for padlocking operating handle in OFF position. Safety switches shall be by the same manufacturer as panelboards.

2.11 RECEPTACLES

A. NEMA WD1, heavy-duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of white, gray, brown or ivory thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Connect grounding pole to the mounting strap. Colors shall be as directed by Architect.

B. Weatherproof Receptacles: In all damp or wet locations, provide in a cast metal box with a gasketed, weatherproof, cast-metal cover plate and a gasketed cap over each receptacle opening. The cap(s) shall be provided with a spring-hinged flap. Cover shall be "in use" type where required by local codes. Receptacle shall be UL listed for use in "damp location" or "wet location" to suit installation location.

C. Tamper-Resistant Receptacles: All receptacles in kindergarten areas, required by NFPA 70 or as indicated shall be UL listed as tamper resistant. Tamper-resistant covers will not be accepted.

D. Ground Fault Circuit Interrupter Receptacles: UL 943, and shall be duplex type for mounting in a standard outlet box. The device shall be capable of detecting a current leak of 5 milliamperes.

E. Receptacles shall be by same manufacturer as toggle switches, as specified above.

F. Install grounding type receptacles with the grounding terminal at the top.

2.12 PANELBOARDS

A. Circuit Breakers: Fed. Spec. W-C-375 thermal magnetic type with interrupting capacity to match existing. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plug-in circuit breakers shall be provided only where indicated in drawings.

1. Multi-pole Breakers: Provide common-trip type with a single operating handle. Breaker design shall be such that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.
2. Circuit Breaker with Ground-Fault Circuit Interrupter: UL 1053 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect a current imbalance of approximately 5 milliamperes.
3. Breakers used to serve refrigeration and air conditioning compressors shall be type "HACR."
4. Circuit Breaker used to serve fire alarm components shall be provided with red, locking hardware as well as red engraved nameplate mounted immediately adjacent to breaker.

2.13 FUSES

A. Provide a complete set of fuses for each fusible device provided. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation; submit coordination data for approval. Fuses shall have a voltage rating not less than the circuit voltage.

B. Cartridge Fuses, Current-Limiting Type (Class R): UL 198E, time-delay type. Associated fuseholders shall be Class R only.

C. Cartridge Fuses, Current-Limiting Type (Classes J and L): UL 198C, Class J for 0 to 600 amps and Class L for 601 to 6000 amps.

2.14 GROUNDING AND BONDING EQUIPMENT

A. UL 467.

PART 3 - EXECUTION

3.1 RACEWAYS

A. Provide raceways for all conductors and cables. See drawings for raceway types approved for various locations and applications in the project.

B. Provide flexible metal conduit for connection to rotating or vibrating equipment. In all potentially wet locations, provide waterproof flexible conduit. In no case shall length of flexible conduit exceed 3 feet, except for transformers, where length shall not exceed 2 feet. Support in accordance with NEC and as approved by Engineer.

C. Contractor shall size pull and junction boxes. Comply with requirements for dimensions and conduit spacings as defined in the NEC Article 314.

D. Raceways shall be continuous between outlets and enclosures. Bond raceway system as described in drawings and grounding specifications, and make all connections wrench tight for electrical continuity. Connect raceways at boxes and enclosures using locknuts and bushings. Provide insulating bushings with grounding lug on all raceways one inch and larger.

