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PROJECT MANUAL

Volume II of II

VICTOR ELEMENTARY SCHOOL DISTRICT

12219 2nd Avenue
Victorville, California 92395

HVAC IMPROVEMENTS

Park View ES - A# 04 - 12 20 83

13428 Cahuenga Road
Victorville, CA 92394

WD Project #22825

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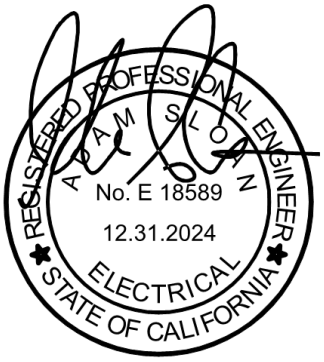
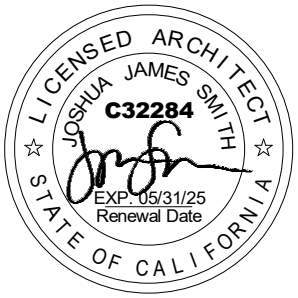
EHCC PROJECT NO. 4309

SECTION 00 01 07
SEALS PAGE

END OF SECTION





IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 04-122083 INC:
REVIEWED FOR
SS ☑ FLS ☑ ACS ☐
DATE: 10/18/2023

SECTION 00 01 10
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END OF SECTION

SECTION 01 10 00

GENERAL REQUIREMENTS – DIVISION 1

PART 1 GENERAL

1.1 Bid Package Contractor is responsible for own assessment of security needs within and around site boundaries and to maintain sufficient security and safety measures to effectively prevent vandalism, vagrancy, theft, arson, and all other such negative impacts to own work. Any impacts to the progress of the work due to loss from inadequate security and safety measures, will be the responsibility of the Contractor.

1.1 The method of correspondence for Bid Package Contractor shall be Procore. Bid Package Contractor shall create a Procore account, which is a web based program. A meeting to discuss the Procore process will be scheduled prior to submittal submission.

1.2 This Bid Package Contractor, by submitting a bid, is acknowledging that he/she has made a thorough inspection of the project sites and that Contractor has made a detailed comparison between the existing conditions on the site and those indicated within the Contract Documents.

1.3 Provide all submittals including product data, shop drawings, samples, deferred submittals, schedules, and any other documentation required for approval required by the project documents and Architect to assure long lead times do not affect the scheduled work. The Bid Package Contractor shall provide a list of long lead material and equipment and expected lead times for scheduling purposes. In addition, all required architectural selections (i.e. colors, material, finish, texture, etc.) embedded in the submittal must be specifically tabbed and highlighted within the submittal and also noted on the transmittal page. In the event no option is chosen by the Architect, the Contractor shall submit an RFI for clarification.

1.4 A post-bid review will be required for the specified Low Bid Package Contractor, which will be conducted at the District's or Construction Manager's Office. See Construction Manager Supplemental Specification Section 00 46 00 – Post Bid Interview. Low Bid Contractor shall bring to the meeting the questionnaire included in the Specification Section 00 46 00 filled out and ready to discuss. This is a mandatory meeting for the low bidder. The meeting will take place the day after the bid, or closest proximity thereof as scheduled.

1.5 This Bid Package Contractor will have a foreman/superintendent attend and participate in mandatory weekly coordination meetings as scheduled by the Construction Manager. In these meetings, the foreman/superintendent will be prepared to discuss coordination and scheduling of their bid package work and as it relates to other bid package contractor's work. Failure of Contractor's representative to attend scheduled weekly mandatory Progress Meetings will result is a $100 backcharge to Contractor for each missed meeting unless specifically excused by the Construction Manager.

1.6 Bid Package Contractor shall provide a detailed CPM project schedule and the work shall be scheduled within the timeline identified in the Special Conditions. Based on that CPM schedule, the Bid Package Contractor shall be required to participate in the Pull Planning Scheduling as a means of activity scheduling in order to meet the project schedule. The Bid Package Contractor will be required to provide a foreman and management level of representation at all Pull Planning weekly sessions. Bid Package Contractor also agrees

to provide a Foreman level of representation at all Pull Planning daily update "quick meets".

1.7 For the Bid Package Contractor performing trenching, backfilling, and grading operations, base bid shall include obtaining and paying for all governmental agencies, utility company permits, licenses and fees required in accordance with the contract documents for the performance of the work as applies to this Bid Package Contractor during trenching, backfilling and grading operations such as traffic control permits and haul route permits. All cost associated with the permits shall be the responsibility of this Bid Package Contractor.

1.8 Bid Package Contractors are required to ensure they have all permits associated with their scope of work including, but not limited to, OSHA's annual permit and any other permit necessary.

1.9 Bid Package Contractor is responsible for environmental conditions for own work.

1.10 Work hours shall comply with the City of Victorville's local ordinances including adherence to limited hours for noisy exterior work.

1.11 Bid Package Contractor shall adhere to inspections as required by DSA and the DSA Form 103. Bid Package Contractor shall schedule inspections as indicated in the contract documents including submitting IOR inspection requests 48 hours in advance of inspection for both on site and in-plant inspections.

1.12 Bid Package Contractor acknowledges that in the event closeout and warranty documentation required by the contract documents for own scope of work is not received prior to completion of the project, $1,500 will be detained from Contractor's payment until all documentation is received.

1.13 All Bid Package Contractors will be required to upload required forms to the DSA Box.

1.14 Notify affected utility companies and District prior to starting utility work and comply with their requirements.

1.15 All Bid Package Contractors shall practice and implement Best Management Practices, BMPs for own Work. Bid Package Contractor shall be responsible for the repair or replacement of the BMPs.

1.16 All Bid Package Contractors shall be responsible for temporary site fencing and gates for own Work at each campus, all to ensure no interaction with work zone and student activity. Location of fencing and gates to be coordinated with Construction Manager. Site fencing shall be temporary, adequate to protect Contractor and students and be maintained on hourly basis while up and in use.

1.17 All Bid Package Contractors shall provide and maintain temporary chemical type toilet and wash facilities throughout the duration of the project in sufficient quantities as required for own workforce at each of the project sites. Location of chemical toilets to be coordinated with Construction Manager. Each Contractor will add additional facilities as required based

on fluctuations in workforce. All temporary toilets shall be properly serviced twice weekly and shall meet all applicable governmental codes at all times. Contractors are not permitted to use existing toilet facilities, such as student's and staff's restrooms.

1.18 Bid Package Contractor shall provide protection of areas of work either by caution tape or fencing. At locations where trench excavation is occurring, no trench shall be left uncovered overnight. Provide trench plate covers at open trenches at the end of each day.

1.19 All Bid Package Subcontractors shall be required to provide the appropriate California Contractor's License and City of Victorville Business License when performing the work of each section included in each bid package.

1.20 Multiple move-ins may be required for the performance of this bid package. There is no predetermined number of move-ins required to meet contract schedule. Work shall be done in accordance with the project schedule and the requirements of the Construction Manager.

1.21 Daily clean-up of all debris related to the Work of this Bid Package Contractor is required. All debris generated by this Bid Package Contractor shall be legally removed daily and disposed of offsite by this Bid Package. As each campus is active with students, teachers and administrators, requirement for daily clean-up will be adhered to prior to leaving each day.

1.22 Promptly obscure and/or repair any vandalism and graffiti on own work on a daily basis.

1.23 Bid Package Contractor will provide Daily Work Reports on a daily basis delivered to Construction Manager's field office no later than 9:00 a.m. for the previous day worked. Include all information of Work and workmen by vendors, equipment owner/operators, visitors and sub-contractors. Sub-Contractors Daily Work Report shall be attached to Bid Package Contractor's daily work report.

1.24 All Certified Payrolls must be uploaded to DIR prior to payment for each month billed including all subcontractors and tier subcontractors.

1.25 The Bid Package Contractor and their Subcontractors and tier Subcontractors will be required to submit a DAS 140, DAS 142, and Fringe Benefit Statement prior to start of any work on site. In the event these documents are not received, no work will shall be performed.

1.26 Provide all scaffolding and equipment necessary to efficiently and safely install all of the work of this bid package. All scaffolding placed on a finish slab may not be done without proper plywood and sand base for protection. All scaffolding work shall be OSHA compliant.

1.27 All Bid Package Contractors are responsible for their own temporary fall protection system. Fall protection system to comply with OSHA requirements.

1.28 Work will be performed uninterrupted throughout the project duration, sometimes if necessary, at night and during weekends. This Bid Package Contractor will be available to perform Work for the duration of the project and will respond, and be on site, to perform the Work, within 24 hours if requested by the Construction Manager.

1.29 Bid Package Contractor shall bid the most costly option in the event of conflict, duplicative work scope assignments, or ambiguities in the contract documents unless clarified prior to bid.

1.30 This Bid Package Contractor shall protect all work related to this bid package from weather related damage. Contractor will replace all weather damaged work at their own cost for all labor, material, equipment and time.

1.31 Bid Package Contractor shall coordinate with all School District representative, Construction Manager, and Utility Agencies as necessary to permit, schedule, and perform work related to this Bid Package Contractor.

1.32 Bid Package Contractor shall forward cost proposals no later than 5 days from requested timeframe. In the event cost proposals are not received within the allotted time frame, the Construction Manager will determine all additional costs and credits for the scope of work based on the most current Great West Saylor pricing manual.

1.33 This Bid Package Contractor shall provide a fire protection plan and fire protection as required by OSHA including fire extinguishers for construction safety.

1.34 Provide all required layout as required for the work of this Bid Package Contractor

1.35 Bid Package Contractor to provide all necessary protection to all existing and surrounding buildings, surfaces and finishes, utilities, underground utilities during installation of work. Any damage caused shall be repaired to the satisfaction of the Construction Manager, District and Architect of Record.

1.36 Prequalification of all Bid Package Prime Contractors is required per AB 1565 as of January 1, 2014 (California Public Contract Code 20111.6). Prequalification is also required from mechanical, electrical, or plumbing (“MEP”) subcontractors (contractors that hold C-4, C-7, C-10, C-16, C-20, C-34, C-36, C-38, C-42, C-43 or C-46 licenses). See the District’s website for Prequalification packets. Prequalification packets must be received by the District 10 days prior to the bid.

1.37 Bid Package Contractor shall include products from listed manufacturers only. As the product has gone through a board resolved District Standard process, substitutions will not be accepted. For product that is not District Standard, any substitutions must be submitted with a complete substitution request form and appropriate credit to owner. No exceptions

1.38 Bid Package Contractor acknowledges that any deviation from the contract documents shall be documented through the RFI process. In the event the Bid Package Contractor proceeds with installation of any deviation from the contract documents, the Bid Package

Contractor will be responsible for all re-work or correction if the deviation is unacceptable to the Owner, Construction Manager, or Design Team.

1.39 Prior to commencement of any underground excavations, notify Dig Alert of Southern California. Dial 811 for Dig Alert of Southern California. Provide to the Construction Manager verification of notification for this project.

1.40 Do not damage existing underground utilities scheduled to remain in place. Bid Package Contractor shall pothole to determine existing utility routing. Contractor shall as-built these utilities in the horizontal and vertical locations in the field and provide the as-built to the Construction Manager on the master as-built plan at the end of each work day.

1.41 Bid Package Contractor shall pothole as necessary and review contract and as-built drawings to verify no utility conflicts exist.

1.42 All excess spoils generated by this operation shall be removed and legally disposed of off-site on a daily basis.

1.43 Bid Package Contractor is responsible for safe-off and cutting and capping of utilities as it applies to own Bid Package prior to demolition.

1.44 There shall be no interruptions of utility services to adjacent property owners for performance of this bid package contractor's work. Coordinate utility shut downs with the Construction Manager and District. Notify Construction Manager 48 hours prior to scheduled shut-downs.

1.45 Upon discovery of any unknown utilities or concealed conditions, which would affect the scope of work, notify the Construction Manager immediately.

1.46 Include and pay all costs associated with additional testing and inspections due to failed tests for work in place by the bid package contractor.

1.47 Bid Package Contractor agrees and acknowledges that certain design errors and omissions can and do occur in the project contract documents and that it has been the Bid Package Contractor's duty and responsibility to fully and thoroughly review the contract documents for such type of errors and omissions as related to their scope of work. Whereas the Bid Package Contractor has had adequate opportunity to bring these discrepancies to the attention of the Construction Manager and Architect and offer solutions. This Bid Package Contractor agrees and acknowledges that any discrepancy that could have been discovered with reasonable due diligence shall be the sole responsibility of the Bid Package Contractor to resolve at no additional cost to the District. Bid Package Contractor, being a licensed professional, is responsible to know and understand code issues as related to their area of work and therefore be able to identify obvious design discrepancies as related to buildings codes and thereby accepts responsibility as listed above. However, the Bid Package Contractor is not a licensed Engineer or Architect and thereby is not responsible for design discrepancies that would have been reasonably required the expertise of a licensed Engineer or Architect to discover during the pre-construction phase of work.

1.48 Change Orders and Construction Change Documents (CCDs).
The intent of these drawings and specifications is that the work of the alteration, rehabilitation, or reconstruction is to be in accordance with title 24, CCR. should any existing conditions such as deterioration or non-complying construction be discovered which is not covered by th contract documents wherein the finished work will not comply with title 24, CCR, a construction change document (CCD), or a separate set of plans and specifications, detailing and specifying the required work shall be submitted to and approved by DSA before proceeding with the work. (Section 4-317(C), part 1, title 24, CCR). Construction Change Documents must be signed by A/E of Record, Structural Engineer, Delegated professional engineer (when applicable) and DSA.

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.

B. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Discontinued.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.04 REGULATORY REQUIREMENTS

A. All substitutions affecting DSA regulated items shall be considered as a Construction Change Document or Addenda. and shall be approved by DSA prior to fabrication and installation. (CAC, Section 4-338(C). IR A-6)

B. All addenda must be signed by Architect and approved by DSA per CAC, Section 4-338(b).

PART 3 EXECUTION

2.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.
   5. Agrees to reimburse Architect for review or redesign services associated with re-approval by authorities.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name, and any additional required identifiers established in Contract Documents.
         2) Owner's, Architect's, and Contractor's names.
      b. Substitution Request Information:

1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
2) Indication of whether the substitution is for cause or convenience.
3) Issue date.
4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
5) Description of Substitution.
6) Reason why the specified item cannot be provided.
7) Differences between proposed substitution and specified item.
8) Description of how proposed substitution affects other parts of work.

c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
1) Physical characteristics.
2) Visual effect.
3) Warranties.
4) Other salient features and requirements.
5) Include, as appropriate or requested, the following types of documentation:
(a) Product Data:
(b) Certificates, test, reports or similar qualification data.
(c) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:
1) Savings to Owner for accepting substitution.
2) Change to Contract Time due to accepting substitution.

D. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

2.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

2.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

B. Submit request for Substitution for Convenience 14 days after date established in Notice to Proceed.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
b. Other unanticipated project considerations.

C. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.

2.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
   1. Architect's decision following review of proposed substitution will be noted on the submitted form.

2.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

2.06 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record.

END OF SECTION

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SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Electronic document submittal service.
C. Preconstruction meeting.
D. Site mobilization meeting.
E. Progress meetings.
F. Construction progress schedule.
G. Contractor's daily reports.
H. Progress photographs.
I. Coordination drawings.
J. Submittals for review, information, and project closeout.
K. Requests for Interpretation (RFI) procedures.
L. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements: General product requirements.
B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.
D. Section 01 91 13 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.

1.03 REFERENCE STANDARDS

A. AIA G716 - Request for Information 2004.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
    1. Requests for Interpretation (RFI).
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Design data.
    6. Manufacturer's instructions and field reports.
    7. Applications for payment and change order requests.
    8. Progress schedules.
    9. Coordination drawings.
    10. Correction Punch List and Final Correction Punch List for Substantial Completion.
    11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

3.02 PRECONSTRUCTION MEETING

A. Project Coordinator will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, schedule of values, and progress schedule.
   5. Submission of initial Submittal schedule.
   6. Designation and contact information of personnel representing the parties.
   7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   8. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Project Coordinator will schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.

C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements.
   3. Construction facilities and controls provided by Owner.
   4. Temporary utilities provided by Owner.
   5. Survey and building layout.
   6. Security and housekeeping procedures.
   7. Schedules.
   8. Application for payment procedures.
   9. Procedures for testing.
   10. Procedures for maintaining record documents.

11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

A. If preliminary schedule requires revision after review, submit revised complete schedule for review within five working days.

B. Within five working days after joint review, submit complete schedule.

C. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Photography Type: Digital; electronic files.

C. Provide photographs of site and construction throughout progress of work.

D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768.
1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.07 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:

1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
    a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    b. Do not forward requests which solely require internal coordination between subcontractors.
2. Combine RFI and its attachments into a single PDF electronic file.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
    a. Approval of submittals (use procedures specified elsewhere in this section).
    b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
    c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
    d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.

E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number.
2. Owner's, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.

2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.

H. Review Time: Architect will respond and return RFIs to Contractor within five working days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to the complexity of the RFI, and recorded in a timely manner in progress meeting minutes.

I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.08 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
1. Submit at the same time as the preliminary schedule.
2. Coordinate with Contractor's construction schedule and schedule of values.
3. Format schedule to allow tracking of status of submittals throughout duration of construction.
4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.09 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
1. Design data.
2. Sustainability design submittals and reports.
3. Certificates.
4. Test reports.

5. Inspection reports.
6. Manufacturer's instructions.
7. Manufacturer's field reports.
8. Other types indicated.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.12 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a separate transmittal for each item.
   2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
   7. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
      c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
   8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   9. When revised for resubmission, identify all changes made since previous submission.
   10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
   11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
   12. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:
   1. Submit only information required by individual specification sections.
   2. Collect required information into a single submittal.
   3. Submit concurrently with related shop drawing submittal.
   4. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
   2. Do not reproduce Contract Documents to create shop drawings.
   3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
   1. Transmit related items together as single package.
   2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

3.13 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt, but will take no other action.

C. Architect's actions will be reflected by:
   1. Notations may be made directly on submitted items and/or listed on Submittal Review cover sheet.

D. Architect's and consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "No Exception Taken", or language with same legal meaning.
      b. "Furnish as Corrected", or language with same legal meaning.
         1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit".
         1) Resubmit revised item, with review notations acknowledged and incorporated.
         2) Non-responsive resubmittals may be rejected.
      b. "Rejected & Resubmit".
         1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
   1. Items for which no action was taken:
      a. "Received" - to notify the Contractor that the submittal has been received for record only.

END OF SECTION

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SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 SUBMITTALS

A. Within 10 days after date established in Notice to Proceed, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit in PDF format.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.03 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within three days.

3.04 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Update diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

3.05 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

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SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. Quality assurance.
C. References and standards.
D. Testing and inspection agencies and services.
E. Control of installation.
F. Manufacturers' field services.
G. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
B. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Test Reports: After each test/inspection, promptly submit a copy of the report to Architect and to Contractor.
    1. Include:
        a. Date issued.
        b. Project title and number.
        c. Name of inspector.
        d. Date and time of sampling or inspection.
        e. Identification of product and specifications section.
        f. Location in the Project.
        g. Type of test/inspection.
        h. Date of test/inspection.
        i. Results of test/inspection.
        j. Compliance with Contract Documents.
        k. When requested by Architect, provide interpretation of results.
C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor to Architect, in quantities specified for Product Data.
    1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
    2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
E. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
    1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.04 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.05 REGULATORY REQUIREMENTS

A. Material testing, project inspection, special inspections, and construction observations shall be described in detail in accordance with CAC, Section 4-333 and Chapter 17A.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.

4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.03 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Owner 30 days in advance of required observations.
1. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.04 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Owner, it is not practical to remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION

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SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations.

1.02 RELATED REQUIREMENTS

A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 01 40 00 - Quality Requirements: Product quality monitoring.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 01 40 00 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:

1. Made using or containing CFC's or HCFC's.
2. Made of wood from old growth timber.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming Bases of Design Manufacturer shall be deemed to be followed by the words "Or Approved Equal": Submit a request for substitution for any manufacturer not named.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

F. For exterior storage of fabricated products, place on sloped supports above ground.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Cutting and patching.

D. Cleaning and protection.

E. Starting of systems and equipment.

F. Demonstration and instruction of Owner personnel.

G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

H. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures.

B. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.

C. Section 01 73 29 - Cutting and Patching Requirements.

D. Section 01 79 00 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

E. Section 01 91 13 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Cutting and Patching: See Section 01 73 29 - Cutting and Patching Requirements

C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.04 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 indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

D. Services (Including but not limited to HVAC and Electrical): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. 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.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.

5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

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

F. Clean existing systems and equipment.

G. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

3.05 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.

C. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

D. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material , to full thickness of the penetrated element.

3.06 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

E. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 SYSTEM STARTUP

A. Coordinate with requirements of Section 01 91 13 - General Commissioning Requirements.

B. Coordinate schedule for start-up of various equipment and systems.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

A. See Section 01 79 00 - Demonstration and Training.

3.10 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.13 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections.

C. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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SECTION 01 73 29
CUTTING AND PATCHING REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements and procedural requirements for cutting and patching, including:
   1. Cutting and patching existing construction altered or disturbed to accommodate new modifications.
   2. Cutting and patching existing construction damaged or defaced during new construction as required to restore to existing or better condition at the time of award of Contract.
   3. Cutting and patching required to:
      a. Install or correct non-coordinated Work.
      b. Remove and replace defective and non-conforming Work.

1.02 RELATED REQUIREMENTS

A. Section 02 41 00 - Selective Demolition: Removal of existing site elements and construction.

1.03 SUBMITTALS

A. Written Request for Cutting and Alterations
   1. Submit written request in advance of cutting or alteration which affects:
      a. Structural integrity of any element of new or existing construction.
      b. Integrity of weather-exposed or moisture-resistant elements.
      c. Efficiency, maintenance, or safety of operational elements.
      d. Visual qualities of elements exposed to view in the completed construction.
      e. Existing construction not otherwise indicated to be revised by Work under the Contract.
   2. Include in requests for cutting and alteration:
      a. Location and description of affected Work. Include shop drawings as necessary to identify locations and communicate descriptions.
      b. Explanation of necessity for cutting and patching.
      c. Description of proposed Work and products to be used.
      d. Alternatives to cutting and patching.
      e. Effect on existing construction.
      f. Effect on the work performed by other trades.
   3. Provide written evidence that trades performing other work have been notified and acknowledge that cutting and patching work will be occurring.
   4. Indicate date and time cutting and patching Work will be performed, including duration.
   5. Describe the extent of cutting and patching required and how it is to be performed.
   6. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
   7. List products to be used and firms or entities that will perform work.
   8. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
   9. Where cutting and patching involves addition of reinforcement to structural elements, submit details to show how reinforcement is integrated with the original structure.
   10. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.
   11. Minimize effects on user operations and on concurrent operations construction by other trades.

1.04 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
   1. Obtain approval from the Architect of the cutting and patching proposal before cutting and patching the following structural elements:
      a. Bearing and retaining walls Structural concrete Structural steel
      b. Lintels
      c. Timber and primary wood framing Structural decking

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety-related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
   1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety-related systems:
      a. Primary operational systems and equipment Air or smoke barriers
      b. Water, moisture, or vapor barriers Membranes and flashings
      c. Fire protection systems
      d. Noise and vibration control elements and systems Control systems
      e. Communication systems Electrical wiring systems

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.01 PATCHING MATERIALS

A. Patching Materials, General: As required for original installation and to match surrounding construction.
   1. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing.
   2. Generally the Contract Documents will not define products or standards of workmanship present in existing construction; Contractor shall determine products by inspection and necessary testing, and determine quality of workmanship by using existing as a sample for comparison.
   3. The presence of a product, finish, or type of construction requires that patching, extending or matching shall be performed as necessary to make work complete and consistent with identical standards of quality.

B. Patching at Paving: At Portland cement concrete (PCC) paving, use concrete mix with maximum 3/8-inch aggregate and minimum 3000 psi 28-day compressive strength. Contractor shall provide dowels to existing paving with min. 6” penetration into existing surface and reinforce new paving with minimum No. 3 reinforcing steel bars at 16-inches on center each way placed in the vertical center of the slab. Welded wire fabric reinforcement will not be acceptable.
   1. All PCC paving shall be cut and patched from score line to score line and shall match as closely as possible in color and texture of the adjacent finish.

C. Patching of Lawns and Grasses:
   1. Restore areas trenched, disturbed or damaged. Provide sod or seeded planting mix, to match existing lawn or grass area.
   2. Properly barricade the area until such time as the planting mix establishes.

D. Patching of Building Finish Materials: Contractor shall
   1. Match existing products and finishes.
   2. Confirm colors, patterns and textures with Architect.
   3. Custom cut new materials to fit and to match joint patterns with existing materials.

E. Product Substitutions: For each proposed change in materials, submit request for Architects approval.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

B. Before proceeding, meet at the site with parties involved in cutting and patching. Review areas of potential interference and conflict, coordinate procedures, and resolve potential conflicts before proceeding.

C. Beginning of cutting or patching shall be interpreted to mean that existing conditions were found by Contractor to be acceptable.

D. After uncovering existing Work, inspect conditions affecting proper accomplishment of Work.

3.02 PREPARATION

A. Temporary Supports: provide supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

E. Weather Protection: Provide protection from elements for areas which may be exposed by uncovering Work. Maintain excavations free of water.

3.03 CUTTING AND PATCHING

A. General:
   1. Execute cutting, fitting, and patching, excavation and fill, as necessary to complete the Work.
   2. employ skilled workers to perform cutting and patching.
   3. Coordinate installation or application of products for integrated Work. Avoid having to cut and patch new substrates and finishes.
   4. Uncover completed Work as necessary to install or apply products out of sequence.
   5. Cut, remove and replace defective and non-conforming Work.
   6. Cut and patch as necessary to provide openings in the Work for penetration of plumbing, fire protection, HVAC and electrical Work.
   7. Where partitions are removed, patch floors, walls, and ceilings with finish materials to match existing.
   8. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting. Update as-built set with photographs or notations for the actual conditions.

B. Cutting:
   1. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations. Provide appropriate surfaces to receive final finishing. It is recommended to photograph the existing condition prior to cutting. This photo record shall serve as the pre-cut condition for comparison to the final patched outcome.

2. Execute cutting and patching of weather-exposed, moisture-resistant elements and surfaces exposed to view by methods to preserve weather, moisture and visual integrity.
3. Cut rigid materials using carbide tip saw blades, diamond grit abrasive saw blades, diamond core drills and hole saws, and similar cutters for smooth edges. Do not overcut corners.
    a. Core drill holes through concrete and masonry.
4. Provide fire and smoke seals at new penetrations to maintain fire rating at all penetrations.

C. Patching:
1. Provide durable seams that are as invisible as possible.
2. Comply with specified tolerances.
3. Restore substrates and finishes with products to match existing construction.
4. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
5. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
6. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
    a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat.
7. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
8. Finish surfaces flush and textured to match surrounding finishes.
9. Fit work neat and tight allowing for expansion and contraction.
10. Butt new finished to existing exposed structure, pipes, ducts, conduit, and other penetrations through surfaces.

D. Finishing: Refinish surfaces to match adjacent and similar finishes as used for the Project.
1. For continuous surfaces, Contractor shall refinish to nearest intersection or natural break.
2. For an assembly, Contractor shall refinish entire unit.

E. Restoration and Finishing: Finish surfaces to match adjacent and similar finishes as used for the Project.
1. Patch and replace any portion of an existing finished surface which is found to be damaged, lifted, discolored, or shows other imperfections, with matching material.
2. Provide adequate support of substrate prior to patching the finish.
3. Refinish patched portions of painted or coated surfaces in a manner to produce uniform color and texture over the entire surface.
4. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

F. Transition from Existing to New Construction:
1. When new work abuts or finishes flush with existing work, make a smooth and clean transition. Patched work shall match existing adjacent work in texture and appearance so that the patch or transition is invisible at a distance of five feet.
2. When finished surfaces are cut in such a way that a smooth and clean transition with the new work is not possible, notify Architect. Terminate existing surface in a neat manner along a straight line at a natural line of division, and provide trim appropriate to finished surface, or as otherwise directed by Architect.

G. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access to work.

B. Remove completely paint splater, mortar, oils, putty and items of similar nature.

C. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied.

END OF SECTION

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SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.

B. Section 01 91 13 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

C. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that

could not be answered in original training session.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

C. Provide training in minimum two hour segments.

D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

F. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.

8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

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SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
   1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
   2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
   4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.

C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

D. The Commissioning Authority is employed by Owner.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

B. HVAC System, including:
   1. Major and minor equipment items.
   2. Piping systems and equipment.
   3. Ductwork and accessories.
   4. Terminal units.
   5. Control system.
   6. Sound control devices.
   7. Vibration control devices.
   8. Variable frequency drives.

C. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

B. Section 01 79 00 - Demonstration and Training: Scope and procedures for Owner personnel training.

C. Section 23 08 00 - Commissioning of HVAC: HVAC control system testing; other requirements.

1.04 REFERENCE STANDARDS

A. PECI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests Current Edition.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:

1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
2. Submit one copy to the Commissioning Authority, not to be returned.
3. Make commissioning submittals on time schedule specified by Commissioning Authority.
4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.

B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
1. Manufacturer's product data, cut sheets, and shop drawings.
2. Manufacturer's installation instructions.
3. Startup, operating, and troubleshooting procedures.
4. Fan and pump curves.
5. Factory test reports.
6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.

C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.

D. Startup Plans and Reports.

E. Completed Prefunctional Checklists.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F (0.3 degree C) and resolution of plus/minus 0.1 degree F (0.05 degree C).
2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
3. Calibration: According to the manufacturer’s recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

A. Commissioning Authority has prepared the Commissioning Plan.

1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

B. Contractor is responsible for compliance with the Commissioning Plan.

C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.

D. Commissioning Schedule:
1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.

B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.

C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
1. No sampling of identical or near-identical items is allowed.
2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
    a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
    b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
    c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
    d. Serial number of installed unit.
    e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer’s start-up checklist items and minor testing.
    f. Sensor and actuator calibration information.
4. A preliminary list of Prefunctional Checklists is attached, to indicate anticipated scope.
5. PECI (Samples) found at http://www.peci.org/library/mcpgs.htm indicate anticipated level of detail for Prefunctional Checklists.

B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.

2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
4. If any Checklist line item is not relevant, record reasons on the form.
5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
7. Submit completed Checklists to Commissioning Authority within two days of completion.

C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.
2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
4. When asked to review the proposed Checklists, do so in a timely manner.

D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
2. A sampling of non-primary equipment, as allowed by the commissioning plan.

E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.

B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.

C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.

D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.

4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:
1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
c. Systems are run through all the HVAC control system’s sequences of operation and components are verified to be responding as the sequence's state.
d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
3. A preliminary list of Functional Tests is attached, to indicate anticipated scope.
4. PECI (Samples) found at http://www.peci.org/library/mcpgs.htm indicated anticipated level of detail for Functional Tests.

F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.

C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
2. Verify that sensors with shielded cable are grounded only at one end.
3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
4. Tolerances for critical applications may be tighter.

D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.

3. If not, install offset, calibrate or replace sensor.

E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
2. Connect a signal generator in place of sensor.
3. Connect ammeter in series between transmitter and building automation system control panel.
4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
8. Reconnect sensor.
9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
11. If not, replace sensor and repeat.
12. For pressure sensors, perform a similar process with a suitable signal generator.

F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
2. Pressure, Air, Water, Gas: 3 percent of design.
3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
4. Relative Humidity: 4 percent of design.
5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
6. Flow Rate, Air: 10 percent of design.
7. Flow Rate, Water: 4 percent of design.
8. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).

G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper to open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the

specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
   1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
   2. Sampling is not allowed for:
      a. Major equipment.
      b. Life-safety-critical equipment.
      c. Prefunctional Checklist execution.
   3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
   4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
   5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
   6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
   7. If YY percent of the units in the second sample fail, test all remaining identical units.
   8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.

D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.

F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.

G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.

H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
   1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority’s request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
   2. Other points will be monitored by the Commissioning Authority using dataloggers.
   3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
   4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
   5. Graphical output is desirable and is required for all output if the system can produce it.
   6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 78 00 - Closeout Submittals for additional requirements.

B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.

C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration and installation purposes.

1.02 RELATED REQUIREMENTS

1.03 DEFINITIONS

A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.

C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.

D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 DEMOLITION

A. Remove portions of work as indicated on the drawings and as required to accomplish new work.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of work to be removed.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. 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. Protect existing structures and other elements to remain in place and not removed.

D. Minimize production of dust due to demolition operations.

E. Hazardous Materials:
   1. If hazardous materials are discovered during removal operations, stop work and notify Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

3.03 EXISTING UTILITIES

A. Protect existing utilities to remain from damage.

B. Do not disrupt public utilities without permit from authority having jurisdiction.

C. 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.

D. 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.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   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. Separate areas in which demolition is being conducted from areas that remain occupied.

C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

D. Remove existing work as indicated and required to accomplish new work.

E. Services including, but not limited to, HVAC: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
   1. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   2. Repair adjacent construction and finishes damaged during removal work.
   3. Patch to match new work.

3.05 DEBRIS AND WASTE REMOVAL

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

B. Leave areas of demolition in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.02 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture, by a recognized, approved testing laboratory.

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I, gray

B. Normal-Weight Aggregates: ASTM C 33, graded.
   1. Maximum Coarse-Aggregate Size: 1 inch
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.04 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

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

2.05 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Water: Potable.

C. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 and ACI 318, Ch. 5. Submit to Architect/Engineers & Special Inspector for review of general conformance.

B. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

C. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,500 pounds per square inch.
2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
4. Silica Fume Content: Maximum 5 percent of cementitious materials by weight.
5. Cement Content: Minimum 5 sacks per cubic yard.
   a. Minimum 5 sacks per cubic yard.
   b. Maximum 7 sacks per cubic yard.
6. Water-Cement Ratio: Maximum 45 percent by weight where in contact with soil.
7. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
8. Maximum Slump: 3-inches, +/- 1-inch.
9. Maximum Aggregate Size: 1 inch.

2.07 FABRICATING REINFORCEMENT

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

2.08 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer where indicated at exterior corners and edges of permanently exposed concrete.

3.02 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates,

diagrams, instructions, and directions furnished with items to be embedded.

3.03 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.04 JOINTS

A. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.05 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 305R.

3.06 FINISHING FORMED SURFACES

A. Rough-Formed Finish at surfaces not exposed to view: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

B. Smooth-Formed Finish at surfaces exposed to view: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

3.07 FINISHING

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface by hand floating. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

C. Trowel Finish Slab on Grade: After applying float finish, apply first troweling and consolidate concrete by hand trowel. Continue troweling until surface is free of trowel marks and uniform in texture and appearance.

3.08 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305R for hot-weather protection during curing.

B. Cure concrete according to ACI 308.1.

END OF SECTION

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items, including: roof top equipment guardrails.

1.02 RELATED REQUIREMENTS

A. Section 09 96 00-High-Performance Coatings

1.03 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2018.

B. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.

C. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

B. Plates: ASTM A283/A283M.

C. Pipe: ASTM A53/A53M, Grade B Schedule 40, hot-dip galvanized finish.

D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Guard Rails: As detailed; prime paint finish.

2.04 FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Perform field welding in accordance with AWS D1.1/D1.1M.

END OF SECTION

SECTION 06 10 53
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof-mounted curbs.

B. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

B. PS 20 - American Softwood Lumber Standard 2021.

C. WWPA G-5 - Western Lumber Grading Rules 2021.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   3. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Western Wood Products Association; WWPA G-5.

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Stud Framing for sizes 2 by 2 through 2 by 6 (.):
   1. Species: Douglas Fir.
   2. Grade: No.2.

E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No.2 or Standard Grade.

2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.03 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.04 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fall Arrest Harness and Lanyard Kit

1.02 REFERENCE STANDARDS

A. 29 CFR 1926.502 - Fall protection systems criteria and practices Current Edition.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Installation methods.
   2. Maintenance requirements.

C. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 FALL ARREST HARNESS AND LANYARD KIT

A. Basis-of-Design:
   1. Super Anchor Safety; www.superanchor.com
      a. Product: Mini MAX Kit – Deluxe Harness – 4303 Series
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Harness Features
   1. Fully Padded Chest, Shoulder and Leg Strap with Tri-Lam3 Closed Cell Foam Padding that Resist Water Absorption.
   2. 3 D-Rings for Fall Arrest or Work Positioning
   3. Heavy Duty Rear D-Ring Pad
   4. 2 Side D-Rings with Elastic Storage
   5. Fixed Position Chest Strap
   6. Quick Connect Leg and Chest Buckles
   7. 16 Grommet Waist Belt
   8. Fall Indicator Labels on Shoulder Straps

C. Lanyard Features
   1. Relaxed length 4ft 5in – Expanded length 6ft
   2. Stretching feature helps reduce tripping hazards for the user
   3. ANSI Z359 Rated 3,600lb Gate Strength Hardware
   4. Impact Indicator Label Helps Identify if Lanyard has been Subjected to Fall

D. Accessories
   1. Carry Bag - #6003
   2. Fall Protection Manual English/Spanish – #3011
   3. Flex Lanyard Manual

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

B. Test units for proper function and adjust until proper operation is achieved.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Interior painting and coating systems.

1.02 RELATED REQUIREMENTS

A. Section 09 96 00 - High-Performance Coatings: Other painted metal items.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2020.

C. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015). 2003.

1.04 REGULATORY REQUIREMENTS

A. Conform to T24, CCR for flame and smoke rating requirements for finishes.

B. Conform to T19, CCR for all application processes and safety procedures.

C. Materials shall comply with FDA requirements.

D. Conform to requirements of SCAQMD.

E. 2022 California Green Building Standards Code

1.05 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.06 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. See Section 01 30 00 - Administrative Requirements for submittal procedures.

C. Samples: Submit four paper draw down samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.

D. Maintenance Data: Submit coating maintenance manual including care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon (4 L) of each colorand gloss, store where directed.
   3. Label each container with color, type, and gloss in addition to manufacturer's label.

1.07 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.

C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Products: Subject to compliance with requirements, provide Dunn Edwards products indicated; Contact Kim Hampton – Kim.Hampton@DunnEdwards.com

B. Acceptable Manufacturers subject to submitting products that meet or exceed performance and physical characteristics of basis of design products:
   1. Sherwin Williams.
   2. PPG.
   3. Vista.

2.02 PAINTINGS AND COATINGS

A. General:
   1. Provide materials for use within each paint system that are compatible with one another, and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. Provide factory-mixed coatings unless otherwise indicated.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction

C. Colorants: The use of colorants containing hazardous chemicals, such as ethylene glycol, is prohibited and zero VOC colorants should be used whenever possible.

D. Colors: As selected by the Architect.

E. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

2.03 PAINT SCHEDULE - INTERIOR

A. Gypsum Board Substrates: 3 coats
   1. Prime Coat: Primer sealer, latex, Vinylastic Premium VNPR00.
   2. Intermediate Coat: Latex, interior, matching topcoat.
   3. Topcoat: Paint gloss and colors as scheduled on drawings.
      a. Latex, interior, eggshell, Spartawall Eggshell SWLL30
      b. Latex, interior, semi-gloss, Spartawall Eggshell SWLL50
      c. Latex, interior, flat, Spartazero Flat SZRO10

B. Gypsum Board Substrates (where indicated for enamel paint): 3 coats
   1. Prime Coat: Vinylastic Slect Latex wall sealer (VNSL00)
   2. Intermediate Coat: Enduracat Semi-Gloss Pre-CAtalyzed, water based, single component epoxy (ENPX50)
   3. Topcoat: Enduracat Semi-Gloss Pre-Catalyzed, water based, single component epoxy (ENPX50)

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.

3.02 PREPARATION

A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing. Mask permanent labels for items certified or tested by Underwriter's Laboratories, Warnock-Hersey, or other testing agencies, fusible links, and identification stamps.

B. Clean surfaces thoroughly and correct defects prior to application.

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

D. Remove mildew from impervious surfaces by scrubbing with solution of water and bleach. Rinse with clean water and allow surface to dry.

E. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions.

C. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness and a uniform finish.

D. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

E. Walls with Base: Paint the entire wall, including the wall behind the base.

3.04 PRIMING

A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Primers specified in painting schedules may be omitted on items factory primed or factory finished items if acceptable to top coat manufacturers.

3.05 CLEANING

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

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

A. Protect finished coatings from damage until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

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SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings for all exposed, unfinished metal including but not limited to:
   1. Fabricated railings
   2. Hollow metal doors and frames not scheduled with factory finish

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. 05 50 00 - Metal Fabrications

B. 08 11 00 Hollow Metal Doors and Frames

1.03 REFERENCE STANDARDS

A. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2020.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition, www.paintinfo.com.

C. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

D. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1 Fourth Edition.

E. SSPC V2 (PM2) - Systems and Specifications: Steel Structures Painting Manual, Volume 2 Fourth Edition.

F. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel 2016.

G. SSPC-PA 2 - Procedure For Determining Conformance To Dry Coating Thickness Requirements 2015.

H. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

I. SSPC-SP 2 - Hand Tool Cleaning 1982, with Editorial Revision (2004).

J. SSPC-SP 3 - Power Tool Cleaning 1982, with Editorial Revision (2004).

K. SSPC-SP 6 - Commercial Blast Cleaning 2007.

L. SSPC-SP 11 - Power Tool Cleaning to Bare Metal 2012 (Ed. 2013).

1.04 SUBMITTALS

A. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
   4. Manufacturer's installation instructions.

B. Product Data: Provide data indicating coating materials .

C. Samples: Submit three 8 -1/2 x 11 inch (200 x 200 mm) samples of selected colors.

D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Maintenance Data: Include cleaning procedures.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

B. Single-Source Responsibility: Provide primers and undercoat material produced by the same manufacturer as the finish coats for each type of coating. Use only thinners recommended by the manufacturer and only within recommended limits.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

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

B. Restrict traffic from area where coating is being applied or is curing.

1.08 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Specified Manufacturer: Tnemec Company, Inc., North Kansas City, MO (816/474-3400; regional representative, TPC Consultants, INC., Compton, CA, 310/637-2363).

B. Acceptable Manufacturers: Equivalent products of the following manufacturers:
1. Ameron Protective Coatings, Brea, CA (714/529-1951 or 800/344-0025).
2. Carboline Company, St. Louis, MO (800/848-4645).

C. Substitutions will be considered in accordance with the provisions of Product Substitutional Procedures

2.02 HIGH-PERFORMANCE COATING SYSTEM

A. General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

B. Urethane Coating System:
1. Primer Coating: For shop application at time steel products are fabricated.
   a. Plain steel: Tnemec Series 94-97 Tneme-Zinc, two-component catalyzed epoxy coating at 2.5-3.5 mils DFT.
   b. Galvanized steel: Tnemec Series L69 Epoxoline, two-component catalyzed epoxy coating at 2-3 mils DFT.
2. Spot Primer Coating: For field application where primer coating is damaged due to erection, cutting, welding and installation of steel products, Tnemec Series 94-H20 Hydro-Zinc at 2.5 - 3.5 mils DFT over bare metal.
3. Intermediate Coating: For field application over all surfaces of steel products after erection, cutting, welding and installation, Tnemec Series L69 Epoxoline, two-component catalyzed epoxy coating at 2 - 4 mils DFT.

4. Finish Coating: Tnemec Series 1095 Endura-Shield, pigmented, aliphatic, polyurethane coating, semi-gloss sheen at 3mils DFT minimum.
5. Finish Colors: As indicated on the Drawings or, if not indicated, as directed by the Architect from full range of standard colors.

2.03 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

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

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

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

3.02 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

C. Remove finish hardware, fixture covers, and accessories and store.

D. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

E. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning", and protect from corrosion until coated.

F. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection.

3.06 CLEANING

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

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.07 PROTECTION

A. Protect finished work from damage.

END OF SECTION

SECTION 23 0130
HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.01 QUALIFICATION OF THE HVAC SYSTEM CLEANING CONTRACTOR

A. Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

B. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.

C. Experience: The HVAC system cleaning contractor shall submit records of experience (from previous jobs) in the field of HVAC system cleaning as requested by the Owner.

D. Equipment, Materials and Labor: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.
   1. The contractor shall assure that its employees have received safety equipment training, medical surveillance programs (fit testing record), individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification.
   2. The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs (such as ladder safety, fall protection, etc.) and this specification
   3. Contractor shall submit to the Owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.

E. Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s) (i.e. NADCA certified), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

1.02 STANDARDS

A. NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).
   1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.
   2. NADCA Standards must be followed with no modifications or deviations being allowed.

1.03 DESCRIPTION

A. Mechanical Drawings: The Owner shall provide the HVAC system cleaning contractor with one copy of the following documents:
   1. Project drawings and specifications.
   2. Approved construction revisions pertaining to the HVAC system.
   3. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 SCOPE OF WORK

A. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

1. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.
2. Refer to the Specific Tasks in the Turn-key SOW for details.

3.02 HVAC SYSTEM COMPONENTS INSPECTIONS AND SITE PREPARATIONS

A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected.
   1. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented.
   2. Damaged system components found during the inspection shall be documented and brought to the attention of the Owner.

B. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

C. Inspector Qualifications: Qualified personnel should perform the HVAC cleanliness inspection to determine the need for cleaning. At minimum, such personnel should have an understanding of HVAC system design, and experience in utilizing accepted indoor environmental sampling practices, current industry HVAC cleaning procedures, and applicable industry standards.

3.03 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.

B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

C. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.

D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

F. Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
   1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.

2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards, which include the NFPA.
3. Closures must not significantly hinder, restrict, or alter the airflow within the system.
4. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
5. Openings must not compromise the structural integrity of the system.
6. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.
7. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.
8. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the Owner in project report documents.

G. Ceiling sections (tile): The contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.

H. Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.

I. Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The contractor shall insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:
   1. Clean all air handling units (AHU) internal surfaces, components and condensate collectors and drains.
   2. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
   3. Clean all coils and related components, including evaporator fins.

J. Duct Systems. Contractor shall:
   1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
   2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

3.04 HEALTH AND SAFETY

A. Safety Standards: Cleaning contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

C. Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

3.05 MECHANICAL CLEANING METHODOLOGY

A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests (such as Cleaning Verification Test), in accordance with all general requirements.

No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system. Provide the building owner three (3) hardcopies and one electronic copy of the test report(s) either on a CD or email attachment to the VA representative.

1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.
2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.
4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components
   1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.
   2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material
   1. Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.
   2. Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
   3. Replacement material: In the event fiber glass materials must be replaced, all materials shall conform to applicable codes and standards, including those of UL and SMACNA.
   4. Replacement of damaged insulation is not covered by this section.

D. Cleaning of coils
   1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.
   2. Notify Owner if fins are found to be damaged prior to cleaning of coils.

E. Antimicrobial Agents and Coatings
   1. EPA registered and FDA approved antimicrobial agents for hospital use shall be applied to prevent fungal growth.

2. Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
3. When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations and EPA registration listing.
4. Antimicrobial coatings shall be applied according to the manufacturer's written instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than, "fogged" downstream onto surfaces.

3.06 CLEANLINESS VERIFICATION

A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including bio-cidal agents and coatings.

B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.
   1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the Owner reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.
   2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
   3. NADCA vacuum test analysis should be performed by a qualified third party experienced in testing of this nature. To be considered clean by the NADCA vacuum test, the net weight of the debris on the sample filter media collected on a non-porous surface shall not exceed 0.75 mg/100 cm2.
   4. Representative post cleaning surface fungal sampling shall be conducted and results shall be in the range of none to rare fungal structures for the representative samples collected.
   5. Representative post cleaning lead wipe samples shall be collected on horizontal interior surfaces and results shall not exceed 40 micrograms of lead per square foot.
   6. Each portion of the HVAC system, which does not meet the cleanliness verification test criteria shall be thoroughly re-cleaned and then re-inspected. The process shall be repeated until the system passes the test. Additional inspection and testing will be at the expense of the Contractor.