E. Install raceways generally as follows:

1. Run concealed raceways in straight lines with long sweep bends and offsets.
2. Where raceways turn up out of floor, curved portion shall not be visible.
3. Run exposed raceways parallel and perpendicular with building lines. Strap with two-hole flat straps; do not use minerallac straps.
4. Support raceways within 3' of each outlet box, fitting, or enclosure, and at 10' intervals. Use malleable iron or stamped steel clamps for branch circuit raceways; use pipe hangers for feeder raceways. Do not hang conduit with wire, perforated strap, or nails.
5. Cut all joints square, thread, ream and draw tight. Make bends and offsets with standard conduit ells or with an approved bender or hickey.
6. No more than three quarter-bends equivalent in any run.
7. Cap raceway ends to prevent entrance of debris during construction. Cap with approved pennies, plastic caps or covers; do not tape.
8. Complete raceway installation and clean thoroughly before pulling conductors.
9. Where conduits pass through fire-rated walls and/or floors, provide a UL-listed through-penetration assembly with fire rating equal to wall or floor penetrated. Materials shall be by 3M Company or equal. Each assembly shall be specific to the penetrating device, e.g., single conduit, multiple conduits, busway, etc. and shall be specific to the wall or floor construction penetrated, e.g., concrete, gypsum board on wall studs, etc. Install assemblies in accordance with material manufacturer's instructions and UL Building Materials Directory, latest edition.
10. Install expansion fittings with copper bonding jumpers in conduit runs which cross building expansion joints.

11. Ferrous metal raceways, cable trays, cablebus, auxiliary gutters, cable armor, boxes, cable sheathing, cabinets, metal elbows, couplings, nipples, fittings, supports, and support hardware shall be suitably protected against corrosion inside and outside (except threads at joints) by a coating of approved corrosion-resistant material (Thomas & Betts, Kopr-Shield, or equal). Where corrosion protection is necessary and the conduit is threaded in the field, the threads shall be coated with an approved electrically conductive, corrosion-resistant compound.

F. Install pull boxes as shown in drawings and as required to pull conductors without damage to insulation. Provide pull boxes in accessible locations only, and size in accordance with NEC.

G. Cover all raceways below grade and in concrete slabs with two brushed applications of a coal tar base coating conforming to MIL-C-18480.

H. All feeder raceways shall be metallic as specified above.

I. Install raceways of sizes shown in drawings and comply with Table 1 of NEC (latest edition). In case of conflict, install larger size.

J. Provide in each empty raceway a pull cord or wire, identified with a cardboard tag as to location of equipment or outlet fed by conduit.

3.2 SURFACE RACEWAYS

A. Provide surface metal raceways, with or without outlets, as indicated.

B. Provide all required feed-in boxes, inside and outside corner pieces, end caps, clamps, hangers and all other hardware to make complete systems, all to be standard components of the manufacturer.

C. Provide multioutlet assemblies (“plugmold”) where indicated. Contractor may provide prewired assemblies or field wiring of outlets, at his option. Circuits shall be AWG #12 copper unless otherwise indicated.

D. Install surface raceways plumb and level and at heights indicated or directed on the job. Do not butt 90-degree joints; use corner pieces. Ground raceway enclosure and grounding lug of all outlets. Secure enclosures to mounting surface and at each fixed structural member such as a stud or joist. Where raceway enclosure is cut, saw perpendicular to length or at angle required and remove burrs before installing fitting. Touch up paint where required using manufacturer's standard paint or field paint color and type as dictated by job site conditions or as directed by the Architect.

3.3 OUTLET, SWITCH, AND JUNCTION BOXES, FITTINGS

A. Provide outlet and junction boxes as required for power, lighting, and communications systems as shown in drawings.

B. Boxes shall be held securely in place by being imbedded in masonry, or shall be secured to a fixed structural unit such as a stud or joist.

3.4 CONDUCTORS

A. Provide conductors in raceways as shown in drawings for service, feeders and branch circuits.

B. Conductors No. 8 and larger shall be connected to equipment by means of pressure type mechanical lugs. Where multiple conductors are connected to the same terminal each conductor shall be provided with an individual lug.

C. Soldered splices shall be made mechanically secure before soldering.

D. Wire and cable shall be suitably protected from weather during storage and handling and shall be in good condition when installed.

E. Join conductors with approved connectors, or by soldering, brazing or welding. Tape all connections or cover with approved prefabricated insulating devices to provide insulation resistance at the connection equal to that of the wire. Make splices in boxes or fittings only.

F. Do not pull conductors before completion of masonry, concrete and other trades which generate dust and debris. See raceways section, above.

G. Install and terminate variable frequency drive cable in accordance with manufacturer guidelines. Shield and ground conductors shall be securely bonded to motor case and drive enclosure to ensure control of ground current and electrical noise.

3.5 PANELBOARDS

A. Provide multi-pole breakers of common-trip type to simultaneously disconnect all ungrounded conductors in multiwire branch circuits.

3.6 SAFETY SWITCHES

A. Provide heavy duty, fusible safety switches at locations shown on drawings, and in accordance with NEC requirements. Provide nameplates on switches as specified in Section 260500. Wording shall identify the load which switch disconnects.

3.7 SWITCHES AND RECEPTACLES

A. Provide switches and receptacles for power and lighting as shown in drawings. Where indicated, verify location of receptacles with Owner prior to roughing.

B. Gang plates where two or more devices occur at the same location. Verify locations in relation to door swings, and place devices on the strike side.

C. Install devices at locations indicated in details.

D. Install outlets and devices plumb, level and with positioning at roughing to suit final wall covering. Device plates shall contact finished walls all-around on all four sides.

E. Protect devices during painting and clean-up of job. Leave devices clean and free from paint, dirt and debris.

F. Prior to final completion, check all receptacles for shorts, opens and grounds and correct all incorrect connections. Use receptacle checker as manufactured by Daniel Woodhead Company, General Electric, Leviton, or equal.

3.8 GROUNDING

A. Provide grounding system to comply with NEC, as shown on drawings and as specified.

B. All ground rods and fittings used shall be free from paint, grease, and other poorly conducting material, and contact surfaces shall be cleaned thoroughly to ensure good metal-to-metal contact.

C. Install bonding jumpers between all panelboards and feeder raceways connected thereto; across pull box and raceway expansion joints and across water meters located within buildings.

D. Provide a ground wire in all circuits sized per NEC Table 250-122 as applicable.

E. Provide in all runs of flexible conduit a separate grounding conductor sized per NEC Table 250-122.

END OF SECTION 262000

SECTION 265100

LIGHTING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems

1.2 SCOPE

A. Provide lighting fixtures, fixture assemblies, controls and appurtenances as indicated on drawings and as required, complete with the required lamps, power supplies, drivers, hangers, escutcheons, end caps, spacers, foundations and structural supports to make a complete, safe and operable system.

PART 2 – PRODUCTS

2.1 LIGHTING FIXTURES

A. Fixtures scheduled in drawings indicate the type and quality of equipment which will be accepted. Substitutions may be considered on the basis of equal LED, lens and driver quality, structural rigidity, and performance.

B. Fixtures scheduled generally include metal or acrylic louvers and lenses. The intent of these specifications is that 100% virgin acrylic material be furnished where indicated. Copolymer and polystyrene lens materials will not be accepted. Lenses may be subjected to test on the job by the Engineer. Where prismatic lenses are scheduled, minimum thickness shall be 0.125 inch.

C. Recess- and Flush-Mounted Fixtures: Type that can be serviced from the bottom unless noted otherwise.

D. Suspended Fixtures: Provide with hangers to ensure a plumb installation.

E. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.
4. Variations in finishes are unacceptable in the same piece.

F. All doors, frames and other internal access shall be smooth operating, free of light leakage under operating conditions and designed to permit minor servicing without use of tools. Fixtures shall be designed to prevent doors, frames, lenses, diffusers and other components from falling accidently during servicing and when secured in operating position.

G. Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Luminaires and LED assemblies shall be labeled vibration and shock resistant.

H. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70.

2.2 LAMPS

A. LED luminaires/lamps shall have an average rated life of 50,000 hours minimum (L70).

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaries.

C. Minimum CRI shall be 80 for all LED luminaires and lamps.

D. Color temperature for all lamps shall be **[2700] [3500] [4100] [match existing]** degrees K. **[as indicated on drawings].**

E. Lamps shall be dimmable from 100 percent to 0 percent of maximum light output where dimming is indicated.

2.3 POWER SUPPLIES AND DRIVERS

A. Power supplies and drivers shall be provided to suit the voltage applied, regardless of whether fixture catalog numbers shown in drawings include designation of voltage or not.