C. Verification of Coil Cleaning
   1. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

3.07 PRE-EXISTING SYSTEM DAMAGE

A. Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

3.08 POST-PROJECT REPORT

A. At the conclusion of the project, the Contractor shall provide a report to the Owner indicating the following:
   1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
   2. Areas of the system found to be damaged and/or in need of repair.
   3. Microbial test and lead wipe test results.
   4. Provide before and after photographs of duct cleaning.

3.09 APPLICABLE STANDARDS AND PUBLICATIONS

A. The following current standards and publications of the issues currently in effect form a part of this specification to the extent indicated by any reference thereto:

B. National Air Duct Cleaners Association (NADCA): “Assessment, Cleaning & Restoration of HVAC Systems (ACR 2005),” 2004.

C. National Air Duct Cleaners Association (NADCA): “Understanding Microbial Contamination in HVAC Systems,” 1996.

D. National Air Duct Cleaners Association (NADCA): “Introduction to HVAC System Cleaning Services,” 2004.

E. National Air Duct Cleaners Association (NADCA): Standard 05 “Requirements for the Installation of Service Openings in HVAC Systems,” 2004.

F. Underwriters’ Laboratories (UL): UL Standard 181

G. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-89, "Ventilation for Acceptable Indoor Air Quality".

H. Environmental Protection Agency (EPA): "Building Air Quality," December 1991.

I. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): “HVAC Duct Construction Standards - Metal and Flexible,” 1985.

J. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 1993.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Project specification Sections, apply to this and the other sections of Division 23.

B. This Division is an integrated whole comprising interrelated and interdependent Section and shall be considered in its entirety in determining requirements of the Work.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for HVAC installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
   1. Submittals.
   2. Coordination drawings.
   3. Record documents.
   4. Maintenance manuals.
   5. Rough-ins.
   6. Mechanical installations.
   7. Cutting and patching.

1.03 SUBMITTALS

A. General: Follow the procedures specified in Division 01.

B. HVAC submittals shall include shop drawings, product data, and samples per requirements of each section of specification

C. HVAC Submittals and Product Data: Assemble “submittals” and “product data” into tabbed brochures according to main areas of work i.e. (HVAC); Temperature Control; Testing, Adjusting, and Balancing.
   1. Assemble each brochure with tabbed separators for each Specification Section where products are noted to be submitted, with separate tabs for each product listed.
   2. Temperature "control shop drawings" may be submitted separately after preparations for review.
   3. For items such as valves, hangers and accessories, indicate specific items and where they are to be used.
   4. Contractor need only to submit for review those items specified to be submitted, unless requested by the Architect for special review.

D. All submittals shall be submitted in hard copy, electronic submittals are not acceptable.

E. Increase the number of HVAC related submittals including shop drawings, product data, and samples submitted to allow for required distribution by one additional copy, which will be retained by the Mechanical Consulting Engineer.

F. Submit for review, only the specific items required in this Section or other Sections of Division 23.

G. Additional submittals shall include, but not limited:
   1. Air balance reports and equipment data record drawings.
   2. Certification of completion of testing.
   3. Certification of completion of operation instructions.
   4. Operating instruction brochure.

5. Maintenance instruction brochures.
6. Equipment guarantees.
7. 1/4" = 1'-0" or larger scale layouts of "Equivalent" equipment or "Or Approved Equal" equipment.
8. Coordination Drawings, where requested or required.

H. Submittal materials will be reviewed for substantial conformity with the intent of the contract plans and specifications only. Such review does not indicate approval of dimensions, quantities, coordination with other trades, or work methods of the contractor, which are indicated thereon.

I. Additional copies may be required by individual sections of these specifications.

1.04 COORDINATION

A. The Contractor shall be totally responsible for coordinating the layout of all building elements to avoid conflict of the work of the structural, mechanical, electrical systems, and architectural features of the building.

B. The cost of any extra work of any kind caused by a conflict due to this lack of coordination shall be borne by the Contractor.

1.05 COORDINATION OF DRAWINGS

A. Prepare coordination drawings in accordance with requirements of Project Specification to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, required clearances, and systems of HVAC equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of the installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:
   1. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:
      a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      b. Equipment for connections and support details.
   2. Prepare reflected ceiling plans to coordinate and integrate installations with other systems and components, such as, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

B. Submittal of "Or Equal" substitutions of equipment will not be reviewed unless accompanied by coordination drawings.

1.06 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements of project specification. In addition to the requirements of project specification, indicate the following installed conditions:
   1. Record drawings of all installed as specified in Division 01 the locations and invert elevations of underground installations.

1.07 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Project specification and Division 23 Section "Supplementary Mechanical Requirements."

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, mill certification, and other information needed for identification.

1.09 EQUIVALENT EQUIPMENT

A. In these specification and drawings, whenever more than one (1) manufacturer's product is specified, the manufacturer specified on the drawings and the first named product in these specifications is the basis of design and the use of alternate-named manufacturer's product or

substitutes may require modification in the design work and agency approvals. If such alternatives or substitutions are proposed by the contractor, contractor shall adhere to the following requirements:

1. Contractor shall clearly identify all proposed alternatives or substitutions in the submittal package.
2. The Contractor shall assume all costs required to make all necessary revisions and modifications of the contract documents resulting from the substitution or selection of an alternate manufacturer's product, including all professional fees and the cost of DSA approval.
3. The Contractor shall assume all costs required for any additional modification to building structure, electrical and all other related construction costs resulting from the substitution or selection of an alternate manufacturer's product.

B. These specifications and/or drawings, names and specifies certain equipment in detail which are the basis of design and are explained in paragraph 1.09-A above. It also names alternate equipment by manufacturer, which is not considered to be a "substitution."

C. Submit equivalent equipment to the Architect for review per the requirements of Division 01, and Section "Common Work Results for HVAC."

D. Equipment of Manufacturers named in Division 23 will be considered equivalent to that specified in detail and/or named on the drawings if:

1. The proposed equipment is of equivalent quality, capacity.
2. Equipment is as fully equipped, fits the space allotted, and has physical configuration and weight similar-to the equipment specified in detail.

E. A complete lay out of an equipment room or area must be submitted for equivalent equipment. Notice space limitations. Layouts to include plans and section views at a scale of not less than 1/4" = 1 ft.

F. The Architect shall determine the acceptability of "Equivalent Equipment."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 ROUGH-IN

A. Verify final locations for rough-in with field measurements and with the requirements of the actual equipment to be connected.

3.02 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of HVAC systems, materials, and equipment. Comply with the following requirements:

1. Coordinate HVAC systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for HVAC installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible as required by California Building Code.

7. Coordinate connection of HVAC system with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect prior to commencement of installation.
9. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.
10. Install all HVAC equipment to facilitate servicing, maintenance, and repair or replacement of equipment components in full compliance with California Building Code and the equipment manufacturer's recommendations. If the drawings or the manufacturer does not provide a specific space requirement for servicing equipment, provide as a minimum, horizontal distance of 36" from face of equipment to opposite vertical surface.
11. Install access panels or doors for all equipment and components which require access for adjustment and maintenance, where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Any equipment located above a ceiling that has any component, which is serviceable shall be installed within 12" of the top-of the ceiling.

3.03 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with project specification. In addition to the requirements specified in project specification, the following requirements apply:
   1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of HVAC equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed Work.
   2. Remove and replace defective work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Cut, remove, and legally dispose of selected HVAC equipment, components, and materials as indicated, including but not limited to removal of HVAC piping, refrigerant lines, heating units, and other HVAC items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
   1. Patch existing finished surfaces and building components using experienced installers and new materials matching existing materials. For installer’s qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

SECTION 23 05 11
SUPPLEMENTARY HVAC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies supplementary requirements for HVAC installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements specified in Section 23 05 00 "Common Work Results for HVAC."

1.02 DESCRIPTION

A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.03 COORDINATION

A. Coordination of the work is the responsibility of the Contractor.

B. Contractor shall designate an individual competent and versed in the HVAC trades to coordinate the HVAC work with the work of other trades.

1.04 DEFINITIONS (AS USED ON DIVISION 23 DRAWINGS AND HEREIN)

A. "Provide" means furnish, install, and connect unless otherwise described in specific instances.

B. "Piping" means pipes, fittings, valves, and all like pipe accessories connected thereto.

C. "Ductwork" means ducts, plenums, compartments, or casings including the building structure, which are used to convey or contain air.

D. "Extend", "Submit", "Repair" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.

E. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constituted authorities and public utility franchise holders having jurisdiction.

F. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.

G. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces, which are not included in the utility areas definition.

H. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.

I. "Below Grade" means buried in the ground.

J. "Substantial Completion" means all components of all systems are functioning but lacking in final adjustment.

K. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid, which the device will serve.

1.05 RELATED WORK

A. Coordination: Refer to Architectural, HVAC, Plumbing, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the correct placing and connection of HVAC work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the Work of this Division, especially Division 26.

1.06 EXISTING CONDITIONS

A. Visit the site prior to bidding and investigate the existing conditions, which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into-account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the foregoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.

B. The locations of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate, and the Bidder shall include adequate funds in his Bid to cover costs of connection regardless of their exact location.

C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to the existing utility lines, at no cost to the Owner, whether the lines are shown on drawings or not.

1.07 DRAWINGS AND SPECIFICATIONS

A. These drawings and specification do not include necessary components for construction safety.

B. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

C. Except where dimensioned, the drawings relating to this division are a diagrammatic presentation of the design concept, which indicates the general area where piping and ductwork is to be run. The drawings do not necessarily indicate any, and all offsets and configurations required for coordination with other trades. The contractor is responsible for the correct placing of his work, and the proper location and connection of his work in relation to the work or other trades.

1.08 PERMITS AND INSPECTIONS

A. Obtain, schedule, and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.09 CODES AND REGULATIONS

A. By submitting a Bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract Documents and Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specific references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options, which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted).
   1. All local codes; city and/or county as applicable.
   2. OSHA requirements.
   3. California Building Code.
   4. California Code of Regulations (CCR) Titles (as applicable).
   5. Fire Marshal Regulations.
   6. State, County, City Health Department Ordinances and Regulations.
   7. Regulations of all other authorities having jurisdiction.
   8. California Mechanical Code.
   9. California Plumbing Code.

C. Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.10 RECORD AND DOCUMENTATION

A. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work.
   1. Record (As-Built) Drawings:
      a. Maintain in good order in the field office a complete set of prints for all work being done under Division 23. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
      b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
      c. Furnish the original marked up AS-Built drawings and an electronic copy in AutoCAD-14 format.
   2. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated HVAC systems and equipment. Seven copies of the manual, bond in hardback binders or an approved equivalent shall be provided to the Architect.
   3. Furnish one complete manual prior to the time that system or equipment tests are performed.
   4. Furnish the remaining manuals before the contract is completed.
   5. The following identification shall be inscribed on the cover:

      OPERATION AND MAINTENANCE MANUAL

      PROJECT TITLE . . . . . .

      CONTRACTOR NAME & CONTACT INFORMATION

   6. Provide a Table of Contents.
      a. Insert tab sheets to identify discrete subjects.
      b. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in.
      c. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories, and appurtenances stipulated. Include as a minimum the following:
         1) Updated approved materials lists, shop drawings and catalog information of all items of HVAC system equipment.
         2) System layout showing piping, valves, and controls.
         3) Wiring and control diagrams with data to explain detailed operation and control of each component.
         4) A control sequence describing start-up, operation, and shutdown.
         5) Detailed description of the function of each principal component of the system.
         6) Procedure for starting.
         7) Procedure for operating.
         8) Shut-down instructions.
         9) Installation instructions.
         10) Adjustments, maintenance, and overhaul instructions.
         11) Lubrication schedule including type, grade, temperature range and frequency.
         12) Safety precautions, diagrams, and illustrations.
         13) Test procedures.
         14) Performance data.
         15) Parts list, with manufacturer's names and catalog numbers.
         16) Preventive maintenance schedule.
         17) Service organization with name, address, and telephone number.
         18) Valve identification chart and schedule.

19) ASME certificates.
20) Air balance report.
21) Hydronic balance report.

B. Standards Compliance: Where equipment or materials are specified to conform to requirements of standards of recognized technical or industrial organizations such as American National Standards Institute (ANSI) American Society for Mechanical Engineers (ASME) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Society for Testing Materials (ASTM), Underwriters Laboratories (UL), American Gas Association (AGA), American Refrigeration Institute (ARI), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements.

D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests, which are required to be performed on the actual materials or equipment, proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.

F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.11 CONSTRUCTION COST BREAKDOWN

A. Prepare and submit for review a construction cost breakdown for the major subdivisions of the HVAC work in accordance with General and Supplemental Conditions and Project Specification.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Submit one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.

1.12 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.13 WARRANTIES

A. Refer to Project Specification for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Where periods more than one year are specified in the specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components, which are inactive because of, said failure shall be suspended. The warranty period for such components shall resume to-run for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

C. Neither payment for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work, or shall condone any negligence or omission of Contractor in doing the work.

D. Compile and assemble the warranties specified in Division 23, into a separated set of vinyl covered, three ring binders, tabulated, and indexed for easy reference.

E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names and addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.14 SEISMIC RESTRAINT

A. Provide seismic restraint for HVAC equipment, piping, and ductwork.

B. Contractor shall submit certification of suitability of seismic restraint methods signed by Licensed Structural Engineer registered in State of California.

C. Contractor may refer to details applicable in the SMACNA, "GUIDELINES FOR SEISMIC RESTRAINT OF HVAC SYSTEMS", using the 'g' forces for "other buildings" classification CCR Title 24 all such details shall be DSA approved. Deliver a copy of these Guidelines to the Owner's Resident Inspector.

1.15 SYSTEM OPERATIONAL TESTS

A. The Contractor shall inform the Owner one week prior to start of testing in order that the Owner's representative may be present.

B. After balancing and prior to final inspection, the contractor shall operate all systems continuously trouble free and stable for a minimum period of fourteen (14) consecutive days including Saturday and Sunday. Each day shall be a minimum of an 8-hour day. Should a problem arise, the fourteen (14) day period shall be restarted and repeated until successfully operated for full 14 days. A written report certified by the Owner's representative shall indicate the successful completion of a stable and trouble free 14-day period.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements.

B. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening, unless more stringent requirements are specified. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer.

C. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

D. In these specification and drawings, whenever more than one (1) manufacturer’s product is specified, the manufacturer specified on the drawings and the first named product in these specifications is the basis of design and the use of alternate-named manufacturer’s product or substitutes shall comply with the requirements of Section 23 05 00.

2.02 PRODUCT LISTING

A. When two or more items of same material or equipment are required (pipe and fittings, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, sheet metal, wire, steel bar stock, welding rods, solder, fasteners, and similar items used in Work, except as otherwise indicated.

2.03 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated HVAC equipment, indicating manufacturer, product name, model name, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.04 SUBSTITUTIONS

A. General: Submittals of "Substitutions" shall be in accordance with requirements of Division 01.

B. By proposing a-substitution it is deemed that the Contractor shall bear the cost of any, and all design and construction changes (whether architectural, structural, electrical, HVAC and Plumbing) necessary to accommodate the substitution, if said substitution is accepted.

C. Specific: Refer to Specification Sections 23 05 00 & 23 05 12 for additional requirements.

2.05 SUBMITTALS

A. General: Make submittals in accordance with requirements of Division 01.

B. Specific: Refer to Specification Sections 23 05 00 for additional requirements.

PART 3 - EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

A. Workmanship shall be in the best standard practice of the trade.

B. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TESTS

A. General:
   1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
   2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.

B. Specific: Refer to the other sections of this Division for test requirements.

3.03 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damages both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.

C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop-fabricated ductwork.

D. Air distribution systems shall be aggressively protected from dust during the construction process to ensure that no contamination of the duct system occurs.

E. The use of permanently installed AHUs and associated air distribution systems for temporary heating and cooling during construction is prohibited.

F. Keep cabinets and other openings closed to prevent entry of foreign matter.

G. Specific: Refer to other sections of this Division for additional requirements.

3.04 PROJECT CONDITIONS

A. Check and coordinate for clearance, accessibility, and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped disassembled, or disassembly of equipment at Project Site and reassembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.

B. Verify location of all equipment within finished spaces with the Architectural Drawings. In the event, that HVAC drawings do not indicate exact locations, or are in conflict, with the Architectural drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

3.05 INSTRUCTION TO OWNER PERSONNEL

A. Contractor shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance of work. Instruction shall be given at the Owner's convenience. The number of man-days (eight-hours) of instruction furnished shall be as specified in other sections. When more than four man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall videotape, both visual and audio, instruction to Owner's personnel on the maintenance and operation of the HVAC systems.

C. Submit certification, signed by Owner's agent that instructions have been completed and the videotape has been reviewed and delivered to the Owner.

D. Printed operating instructions and a copy of wiring diagrams are to be mounted in all equipment areas, framed and behind glass or encased in plastic. Printed operating instructions shall include steps for starting up and securing equipment. As a precedent to final acceptance four (4) copies of instructions are to be submitted to the Architect for review. Contractor shall turn over to Owner in a neat brochure form, equipment-guarantee, and maintenance instructions.

3.06 CLEANING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Refer the Division 01 for general requirements for cleaning.

C. Leave exposed parts of the HVAC work in a neat, clean, and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

D. Thoroughly clean all materials, equipment, and appliances. Clean and prepare all surfaces to be painted. Clean the entire premises of unused materials, debris, spots, and marks to the satisfaction of the Architect.

E. Remove, thoroughly clean, and replace all strainers and automatic valves after the system has been put in operation until system is clear of all foreign matter and repeat this operation after ten (10) days and again after the system has been in operation thirty (30) days. Submit certification that this operation has been completed.

3.07 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with OSHA requirements. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or create a fire hazard.

END OF SECTION

SECTION 23 05 12
HVAC PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies administrative and procedural requirements for handling requests made after award of the Contract for substitutions of products specified in Division 23.

1.02 RELATED SECTIONS

A. Procedure for Contractor's construction Schedule and the Schedule of Submittals are included under Division 01, Section 01 32 16.

B. Standards: Refer to Division 01 for applicability of industry standards to products specified.

C. Procedural requirements governing the Contractor's selection of products and product options are included under Division 01.

D. Refer to Division 01, Section 01 60 00 for Products and 01 25 00 for Substitutions.

E. Refer to Sections 23 05 00 & 23 05 11 for additional requirements.

1.03 DEFINITIONS

A. "Products" is defined to include purchased items for incorporation into the work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. "Materials" is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work.

B. "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, etc.). Definitions in this paragraph are not intended to negate the meaning of other terms used in contract documents, including "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

1.04 SUBSTITUTIONS

A. The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to contract documents, where requested by Owner, Architect or Engineer, are "changes" not "substitutions". Substitutions requested during bidding period, which have been accepted prior to Contract Date, are included in contract document and are not subject to requirements for substitutions as specified herein. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions"; and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, contractor's requests of changes in products, materials and methods of construction required by contract documents are considered requests for "substitutions" and are subject to requirements hereof.

B. Conditions: The Contractor's substitution request will be received and considered by the Architect when one or more of the following conditions are satisfied, as determined by the Architect; otherwise, requests will be returned without action except to record noncompliance with these requirements.
   1. Extensive revisions to Contract Documents are not required.
   2. Proposed changes are in keeping with the general intent of Contract Documents.
   3. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
   4. All costs required to make all necessary revisions and modifications to the contract documents resulting from the substitution, including but not limited to, all professional fees and the cost of DSA approval will be the Contractor’s responsibility.

5. All costs required to make all necessary revisions and modifications to the building structure, electrical and all other related construction costs resulting from the substitution, including but not limited to, material, products, equipment, testing, and inspection will be the Contractor's responsibility.
6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
7. Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.
8. Contractor certifies that the substitution is not heavier than the specified item and does not necessitate any structural and electrical redesign; will fit within the room or area designed for the specified item; and will not exceed any maximum dimensions specified or shown on the original contract Documents.
9. All roof mounted equipment must be less than or equal to the maximum height dimension from the finished roof as shown on the drawings.
10. Contractor represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.
11. Contractor represents that he will provide the same warranty for the substitution that he would for that specified.

1.05 SUBMITTALS

A. Requests for Substitutions: Any request for substitution shall follow the guidelines of Substitution Requirements in Division 01, Section 23 05 00 & 23 05 11.

B. Substitution Warranty: All submittals of Request for Substitutions under the General and Supplementary Conditions of this Section shall be accompanied by a completely executed (filled out) and signed Substitution Warranty in the form entitled "Substitution Warranty", bound herein. Substitutions will not be accepted without the Substitution Warranty. In addition to other requirements, Contractor shall warrant in writing on his own letterhead that substituted materials shall perform as specified, and assume complete responsibility for same, including responsibility and costs required for modifications to building or other materials or equipment, and any additional coordination with work of other trades. Testing, if required, shall be paid by Contractor.

C. Responsibility of Contractor: The contractor shall be solely and directly responsible for fitting accepted substitute material and equipment into the available space in a manner acceptable to the Architect, and for the proper operation of the substituted equipment with all other equipment with which it may be associated. The Contractor shall bear all costs of meeting the above requirements for presenting a proposed substitution, and if the substitution is accepted, he must bear all costs involved.

D. Submit the following as part of the Request for Substitutions:
   1. Data showing proposed equipment is "equal" to that specified and is fully equipped, fits the space allotted and has physical configuration and weight similar-to the equipment specified in detail.
   2. A complete layout, where applicable, of equipment room or area must be submitted for equipment proposed in "Request for Substitution". Submittal shall conform to requirements of Division 01 and Section 23 05 00 "Common Work Results for HVAC" as it applies to "Coordination Drawings."
   3. Seismic Restraint: Where seismic restraint is required for products or equipment as specified, methods of seismic restraint signed by licensed Structural Engineer registered in the State of California, shall be submitted for review to the Division of the State Architect.

1.06 ARCHITECT'S ACTION

A. The Architect may request additional information or documentation necessary for evaluation of the request. Requests, by the Architect, for additional information or documentation will be in accordance with Division 01 requirements. The Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, Contractor shall use the "Bases of Design" product specified by name in the contract documents. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

A. Substitutions shall conform to the product requirements for the specified products or equipment.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SAMPLE

S U B S T I T U T I O N S W A R R A N T Y

In addition to other requirements, Contractor shall warrant in writing that substituted materials shall perform as specified, and assume complete responsibility for same, including responsibility and costs required for modifications to building or other materials or equipment, and any additional coordination with work of other trades. Testing, if required, shall be paid by contractor. The following is an example of the type of Substitution Warranty which shall be executed by the Contractor, on his own letterhead:

SUBSTITUTION WARRANTY
We propose to provide the following:

_____
(Describe items being proposed for substitution)

for_____ in lieu of
(List project name)

as indicated on the drawings and described in Section _____ of the Specifications.

We agree to assume the cost of any, and all modifications to the Contract Documents and to other portions of the work as indicated in the Specification Sections 23 05 00, 23 05 11, & 23 05 12, and as necessary to accommodate for substituted material(s) and system(s) as indicated in this letter of “Substitution Warranty.”

We hereby warrant that _____
(Provide Description)

is the equivalent of _____
(Specified Product)

in every respect and will perform satisfactorily under the conditions and use indicated on the Drawings and described in the Specifications.

Signed: _____ Date: _____
(Manufacturer/Supplier)

Signed: _____ Date: _____
(Subcontractor)

Signed: _____ Date: _____
(Contractor)

NOTE: Affix Corporate Seal over Signatures.

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. This Section specifies the basic requirements for electrical components, which are an integral part of packaged HVAC equipment. These components include, but are not limited to factory-installed motors, starters, and disconnect switches furnished as an integral part of packaged HVACequipment.

B. Specific electrical requirements (i.e., horsepower and electrical characteristics) for HVAC equipment are scheduled on Drawings.

C. All motors, power driven equipment and automatic control equipment, except motor starters as hereinafter set forth required and connected with the work of this section of the specifications are to be furnished and installed under Division 23.