B. Examine plans for switching schemes and provide power supply and driver quantity and configuration as required for switching as indicated. Multi-level (stepped) lighting control shall be via stepped dim switching unless otherwise noted.

C. Power supplies and drivers shall be compatible for use with controls furnished.

2.7 TIME SWITCH

A. 24-hour, 7-day type with astronomic dial arranged to turn "ON" at set hour, "OFF" at set hour, automatically changing the setting each day in accordance with seasonal changes of sunset and sunrise. The switch shall be provided with automatically wound spring mechanism to keep the switch on time for a minimum of 15 hours following failure of normal power and "skip-a-day" capability. The time switch shall be provided with a manual on-off by-pass switch. Housing for the time switch shall be surface or recess mounted, as indicated. Switch shall be as manufactured by Paragon, Tork, Intermatic or approved equal, rated 40 amperes with 4 poles. Drive motor rating shall suit voltage of circuits controlled or of voltage specified and switch contact rating shall suit voltage of circuits controlled.

2.8 DIMMING SYSTEM

A. Provide dimming system as indicated in drawings, complete and ready for operation. Equipment shall be by Acuity, Lehigh, Lutron, Marlin, Leviton, or approved equal. System shall be configured with input as indicated. Dimmers shall be the solid state-type utilizing

SCRs and internal components shall be arranged in a modular fashion representing the best commercial state of the art. Circuits shall be fully choked to prevent filament hum.

B. Modules shall be dimming or switched type to suit loads served. Dimmer shall be capable of controlling fluorescent, LED, tungsten-halogen, incandescent, motor, or DALI to suit loads served.

C. All dimmers shall provide a response to control that approximates the "square law" dimming curve. Nominal input voltage to loads dimmed shall be 120 volts, 60 Hz; dimmers shall operate satisfactorily over an input range of 100 to 130 volts AC. The control voltage may be either AC or DC but shall not exceed 24 volts.

D. Each dimmer shall control from full output to blackout any load from 100 watts to 100% of dimmer capacity. When a controller is set at the "zero" position, dimmer output shall not exceed two volts. System shall not cause interference with audio or video equipment having properly decoupled power supplies. Current rise time of the output wave form measured from "turn-on" to 95% of maximum amplitude shall be at least 450 microseconds with the dimmer at rated load and with the control voltage adjusted to provide SCR firing at 90 degrees.

E. Dimmers shall exhibit no tendency to false trigger or interact with other dimmers when installed in accordance with manufacturer's recommendations. Output voltage shall remain stable indefinitely with a constant input voltage for a given controller setting. The dimmers and the dimming system shall be designed to operate within an ambient temperature of 0 to 40 degrees C and in relative humidities of 20% to 90% with no degradation in performance and no interim or long term reduction in reliability. Each dimmer shall be component listed by UL and clearly identified with manufacturer's name and catalog number.

F. Controls: Provide remote or integral controls in locations indicated on drawings, complete with the required low voltage, multiconductor cable between control points and dimmer. Each control shall be identified as to function and scale of values in a manner approved by the Engineer.

G. Include programming module as required for astronomic time control of system as required for compliance with International Energy Conservation Code.

H. Include on-site factory startup and training. Manufacturer’s representative shall meet with school personnel to establish standard programming and control needs prior to actual programming and startup. Include a minimum of four (4) hours training.

2.9 WALLBOX DIMMER

A. Provide dimmers as indicated in drawings, complete and ready for operation. Dimmer shall be specification grade, preset, slide type by Lutron, Leviton, Hubbell, Acuity, Pass & Seymour or approved equal. Dimmer shall be for LED application with capacity equal to or greater than connected load plus 20% spare capacity.

B. Nominal input voltage to line-voltage controlled loads shall be 120 volts, 60 Hz; dimmers shall operate satisfactorily over an input range of 100 to 130 volts AC.

C. Dimmer shall control from full output to blackout any load to 100% of dimmer capacity without flickering. Controller shall utilize air-gap switch for on-off operation. System shall not cause interference with audio or video equipment having properly decoupled power supplies.

D. Dimmers indicated for LED luminaires shall be designed and rated for used with lamping source indicated. Coordinate with power supplies and drivers and provide compatible dimmers (e.g., line voltage vs. 0-10V, etc.).

E. Dimmers shall be compatible with three-way and four-way switching where required for switching from multiple locations.

2.10 LIGHT TRACK

A. Housing extruded aluminum of minimum .070 inch wall thickness, nominal dimensions 1-1/2" by 1-1/2" with white, baked enamel finish. Conductors shall be solid copper of cross-section equal to #12 AWG wire encased in rigid extruded polyvinyl insulators; 20-ampere rating; number of conductors as indicated. Track systems shall be complete with all required covers, fasteners, end caps, connectors and fittings. Track sections shall plug together using manufacturer's standard fitting. Tracks shall be provided with grounding bus in addition to circuit conductors indicated.

B. Light Track Fixtures: As indicated, each equipped with adapter to lock fixture to track and to make electrical connection to appropriate track phase and grounding bus.

2.11 EMERGENCY LIGHTING EQUIPMENT - UNIT BATTERY TYPE

A. UL 924, NFPA 70, NFPA 101 and International Building Code (IBC). Lamps shall be tungsten halogen type having wattage and voltage as required for the application and having the accessories required for remote mounting where indicated.

B. Emergency Lighting Units: Each unit shall have an automatic power failure device, test switch, pilot light, fully automatic high/low trickle charger, low voltage battery disconnect device, automatic overload protection and brown-out sensitive circuit to activate battery when AC input falls to 75% of normal voltage. Battery shall be sealed wet-cell type, shall operate unattended, and shall be maintenance-free for a period of not less than 10 years under normal operating conditions. Emergency lighting units shall be rated for 6 volts.

2.12 EMERGENCY LIGHTING EQUIPMENT - INTEGRAL-FIXTURE TYPE

A. UL 924, NFPA 70, NFPA 101 and International Building Code (IBC). Units shall be integral with normal LED luminaires as indicated, consisting of battery and electronics modules mounted integral with fixture. Provide test switch, derangement signal light and connections for remote lamp on-off switch. Unit shall operate each LED fixture indicated with at least 1100 lumens total light output for a minimum of 1-1/2 hours. Charger shall be capable of recharging battery in a maximum of 16 hours. Estimated battery life shall be 7 years, minimum. Equipment shall be by IOTA, Bodine, Chloride, Dual-Lite, or approved equal.

2.13 GENERATOR TRANSFER DEVICE

A. UL 924, NFPA 70, NFPA 101 and International Building Code (IBC).

B. Provide device with amperage and voltage rating to suit application. Unit shall automatically sense the loss of normal power and shall switch to the emergency power source regardless of control position. Units shall be compatible with emergency generator and central inverter systems and designed for use with LED lighting. Equipment by Bodine, IOTA, Chloride, Dual-Lite or approved equal.

2.14 OUTDOOR

A. Luminaires shall be weatherproof and shall be of multiple enclosed type for lamps with distribution as indicated. The luminaire shall permit easy access for LED assembly and driver servicing. Glass refractors where specified shall be resistant to thermal shock. LED luminaires shall be provided with a surge protected driver with rating, to suit the lamp and circuit specified, and mounted integrally in the luminaire. Wiring of luminaires shall be internal and rated at 600 volts. Floodlights shall be of the enclosed type conforming to NEMA FA 1 and shall be Class HD, heavy duty, NEMA type and beam spreads as indicated.

B. Brackets and Supports: Brackets and supports shall be steel or aluminum and conform to NEMA SH 7 or NEMA SH 5, as applicable, with mountings as indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb and square with ceilings and walls.