D. Control low (24V) and control line (120V) voltage wiring, conduit and related switches and relays required for the automatic control and/or interlock of motors and equipment includes final connection, are to be furnished and installed under Division 23. Materials and installation to conform to Class 1 or 2, CAC Title 24, Article E725, and as restricted under Division 26 of these specifications.

E. Power wiring, conduit, outlets, disconnect switches, motor starters and motor-rated contactors, and making of final connections, except as hereinafter specified, are to be furnished and installed under Division 26 of these Specifications.

F. All power supply wiring for providing a power source to control dampers, control valves, VAV boxes, control transformers, etc., shall be furnished and installed under Division 23.

G. Identify circuits and equipment as outlined in the Electrical Sections of these Specifications.

H. Coordinate requirements for underground conduit only between buildings for control interlocks shown on the drawings. This conduit to be furnished and installed under Division 26 of these Specifications.

I. Space provisions have been made on electrical panels for control power source.

1.02 RELATED SECTIONS

A. Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

B. This section applies to all Division 23 sections specifying packaged HVAC equipment.

1.03 REFERENCES

A. NEMA Standards MG 1: Motors and Generators.

B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.

C. NEMA Standard 250: Enclosures for Electrical Equipment.

D. NEMA Standard KS 1: Enclosed Switches.

E. Comply with National Electrical Code (NFPA 70).

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

PART 2 - PRODUCTS

2.01 MOTORS

A. Provide all motors necessary for equipment under the HVAC Work. See Electrical Drawings for voltage and phase of electrical services.

B. The following are basis requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.
   1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
   2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
   3. 2-speed motors shall have 2 separate windings on poly-phase motors.
   4. Temperature Rating: As a minimum, motors shall be rated for 40 degree C environment with maximum 50 degree C temperature rise for continuous duty at full load (Class A Insulation).
   5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.
   6. Service Factor: 1.23 for poly-phase motors and 1.35 for single-phase motors.
   7. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, deign "B", except "C" where required for high starting torque.
      a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
      b. Bearings:
         1) Ball or roller bearings with inner and outer shaft seals.
         2) Re-greasable bearings, except permanently sealed where motor is normally inaccessible for regular maintenance.
         3) Bearings designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
         4) Bearings for fractional horsepower, light duty motors, sleeve type bearings are permitted.
      c. Enclosure Type:
         1) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
         2) Guarded drip-proof motors where exposed to contact by employees or building occupants.
         3) Weather protected Type I for outdoor use, Type II where not housed (Epoxy encapsulated or TEFC).
      d. Overload protection: Polyphase built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter. Single phase, provide thermal overload protection.
      e. Noise rating: "Quiet".
      f. Efficiencies shall be guaranteed minimum values in accordance with the following tabulation. Efficiencies shall be established in accordance with NEMA Test Standards MG1-12.53A using IEEE Test Procedure 112, Method B:

HP	EFFICIENCY
1 - 2	81.5
3 – 5	86.5
7-1/2 - 10	90.6
15 - 30	92.0

      g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
      h. Provide all motors with junction boxes or terminals boxes and provide adjustable slide rails for all motors with belt drives.

i. Motors rated 1 HP and larger shall have shaft, bearings and etc. capable of operating with multiple grooved sheaves and two or more belts.
j. V Type Belt Drives: Drives requiring not more than 2 belts; variable pitch type; size for mid-point of operating range. Drives requiring 3 or more belts; nonadjustable constant speed type. Provide belts in matched sets.

2.02 MOTOR STARTERS

A. Unless provided as part of packaged HVAC equipment or otherwise indicated, starters for motors will be provided under Division 26. Provide to Division 26 the data necessary for motor starter heater sizing for all motors.

B. Starters for factory packaged HVAC equipment specified under Division 23 shall be provided as part of the package.

C. Motor Starter Characteristics:
1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations, which shall have NEC proper class and division.
2. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

D. Manual switches shall have:
1. Pilot lights and extra positions for multi-speed motors.
2. Overload protection: melting alloy type thermal overload relays.

E. Magnetic Starters:
1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches, and similar devices as required for coordination with control requirements.
4. Built-in control circuit transformer, fused from line side, where service exceeds 240 volts.
5. Externally operated manual reset.
6. Under-voltage release or protection.

F. Motor Connections:
1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.03 DISCONNECT SWITCHES

A. When applied as part of factory furnished and mounted equipment, disconnects shall meet the requirements for disconnect switches set forth in Division 26.

PART 3 - EXECUTION

3.01 SEISMIC RESTRAINT

A. All electrical devices shall be seismically restrained.

END OF SECTION

SECTION 23 05 14

SELECTIVE HVAC DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes limited scope of selective HVAC demolition work as follows:
   1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
   2. Dismantling HVAC components, materials and equipment made obsolete, by these installations.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01, Section 01 30 00 and Division 23 Specification Sections.

B. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
   1. Coordinate sequencing and Owner occupancy specified in Division 01.
   2. Coordinate other selective demolition work as outlined in Division 01, Section 01 73 29.

1.03 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas. Provide minimum of 72-hour notice to Owner prior to utility interruption.

1.04 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least 7 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where selective demolition is to occur. Determine extent of work and effect on existing conditions to remain. Advise Architect of any conditions that might create extensive alterations beyond indicated scope.

3.02 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned HVAC components, materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing, HVAC components, materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
   1. Protect all removed and salvaged equipment from being damaged during the demolition work.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. HVAC Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
   1. Inactive and obsolete, piping, fittings and specialties, equipment, controls, fixtures, and insulation.
      a. Obtain written approval form Architect and owner for piping embedded in floors, walls, and ceilings which may remain, if such materials do not interfere with new installations.
         1) Drain and cap piping allowed to remain.
      b. Remove materials above accessible ceilings.
   2. Perform cutting and patching required for demolition.

END OF SECTION

SECTION 23 05 29
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of supports and anchors required by this section is indicated on drawings or in other Division 23 sections and include the following:
   1. Horizontal-Piping Hangers and Supports.
   2. Vertical-Piping Clamps.
   3. Hanger-Rod Attachments.
   4. Building Attachments.
   5. Saddles and Shields.
   6. Miscellaneous Materials.
   7. Anchors.
   8. Equipment Supports.

1.02 RELATED SECTIONS

A. This section is part of each Division 23 section making reference to or requiring supports and anchors specified herein.

B. Supports and anchors furnished as part of factory fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

C. Section 03 30 00: Cast-in-Place Concrete.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
   2. UL and FM Compliance: Provide products which are UL-Listed and FM approved.
   3. MSS Standard Compliance:
      a. Provide pipe hangers and supports of which materials, design, and manufacturer comply with MSS SP-58.
      b. Select and apply pipe hangers and supports, complying with MSS SP-69.
      c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
      d. Terminology used in this section is defined in MSS SP-90.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
   1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
   2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal Hanger Shield Inserts: 100 PSI average compressive strength, waterproofed calcium silicate, encased with a sheet metal shield. Insert and shield shall cover entire circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

2.02 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
   1. Adjustable Steel Clevis Hangers: MSS Type 1.
   2. Adjustable Swivel Pipe Rings: MSS Type 6.

2.03 VERTICAL PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8.

2.04 HANGER ROD AND BUILDING ATTACHMENTS

A. General Hanger Rod Attachment: Refer to structural drawings for requirements of hanger rod and building attachments. If a specific attachment that is required is not detailed on the structural drawings, one of the following attachments may be submitted for review by the structural engineer prior to installation. Except as otherwise indicated, provide factory fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachment to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. General Building Attachment: Except as otherwise indicated, provide factory fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
   1. Concrete Inserts: MSS Type 18.
   2. Center Beam Clamps: MSS Type 21.
   3. Steel Beam Clamps W/Eye Nut: MS Type 28.
   4. Linked Steel Clamps W/Eye Nut: MSS Type 29.
   5. Malleable Beam Clamps: MSS Type 30.
   6. Steel Brackets: One of the following for indicated loading:
   7. Light Duty: MSS Type 31.

2.05 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Shields: MSS Type 40; provide high density insert of same thickness of insulation.

2.06 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide hangers and supports of one of the following:
   1. B-Line Systems, Inc.
   2. Tolco, Inc.
   3. Elcen Metal Products Co.

4. Fee & Mason Mfg. Co.; Div. Figgie International.
5. ITT Grinnel Corp.

2.07 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes and Bars: ASTM A36.

B. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 parts cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

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

D. Pipe Roll Stand: Factory fabricated cast iron stand, size as required, with insulation installed on piping.

2.08 ISOLATORS

A. Isolators: Provide factory-fabricated isolators of size required.

B. Spring Isolators: Refer to Section 23 05 48 "Vibration Control for HVAC."

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine substrates and conditions under which supports, and anchors are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other building structural attachment.

B. Prior to installation of hangers, supports, anchors and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection, and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69.

B. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers, and supports of same type and type as installed for adjacent similar piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Provisions of Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide required pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

H. Bare Piping: Install isolators for all bare domestic water and bare hydronic piping.

I. Insulated Piping: Comply with the following installation requirements.
   1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
   2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. Provide rigid insulation reinforcement at shields.

J. Hangers and supports to be capable to resist the minimum seismic forces indicated in drawings.

3.05 EQUIPMENT SUPPORTS

A. Concrete housekeeping bases will be provided as work of Division 03.

B. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

3.06 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

E. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48
VIBRATION CONTROL FOR HVAC

PART 1 - GENERAL

1.01 DESIGN REQUIREMENTS

A. It is the intent of this Specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or equipment, or due to interconnected piping, ductwork, or conduit and to seismically restraint piping, ductwork, and equipment per the applicable codes against seismic forces in any direction.
   1. All isolators shall:
      a. Be provided by a single manufacturer.
      b. Be designed or treated for resistance to corrosion. Structural steel bases shall be cleaned of welding slag and coated with an SCAQMD compliant primer.
      c. Be selected to perform their function without undue stress or overloading. All isolators shall have a method for leveling and have a 1/4" thick ribbed neoprene acoustical pad under the spring baseplate.
      d. Be installed in a manner to prevent the transmission of vibration to the structure. No rigid connections between rotating or oscillating equipment or piping and the building will be permitted.
      e. Be designed to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
   2. Anchor floor mounted isolated equipment to concrete housekeeping pads of sufficient size to accommodate the anchorage of seismic restraints. Housekeeping pads shall be anchored to the structure as specified by the Structural Engineer of Record.
   3. Each fan and motor assembly shall be supported on a single structural steel frame. Flexible duct connections shall be provided at inlet and discharge ducts.
   4. Where called for in the specifications or on the drawings, all structural steel bases, including concrete pouring form bases, shall be designed, and fabricated by the isolation manufacturer. Isolation manufacturer shall be a licensed fabricator for the City of Los Angeles, California.
   5. Unless otherwise indicated, all equipment mounted on vibration bases shall have a minimum operating clearance of 1" between structural steel base and floor or support base beneath. The minimum operating clearance between concrete inertia bases and housekeeping pads shall be 1 inch. Check clearance space after installation to ensure that no debris has been left to possibly short circuit isolation bases.
   6. Where necessary due to height limitations, provide height saving brackets.
   7. Design isolators for positive anchorage against uplift and overturning.

1.02 MANUFACTURERS

A. Acceptable Isolation Manufacturer:

B. M. W. Sausse' & Co., Inc. (Vibrex).

C. Mason Industries, Inc.

D. Or Approved Equal.

E. Purchased and/or fabricated equipment must be designed and manufactured with provision for positive anchorage against seismic forces.

F. Seismic restraints for pipes and ducts shall be as per the SMACNA Guidelines for seismic Restraint of Mechanical Systems and shall be approved by DSA.

G. Seismic restraints for equipment and piping shall be designed to meet the criteria of the current California Code of Regulations.

H. The manufacturer of Vibration Isolation and Seismic Control Equipment shall have the following responsibilities:

1. Determine adequate vibration isolation and seismic restraint sizes and locations.
2. Provide piping and equipment isolation systems and seismic restraints as scheduled and/or specified.
3. Provide installation instructions and drawings to assure proper installation and performance.

1.03 SUBMITTALS

A. Make Submittals in Accordance with:
   1. Contract General Provisions - Division 01, Section 01 30 00.
   2. Mechanical General Provisions - Sections 23 05 00 and 23 05 11.

B. Submit Shop Drawings and Manufacturer's Literature.
   1. Specific vibration isolators and seismic restraints to be utilized showing compliance with the specifications.
   2. Isolation frame construction for each machine including dimensions, structural member sizes, support points and restraint locations and details.
   3. Methods for isolation and restraint of suspended piping, ductwork, and equipment.
   4. Methods for guides and isolation of piping risers.
   5. Seismic restraint calculations signed and stamped by an engineer licensed in the State of California and experienced in the design of isolation and seismic restraint for flexibly mounted equipment.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATOR TYPES

A. "RMS" shall be a laterally stable un-housed spring isolator. Spring, top plate, and baseplate assembly shall be welded. Mounting shall comply with all requirements stated in paragraph above.

B. "RMSG" shall be the same as "RMS" above but shall include height saving brackets for attachment to the equipment frame or isolation base.

C. "RMSP-EQ" shall be the same as "RMS" above except that the spring shall be enclosed in a welded steel cylinder with uplift restraints for horizontal and vertical seismic control.

D. "RMLS-EQ" shall be the same as "RMS" above and shall be equipped with a steel housing designed for seismic restraint and with vertical limit stops to prevent the equipment changing from its loaded height should it be necessary to remove a portion of its weight. This housing may also be used as rigid blocking during rigging so that the installed height and the operating height of the isolated equipment remain the same. O.S.H.P.D. (HCAi) pre-approval # OPM-0401-13.

E. "RMLS-SB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. The steel frame is placed directly on top of the RMLS-EQ type isolators. O.S.H.P.D. (HCAi). Pre-approved isolator/seismic restraints.

F. "RMU-EQ-SH": shall be an individual semi-housed steel spring isolator complete with vertical motion limit stops incorporating seismic restraints, leveling, and ribbed neoprene pad bonded to the base plate. O.S.H.P.D. (HCAi) pre-approval # OPM-0401-13.

G. "AS" shall be air spring isolators and shall incorporate the following:
   1. A complete vibration isolation system consisting of a minimum of three air springs and a total of three height sensing valves. If there are two or more air springs per location, they shall be connected to the outlet of the height control valve in parallel. An associated interconnecting air supply system is required which is not included in this work.

2. The air spring shall operate at its normal operating height and the maximum pressure shall not exceed the manufacturer's recommended rating of 100 PSI. The system shall maintain an elevation of +/- 1/8", once adjusted.
3. The type of air spring to be utilized shall be based upon the required natural frequency as indicated in the schedule. In-order to avoid instability, auxiliary height saving brackets, housings, etc. may be utilized, subject to approval.

H. "RP-EQ" shall be a rubber pad type elastomer mounting, consisting of a steel bearing plate with 1/4" thick neoprene ribbed acoustical pad. Maximum loading shall be 60 PSI. Proper anchorage for seismic loads shall be indicated on drawings.

I. FUD-EQ shall be rubber-in-shear isolators incorporating mounting bolts for bolting to equipment base, a bottom steel plate for bolting isolator to sub-base or structure and built-in seismic restraints.

J. "RMXA" shall be a rectangular steel housing that shall be bolted to the overhead structure and designed to allow up to 30 degrees rod misalignment. Hanger shall consist of a steel spring located in a molded neoprene retaining cup with hanger rod bushing.

K. "PRMXA" - Same as type "RMXA" with the addition of a steel load transfer plate so that the equipment or piping operating height is the same as the installed height.

L. "HXA" -Same as type "RMXA" with the addition of a neoprene element in series to isolate the upper connection.

M. "PHXA" - Same as type "HXA" with the addition of a steel load transfer plate so that the equipment or piping operating height is the same as the installed height.

N. "HSS" - shall be a 'rubber in shear' isolator element contained within a rectangular steel housing.

2.02 RAIL AND BASE TYPES

A. "RMR" spring rail isolator. Rails shall have springs of proper size and constant, installed between a continuous structural steel channel (upper member) and a continuous flat steel plate (bottom member) in such manner, quantity, and location that efficient uniform deflection and loading to the structure is assured. Rails shall be furnished with Vibrex hold down stabilizers to restrict excessive amplitudes. Cross bracing must be used when necessary for seismic stability.

B. "RMB" shall be the same as "RMR" above except that it shall be designed as an integral fan and motor base with an adjustable motor slide base.

C. "RMSR" shall be a set of wide flange structural steel rails supplied with height saving brackets to reduce the mounting height of the equipment. The maximum allowable deflection of any point on the loaded frame relative to the unloaded frame shall be 0.005". A wide flange section depth greater than 1/10 the supporting span between isolators will be accepted as satisfying the deflection requirement.

D. "RMSB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia.

E. All steel members shall be coped and fitted or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. Adjustable motor slide bases shall be included when required for centrifugal fan applications. The steel bases shall have an operating clearance of one (1") inch above the supporting structure. Where bases are used to mount pumps, the bases shall be large enough to support the pipe elbows if required.

F. "RMSBI" shall be a steel frame inertia base with all welded members and constructed of structural channel shapes. The base shall be designed for a thickness or inertia mass to equipment weight ratio as shown on the schedule with a minimum thickness of six (6") inches. The bases shall include a template and anchor bolts to anchor the equipment. Inertia bases shall have 1/2" (#4) rebar spaced a maximum of 12" on centers in each direction and located 1-1/2" from the bottom of the base. Adjustable motor slide bases shall be included when required for centrifugal fan applications. Bases shall be supplied with height saving brackets to reduce the mounting height of the equipment.

G. “RMUAB-EQ” shall be a steel frame made of structural angle with type “RMU-EQ-SH” O.S.H.P.D. (HCAi) pre-approved combination isolator/restraints.

H. "RMLSR" shall be a set of multiple wide flange structural steel rails supplied with type RMLS-EQ vibration isolator/seismic restraints and height saving brackets to reduce the mounting height of the equipment. The maximum allowable deflection of any point on the loaded frame relative to the unloaded frame shall be 0.005". A wide flange section depth greater than 1/10 the supporting span between isolators will be accepted as satisfying the deflection requirement.

I. Type "RMLSB" shall be a steel frame constructed of structural wide flange members unless shown otherwise and shall be rectangular in shape. The depths of the steel members shall not be less than one tenth (1/10) of the longest span between base supports or designed for a maximum beam deflection of .005". If the latter method is used, submittals shall include calculations showing the necessary moment of inertia. All steel members shall be coped and fitted or constructed using the overlap insert method to assure a structural strength that is greater than the individual member strength. Frame shall be supplied complete with height saving brackets and type RMLS-EQ, O.S.H.P.D. (HCAi) pre-approved isolator/seismic restraints.
   1. Type RMLS-SB is the same as type “RMLSB” but rather than utilizing height saving brackets the steel frame is placed directly on top of the RMLS-EQ type isolators.

2.03 CURB TYPES

A. Type "VIC-EQ-SS" shall be a factory fabricated combination roof mounting curb and vibration isolation base for rooftop package units over 25 tons. The curb assembly shall be designed so that it can be re-roofed without disturbing the HVAC equipment. Curbs must be designed so that roofing material cannot cover access to isolators. The vibration isolation portion of the assembly shall be constructed of structural steel and designed to mate with the bottom of the rooftop unit. System shall include factory fabricated duct supports and any required bracing welded in place. The sheet metal weather proofing curb portion shall be supplied complete with a wood-nailer strip to facilitate flashing by the roofing contractor. Internal vibration isolator/seismic restraints shall be O.S.H.P.D. (HCAi) pre-approved number OPM-0401-13 as manufactured by MW Sausse’ & company, inc. Required anchorage calculations shall be supplied with submittal package. When required, curb shall include an optional acoustical package for sound reduction.

B. Type "VIC-EQ" shall be a factory fabricated combination roof mounting curb and vibration isolation base for rooftop package units up to 20 tons. Steel members and cross bracing shall all be welded. The assembly shall be shipped and installed in one piece complete with curb, weather-seal, removable O.S.H.P.D. (HCAi) pre-approved isolator/restraints #OPM-0401-13, exterior accessible leveling device, and minimum 14 gage galvanized steel top section to match the unit. Curb shall be fabricated of minimum 12 gage galvanized steel designed to carry the seismic loads to the supporting structure. System shall include factory fabricated duct supports welded in place as well as insulated panels when required. Required anchorage and lower curb structural calculations shall be supplied with submittal package. When required, curb shall include an optional acoustical package for sound reduction. Curb shall be manufactured to match roof slope if specified in drawings.

2.04 SEISMIC RESTRAINTS

A. Shall be capable of safely accepting external forces as specified in the applicable codes without failure. Restraints shall maintain equipment, duct, and piping in a captive position during an earthquake. Restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise under normal operating conditions. Seismic restraints shall be provided on all equipment as scheduled on the drawings. Submit calculations by a Licensed Structural Engineer Registered in State of California to verify snubber capacities.

B. Type "3500" seismic restraint shall be constructed of steel plate, concentric steel pipes, and structural members in an all-welded assembly. All contact points shall be cushioned with minimum 1/4" thick resilient pad. Restraints shall be O.S.H.P.D (HCAi) pre-approved type OPM-0401-13.

C. Type "3200" seismic restraint shall be all directional type with interlocking steel members constructed of structural angle and A-36 threaded rod. All contact points shall be cushioned with minimum 1/4" thick resilient pad or bushing.

D. Type "CR" seismic restraints shall be constructed of 7x19 strand galvanized aircraft cable. Cable assembly shall come complete with minimum (2) "U" bolt clamps per end and thimbles to protect cable from chafing. Allowed loads shall be the cable breaking strength with a safety factor of three. Actual loads shall be calculated with the worst case of all loads applied to one cable and anchor pattern. Cable shall be installed with 1/4" slack to prevent the transmission of vibration to the structure.

PART 3 - EXECUTION

3.01 GENERAL

A. Install in accordance with manufacturer's written instructions. Vibration isolators must not be installed in a manner that will result in piping stress or misalignment.

B. The structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment or isolators. The isolators shall be installed without raising the equipment and frame assembly.

C. After the entire installation is complete and under full operational load, the isolator shall be adjusted so that the load is transferred from the blocks or shims to the isolator. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.

D. Once the equipment is in operation, install and anchor the seismic restraints with proper operating clearances as indicated on drawings.

E. HVAC equipment shall be isolated from the building structure by vibration isolators as scheduled on the drawings.

F. All piping 1 1/4" and over located in mechanical equipment rooms, and for a minimum of fifty (50) feet or 100 pipe diameters whichever is greater, from connection to vibrating mechanical or electrical equipment, shall be isolated from the building structure by means of vibration isolators as identified above.

G. All HVAC piping and vertical risers shall be isolated from the building structure by means of vibration isolators and guides.

H. All piping and ductwork to be isolated shall freely pass-through walls and floors without contact. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork and maintain adequate clearance (Minimum of 2 inches all around) around the outside surfaces. Any materials used to fill the clearance space shall be permanently flexible so that vibration will not pass through it.

I. No rigid connections between equipment and building structure, including electrical conduit and refrigerant lines, shall be made that degrades the vibration isolation system herein specified. Inform other following trades, such as plastering, or electrical, to avoid any contact which would short-circuit the vibration isolation.

J. Bring to the Architect's attention prior to installation any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the contractor's expense.

K. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.

L. Obtain inspection and approval of any isolation installation to be covered or enclosed, prior to such closure.

M. Thrust restraints shall consist of spring hangers with the same deflection as specified for the spring mountings. Thrust restraints shall be attached to the fan at the centerline of air discharge opening.

N. Correct, at no additional cost, all installations that are deemed defective in workmanship or materials.

3.02 PIPING ISOLATORS

A. All piping except fire standpipe systems, are included under this section.

B. Isolate piping within 50 feet of rotating equipment and pressure reducing stations.

C. The isolators shall be installed with the isolator hanger box attached to, or hung as close as possible to, approved locations on the supporting structure.

D. The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically permitted.

E. Hanger rods shall be aligned to clear the hanger box.

F. Horizontal floor supported piping shall be isolated by type "RMLS-EQ", with a minimum static deflection of 1.0 inch or the same deflection as isolated equipment to which pipe is connected, whichever is greater.