C. Provide lamps/lamp assemblies in each luminaire.

D. Remote Mounting of Power Supplies, Drivers and Batteries: Distance between power supplies, drivers or batteries and luminaire shall not exceed that recommended by manufacturer.

E. All supports shall be sized and rated for luminaire weight, able to maintain luminaire position during and after servicing and provide support for luminaire without deflection of ceiling or wall.

F. Comply with all regulations and requirements of local jurisdiction and applicable building codes for seismic restraints. Provide all required supports, mounts, rods, safety chain/cable/wire, hardware and the like to suit seismic requirements for project site.

G. Coordinate layout and installation of luminaires, support and suspension system with other construction above, below and part of ceiling system.

3.2 INTERIOR LIGHTING SYSTEMS

A. Lighting fixtures and fixture assemblies shall be set plumb, square, level, and in alignment and shall be secured in accordance with manufacturers' directions, approved shop drawings and drawings accompanying these specifications. The installation shall meet with the requirements of NFPA 70. Mounting heights shall be as indicated. Recessed and semi-recessed fixtures shall be supported from rods or wires as indicated in drawings. Attach to the building structure. Support rods or wires for round fixtures or fixtures smaller in size than the ceiling grid shall be

provided at a minimum of 2 rods or wires per fixture attached to the building structure or as indicated in drawings. Fixtures shall not be supported by acoustical ceiling panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, such fixtures shall be supported independently or with at least two 3/4-inch metal channels spanning and secured to the ceiling tees and also to the building structure. Secure all lay-in fixtures to grid by UL-approved clips or fasteners as approved by code jurisdiction having authority.

B. Support Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge minimum.

C. Lighting fixtures shall not be used as raceways to serve other fixtures. Daisy-chain connection of fixtures will not be accepted. Fixture whips shall be no longer than 6’0” and shall connect from fixture to branch circuit junction box.

3.3 EXTERIOR LIGHTING SYSTEMS

A. For underground circuits serving outdoor fixtures, cables shall be in accordance with the requirements of NFPA 70 and Section 262000. If paving is already in place, galvanized steel pipes shall be driven under it. Where conduit installed underground is indicated, the conduit shall be field coated with a coal tar base conforming to MIL-C-18480, per Section 262000, or Schedule 40 PVC conduit, as indicated. Non-current-carrying parts of outdoor lighting assemblies shall be grounded. The ground conductor shall be soft-drawn copper, having a current capacity of at least 20 percent of that of the largest conductor to which it is connected, but not smaller than No. 6 AWG and not smaller than indicated. Ground conductors shall be connected to a 3/4" x 10' copper-clad steel ground rod driven at least 11 feet into the ground approximately 3 feet out from the base of the pole. After installation is completed, top of the ground rod shall be approximately 1 foot below finished grade. All ground connections shall be made with direct-burial, solderless connectors or by the molded fusion-welding process.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, controls and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency/battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operational tests and inspections.

C. Adjust all aiming in the presence of the Architect.

END OF SECTION 265100

SECTION 283110

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The following apply to the work under this section:

1. Section 260500, Electrical, General
2. Section 262000, Interior Wiring Systems

1.2 SCOPE

A. Provide complete and ready for operation a fire alarm system extension as shown in the drawings and as specified herein. Equipment shall match existing and shall include all required modifications to current programming as required to suit any required demolition and new work.

B. The system shall meet the requirements of NFPA-72, *National Fire Alarm Code*, NFPA-70, *National Electrical Code*, State Fire Marshal's Office, *International Fire Code*, SC Office of School Facilities, Accessible and Usable Buildings and Facilities (ICC / ANSI 117.1 – 2009).

C. All electronics work shall be provided by a franchised distributor-representative of the system equipment manufacturer, who shall maintain a spare parts stock and factory-trained personnel within two hours of the job site by normal ground transportation. Systems purchased from a market source and installed by the electrical contractor will not be accepted.