G. Vertical riser pipe support and restraint system shall consist of type "RMS" springs and type "PG-EQ" guides. Install vertical riser guides so that clearances are maintained around concentric pipes in the guides. Install vertical restraints on the floor location as shown on drawings.

H. Pipe anchors, where required, shall utilize resilient pipe anchors, type "RPA" or equivalent, to avoid direct contact of piping with building.

I. Pipe Extension and Alignment connectors: Provide connectors at pump suction and discharge, riser take offs, cooling, and heating coils, and elsewhere as required to accommodate thermal expansion and misalignment.

J. Seismic restraint spacing shall be in accordance with applicable codes.

3.03 INSPECTION

A. On completion of installation of all vibration isolation and seismic control devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation error, improperly selected isolation devices, or other faults in the system that could affect the performance of the system. The contractor shall submit a report to the Architect, including the above report with consequent steps taken to properly complete the isolation work.

END OF SECTION

SECTION 23 05 53
HVAC IDENTIFICATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of HVAC identification work required by this section is indicated on drawings or specified in other Division 23 sections, and includes the following:
   1. Painted Identification Materials.
   2. Plastic Pipe Markers.
   3. Plastic Tape.
   4. Underground-Type Plastic Line Marker.
   5. Plastic Duct Markers.
   6. Valve Tags.
   7. Diagram and Schedule Frames.
   8. Engraved Plastic-Laminate Signs.
   9. Plastic Equipment Markers.
   10. Plasticized Tags.

1.02 RELATED SECTIONS

A. This section is part of each Division 23 section making reference to identification devices specified herein.

B. HVAC identification furnished as part of factory-fabricated equipment is specified as part of equipment assembly in other Division 23 sections.

C. Refer to Division 26 Sections for identification requirements of electrical work; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules and Diagrams:
   1. Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any).
   2. Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.
   3. Submit temperature control diagrams and Sequence of Operation on bond paper suitable for framing.

D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01, Section 01 78 00 and Division 23 Section 23 05 11 "Supplementary HVAC Requirements."

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
   2. No adhesive type identification markers will be accepted. All markers and tags shall be permanently attached to pipe, etc.
   3. All identification markers installed exterior of buildings shall be ultra-violet resistant.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

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

2.02 HVAC IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selections is Installer's option, but provide single selection for each product category.

2.03 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subject to fluid temperatures of 125oF. (52oC) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   2. Laminated or bonded application of pipe marker to pipe (or insulation).
   3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

D. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
   1. Laminated or bonded application of pipe marker to pipe (or insulation).
   2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, taped lapped 3".
   3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless-steel bands.

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

2.04 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.05 UNDERGROUND TYPE PLASTIC LINE MARKER

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

2.06 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamped-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
   1. Provide 1-1/2" diameter tags, except as otherwise indicated.
   2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

C. Access panel markers: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

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

2.07 DIAGRAM AND SCHEDULE FRAMES

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

2.08 ENGRAVED PLASTIC LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.09 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in HVAC identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording as indicated, as recommended by the manufacturers or as required for proper identification and operation/maintenance of HVAC systems and equipment.
   1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

2.10 EQUIPMENT MARKERS

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number, and serial number.
      b. Capacity, operating and power characteristics, and essential data.
      c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
2. Data.
3. Name and plan number.
a. Equipment service.
b. Design capacity.
c. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
4. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Retain and edit subparagraph above or first subparagraph below.
4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.11 PLASTIC DUCT MARKERS

A. Engraved color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

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

3.02 PIPING SYSTEM IDENTIFICATION

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

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
1. Near each valve and control device.
2. Near each branch, mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls, floors ceilings, or enter non-accessible enclosures.
4. At access doors, manholes similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment. On piping above removable acoustical ceilings, except omit intermediately.

3.03 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top soiling of each exterior underground piping systems, except sanitary sewer and storm drainage install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock, and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units. List each tagged valve on valve schedule for each piping system.

B. Mount valve schedule frames and schedules in machine rooms, where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

3.05 HVAC EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of HVAC equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   1. Fuel-burning units including boilers, furnaces, heaters.
   2. Pumps, compressors, chillers, condensers. and similar motor-driven units.
   3. Fans and blowers.
   4. Packaged HVAC central-station or zone-type units.
   5. Split air conditioner indoor and outdoor units
   6. Single Duct terminal units and all equipment in ceiling space.
   7. In addition to the equipment tag, install an identification tag for VAV units in locations approved by Architect to indicate where each unit is installed above the ceiling. Coordinate the installation location, type, size, and color of this tag with the Architect.

B. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

C. Test of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.06 ADJUSTING AND CLEANING

A. Adjusting: Relocate any HVAC identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes pre-testing, testing, adjusting, and balancing HVAC systems to produce design objectives and measurement and reporting of sound and vibration levels. including the following:
   1. Balancing airflow and water flow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Test, adjust and balance hydronic system based on the requirements of the existing variable flow chilled and heating water systems.
   3. Adjusting total HVAC systems to provide indicated quantities.
   4. Measuring electrical performance of HVAC equipment.
   5. Setting quantitative performance of HVAC equipment.
   6. Verifying that automatic control devices are functioning properly.
   7. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:
   1. Testing and adjusting requirements unique to particular-systems and equipment are included in the Sections that specify those systems and equipment.
   2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. T&B: Testing, adjusting, and balancing.

O. T&B Agency: An independent entity certified by AABC to perform testing and balancing work.

P. TBE: AABC certified test and balance engineer.

Q. TBT: AABC certified test and balance technician.

R. HVAC: Heating, ventilating, and air conditioning.

S. BAS: Building automation systems.

T. Contract documents: the mechanical drawings and test and balance specification.

U. NC: noise criteria.

V. RC: room criteria.

W. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.04 SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation T&B of AABC certification of T&B agency and personnel, including a sample copy of the AABC "National Performance Guaranty." If not submitted within the timeframe specified, the engineer has the right to choose an AABC agency at the Contractor’s expense.

B. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit T&B strategies and step-by-step procedures as specified in "Preparation" Article. Include a complete set of report forms intended for use on this Project.

C. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article to be used and filled out by systems Installers verifying that systems are ready for T&B.

D. Examination Report: Within 60 days of Contractor's Notice to Proceed, provide a summary report of the examination review required in Part 3 “Examination”, if issues are discovered that may preclude the proper testing and balancing of the systems.

E. Certified T&B reports: Within 14 days of completion of balancing work, submit AABC-Certified T&B report.
   1. Submit one copy of the final T&B Report directly to the design professional of record. Provide five additional copies to the contractor.

F. Warranty: Submit 6 copies of special warranty specified in the "Warranty" Article below.

G. Provide a summary of any discrepancies found in the system, by Air balance contractor to each system as described hereafter. Include a complete list of deficiencies and problems found in system being tested and balanced. Add this report to final submittal package.

1.05 QUALITY ASSURANCE

A. T&B Agency Qualifications: Engage a T&B entity certified by AABC.
   1. T&B Field Supervisor: Employee of the T&B Agency who is certified by AABC.
   2. T&B Technician: Employee of the T&B Agency and who is certified by AABC as a TBT.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   b. Contract Documents examination report.
   c. Testing, adjusting, and balancing plan.
   d. Work schedule and Project site access requirements.
   e. Systems readiness checklists.
   f. Coordination and cooperation of trades and subcontractors.
   g. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
   2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC "National Standards for Testing, Adjusting, and Balancing."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire T&B period. Cooperate with Owner during T&B operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during T&B operations to minimize conflicts with Owner's operations.

1.07 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

D. Review Division 23 contract documents to assure that the design has considered all required components necessary for a complete and successful testing, adjusting, and balancing of the system as described hereafter. Prepare a report for this examination of contract documents and propose any additional components required to complete the scope of work this section no later than 45 days after the award of the contract.

1.08 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. National Project Performance Guarantee: Provide a guarantee on AABC "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers.
   1. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation. Note the locations of devices that are not accessible for testing and balancing.

C. Examine approved submittal data of HVAC systems and equipment.

D. Examine project record documents described in Division 01 Section 01 78 00 "Closeout Submittals."

E. Examine ceiling plenums and under-floor air plenums used for supply, return, or relief air to verify that are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine HVAC equipment and verify that bearings are greased, belts are aligned, and tight, clean permanent filters are installed, and equipment with functioning controls is ready for operation.

G. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

H. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

J. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

K. Examine system and equipment test reports.

L. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

M. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

N. Examine Air Conditioning equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

O. Examine terminal units, such as variable-air-volume boxes, VVT dampers and By-Pass Dampers are accessible and their controls are connected, configured by the Controls Contractor, and functioning.

P. Examine strainers to verify that mechanical contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.

Q. Examine Air Conditioning heat-transfer coils for clean and straight fins.

R. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

S. Examine equipment for installation and for properly operating safety interlocks and controls.

T. Prior to examination of the vibration isolation system, verify that all system and equipment installations are complete and that testing, adjusting, and balancing specified in the contract documents have been performed.

U. Examine all vibration Isolation system. All vibration isolated equipment and piping must be inspected and examined before startup and shall include the following:
   1. Verify that all isolators are installed in accordance with manufacturer's recommendations.
   2. Verify that all isolation roof curbs have been adjusted by unit manufacturer. Provide a copy of the manufacturer's certification for adjustment of the isolators of the roof curb.
   3. Verify that piping, duct, and conduit penetrations through mechanical equipment room envelope are sealed, and if required, rigid contact with building structure does not exist.
   4. Steel isolation bases must be inspected for cracked welds, excessive bending or twisting of steel members.
   5. Concrete isolation bases must be examined for cracked concrete. Isolator retainer brackets must be checked for looseness. The concrete base must be flat and true in plane.
   6. Elastomer isolators must be examined for cracks in the rubber and for loose bonds between the rubber and steel plates or other steel components. Adequate clearance must be provided between bolts and the side of the bolt holes to prevent short circuiting.
   7. Steel spring isolators must be examined for loose or missing bolts, nuts or lock washers. Check for spring overloading or under-loading, completely collapsed spring coils, and cocked springs. Note if rubber or glass fiber pad between the bottom plate of the steel spring and the concrete slab or supporting structure is present.
   8. Housed steel springs must be examined for proper centering of the springs, clearance between the cast housing and rubber snubber, and the steel spring for tilted or cocked springs.
   9. When the specifications require that the isolators be bolted to the concrete slab or other supporting structure, the bolts may be isolated by means of rubber bushings and rubber washers.
   10. Inspect isolators with restraint devices to make sure that all shims have been removed and supportive nuts have been properly adjusted to allow for free floating of the isolated system.
   11. Seismic restraints shall not prevent the proper functioning of vibration isolation system.
   12. Pneumatic isolators must be inspected for overload or under-load by checking the air pressure gauge against manufacturer's submittals or catalog. The pneumatic isolator system should include the isolator, strainer, oil separator, height regulator, and air pressure gauge. Inspect the vicinity of the isolator. Note if the isolator is exposed to damage from vehicle or other traffic.
   13. Carefully inspect the space under all isolated bases to assure that these spaces are clean and free of debris to prevent short-circuiting.

14. Check to ensure that all shipping bolts associated with spring isolators have been removed.
15. Inspect all flexible piping, hoses, and expansion joints as to type, length and location as called for by the specifications. Examine flexible hose for excessive elongation.
16. Inspect all electrical and control connections to ensure that they do not restrain the movement of the vibration isolated equipment.
17. Inspect all fabric connections between fans and ductwork to ensure that a fabric "bellows" exists when the fans are operating.
18. Each piece of vibration isolated machinery must be free of any structural tie or rigid connection that may "short circuit" the isolation system. All limit stops, shipping bolts, and leveling bolts on all isolators must be inspected to ensure that they are not "short circuiting" the isolation system.
19. Hanger isolators should be free of misalignment and over / under-loading. Under no circumstances the isolator rod should be allowed to make rigid contact with the hanger housing.
20. Report deficiencies as discovered to the appropriate parties.

V. Examine automatic temperature system components to verify the following:
1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves, are properly connected.
5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

W. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PRE-TESTING & CFM MEASUREMENT & REPORTING

A. Prior to removal of the existing air moving equipment such as air handlers, air conditioners, heat pumps, furnaces, etc.. as indicated on the drawings and contract documents and prior to performance of the air distribution system duct cleaning perform the following:
1. Measure total supply and return airflow at each unit.
a. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
b. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
c. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
d. Record and report total supply and return airflow for each unit.
2. Measure fan static pressures as follows:
a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Report any artificial loading of filters at the time static pressures are measured.
d. Record and report static pressure at the supply fan outlet and return fan inlet for each unit.
3. Measure airflow at each terminal.
a. Record and report supply and return airflows at each terminal.

3.03 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures that includes the following:
   1. Equipment and systems to be tested.
   2. Strategies and step-by-step procedures for balancing the systems.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Prepare system-readiness checklists, as described in the "AABC National Standards for Total System Balance," for use by systems installers in verifying system readiness for T&B. These shall include, at a minimum, the following:
   1. Airside:
      a. Ductwork is complete with terminals installed.
      b. Volume, smoke, and fire dampers are open and functional.
      c. Clean filters are installed.
      d. Fans are operating, free of vibration, and rotating in correct direction.
      e. Variable-frequency controllers' start-up are complete and safeties are verified.
      f. Automatic temperature-control systems are operational.
      g. Ceilings are installed.
      h. Windows and doors are installed.
      i. Suitable access to balancing devices and equipment is provided.
   2. General
      a. Permanent electrical power wiring is complete.
      b. Equipment and duct access doors are securely closed.

3.04 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for T&B procedures.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP)units.

3.05 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare single-line schematic diagram of systems "as-built" for the purpose of identifying HVAC components.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check condensate drains for proper connections and functioning.

H. Check for proper sealing of air-handling-unit components.

I. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

J. Check dampers for proper position to achieve desired airflow path.

K. Check for airflow blockages.

3.06 PROCEDURES FOR CONSTANT VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
      b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   2. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report any artificial loading of filters at the time static pressures are measured.
   3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of sub-main and branch ducts.
   2. Adjust sub-main and branch duct volume dampers for specified airflow. Re-measure each sub-main and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure airflow at all inlets and outlets.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after all have been adjusted.

D. Verify final system conditions.
   1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
   2. Re-measure and confirm total airflow is within design.
   3. Re-measure all final fan operating data, RPM, Volts, Amps, static profile.
   4. Mark all final settings.
   5. Test system in economizer mode. Verify proper operation and adjust, if necessary.
   6. Measure and record all operating data.
   7. Record final fan performance data.

3.07 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature control system.

B. Measure indoor wet-bulb and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside air wet-bulb and dry-bulb temperatures.

3.08 PROCEDURES FOR VIBRATION MEASUREMENTS

A. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
   1. Turn off equipment in the building that might interfere with testing.
   2. Restrict people from occupying areas where human activity may affect accuracy of measurements.
   3. Note all exterior vibration sources i.e., trains, roadway traffic, adjacent construction activities, etc.

B. Attach and secure the vibration transducer in accordance with the latest edition of the AABC S&V Procedural Standards for Measurement of Sound and Vibration.

C. Measure and record, on all pumps and fans over 3 HP, and all chillers and compressors over 5 HP, at discrete frequencies or in 1/3 octave bands as follows:
   1. Discrete vibration levels from 1 to 200 Hz in 1 Hz increments, or
   2. In each 1/3 octave band from 12.5 Hz to 100 Hz.

D. Measure and record equipment vibration, bearing vibration, equipment base vibration, and on building structure adjacent to equipment. Record velocity and displacement readings in the radial vertical, radial horizontal and axial planes, where measurements can be performed safely.
   1. Fans and HVAC Equipment with Fans:
      a. Fan Bearing: Drive end and opposite end.
      b. Motor Bearing: Drive and opposite end.
      c. Equipment Base: Top and side, within 6” of each isolator.
      d. Building: Floor adjacent to fan/motor, within 6” of each isolator.
   2. Chillers and HVAC Equipment with Compressors:
      a. Compressor Bearing: Drive end and opposite end.
      b. Motor Bearing: Drive end and opposite end.
      c. Equipment Base: Top and side, within 6” of each isolator.
      d. Building: Floor adjacent to equipment, within 6” of each isolator.

E. Vibration Measurement Reports:
   1. Date and time of test.
   2. Equipment designation, location, equipment speed, motor speed and motor horsepower.
   3. Measured acceleration (in units of g’s, inches/sec^2), and measured velocity (in units of inches/sec) and measured displacement (in units of inches).

3.09 PROCEDURES FOR SOUND LEVEL MEASUREMENTS

A. Close windows and doors to the space.

B. Perform measurements when the space is not occupied, or when the occupant noise levels from other spaces in the building and outside are at a minimum, or do not affect sound readings.

C. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Turn off all sound sources (personal computers, printers, fax machines, etc) in the space that may affect sound readings.

D. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

E. Take sound measurements at a height approximately 48 inches above the floor and at least 36inches from a wall, column, or any other large surface capable of altering the measurements.

F. Take sound measurements in dB (linear or flat), with the slow time constant, in the octave bands from 31.5 to 8000 Hz.

G. Take sound measurements with the HVAC systems off to establish the background levels and take sound measurements with the HVAC systems operating. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

H. Perform sound testing in all occupied space horizontally and vertically adjacent to all mechanical equipment rooms and all mechanical chases.

I. Perform sound testing at 10% of locations on the project for each type of the following spaces. For each space type tested, select a measurement location that has the greatest anticipated sound level. If testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.
   1. Private office.
   2. Open office area.
   3. Conference room.
   4. Auditorium/large meeting room/lecture hall.
   5. Classroom/training room.
   6. Library open space.
   7. Public areas (such as, lobbies, hallways, break rooms).
   8. Perform sound testing in all spaces with a design criterion of NC or RC 25 or less.

J. Sound Measurement Reports: Record sound measurements on appropriate test forms, indicating the decibel levels measured in for both “background” and “HVAC system operating” readings. Record each tested location on a separate NC or RC chart. Record the following on the forms.
   1. Date and time of test.
   2. Equipment operational parameters – speed / frequency at time of measurements.
   3. Indoor measurements - space location within building including floor level and room /space number.
   4. Outdoor measurements – location identifier such as location relative to equipment, building, or property line.
   5. Indicate where measurements meet or exceed design criteria.

3.10 CONTROL VERIFICATION

A. In conjunction with system balancing perform the following:
   1. Work with the temperature control contractor to ensure the system is operating within the design limitations and gain a mutual understanding of intended control performance.
   2. Confirm that the sequences of operation are in-compliance with the approved drawings. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
   3. Verify that controllers are calibrated and function as intended.
   4. Verify that controller set points are as specified.
   5. Verify operation of limiting controllers (i.e., high, and low temperature controllers).
   6. Verify the operation of lockout or interlock systems.
   7. Verify the operation of all valve and damper actuators.
   8. Verify that all controlled devices are properly installed and connected to the correct controller.
   9. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
   10. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidity, or pressures. Note conditions that would adversely affect control functions.
   11. Record controller settings and note variances between set points and actual measurements.
   12. Confirm interaction of electrically operated switch transducers.

13. Verify main control supply-air pressure and observe compressor and dryer operations.
14. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
15. Note operation of electric actuators using spring return for proper fail-safe operations.

B. Reporting
1. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions.

3.11 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans: Minus 10 to plus 10 percent.
2. Fresh air intake: 0 to plus 5%.
3. Air Outlets and Inlets: Minus 10 to plus 10 percent.
4. Heating-Water Flow Rate: Minus 5 to plus 5 percent.
5. Cooling-Water Flow Rate: Minus 5 to plus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 REPORTING

A. Initial Construction Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Computer printout in letter-quality font, on standard bond paper, in a fine quality 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. The final report for sound and vibration measurement shall be in accordance with the requirements of the current edition of the AABC Procedural Standards for Measurement of Sound and Vibration.

C. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of the instruments used for procedures, along with proof of calibration.

D. Final Report Contents: In addition to the certified field report data, include the following:
1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.

6. Engineer's name and address.
7. Contractor's name and address and field technician responsible for the project.
8. Report date.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
    a. Settings for outside-air, return-air, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet-bulb, and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

F. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Balancing stations.

G. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Sheave dimensions, center to-center and amount of adjustments in inches.
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.
2. Motor Data: Include the following:
    a. Make and frame type and size.
    b. Horsepower and RPM.
    c. Volts, Phase, and Hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Sheave dimensions, center-to-center, and amount, of adjustments in inches.
3. Test Data: Include design and actual values for the following:
    a. Total airflow rate in CFM.
    b. Total system static pressure in Inches W.G.
    c. Fan RPM.
    d. Discharge static pressure in Inches W.G.

e. Filter static-pressure differential in Inches W.G.
f. Preheat coil static-pressure differential in Inches W.G.
g. Cooling coil static-pressure differential in Inches W.G.
h. Heating coil static-pressure differential in Inches W.G.
i. Outside airflow in CFM.
j. Return airflow in CFM.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

H. Apparatus-Coil Test Reports: For apparatus coils, include the following:
1. Coil Data: Include the following:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch.
f. Make and model number.
g. Face area in Sq. Ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in CFM.
b. Average face velocity in FPM.
c. Air pressure drop in Inches W.G.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in GPM.
i. Water pressure differential in Feet of Head or PSIG.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in PSIG.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in PSIG.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data: Include the following:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center to-center and amount of adjustments in inches.
2. Motor Data: Include the following:
a. Make and frame type and size.
b. Horsepower and RPM.
c. Volts, Phase, and Hertz.
d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center to-center and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:
a. Total airflow rate in CFM.
b. Total system static pressure in Inches W.G.
c. Fan RPM.
d. Discharge static pressure in Inches W.G.
e. Suction static pressure in Inches W.G.

J. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data: Include the following:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in Inches W.G.
e. Duct size in Inches.
f. Duct area in Sq. Ft.
g. Design airflow rate in CFM.
h. Design velocity in FPM.
i. Actual airflow rate in CFM.
j. Actual average velocity in FPM.
k. Barometric pressure in PSIG.

K. Air-Terminal-Device Reports: For terminal units, include the following:
1. Unit Data: Include the following:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in CFM.
b. Air velocity in FPM.
c. Preliminary airflow rate as needed in CFM.
d. Preliminary velocity as needed in FPM.
e. Final airflow rate in CFM.
f. Final velocity in FPM.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flow-meter type.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in CFM.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in Feet of Head or PSIG.

e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Instrument Calibration Reports: For instrument calibration, include the following:
1. Report Data: Include the following:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing. Perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

C. Duct Leakage Testing:
1. Perform duct pressure/leakage testing on newly constructed ductwork.
2. Verify that proper test methods are used and that leakage rates are within specified tolerances per section 23 31 13.
3. Report any deficiencies observed.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of HVAC insulation required by this section is indicated on drawings and schedules, and by requirements of this section, and includes the following:
   1. Piping Systems Insulation:
      a. Fiberglass.
      b. Calcium Silicate.
      c. Flexible Unicellular.
   2. Ductwork System Insulation:
      a. Fiberglass.
      b. Flexible Unicellular.
   3. Equipment Insulation:
      a. Fiberglass.
      b. Calcium Silicate.
      c. Flexible Unicellular.
   4. Acoustical Insulation:
      a. Fiberglass.

1.02 RELATED SECTIONS

A. Refer to Division 23 Section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

B. Refer to Division 23 Section "HVAC Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of HVAC insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each HVAC system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of HVAC insulation. Include this data and product data in maintenance manual.

1.04 QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

B. As a minimum, insulation shall meet installed conductance as set forth in Title 24 California Code of Regulations (CCR) 2022 Building Energy Efficiency Standards or as indicated in contract documents, whichever is greater.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
   1. Owens-Corning Fiberglas Corp.

2. Manville Products Corp.
3. CertainTeed Corp.
4. Armstrong World Industries, Inc.
5. Knauf Fiber Glass GmbH.

2.02 PIPING INSULATION MATERIALS

A. Fiberglass (Mineral Fiber) Piping Insulation: ASTM C547, Class 1 unless otherwise indicated. Manville Products Corp. Micro-Lok, Owens-Corning Fiberglas Corp., ASJ/SL-II or equivalent.

B. Calcium Silicate Piping Insulation: ASTM C533, Type I. Owens-Corning Fiberglass Corp. "Kaylo Asbestos Free" or equivalent.

C. Flexible Unicellular Piping Insulation: ASTM C534, Type I. Armstrong World Industries, Inc. meeting ASTM E-84 25/50 index.

D. Jackets for Piping Insulation: ASTM C921, Type I (Vapor Barrier) for piping with temperatures below ambient. (Type II (Water Vapor Permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.
   1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations. Zeston PVC Insulated fitting covers or equivalent.
   2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

G. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.03 DUCTWORK INSULATION MATERIALS

A. Flexible Fiberglass Ductwork Insulation: ASTM C553, Type I, Class B-2, Owens-Corning Fiberglas Inc. un-faced duct wrap insulation, Type 100 or equivalent.
   1. Nominal thickness or equivalent to provide installed R-value as follows:
      a. 1.5" thick - Installed R = 4.2
      b. 2.0" thick - Installed R = 5.6

B. Flexible Fiberglass Ductwork Insulation: ASTM C612, with ASTM C921 Type I vapor barrier jacket. Owens/Corning Fiberglas All Service Wrap Insulation, Type 100 or equivalent:
   1. Nominal thickness or equivalent to provide an installed R-value as follows:
      a. 1.5" thick - Installed R = 4.2
      b. 2.0" thick - Installed R = 5.6

C. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

D. Rooftop ductwork and ductwork that are not in conditioned space or indirectly conditioned spaces are to be insulated with material to achieve minimum installed R value equal to 8.0 to meet the 2022 Building Energy Efficiency Standards. For double wall rooftop ductwork see HVAC drawings.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.04 EQUIPMENT INSULATION MATERIALS

A. Flexible Fiberglass Equipment Insulation: ASTM C553, Type II, Class F-1, Owens-Corning Fiberglass, Inc., Type 701 1.5 lbs/Ft3.

B. Calcium Silicate Equipment Insulation: ASTM C533, Type I, Block; Owens/Corning Fiberglass, Inc., Kaylo Asbestos Free, U-Grooved block insulation.

C. Jacketing Material for Equipment Insulation: Provide canvas jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.

D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape corner angles, anchors and stud piping as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.05 ACOUSTICAL INSULATION

A. Rigid Fiberglass Insulation: ASTM C612, Class 1, Owens/Corning Fiberglass, Inc., 10 Lbs/Cu. Ft.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which HVAC insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 HVAC PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on the following:
   1. Hot piping within radiation enclosures.
   2. Hot unions, flanges, strainers, flexible connections, and expansion joints.

B. Cold Piping (40ºF to ambient):
   1. Application Requirements: Insulate the following cold HVAC piping systems:
      a. HVAC chilled water supply and return piping.
      b. Air conditioner condensate drains piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 1" thick for pipe sizes up to and including 4", 1-1/2" thick for pipe sizes over 4".
      b. Flexible Unicellular: 1/2" thick for pipe sizes up to 1-1/2" (A.C. condensate piping only).

C. Hot Low-Pressure Piping (to 250ºF.):
   1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (steam piping up to 15 PSI, water piping up to 250ºF. (121ºC.).
      a. HVAC heating water supply and return piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 1" thick for pipe sizes up to and including 1", 1-1/2" thick for pipe sizes 1-1/2"; 2" thick for piping over 2".

3.03 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted:
   1. Do not insulate outside air ductwork unless otherwise indicated.
   2. Do not insulate exhaust air ductwork unless otherwise indicated.
   3. All ductwork specified to be insulated that is located in mechanical rooms, located on roofs or where exposed in conditioned spaces or to weather shall be internally lined under Section 23 31 13 "Metal Ductwork"; unless noted otherwise in these specifications or on the drawings.

B. Insulate the following with flexible fiberglass insulation, faced, 1.5" thickness unless otherwise noted. Firmly wrap insulation around duct work with all joints lapped a minimum of 2 inches. Secure insulation to ducts by means of 16 gauge soft-annealed galvanized wire spaced 12 inches on centers at loose ends.
   1. Warm air heating ductwork in concealed spaces, unless in ceiling plenum provide all service wrap insulation.
   2. Return air ductwork in non-conditioned concealed spaces unless in ceiling supply plenum uses all service wrap insulation.
   3. Return air ductwork located in return air ceiling plenums and outside air ductwork supplying fan coil units.

C. Insulate the following with Flexible Fiberglass insulation with all service vapor barrier facing, 1.5" thickness unless noted otherwise.
   1. HVAC hot/cold mixed air ductwork between fan discharge or HVAC unit discharge, and room terminal unit.
   2. Outdoor air intake ductwork between air entrance and indoor fan inlet or indoor HVAC unit inlet.
   3. Installation:
      a. Neatly wrap insulation around ducts with all joints tightly butted together.
      b. Seal transverse joints with vapor barrier facing tab overlapping all joints 2 inches and secure with vapor barrier adhesive or outward-clinch staples on 4-inch centers.
      c. Seal longitudinal joints with 4-inch wide, vapor barrier adhesive tape.
      d. Secure insulation to underside of ducts, 100 percent coverage, with ductwork insulation adhesive.
      e. In addition to adhesive, on underside of ducts 24-inches or greater in width use mechanical fasteners on maximum 12-inch centers.
      f. Seal all penetrations of vapor barrier facing with vapor barrier mastic.

D. Insulate the following with Rigid Fiberglass Insulation, 2.0" thickness unless noted otherwise.
   1. HVAC and unit housings not pre-insulated at the factory or where lining has been specifically omitted.
   2. Installation: Fasten to ductwork with adhesive and pins per manufacturer's recommendations. Provide all Butt-joints with a 16 gage corner angles at corners. Seal all joints with approved duct tape.

E. Contractor's Option: Contractor may provide duct liner as set forth in Section 23 31 13, using equivalent installed "R" values; in lieu of external duct-wrap or rigid insulation as specified above unless ductwork is specifically indicated as being unlined.

F. Hot Ductwork:
   1. Application Requirements: Insulate range and hood exhaust ductwork with PABCO "Super Fire Temp" asbestos free, non-combustible fireproofing board.
      a. Provide 1 to 4-hour fire rating as indicated.
      b. Install per manufacturer's instructions.

3.04 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):
   1. Application requirements: Insulate the following cold equipment:
      a. Refrigeration equipment, including chillers, tanks, and pumps.
      b. Drip pans under chilled equipment.
      c. Cold and chilled water pumps.
      d. Pneumatic water tanks.
   2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 2" thick for cold surfaces above 35ºF. and 3" thick for surfaces 35ºF. and lower.

B. Hot Equipment (Above Ambient Temperature):
   1. Application Requirements: Insulate the following hot equipment:
      a. Boilers (not pre-insulated at factory).
      b. Water heaters.
      c. Hot water expansion tanks.
      d. Hot water pumps.
   2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation.
      a. Fiberglass: 2" thick, except 3" thick for low-pressure boilers and steam-jacketed heat exchangers.

C. Breeching and Stacks:
   1. Application Requirements: Insulate the following breechings and stacks:
      a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.

3.05 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems, subsequent-to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulated each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor barrier jackets on pipe insulation and protect to prevent puncture or other damage.

F. Cover valves, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.06 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor barrier on ductwork insulation and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

G. Ductwork Exposed to Weather: Where external insulation has been specifically indicated, protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.

H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.07 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breechings, or stacks while hot.

E. Apply insulation using the staggered joint method for both single, and double-layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, trowel in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, hand-holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.

J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

3.08 ACOUSTICAL INSTALLATION

A. Install within confines of roof curbs for roof mounted air handlers and air conditioning units, and elsewhere as indicated on drawings.

B. Cut to fit snugly within curb and around duct at duct penetrations, 4" minimum thickness.

3.09 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. The Direct-Digital Control (DDC) System specified herein shall include materials, operator workstation, building controllers, sensors, control valves, wiring, installation, start-up, testing, documentation and training for a complete operable system as required for this project.

B. Controls Engineering shall be provided by the local controls manufacturer representative.

C. Work specified under this section shall be performed by, or under the direct supervision of the local controls manufacturer representative, or by a contractor that is certified by the controls manufacturer to perform all work within Section 23 09 23 Direct Digital Control System for HVAC and those sections of 23 09 23 that have been specified herein.

D. Alternate techniques, modifications or changes to any aspect of these specifications may be submitted as a voluntary alternate no later than (15) days prior to the bid date and with sufficient information for a complete evaluation. This information shall include product data sheets, a UL508A Standard for Industrial Control Panels statement of compliance for any locally manufactured control panels, a detailed sequence of operation and engineered shop drawing. Shop drawings shall include the following as a minimum. Point to point wiring diagrams for each piece of equipment to be controlled, a network riser diagram that will depict quantity and location of the operator workstation, controllers, routers, and repeaters required for this project.

1.02 RELATED SECTIONS

A. 01 30 00: Administrative Requirements.

B. 23 05 00: Common Work Results for HVAC.

C. 26 00 10: Electrical General Provisions.

1.03 SUBMITTALS

A. Submit engineered shop drawings, sequences of operation, third party equipment and controls integration points and product data sheets covering all items of equipment for the proposed system prior to installation for approval. Any deviation from the contract documents shall be noted and the drawings signed and dated by the Contractor. Additionally, submit a UL508A Standard for Industrial Control Panels statement of compliance for any locally manufactured control panels.

B. After completion of the installation and commissioning, a full set of as-built documentation shall be turned over to the Owner. The as-built shall include operation and maintenance manuals, sequence of operation, shop drawings and digital copies of the following.
   1. Complete DDC System database backup.
   2. Source files for all custom written controller applications
   3. Source files for graphics if required for this project.

1.04 WARRANTY

A. Components, system software, and parts shall be guaranteed against defects in materials, fabrication, and execution for (1) year from date of system acceptance. Provide labor and materials to repair, reprogram, or replace components at no charge to the Owner during the warranty period.

B. Provide a list of applicable warranties for components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

C. Respond to the Owner's request for warranty service within (24) hours during normal business hours. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

D. Contractor shall request VPN access from owner and provide remote maintenance, software updates and repair service for the duration of the warranty period.

1.05 TRAINING

A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.

B. Provide (8) hours of onsite owner familiarization and training for the installed system. Training shall include system overview, time schedules, emergency operation, and programming and report generation.

C. Owner employees attending this training session shall be provided with the following documentation:
   1. System layout point to point connection diagram.
   2. System components cut sheets.
   3. Operations and maintenance data.

D. Provide classroom training for (2) owner technicians, classes to include Carrier CS Level and Carrier IS Level training with a total of (48) hours per student.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not store or install electronic hardware on the project until non-condensing environmental conditions have been established.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. DDC Equipment: Carrier OPEN BACnet Controls. No substitutions will be accepted.

B. Controls installation will be by Russell Sigler Inc. Controls Group.

C. The local manufacture representative will operate a free 40 hour a week, toll free customer support hotline for additional user support services that are required.

2.02 SYSTEM LISTING COMPLIANCE

A. Locally manufactured control panels shall meet all requirements as outlined by UL 508A standard and shall be both approved and listed by Underwriters Laboratories, Inc.

2.03 COMMUNICATION

A. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

B. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

C. Use owner provided Ethernet backbone for network segments.

2.04 OPERATOR INTERFACE

A. Description. The control system shall be as shown and consist of a high-speed, peer-to-peer network of DDC controllers and a stand-alone web server operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators with sufficient access level shall have an ability to make changes to all system and equipment graphics in the web server in addition to having full DDC system access to make configuration changes to the control system. Any tools required for making graphic changes shall be provided with web server.

B. Update (1) Existing Web server interface to the latest version as shown on the system drawings.

1. With the use of an owner provided remote SMTP email server the operators interface web server shall notify personnel of an alarm and record information about an alarm in the DDC system.
2. Any required installation or commissioning software shall be provided to the owner.

C. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
1. Log In and Log Out.
2. Point-and-click Navigation.
3. View and Adjust Equipment Properties.
4. View and Adjust Operating Schedules.
5. View and Respond to Alarms.
6. View and Configure Trends.
7. Manage Control System Hardware.
8. Manage Operator Access.

D. System Graphics. Operator interface shall be graphical and shall include at least one graphic per piece of equipment and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.

E. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs.

F. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Furnish the following standard system reports.
1. Alarm Reports.
2. Schedule Reports.
3. Security Reports.
4. Commissioning Reports.
5. Equipment Reports.

G. Energy Conservation
1. Outside Air Lockout. Lock out heating or cooling modes based on configurable outside air temperature limits.
2. Demand Limiting
   a. System shall be capable of monitoring building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer if applicable.
3. Optimal Start. The system shall bring the conditioned space to within occupied set points prior to the occupied time period to ensure occupant comfort.
4. Demand Controlled Ventilation (DCV). Each controlled space shall have a Carbon Dioxide (CO2) sensor and shall maintain a ventilation setpoint through a DCV algorithm to fulfill the requirements of ASHRAE standard, 62-1989 “Ventilation for Acceptable Indoor Air Quality” (including Addendum 62a-1990).

2.05 CONTROLLERS

A. General. The control system shall be available as a complete package with the required input sensors and devices readily available. Provide BACnet Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Sensors (SEN) as required.

B. Stand-Alone Operation. Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure.

C. Serviceability. Controllers shall have diagnostic LEDs for power, communication, and processor.

D. Rooftop Unit Controller (RTC). Defined as Application Specific Controllers (ASC), shall be factory installed by the HVAC manufacturer and shall control all associated HVAC rooftop equipment functions in a single zone application or as part of a zoning system application.
   1. Capacity control shall be based by the RTC internal time clock and setpoints (cooling and heating) coupled with a communicating room sensor. The controls shall provide separate occupied and unoccupied cooling and heating setpoints.
   2. RTC shall utilize up to 2 speed of fan control, up to 3 stages of cooling, and up to 4 stages of heating.
   3. RTC shall provide economizer control that has been certified for Fault Detection and Diagnostics (FDD) by California Energy Commission (CEC). The FDD system shall detect the following faults:
      a. Air temperature sensor failure/fault.
      b. Not economizing when it should.
      c. Economizing when it should not.
      d. Damper not modulating.
      e. Excess outdoor air.

E. Zone Controller (ZC). Defined as Application Specific Controllers (ASC) shall be capable of independent zone control or function as part of the zoning system.
   1. ZC shall have an integrated brushless actuator, onboard pressure sensor and shall perform pressure independent zone control by measuring and controlling CFM being delivered to the zone.
   2. The ZC shall utilize the Dual Maximum Control Setpoints VAV Box Logic as defined by Title 24.

F. Bypass Controller (BC). Defined as Application Specific Controllers (ASC) shall be capable of reading supply static pressure and controlling the bypass damper (or a VFD speed control output) to maintain the supply static set point in the supply duct. This operation shall be provided when operating within a zoning system application, or in a stand-alone mode.
   1. BC shall have an integrated brushless actuator and onboard pressure sensor to measure and control duct static pressure.

G. General Purpose Controller. Defined as Advanced Application Controller (AAC) shall be a solid -state micro-controller with pre-tested and factory configured software designed for controlling building equipment using DDC algorithms and facility management routines. The controller shall be capable of operating in either a stand-alone mode or as part of a network.

2.06 FIELD INSTALLED SENSORS

A. Space Temperature Sensors shall communicate to the controller over a 4-wire communication network and have setpoint adjustment, after hours override, occupancy sensor, LCD display and a communication service port.

B. Carbon dioxide sensor (CO2) shall be integrated into the Space Temperature Sensors and have integral programming to perform automatic baseline calibration without user interface. The recommended manual recalibration period shall not be less than five years.

C. Status indication for fans or pumps shall be provided by current sensing switch. The sensor shall be installed at the motor starter or motor to provide load indication. The unit shall consist of a current transformer, a solid-state current sensing circuit (with adjustable set point) and a solid state switch. A light emitting diode (LED) shall indicate the on off status of the unit.

2.07 CONTROL PANELS

A. Provide single-door, UL 508A Listed; NEMA Type 1, 3R or 4 to match environmental conditions, wall-mount enclosures for each system under automatic control. Mount relays, switches, and controllers in cabinet and indicators, pilot lights, push buttons and switches flush on enclosure exterior face as required.

B. Fabricate panels from 16 gauge steel with ANSI 61 gray finish and shall include (1) black padlock handle that will accommodate a padlock with up to a 5/16-in. locking bar for secure access to the enclosure contents. All additional latches shall be black non-locking handle type.

C. Provide engraved name plates that identify each control panel and for each component mounted to the exterior of the enclosure.

D. Provide a complete wiring diagram, bill of material for all components and markings with the following information:
   1. Manufacturer's name or trademark.
   2. Supply voltage, number of phases, frequency, and full-load current for each incoming supply circuit.
   3. Enclosure type number.

PART 3 - EXECUTION

3.01 ELECTRICAL WIRING

A. This contractor is responsible for all low voltage electrical installation and wiring for a fully operational DDC System as shown on the drawings and shall perform electrical installation in accordance with local and national electrical codes and in accordance with Division 26.

B. Install all HVAC control wiring, 24vdc or less, in electrical metallic tubing (EMT) when wire is concealed in walls and in exposed areas. Rigid metal conduit (RMC) will be used when conduit will be installed on roofs. Plenum wire may be used in ceilings where anchored support is provided every 10 feet.

C. Electrical Contractor is responsible for providing power from local electrical panels to the DDC System control panels.

D. When transitioning between buildings above or below ground level, provide a pull box with necessary surge suppression hardware to transition exterior rated wiring to interior applications.

3.02 ACCEPTANCE PROCEDURE

A. Upon completion of the installation, the contractor shall start-up the system and perform all necessary calibration and testing to ensure the proper operation of the DDC System.

B. After all calibration and testing have been completed, the contractor shall schedule a hardware demonstration and system acceptance test to be performed in the presence of the designated owner's representatives.

C. The contractor shall be a member of the designated Commissioning Team and shall be responsible for performing procedures presented in specification and contract drawings as detailed in the Functional Performance Tests (FPT).

END OF SECTION

SECTION 23 11 23
FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes distribution piping systems for natural gas and manufactured gas within the building and extending from the point of delivery to the building to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:
   1. Pipes, fittings, and specialties of domestic manufacture.
   2. Special duty valves of domestic manufacture.

B. This Section does not apply to LP-gas piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen, and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

C. Natural gas yard piping is not included in this section.

D. Gas pressures for systems specified in this section are limited to 5 PSIG, unless otherwise specified.

E. Products not furnished under this Section include gas meters which will be provided by the utility company, to the site, ready for installation.

1.02 RELATED SECTIONS

A. The following Sections contain requirements that relate to this Section:
   1. Division 23 Section "HVAC Identification" for labeling and identification of gas piping systems.

1.03 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.

C. Gas Yard Piping: That portion of gas distribution system which is underground.

D. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system and/or gas yard piping system being served.

E. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.04 SUBMITTALS

A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 01, Section 01 78 00 “Closeout Submittals” and Division 23 Section "Common Work Results for HVAC."

C. Test reports specified in Part 3. Submit for inclusion in operating and maintenance manual.

1.05 QUALITY ASSURANCE

A. Installation Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

C. Regulatory Requirements: Comply with the requirements of the following codes:
   1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installations, and inspection, testing, and purging of gas piping systems.
   2. California Plumbing Code (CPC).

1.06 SEQUENCING AND SCHEDULING

A. Notification of Interruption of Service: Except in the case of an emergency, notify all affected users when the gas supply is to be turned off.

B. Work Interruptions: When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.

C. Coordinate the installation of pipe sleeves for wall penetrations.

1.07 EXTRA MATERIALS

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:
   1. Gas service cocks: Semi-steel 175 pound with tapered bronze plug and bolted yoke. Furnish one operating wrench for each valve.
      a. Powell Fig. 2200 & 2201.
      b. Nordstrom Fig. 142 & 143.
      c. Walworth Fig. 1796 & 1797F.
      d. Homestead Fig. 611 & 612.
   2. Gas valves at equipment: All bronze, flathead screwed gas cocks.
      a. Powell Fig. 947.
      b. Crane Fig. 270.
      c. Healey Fig. 20F..
      d. Walworth Fig. 591

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the below specified pipe and fitting materials are used.

B. Steel Pipe: ASTM A 53, Schedule 40, seamless, black steel pipe, beveled ends.

2.03 FITTINGS

A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
   1. Joint compound or tape suitable for gas being handled.

B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

C. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:
   1. Material Group: 1.1
   2. End Connections: Butt Welding.
   3. Facings: Raised face.

2.04 PIPING SPECIALTIES

A. Unions: ANSI B16.39, Class 150, black malleable iron; female pattern; brass to iron seat; ground joint.

B. Dielectric Unions: ANSI B16.39, Class 250; malleable iron and cast bronze; with threaded or soldered end connections suitable for pipe to be joined; designed to isolate galvanic and stray current corrosion.

C. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:
   1. Overall thickness; 20 mils.
   2. Synthetic adhesive.
   3. Water vapor transmission rate, gallons per 100 Square Inch; 0.10 or less.
   4. Water absorption, percent; 0.02 or less.
   5. Prime pipe and fittings with a compatible primer prior to application of tape.

2.05 VALVES

A. Gas Cocks 2 inch and Smaller: 150 PSI WOG, bronze body, straightaway pattern, square head, threaded ends.

B. Gas Cocks 2-1/2" Inch and Larger: MSS SP-78; 175 PSI, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

C. Ball Valves: Rated for 400 PSI WOG pressure, two-piece construction; with bronze body conforming to ASTM B62, Standard (or regular) post, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl covered steel handle; with threaded ends.

D. Solenoid Valves: aluminum body, 120 Volts AC, 60 Hz, Class B continuous duty molded coil NEMA 4 coil enclosure; electrically opened/electrically closed; dual coils; normally closed; UL and FM approved and labeled.

E. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform to the requirements in NFPA 54, for the prevention of accidental ignition.

3.02 PIPE APPLICATIONS

A. Install steel pipe above ground with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2" inch and larger.

3.03 PIPING INSTALLATIONS

A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping. Take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: Except as specified below, install concealed gas piping in an air-tight conduit constructed of Schedule 40, seamless black steel with welded joints. Vent conduit to the outside and terminate with a screened vent cap.
   1. Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction) whether, or not such spaces are used as a plenum. Valves shall not be located, in such spaces.

2. Piping in Partitions: Concealed piping shall not be located, in solid partitions.
3. Prohibited Locations: do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb-waiter, or elevator shaft.

D. Install pipe sleeve seals at foundation penetrations.

E. Seal pipe penetrations of fire barriers using fire barrier penetration sealers acceptable to State Fire Marshal.

F. Use fittings for all changes in direction and all branch connections.
1. Weld-o-lets may be used in lieu of tees for branch connections two sizes or more, smaller than main.
2. Mitered elbows or tees not permitted.

G. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

H. Install piping free of sags or bends and with ample space between piping.

I. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

J. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.

K. Locate groups of pipes parallel to each other, spaced to permit servicing of valves.

L. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

M. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

N. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

O. Hangers, supports, and anchors are specified in Division 22 Section "Supports and Anchors." Conform to the table below for maximum spacing of supports:

SIZE (NPS)	SPACING IN FT.	MIN. ROD SIZE IN IN.
1/2	5	3/8
3/4 to 1-1/4	6	3/8
1-1/2 to 3 (horizontal)	12	1/2
3-1/2 to 5 (vertical)	all sizes every floor level	

P. Install unions in pipes 2 inches and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

Q. Install dielectric unions where piping of dissimilar metals is joined.

R. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

S. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

T. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 23 Section "Common Work Results for HVAC."

3.04 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Threaded Joints: Conform to ANSI B1.20.1 tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.

2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads.
4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

3.05 VALVE APPLICATION

A. General: The drawings indicate valve types, locations, and arrangements.

B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.06 VALVE INSTALLATION

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install a gas cock upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.

C. Install ball valves in all locations required for quick emergency shut off.

D. Install pressure relief or pressure limiting devices so they can be readily operated to determine if the valve is free so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.