D. The distributor-representative shall have a minimum of five years documented experience with three or more installations of systems of comparable size and complexity with regard to coordinating, engineering, testing and supervising. Each of these installations shall have been in successful operation for three or more years. The Installer technicians shall be individually certified NICET Level 2 and by the manufacturer of the equipment and trained and certified on the specific model being installed. The Installer shall have at least one technician on staff certified NICET Level 3.

1.3 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified, fire-alarm technician; Level III minimum.
3. The Contractor shall retain on site a copy of the submittal plans and wiring diagrams and shall indicate thereon any modifications to the plans or diagrams

made during construction. Prior to acceptance of the building by the Owner, Contractor shall transfer all modifications to a final, as-built diagram and shall turn over to Owner a reproducible diagram for record.

B. Product Data: Provide for each type of product, including all furnished options and accessories.

1. Include overall bill of materials.
2. Include cutsheet data for all components and cabling.
3. Include construction details, material descriptions, dimensions, profiles and finishes.
4. Include rated capacities, operating characteristics and electrical characteristics.

C. Calculations:

1. Battery capacity and runtime
2. Voltage drop
3. Circuit sizing

D. Shop Drawings:

1. Comply with recommendations and requirements in the “Documentation” section of the “Fundamentals” chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work. Plans shall be computer generated (hand drawn will not be accepted) on a scalable plan of the building.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm. Include override by firefighters’ control or smoke-evacuation system where applicable.
    c. Locate detectors according to manufacturer's written recommendations.

d. Show air-sampling detector pipe routing.

13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

E. Seismic:

1. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
2. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Smoke and Fire/Smoke Dampers: Examine HVAC plans and provide smoke detectors as required for damper system installed. Connect complete to operate dampers and to shut down air handling units where required.

B. Duct Smoke Detectors:

1. Furnish and connect UL 268A addressable duct smoke detectors complete, including power input and fire alarm circuits. Control wiring for fans and dampers shall be by mechanical contractor.
2. Detectors shall suit system furnished. Provide detectors with enclosed detector unit and contacts mounted exterior to duct and with air inlet tube extending into duct. Provide inlet tube lengths as directed by mechanical contractor; tubes shall be a minimum of 75% of duct width.
3. Provide detectors with at least two sets of SPDT auxiliary contacts for connection of fan and smoke damper controls by mechanical contractor.
4. Turn detectors over to mechanical contractor, who will install and connect control wiring through auxiliary contacts for fans and dampers.
5. Power input for detector operation shall be provided through fire alarm wiring. Connect to sound fire alarm on detector activation and for device annunciation as specified above.
6. Provide each duct smoke detector with a remote annunciator/reset station. Station shall display a lighted pilot lamp when detector is in alarm and shall incorporate a switch by which the detector may be remotely reset. Install stations in accessible locations as directed by Owner.
7. Examine HVAC plans and provide detectors as required by applicable codes: one detector (return) for fan units producing 2,000 to 15,000 cfm and two detectors (supply and return) for fan units above 15,000 cfm. All fan units serving areas utilized for egress, regardless of capacity, shall have a return detector installed. In addition, provide supply detector if fan unit exceeds 15,000 CFM. Refer to the 2012 International Mechanical Code (IMC), Section 606 – Smoke Detection Systems Control.

C. Emergency Power Supply: System shall be provided with an additional emergency power supply as required to ensure system operation under conditions of normal power outage. The emergency power supply shall be capable of maintaining the system in a supervisory, standby condition for a period of at least 24 hours, with sufficient power capability after the 24-hour standby period for 15 minutes of alarm condition operation.

D. Provide a smoke detector at every new fire alarm control unit, remote panel and extender panels in compliance with NFPA 72 Section 10.15.

2.2 WIRING

A. All digital communications wiring shall be as recommended by manufacturer for each application and distance; wiring shall be a minimum #18 shielded AWG, foil wrap shield with integral drain wire.

B. Provide end of line (EOL) resistors where necessary; ohmic values as required to suit system furnished.

C. At contractor's option, T-Taps (parallel taps) are permitted if allowed by local codes and permitted by fire alarm manufacturer. Quantity of T-Taps in each circuit shall not exceed the number specified by fire alarm manufacturer to suit system furnished.

D. All network wiring routed outdoors (underground, concealed or overhead) shall be via fiber optic cable to minimize interference or damage from lightning. Provide all required modules, converters and associated work for a complete interface with system.

E. Isolator modules shall be provided to limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on SLC loops. Modules shall automatically isolate wire-to-wire short circuits on an SLC loop and when the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section. Provide isolator modules as follows:

1. After each twenty-five (25) devices/control points on any addressable circuit.
2. For each circuit extending outside the building.
3. In the FACP, at the end of each loop.
4. On loops containing less than twenty-five (25) devices, place an isolator at each end of the loop and one in the electrical center of the loop.

2.3 SEISMIC REQUIREMENTS

A. Fire alarm control panel, NAC panels, and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION

A. The system shall be electrically supervised, non-presignal type with operating sequence to match existing.

3.2 INSTALLATION

A. All conductors and cables shall be as required by system manufacturer for functions specified and shall comply with UL, NFPA, National Electrical Code and International Fire Code in rating, type, survivability and installation.

B. Provide raceways for all conductors and cables. See drawings for raceway types approved for various locations and applications in the project. All metallic raceways shall be minimum 3/4" in size. Install concealed in all finished spaces.

C. Provide red locking kit for all circuit breakers serving new fire alarm system components. Install red engraved nameplate adjacent to each breaker with wording to indicate load served.

D. Protect all detectors in construction areas from contamination and physical damage with appropriate dust covers and protective devices. Do not remove covers until completion of any dust or fume producing work is complete.

3.3 TESTING AND INSPECTIONS

A. Engage a factory-authorized service representative to test and inspect all components, assemblies, connections, wiring and equipment installation.

B. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing. Inspection shall be based on submittals, record drawings and system documentation required by the “Completion Documents, Preparation” table in the “Documentation” section of the “Fundamentals” chapter in NFPA 72. Comply with the “Visual Inspection Frequencies” table in the “Inspection” section of the “Inspection, Testing and Maintenance” chapter in NFPA 72; retain the “Initial/Reacceptance” column and list only the installed components.
2. System Testing: Comply with the “Test Methods” table in the “Testing” section of the “Inspection, Testing and Maintenance” chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer’s written instructions.
4. Test visible appliances for the public operating mode according to manufacturer’s written instructions.
5. Open initiating device circuits and verify that trouble signal actuates.
6. Open signaling line circuits and verify that trouble signal actuates.
7. Open and short notification appliance circuits and verify that trouble signal actuates.
8. Ground all circuits and verify response of trouble signals.
9. Introduce on system each of the alarm conditions the system is required to detect. Verify proper receipt and proper processing of signal at fire alarm control panel and correct activation of control points, door holders and the like.

C. Prepare test and inspection reports upon successful completion of testing.

3.4 CERTIFICATE OF OPERATION

A. At the time of substantial completion, before Engineer makes Substantial Completion Inspection, the contractor shall provide to the engineer a certificate of operation for the fire alarm system. The certificate shall:

1. State that the system (all stations) has been completed, tested and operated successfully.
2. Include all information required in NFPA-72, Sections 10.18.2 and 14.6.2 on forms identical to that contained in NFPA-72 (Forms 10.18.2.1.1 and 14.6.2.4).
3. Include written certification that the system has passed inspection by authority having jurisdiction.

3.5 SYSTEM TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on all adjustments, operations and maintenance of fire alarm system.

B. At a minimum, the training shall cover the following topics in sufficient detail:

1. Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
2. Overall system concepts, capabilities and functions.
3. Explanation of all control functions, system troubleshooting, silence, reset and similar functions.
4. Review of manuals, drawings and all technical documentation.
5. Any programming or performance peculiarities that are inherent within the system.

END OF SECTION 283110