E. Install low pressure gas check in primary gas supply line to each laboratory room. Valve to be installed immediately downstream of manual emergency shut off valve.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Install gas cocks upstream and within 6 feet of gas appliance. Install a union or flanged connection downstream from the gas cock to permit removal of controls.

B. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the gas appliance as practical. Drip-leg shall be a minimum of 3 pipe diameters in length.

3.08 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.09 FIELD QUALITY CONTROL

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

B. Prepare test reports and submit.

END OF SECTION

SECTION 23 31 13
METAL DUCTWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning system from minus 2" to plus 5" Water Gage.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for exterior insulation of metal ductwork; not work of this section.

B. Refer to other Division 23 Sections for ductwork accessories; not work of this section.

C. Refer to other Division 23 Sections for fans and air handling units; not work of this section.

D. Refer to other Division 23 Sections for testing, adjusting, and balancing of metal ductwork systems; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

C. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

1.04 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

B. Codes and Standards:
   1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
   2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
   3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems.”

C. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible.”

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage, and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam

marks, roller marks, stains and discolorations, and other imperfections, including but not limited to those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A653/A653M, lock forming quality, with G90 zinc coating in accordance with ASTM A653/A653M; and mill phosphatized for exposed locations.

2.02 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated or, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 18-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch takeoff connections. Where 90-degree branches are indicated, provide conical type tees.

C. Screws and bolts shall be cadmium plated.

D. Duct Liner: Permacote Linacoustic (rectangular), Permacote Spiracoustic (Round), complying with Thermal Insulation Manufacturer's Association (TIMA) AHC-101; of thickness indicated. 1 inch thick; 2" thick above roofline, unless indicated otherwise. Or approved equal.

E. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation". Adhesive used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

F. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

G. Duct Sealant: Non-hardening, non-migrating mastic, or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

H. Duct Cement. Non-hardening migrating mastic or liquid neoprene-based cement, type applicable for fabrication/installation detail, as compounded, and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork. Cement used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

I. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

J. Flexible ducts: Manufacturer based upon Casco Model Silent Flex II. Equal products by Thermaflex or approved equal. Insulated flexible ductwork shall be a factory fabricated assembly composed of a high carbon spring steel wire with a non-corrosive zinc coating spiral helix permanently bound to a spun-bonded nonwoven nylon interior liner and supporting a fiberglass insulating blanket with a polyethylene jacket vapor barrier. Working pressure: + 1-1/2” W.G. minimum, complying with UL 181; with factory installed metal collar connectors, maximum length 6 feet. Suspend at maximum 3’-0” O.C.

K. Under slab Ducts: For ductwork placed in concrete slabs, or under slabs on grade, fabricate ductwork of one of the following materials:
   1. Galvanized Steel.

2.03 FABRICATION

A. Shop-fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible so-as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop-fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards." Ducts shall be fabricated of galvanized sheet metal no less than 24 gauge.

C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section "Ductwork Accessories" for accessory requirements.

E. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive and fasten with mechanical fasteners.

2.04 FACTORY FABRICATED LOW PRESSURE DUCTWORK

A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct, and fittings.

B. Material: Galvanized sheet steel complying with ASTM A517, lock forming quality, with ASTM A525, G90 zinc coating, mill phosphatized.

C. Gage: 24-gage minimum for round and oval ducts and fittings, 4" through 24" diameter.

D. Elbows: One-piece construction for 90 degrees and 45-degree elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

E. Divided Flow Fittings: 90-degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.

F. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following or equal:
   1. Semco Mfg., Inc.
   2. United Sheet Metal Div. United McGill Corp.
   3. Or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape, and to prevent buckling. Support vertical ducts at every floor.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements

of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation.

Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

F. Where ducts pass through fire-rated floors, walls, or partitions, provide fire stopping between duct and substrate.

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.03 INSTALLATION OF DUCT LINER

A. General: Install duct liner utilizing duct liner fasteners in accordance with SMACNA HVAC Duct Construction Standards.

3.04 INSTALLATION OF FLEXIBLE DUCT

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 5'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

C. Bends in flexible ducts shall have a radius of not less 1.5 times the internal diameters.

3.05 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.06 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, or the period of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, provide temporary closure of duct openings and protection of mechanical equipment during construction.

C. All duct and other related air distribution component openings shall be covered with polyethylene film, tape, plastic, sheet metal or other methods acceptable to the enforcing agency which will prevent entrance of dust and debris.

D. Balancing: Refer to Division 23 Section "Testing, Adjusting and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION

SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of ductwork accessories required for project include the following:
   1. Dampers.
      a. Low pressure manual dampers
      b. Control dampers
      c. Counterbalanced relief dampers
   2. Fire and smoke dampers.
   3. Turning vanes.
   4. Duct hardware.
   5. Duct access doors.
   6. Flexible connections.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not included in work of this section.

B. Division 23 Section "Metal Ductwork."

C. Division 23 Section "HVAC Identification."

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible."
   2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
   3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers."
   4. Fire dampers shall bear California State Fire Marshal Listing Number.
   5. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

PART 2 - PRODUCTS

2.01 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type of multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards." "Jiffy" type dampers are not acceptable.

B. Manufacturers: Subject to compliance with requirements set forth in constriction documents, provide dampers of one of the following:
   1. Ruskin Manufacturing Co.
   2. Air Balance Co.
   3. Pottorff Company, Inc.

2.02 BACKDRAFT DAMPERS

A. General: Provide back-draft dampers of types and sizes indicated. Construct casings of 0.090-thickness aluminum with mitered corners.

B. Blades, 0.025" formed aluminum with extruded vinyl edge seals. Bearings, Zytel. Linkage 1/8" x 1/8" aluminum tie bars concealed in frame.

C. Counterbalance: Zinc plated bar on blades (except top blade). Adjustable for final setting Mill finish

D. Manufacturers: Subject to compliance with requirements, provide dampers of one of the following:
   1. Ruskin Manufacturing Co.
   2. Air Balance Co.
   3. Pottorff Company, Inc.

E. Control Dampers: Refer to Division 23 section "Sequence of Operation" for control dampers; not work of this section.

F. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of 16-ga aluminum provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/2" x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up.

G. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:
   1. Air Balance, Inc.
   2. Ruskin Mfg. Co.
   3. Pottorff Company, Inc.

2.03 FIRE AND SMOKE DAMPERS

A. California State Fire Marshal approved, designed, and constructed in accordance with NFPA 90A and UL Standard 555 and bear stamp showing compliance.

B. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-Ga. galvanized steel. Provide fusible link rated at 160 to 165 degrees F. (71 to 74 degrees C.) (unless otherwise indicated.) Provide damper with positive lock in closed position, and with the following additional features.
   1. Damper Blade Assembly: Curtain type.

C. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:
   1. Air Balance, Inc.
   2. Ruskin Mfg. Co.
   3. Pottorff Company, Inc.

2.04 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" O.C., supported with bars perpendicular to blades set at 2" O.C., and set into side strips suitable for mounting in ductwork.

B. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill.

C. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:
   1. Aero Dynen Co.
   2. Airsan Corp.
   3. Anemostat Products Div.; Dynamics Corp. of America
   4. Barber-Colman Co.
   5. Duro Dyne Corp.
   6. Environmental Elements Corp. Subs, Koppers Co., Inc.
   7. Hart & Cooley Mfg. Co.

8. Register & Grille Mfg. Co., Inc.
9. Souther, Inc.

2.05 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
   1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
   2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
   1. Ventfabrics, Inc.
   2. Young Regulator Co.

2.06 DUCT ACCESS DOORS

A. General: Provide duct access doors where required.

B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for un-insulated ductwork, extended frames for externally insulated duct. Provide one side hinged and other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:
   1. Air Balance Inc.
   2. Duro Dyne Corp.
   3. Register & Grille Mfg. Co., Inc.
   4. Ruskin Mfg. Co.
   5. Ventfabrics, Inc.
   6. Zurn Industries, Inc.; Air Systems Div.

2.07 FLEXIBLE CONNECTORS

A. General: Provide flexible duct connections wherever ductwork connects to vibration-isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement and, also capable of absorbing vibration of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:
   1. American/Elgen Co.; Energy Div.
   2. Duro Dyne Corp.
   3. Flexaust (The) Co.
   4. Ventfabrics, Inc.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90-degree elbows in supply and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL

A. Operate install ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
   1. Label access doors in accordance with Division 23 Section "HVAC Identification."
   2. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

SECTION 23 37 13
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of outlets and inlets required for project include the following:
   1. Linear slot diffusers and returns.
   2. Ceiling air diffusers, rectangular, square, round.
   3. Wall registers and grilles.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

B. Refer to other Division 23 Sections for balancing of air outlets and inlets; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
   1. Schedule of air outlets and inlets indicating drawing designation, room location, quantity furnished, model number, size, and accessories furnished.
   2. Data sheet for each type of air outlet and inlet, and accessory furnished indicating construction, finish, and mounting details.
   3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature, and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
   4. ANSI/ASHRAE Standard 70-1991.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors, when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

1.05 QUALITY ASSURANCE

A. Codes and Standards:
   1. ANSI/ASHRAE Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ANSI/ASHRAE Standard 70-1991.
   2. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems.”

PART 2 - PRODUCTS

2.01 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity, and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

2.02 MANUFACTURER

A. Subject to compliance with requirement diffusers of one of the following:
   1. Krueger Mfg. Co.
   2. Titus Air Distribution Products
   3. Anemostat Air Distribution Products

B. Manufacturers and model numbers are listed and/or scheduled to set a standard of quality. Equivalent manufacturers and models accepted by Architect/Engineer may be used. Equivalents must be submitted for review.
   1. Equivalents: Other manufacturers offering a similar product which is in accordance with the design criteria indicated may be submitted upon architect’s written acceptance prior to bidding. The cost to conduct all tests as may be directed by the architect to demonstrate that the equivalent product can achieve the criteria indicated, including all travel costs, shall be borne by the submitting contractor.

2.03 LINEAR SLOT DIFFUSER AND RETURN

A. General: Provide acoustical ceiling air distribution system. Consisting of ceiling slot air diffusers, base-frames, air chambers and entry collars.

B. Air Distribution Base Frames:
   1. Linear air diffusers base frames shall mechanically lock into the grid system. The base frames shall be extruded aluminum sections. Length shall be 48" unless otherwise noted or required.
   2. Provide air distribution base frame with full supply air pattern control air weir gates. When used for return air, these air weir gates act as a return airflow control damper. Close air weir gates where return is not necessary.
   3. Base frame shall present a substantially uniform appearance through the air slot when used as supply, returns or fully closed. All interior portions of the throat, including the vertical stems of the extrusions, shall be painted flat black to prevent unsightly visual deviations. Paint all exposed surfaces baked white enamel. Base frame shall be compatible with type of ceiling where linear slot diffuser is installed.
   4. Base frame shall be provided with spacer channels located on the ceiling module. The spacer channel shall act as the support means for the adjustable full pattern control air weir gates, which are provided throughout the entire length of the base frame.
   5. The noise criteria of the air distribution base frame shall be expressed in sound power levels (decibels 10-12 Watts) in octave bands 2 through 7 with a room attenuation of 10 decibels and shall not exceed noise-criteria of 30. All data shall be based on tests performed in a certified laboratory.
   6. Where noted on drawings or as required, blank-off airtight backside of supply air linear slot where duct connection is not made.

C. Supply or Return Air Chambers:
   1. Supply or Return air plenum chambers shall be designed, tested, and fabricated by the same manufacturer that furnishes the base frames. Shop fabricated air chambers not acceptable. Provide with damper at inlet to plenum, which is accessible through face of linear diffuser for adjustment.

2. Provide adjustable air pattern controllers that are accessible through the base frame slot for field adjustment of the spread of the air stream. This will be accomplished without the removal of acoustical tile.
3. Provide a round neck air entry collar sized for maximum average air entry velocity of 750 FPM. A volume damper shall be installed at connection to plenum, which is accessible through face of diffuser for adjustment.
4. Construct supply air chamber from not less than 26-gauge galvanized steel and will be lined with one- quarter inch 2 Lbs./Cu. Ft. density thermal acoustical insulating. All surfaces visible through the slot will be painted flat black.
5. Provide spring clip keepers to securely attach the chamber to the base frame when in operation. These spring clips permit releasing of the air chamber for easy relocation.
6. The supply air chamber shall have been tested as composite assembly with the linear base frame for air distribution and noise level performance. The tests shall be conducted in accordance with ANSI/ASHRAE Standard 70-1991.
7. For return air plenums above the ceiling, install Krueger Model DFRH plenum hood on all linear return air bars.

D. Manufacturer: Krueger Model DFL linear slot diffuser.

2.04 SIDEWALL SUPPLY AND RETURN REGISTERS AND GRILLES

A. Supply register - Krueger 1600 or as indicated elsewhere on contract documents.

B. Return register - Krueger S-5480 or as indicated elsewhere on contract documents.

C. Return grille - Krueger S-5480 or as indicated elsewhere on contract documents.

2.05 CONSTANT AIR VOLUME SYSTEM - CEILING DIFFUSERS (SUPPLY)

A. Concealed Spline - Krueger 5PLQ or as indicated elsewhere on contract documents.

B. Glued on Acoustile - Krueger 5PLQ or as indicated elsewhere on contract documents.

C. Plaster or Drywall - Krueger 5PLQ or as indicated elsewhere on contract documents.

D. 24" x 24" T-Bar - Krueger 5PLQ or as indicated elsewhere on contract documents.

Note: For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to create 24" x 24" space.

2.06 CONSTANT AIR VOLUME SYSTEM - CEILING RETURN, EXHAUST AND TRANSFER GRILLES AND REGISTERS

A. Registers shall be provided with opposed blade dampers.

B. Concealed Spline - Krueger EGC5 or EGC5-01 or as indicated elsewhere on contract documents.

C. Glued on Acoustile - Krueger EGC5 or EGC5-01 or as indicated elsewhere on contract documents.

D. Plaster or drywall - Krueger EGC5 or EGC5-01 or as indicated elsewhere on contract documents.

E. 24" x 24" T-bar - Krueger EGC5-F23 or EGC5-01-F23 or as indicated elsewhere on contract documents.

Note: For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to provide 24" x 24" space.

F. Transfer Grille - Ceiling - Same as return grilles.

2.07 VARIABLE AIR VOLUME SYSTEM - MODULAR CEILING DIFFUSERS (SUPPLY)

A. Krueger Model 1900SQ and shall have a frame style to interface with the ceiling grid system being used.

B. Manufactured from extruded aluminum. Provided with air pattern control weirs, and an integral deflection rail allowing for one- to four-way direction air flow producing uniform ceiling effect.

C. The air motion in the occupancy zone at maximum cubic feet per minute shall not exceed 50 feet per minute. Inner panel of matching acoustical tile shall provide an airtight joint.

D. Supply, Return and Exhaust Chambers:
   1. Designed and fabricated by the manufacturer of the base frames. Field fabricated chambers will not be accepted. Chamber to be supplied with spring clips to attach to the base frame. Constructed from not less than 26-gauge galvanized steel and lined with 1/4" 2 LBS/CU. FT. density thermal insulation. All surfaces visible through the air slot painted flat black.
   2. Chamber shall be supplied with a factory installed round entry collar for flex duct connection. Collar shall be sized for maximum average air entry velocity of 750 fpm. Chamber must be tested as a composite assembly with the base frame for air distribution and noise level performance by a certified testing laboratory. If used with side inlet, furnish and install vertical pressure equalizing baffle.

2.08 VARIABLE AIR VOLUME SYSTEM - MODULAR CEILING RETURN

A. Krueger Model 1900SQ Return diffuser.

B. Base frame from extruded aluminum. Frame shall have fixed weirs creating a continuous one-inch closed slot. Provide opposite blade volume damper.

2.09 VARIABLE AIR VOLUME SYSTEM - TRANSFER GRILLES

A. Krueger Model 1900SQ Return diffuser.

B. Base frame from extruded aluminum. Frame shall have fixed weirs creating a continuous one-inch closed slot. Provide opposite blade volume damper.

2.10 SUPPLY, RETURN AND EXHAUST CONNECTIONS TO METAL LINEAR CEILING

A. Air Factors sheet metal air boot (eight-slot for connecting to back of metal linear ceiling with slot openings with labyrinths, as applicable) for supply, return, and exhaust. Air boot shall lock onto back of ceiling system.

2.11 CIRCULAR CEILING DIFFUSERS

A. Krueger Model RA2 circular diffuser with adjustable inner cone.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended function.

B. Provide 12” high plenum box with 1” acoustical insulation. Refer to installation detail on plans for additional requirements.

C. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

D. Coordinate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

E. Supply outlets to provide the required air throw and spread with no apparent drafts or excessive air movement within space being supplied. Contractor to provide necessary accessories to accomplish satisfactory air distribution.

F. Provide felt, cork or rubber gasket between finish-surface and frame to prevent vibration and assure tight fit. Contractor shall be responsible for the correct location of ductwork and outlets.

G. For filler panel type, outlets the manufacturer shall coordinate his design with the ceiling suspension system being used. The Contractor and manufacturer shall match up sizes of outlets to properly fit in ceiling systems, between concrete or masonry components, between architectural items before fabrication.

H. When installing removable core type outlets, secure to frame with screws.

I. Secure outlets to ceiling suspension systems as required by Division of the State Architect.

END OF SECTION

SECTION 23 74 00
WALL MOUNTED HEATING AND COOLING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes packaged sidewall mounted heating and cooling units.

1.02 RELATED SECTIONS

A. Division 23
   1. Section "Common Motor Requirements For HVAC Equipment."
   2. Section "Metal Ductwork."
   3. Section "Testing, Adjusting and Balancing."

B. Division 26
   1. Section "Electrical General Provisions."

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities at scheduled conditions of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:
   1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for wall mount heating and cooling units. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   2. Submit shop drawings detailing the mounting, securing, and flashing of the unit to building structure.
   3. Submit shop drawings for installation of top discharge plenum and flashing the plenum with units.
   4. Submit shop drawings detailing method of securing unit to wall to meet seismic restraint requirement.
   5. If an equal unit is being proposed to be used in lieu of the base specified unit, the contractor shall coordinate all differences as hereinafter described and note such differences on the shop drawings and incorporate all changes (if any) required by the structural and electrical engineers to accommodate the equal unit.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule land procedures. Include this data in maintenance manual in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. Gas-Fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.
   2. Testing and rating of wall mount units of 135,000 Btu/hr capacity or over shall be in accordance with ARI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".
   3. Testing and rating of wall mount units under 135,000 Btu/hr capacities shall be in accordance with ARI 210 "Standard for Unitary Air-Conditioning Equipment" and provide Certified Rating Seal. Sound testing and rating of units shall be in accordance with ARI 270 "Standard for Sound Rating of Outdoor Unitary Equipment.” Units shall bear Certified Rating Seal.
   4. Refrigerating system construction of wall mount units shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration.”

5. Energy Efficiency Ratio (EER) or (SEER) of wall mount units shall be equal to or greater than prescribed by Title 24 - California Code of Regulations" (CCR) or as scheduled.
6. Wall mount units shall be designed, manufactured, and tested in accordance with UL requirements.
7. Wall Mounted units shall comply with ASHRAE 62.1.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle units and components carefully to prevent damage. Replace damaged wall mount units or components with new.

B. Store units and components in clean dry place, off the ground and protect from weather, water, and physical damage.

C. Rig units to comply with manufacturer's rigging and installation instructions for unloading units, and moving them to final location.

1.06 SCHEDULING AND SEQUENCING

A. Coordinate installation of wall mounted units with wall framing system.

B. Coordinate wall opening locations for mechanical and electrical connections.

1.07 SPECIAL WARRANTY

A. Warranty on Compressor (and Heat Exchanger): Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors (and heat exchangers) with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only and does not include labor for removal and reinstallation.
   1. Warranty Period: 4 years extension from date of basic 1-year warranty - See Division 01, Section 01 78 00 “Closeout Submittals.”

1.08 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each heating and cooling unit:
   1. One set of matched fan belts for each belt-driven fan.
   2. One set of filters for each unit.

PART 2 - PRODUCTS

2.01 WALL MOUNT UNITS (GENERAL)

A. General Description: Units shall be factory-assembled and tested, designed for sidewall installation, and consisting of compressors, condensers, evaporator coils, (heat exchanger), condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.

B. Units shall be provided with a sound and vibration reduction curb insulated with an anti-microbial flame/smoke resistant non-fiberglass cotton material (Brentwood ES, Discovery ES).

C. Units as manufactured by Bard were used for the basis of design, and their capacities, weights and electrical characteristics are scheduled on the drawings. Equal manufacturers as hereinafter specified may be used; however, any differences between the base unit and the equal unit, such as weight, electrical characteristics, physical dimensions, etc., shall be coordinated by the contractor, and any differences which affect the building structural framing or electrical requirements shall be incorporated into the project at no additional cost to the Owner.

2.02 WALL MOUNT GAS HEAT/ELECTRIC COOLING AIR CONDITIONING UNIT

A. Unit shall be approved and listed by INTERTEK ETL Listed (ETL US/C).

B. Unit shall be AHRI/GAMA Certified for heating capacity and efficiency.

C. Unit shall be of the single-package type, combination air-to-air cooling and gas-fired heating. Unit shall be AGA certified and meet requirements of CCR Title 24.

D. Unit shall be equipped with the manufacturer's installed NEMA rated disconnect switch and built-in circuit breaker.

E. Unit cooling efficiency shall be in EER and heating efficiency in AFUE.

F. Cabinet – Weatherproof casing constructed of 20-gauge galvanized steel, bonderized and finished with a baked-on exterior polyester enamel paint prior to assembly.
   1. Cooling section shall be fully insulated with 1" fiberglass.
   2. Sloped top shall be factory installed.
   3. Unit shall be provided with factory installed rain flashing.
   4. Unit shall have side mounting brackets. A bottom bracket shall be provided.

G. Compressor(s) - The unit shall contain (one or two) as scheduled, welded, Scroll with suitable vibration isolators and shall have a 5-year warranty.
   1. Factory installed high and low-pressure controls.
   2. Liquid line filter shall be provided.

H. Coils shall be constructed of aluminum (copper) fins mechanically bonded to copper tubes. Evaporator coils shall have a minimum 2" thick filter upstream of the coil. 1" filters are not acceptable. Condenser coils shall be equipped with screen protection grille.

I. Fans and motors - The evaporator air fan shall be of the forward-curved centrifugal type, direct-drive multi-speed or adjustable belt-driven as shown on the equipment schedule. Condenser fan motor shall have ball bearings. Sleeve type bearings are not acceptable. Condenser air fan shall be of the propeller type, directly driven and discharging upward.

J. Heat exchanger shall be tubular in design and constructed of tubular 18-Gauge stainless steel. Heat exchanger shall carry a 10-year non-prorated warranty.

K. Drain Pan – Shall be constructed of 20-gauge galvanized steel, bonderized and finished with a baked-on exterior polyester enamel paint.

L. Safety controls - Cooling section shall be protected by low pressure stat, high pressure switch, compressor motor overloads, crankcase heaters, freeze stat and lockout circuit that prevents compressor short cycling as a result of a rapid change in thermostat setting by automatically preventing compressor restart for at least 5 minutes.

M. Heating controls shall consist of a redundant gas valve, intermittent pilot ignition system, limit switches, centrifugal switch, and rollout switch.
   1. Economizer control shall include return air (R.A.) and outdoor air filter and hood and exhaust air outlet at the unit.
   2. Thermostat assembly shall provide staged heating and cooling, manual and automatic changeover and fan control.

2.03 WALL MOUNT HEAT PUMP AIR CONDITIONING UNIT

A. Unit shall be approved and listed by INTERTEK ETL Listed (ETL US/C).

B. Unit shall be of the single-package type, air-to-air heat pump.

C. Unit shall be equipped with the manufacturer's installed NEMA rated disconnect switch and built-in circuit breaker.

D. Unit cooling efficiency shall be in EER.

E. Cabinet – Weatherproof casing constructed of 20-gauge galvanized steel, bonderized and finished with a baked-on exterior polyester enamel paint prior to assembly.
   1. Cooling section shall be fully insulated with 1" fiberglass.
   2. Sloped top shall be factory installed.
   3. Unit shall be provided with factory installed rain flashing.
   4. Unit shall have side mounting brackets. A bottom bracket shall be provided.

F. Compressor(s) - The unit shall contain (one or two) as scheduled, welded, scroll with suitable vibration isolators and shall have a 5-year warranty.
   1. Factory installed high and low-pressure controls.
   2. Liquid line filter shall be provided.

G. Coils shall be constructed of aluminum (copper) fins mechanically bonded to copper tubes. Evaporator coils shall have a minimum 2" thick filter upstream of the coil. 1" filters are not acceptable. Condenser coils shall be equipped with screen protection grille.

H. Fans and motors - The evaporator air fan shall be of the forward-curved centrifugal type, direct-drive multi-speed or adjustable belt-driven as shown on the equipment schedule. Condenser fan motor shall have ball bearings. Sleeve type bearings are not acceptable. Condenser air fan shall be of the propeller type, directly driven and discharging upward.

I. Drain Pan – Shall be constructed of 20-gauge galvanized steel, bonderized and finished with a baked-on exterior polyester enamel paint.

J. Safety controls - Cooling section shall be protected by low pressure stat, high pressure switch, compressor motor overloads, crankcase heaters, freeze stat and lockout circuit that prevents compressor short cycling as a result, of a rapid change in thermostat setting by automatically preventing compressor restart for at least 5 minutes.

K. The heat pump shall have a factory installed electric resistance heater available that is designed specifically for application in the ‘T’ Series heat pump. Heater shall include automatic unit safety controls.

2.04 MANUFACTURERS

A. Subject to compliance with requirements, provide wall mounted heating and cooling units as manufactured by:
   1. Bard Manufacturing Company, Inc.
   2. Or Approved Equal.

B. All electrical data shall be based on 115oF. ambient; 95oF. data is not acceptable.

C. Units as manufactured by Bard are used as the basis of design and their capacities, weights, dimensions, and mechanical, structural, and electrical characteristics, compatibility with existing roof curbs and existing ductwork connection point are scheduled on the drawings and contract documents. Use of alternate units named in this spec requires owner approval. Contractor shall include such approval in their bid documents. By submitting Alternate equipment named in this specification, contractor shall bear all additional cost and responsibility associated with all additional electrical, mechanical, structural, Title-24 energy calculations. Contractor shall be responsible for resubmitting and obtaining DSA approval for all such changes. Contractor shall provide As-built drawing based on the Alternate equipment information at the project closeout.

D. Bard units are used as the basis of design and their efficiencies are the bases of energy calculations for Title-24 compliance. Contractor submitting units by other manufacturers named in this specification as alternate shall provide the required Title-24 calculations demonstrating compliance. This effort shall be at no cost to the owner, and all required calculations shall be submitted within 14 calendar days after the award of contract. Job will be awarded on basis of specified product. Alternates must comply with the performance and features as specified within these specifications and indicated on the design documents. Any, and all additional cost due to submission of alternate units for redesign and/or increase in construction cost of other trades and/or re-submittal fee to DSA and authorities having jurisdiction shall be borne by the contractor

2.05 BI-POLAR IONIZATION

A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as noted below.

B. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).

C. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.

D. Reducing space static charges and space particle counts.

E. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition as noted below. Manufacturers not providing the equivalent space kill rates shall not be acceptable.

1.	MS2 Bacteriophage (COVID):	99.0% in 10 minutes or less
2.	MRSA:	99.5% in 60 minutes or less
3.	E. Coli:	99.4% in 30 minutes or less
4.	H1N1:	86.6% in 60 minutes or less
5.	H1N5:	99.0% in 60 minutes or less
6.	Staphylococcus Aureus	91.5% in 60 minutes or less
7.	Aspergillus Niger:	97.1% in 60 minutes or less
8.	Candida Albicans:	36.0% in 30 minutes or less
9.	Pseudomonas Aeruginosa	99.9% in 60 minutes or less
10.	Cladosporium	97.7% in 60 minutes or less
11.	Dichobotrys Abundans	90.0% in 60 minutes or less
12.	Penicillium	95.0% in 60 minutes or less
13.	Bacillus Subtilis var Niger	89.3% in 60 minutes or less

F. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.

G. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.

H. Ionization Equipment Requirements:
   1. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
   2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
   3. Ionization output when tested in the occupied space shall be between 800 to 1200 ions/cm3.
   4. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum. Exposed needles protruding into the air steam will not be accepted.

I. Unit Installation:
   1. Ion generators for DX units shall be brush type needlepoint units similar-to Plasma Air PA600/660 series is designed to be mounted at the fan inlet.
   2. The unit shall be rated to treat up to 2,400 CFM or 6 tons nominal capacity. For airflows greater than 2,400 CFM, multiple units shall be utilized.
   3. The PA600/660 housing is made from ABS plastic, contains an LED ionization output indicating LED, and an in-line 1 Amp fuse.
   4. The unit shall contain two (2) mounting feet and shall be configured so the needles are oriented perpendicular to the flow of air entering the fan wheel.
   5. Plasma Air 660 series include integral dry contacts which indicate ionizer functionality to a Building Automation System (BAS).

J. Certifications:
   1. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners and/or UL 2998 - Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners.

K. Electrical Requirements:
   1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply shall not be accepted.
   2. Wiring, conduit, and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

L. Bipolar Ionization Control Requirements:
   1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
   2. Plasma ion generator shall include an external BMS interface to indicate ion generator status and alarm.

M. BMS Controls: Unit manufacturer shall provide a BACnet MS/TP Communication Interface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which wall mount units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install wall mount units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure unit to wall structure, in accordance contract documents and manufacturer’s installation guides. Coordinate Wall penetrations and flashing.

C. Electrical Connections: Refer to Section "Electrical Connections for Equipment" for final connections to equipment and installation of loose shipped electrical components.

3.03 DEMONSTRATION

A. Start-Up Services:
   1. Provide the services of a factory-authorized service representative to start-up Wall mount units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:
   1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of wall mount units. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and trouble-shooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division 01, Section 01 78 00 “Closeout Submittals.”

END OF SECTION

SECTION 23 81 19
PACKAGED ROOFTOP AIR CONDITIONER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes package rooftop heating and cooling units.

1.02 RELATED SECTIONS

A. Division 23
   1. Section "Common Motor Requirements for HVAC."
   2. Section "Facility Natural Gas Piping."
   3. Section "Metal Ductwork."
   4. Section "Testing, Adjusting, and Balancing."

B. Division 26
   1. Section "Electrical General Provisions."

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities at scheduled conditions of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:
   1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling units. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure.
   3. Submit shop drawings detailing method of securing rooftop unit to roof curb to meet seismic restraint requirement.
   4. If an equal unit is being proposed to be used in lieu of the base specified unit, the contractor shall coordinate all differences as hereinafter described and note such differences on the shop drawings and incorporate all changes (if any) required by the structural and electrical engineers to accommodate the equal unit.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each rooftop unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule land procedures. Include this data in maintenance manual in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. Gas-Fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.
   2. Testing and rating of rooftop units of 135,000 BTUH capacity or over shall be in accordance with ARI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment.”
   3. Testing and rating of rooftop units under 135,000 BTUH capacities shall be in accordance with ARI 210 "Standard for Unitary Air-Conditioning Equipment" and provide Certified Rating Seal. Sound testing and rating of units shall be in accordance with ARI 270 "Standard for Sound Rating of Outdoor Unitary Equipment". Units shall bear Certified Rating Seal.
   4. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration.”
   5. Energy Efficiency Ratio (EER) or (SEER) of rooftop units shall be equal to or greater than prescribed by Title 24 - California Code of Regulations" (CCR) and as scheduled.

6. Rooftop units shall be designed, manufactured, and tested in accordance with UL requirements.
7. Rooftop units shall comply with SCAQMB Low NOx requirements

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle rooftop units and components carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store rooftop units and components in clean dry place, off the ground and protect from weather, water, and physical damage.

C. Rig rooftop units to comply with manufacturer's rigging and installation instructions for unloading rooftop units and moving them to final location.

1.06 SCHEDULING AND SEQUENCING

A. Coordinate installation of roof mounting curb with roof structure.

B. Coordinate roof-opening locations for mechanical and electrical connections.

1.07 SPECIAL WARRANTY

A. Warranty on Compressor (and Heat Exchanger): Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors (and heat exchangers) with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only and does not include labor for removal and reinstallation.
   1. Warranty Period: 4-year extension from date of basic 1-year warranty, See Division 01, Section 01 78 00 “Closeout Submittals.”

1.08 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling unit:
   1. One set of matched fan belts for each belt-driven fan.

PART 2 - PRODUCTS

2.01 ROOFTOP UNITS (GENERAL)

A. General Description: Units shall be factory-assembled and tested, designed for roof or slab installation, and consisting of compressors, condensers, evaporator coils, heat exchanger, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.

B. Units as manufactured by Carrier Corporation were used as the basis of design and their efficiencies are the bases of T-24 energy compliance calculation. Their capacities, weights and electrical characteristics are scheduled on the drawings. Units shall be designed for refrigerant R-410a.

2.02 ROOFTOP AIR CONDITIONING UNIT

A. Unit shall be of the single-package type, combination air-to-air cooling and gas-fired heating. Unit shall be AGA certified and meet requirements of CCR Title 24 and ASHRAE/IESNA 90.1.

B. Unit shall be ERR or SEER rated in accordance with ARI Standard 210-81 and California Administrative Title 24.

C. Compressor(s) - The unit shall contain (one or two) as scheduled, welded, fully hermetic scroll compressor(s) with suitable vibration isolators, overload protection, and crankcase heater and shall have a 5-year warranty.

D. Coils shall be constructed of aluminum fins mechanically bonded to copper tubes. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450

PSIG and leak tested at 200 PSIG. Evaporator coils shall be equipped with capillary restrictor. Condenser coils facing the exterior of the unit shall be equipped with screen protection grille.

E. Unit shall have the capability to remove the evaporative coil from top of unit.

F. Filter media shall provide at least a minimum efficiency reporting value of MERV 8.

G. Fans and motors - The evaporator air fan shall be of the forward-curved centrifugal type, direct-drive multi-speed or adjustable belt-driven as shown on the equipment schedule. Condenser fan motor shall have ball bearings. Sleeve type bearings are not acceptable. Condenser air fan shall be of the propeller type, directly driven and discharging upward.

H. Heat exchanger shall be tubular in design and constructed of 409 Stainless Steel heat exchanger corrosion-resistant aluminized steel. Heat exchanger shall carry a 15-year non-prorated warranty.

I. Refrigerant: R-410A.

J. Safety controls - Cooling section shall be protected by low pressure-stat, high pressure switch, compressor motor overloads, crankcase heaters, freeze-stat and lockout circuit that prevents compressor short cycling as a result of a rapid change in thermostat setting by automatically preventing compressor restart for at least 5 minutes.

K. Heating controls shall consist of a redundant gas valve, intermittent pilot ignition system, limit switches, centrifugal switch, and rollout switch. Heating section shall be designed for induced-draft combustion. Forced draft is not acceptable.

L. Roof Curb.
   1. General: Roof Curb shall be of down-shot arrangement and shall be of an approved manufacturer as indicated on the drawings and specification Section 23 05 48 and shall include an insulated panel under compressor section to prevent condensation forming on the bottom. Dimensions shall be provided to allow for each duct location and connection to roof curb prior to unit placement. Roof curb shall be a minimum of 14 in. high, except otherwise noted on drawings. Curb design shall comply with National Roofing Contractors Association requirements. Roof curb must be a manufactured pitched roof curb when applicable. If the manufacturer of the roof curb cannot provide a pitched roof curb due to the excessive slope of the roof, provide a structural leveling platform at no additional cost to the owner, then install a level roof curb. Coordinate this effort with work of all other trades involved.
   2. Isolation Roof Curb Type: Roof Curbs shall be of Prefabricated Isolation Curb type. Unit manufacturer shall furnish spring isolation curbs specifically designed for the air conditioning units. Isolation curb isolators must be pre-approved OSHPD (HCAi). Pre-approval number must be included with the submittal. OSHPD (HCAi) approval Numbers must be included with the submittal. Numbers subject to approval will not constitute pre-approval. Springs must be a minimum of 2" deflection with seismic restraint. Curb shall have access doors for easy inspection and adjustment of each spring without dismantling any portion of the unit or curb assembly.
   3. Isolation curb must include a vandal-proof, galvanized steel counter-flashing skirt to assure long-term air and water seal integrity. Exposed rubber skirt seals are not acceptable. Curb and flashing shall be fully welded. Field assembled and bolted construction is not acceptable. Seismic attached (hold-down) clips with certified calculations by a registered California Structural Engineer shall be furnished with the isolation curb. Installation prior to submittal approval by Mechanical Engineer shall be subject to removal without any cost or obligation to the Owner. The contractor shall not install any unit without written approval.
   4. Roof curb must be a manufactured pitched roof curb when applicable. It the manufacturer of the roof curb cannot provide a pitched roof curb due to the excessive slope of the roof, provide a structural leveling platform at no additional cost to the owner, then install a level roof curb. Coordinate this effort with work of all other trades involved.

5. Power Exhaust and Economizer: Power exhaust shall have a modulating centrifugal blower provided with variable frequency drive (VFD). Economizer control (Down-shot) shall include return air (R.A.) and outdoor air filter and hood, and fully modulating electric control system with O.A. thermostat and mixed air thermostat. Economizer control shall be capable of introducing up to 100% outdoor air. Power Exhaust shall be capable of relieving 100% of system air. The control changeover from mechanical cooling to economizer operation shall be fully automatic through an adjustable integrated control sensing preassigned, outside-air requirements. Economizer shall be integrated type capable of simultaneous compressor and economizer operation for maximum benefit of outdoor air. Economizer shall utilize low leakage, opposing blade, gear driven dampers with UL approved gears. Provide economizer control for all units unless specifically indicated otherwise. Economizer shall incorporate a full-sized barometric relief that has the same face area as the outside air inlet. The relief shall be sized to relieve up to 100% relief air.

M. Thermostat assembly shall provide staged heating and cooling, manual and automatic changeover, fan control and integrated time delay protection.

N. Unit Casing
1. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.
2. Cabinet Interior: Finish of interior surface in contact with the airstream shall comply with requirements of ASHRAE 62.1-2004.
3. Unit cabinet's exterior surface shall be tested for 1000 hours salt spray test in compliance with ASTM B117.
4. Cabinet construction shall allow for all service/maintenance from one side of unit.
5. Cabinet top cover shall be one piece construction, or where seams exist it shall be double-hemmed and gasket-sealed.
6. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
7. Unit Base Pan: Units base pan shall comply with ASHRAE 62.1-2004 requirements for drain pan construction and connections and shall have a raised 1-1/8-inch high lip, around the supply and return openings for water integrity.
8. Insulation: Provide ½-inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
9. Provide 115-Volt convenience outlet, factory-installed and unpowered, per NEC requirements.
10. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections as shown on contract document drawings.
11. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

2.03 MANUFACTURERS

A. Subject to compliance with the requirements project documents provide packaged rooftop air conditioning unit of one of the following manufacturers:
1. Carrier Corporation (Basis of Design).
2. Trane.
3. York.

B. Units as manufactured by Carrier are used as the basis of design and their capacities, weights, dimensions, and mechanical, structural, and electrical characteristics, compatibility with existing roof curbs and existing ductwork connection point are scheduled on the drawings and contract documents. Use of alternate units named in this spec requires Owner approval.

Contractor shall include such approval in their bid documents. By submitting Alternate equipment named in this specification, contractor shall bear all additional cost and responsibility associated with all additional electrical, mechanical, structural, Title-24 energy calculations. Contractor shall be responsible for resubmitting and obtaining DSA approval for all such changes. Contractor shall provide As-built drawing based on the Alternate equipment information at the project closeout.

C. Carrier units are used as the basis of design and their efficiencies are the bases of energy calculations for Title-24 compliance. Contractor submitting units by other manufacturers named in this specification as alternate shall provide the required Title-24 calculations demonstrating compliance. This effort shall be at no cost to the owner, and all required calculations shall be submitted within 14 calendar days after the award of contract. Job will be awarded on basis of specified product. Alternates must comply with the performance and features as specified within these specifications and indicated on the design documents. Any, and all additional cost due to submission of alternate units for redesign and/or increase in construction cost of other trades and/or re-submittal fee to DSA and authorities having jurisdiction shall be borne by the contractor.

2.04 CONTROLS

A. Control Module: Unit-mounted digital panel for interlock with the energy management system for heating, cooling, and fan operation. Include the following features (Refer to specification section 23 09 23 and construction document drawings for additional requirements):
   1. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg. F. outdoor air temperature.
   2. Temperature-Limit Control: Prevents occupant from exceeding preset setup temperature.
   3. Building Automation System Interface: Allows remote on-off control with setback temperature control.

2.05 CAPACITIES AND CHARACTERISTICS

A. Outdoor Air-Intake Rate: Unit outdoor air-intake rates shall be per equipment schedules on contract document drawings.

B. Cooling Capacity: Unit cooling capacities shall be per equipment schedules on contract document drawings.

C. Energy-Efficiency Ratio: Minimum unit Energy-Efficiency (EER) or Seasonal Energy Efficiency (SEER) Ratios shall be per equipment schedule on contract document drawings.

D. AFUE: Minimum unit AFUE shall be per equipment schedules on contract document drawings.

2.06 BI-POLAR IONIZATION

A. Each piece of air conditioning unit, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator, and the required transformer with bipolar ionization output as noted below.

B. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).

C. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.

D. Reducing space static charges and space particle counts

E. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition as noted below. Manufacturers not providing the equivalent space kill rates shall not be acceptable.
   1. MS2 Bacteriophage (COVID): 99.0% in 10 minutes or less
   2. MRSA: 99.5% in 60 minutes or less
   3. E. Coli: 99.4% in 30 minutes or less

4.	H1N1:	86.6% in 60 minutes or less
5.	H1N5:	99.0% in 60 minutes or less
6.	Staphylococcus Aureus	91.5% in 60 minutes or less
7.	Aspergillus Niger:	97.1% in 60 minutes or less
8.	Candida Albicans:	36.0% in 30 minutes or less
9.	Pseudomonas Aeruginosa	99.9% in 60 minutes or less
10.	Cladosporium	97.7% in 60 minutes or less
11.	Dichobotrys Abundans	90.0% in 60 minutes or less
12.	Penicillium	95.0% in 60 minutes or less
13.	Bacillus Subtilis var Niger	89.3% in 60 minutes or less

F. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.

G. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.

H. Ionization Equipment Requirements:
   1. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
   2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
   3. Ionization output when tested in the occupied space shall be between 800 to 1200 ions/cm3.
   4. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum. Exposed needles protruding into the air steam will not be accepted.

I. RTU Installation:
   1. Ion generators for DX Packaged Rooftop Units shall be brush type needlepoint units similar, to Plasma Air PA600/660 series is designed to be mounted at the fan inlet.
   2. The unit shall be rated to treat up to 2,400 CFM or 6 tons nominal capacity. For airflows greater than 2,400 CFM, multiple units shall be utilized.
   3. The PA600/660 housing is made from ABS plastic, contains an LED ionization output indicating LED, and an in-line 1 Amp fuse.
   4. The unit shall contain two (2) mounting feet and shall be configured so the needles are oriented perpendicular to the flow of air entering the fan wheel.
   5. Plasma Air 660 series include integral dry contacts which indicate ionizer functionality to a Building Automation System (BAS).

J. Certifications:
   1. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners and/or UL 2998 - Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners.

K. Electrical Requirements:
   1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply shall not be accepted.
   2. Wiring, conduit, and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

L. Bipolar Ionization Control Requirements:
   1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
   2. Plasma ion generator shall include an external BMS interface to indicate ion generator status and alarm.

M. BMS Controls: RTU manufacturer shall provide a BACnet MS/TP Communication Interface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractors Association (NRCA) installation recommendations and ship drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

C. Provide substructure as required to set curbs plumb and level.

D. Electrical Connections: Refer to Section "Electrical Connections for Equipment" for final connections to equipment and installation of loose shipped electrical components.

E. Unit protection: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, or the period of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, provide temporary closure of duct openings and protection of mechanical equipment during construction.

F. All duct and other related air distribution component openings shall be covered with polyethylene film, tape, plastic, sheet metal or other methods acceptable to the enforcing agency which will prevent entrance of dust and debris.

3.03 DEMONSTRATION

A. Start-Up Services:
   1. Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Provide written start-up report for each unit.

B. Operating and Maintenance Training:
   1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of rooftop units. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and trouble-shooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division 01, Section 01 78 00 “Closeout Submittals.”

END OF SECTION

SECTION 23 81 20
ROOFTOP PACKAGED HEAT PUMP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes package rooftop heating and cooling units.

1.02 RELATED SECTIONS

A. Division 23
   1. Section "Common Motor Requirement for HVAC."
   2. Section "Metal Ductwork."
   3. Section "Testing, Adjusting, and Balancing."

B. Division 26
   1. Section "Electrical General Provisions."

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities at scheduled conditions of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:
   1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling units. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure.
   3. Submit shop drawings detailing method of securing rooftop unit to roof curb to meet seismic restraint requirement.
   4. If an equal unit is being proposed to be used in lieu of the base specified unit, the contractor shall coordinate all differences as hereinafter described and note such differences on the shop drawings and incorporate all changes (if any) required by the structural and electrical engineers to accommodate the equal unit.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each rooftop unit, including "trouble shooting" maintenance guide, servicing guide and preventative maintenance schedule land procedures. Include this data in maintenance manual in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. Unit meets ASHRAE 90.1 minimum efficiency requirements.
   2. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
   3. Unit shall be designed to conform to ASHRAE 15, 2001.
   4. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL-listed and certified under Canadian standards as a total package for safety requirements.
   5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
   6. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
   7. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.
   8. Unit shall be designed in accordance with ISO 9001 and shall be manufactured in a facility registered by ISO 9001.
   9. Roof curb shall be designed to conform to NRCA Standards.

10. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory and must be available upon request.
11. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
12. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 MPH.
13. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
14. High-Efficient Motors listed shall meet Section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).
15. Unit shall meet requirements of CCR Title 24.
16. Unit shall be EER or SEER rated in accordance with ARI Standard 210-81 and California Administrative Title 24.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle rooftop units and components per manufacturer's recommendations and carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store rooftop units and components in clean dry place, off the ground and protect from weather, water, and physical damage. Unit shall only be stored or positioned in the upright position.

C. Rig rooftop units to comply with manufacturer's rigging and installation instructions for unloading rooftop units and moving them to final location.

1.06 SCHEDULING AND SEQUENCING

A. Coordinate installation of roof mounting curb with roof structure.

B. Coordinate roof-opening locations for mechanical and electrical connections.

1.07 SPECIAL WARRANTY

A. Warranty on Compressor (and Heat Exchanger): Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors (and heat exchangers) with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only and does not include labor for removal and reinstallation.
   1. Warranty Period: 4-year extension from date of basic 1-year warranty, See Division 01, Section 01 78 00 "Closeout Submittals."

1.08 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling unit:
   1. One set of matched fan belts for each belt-driven fan.

PART 2 - PRODUCTS

2.01 ROOFTOP UNITS (GENERAL)

A. General Description: Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a hermetic scroll compressor(s) for cooling duty and heat pump for heating duty. Factory assembled, single piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field startup.

B. Unit shall be installed in accordance with the manufacturer's instructions.

C. Unit must be installed in compliance with local, state, and federal codes.

D. Subject to compliance with the requirements project documents provide packaged rooftop air conditioning unit of one of the following manufacturers:
   1. Carrier Corporation (Basis of Design).

2. Trane.
3. York.

E. Units as manufactured by Carrier are used as the basis of design and their capacities, weights, dimensions, and mechanical, structural, and electrical characteristics, compatibility with existing roof curbs and existing ductwork connection point are scheduled on the drawings and contract documents. Use of alternate units named in this spec requires owner approval. Contractor shall include such approval in their bid documents. By submitting Alternate equipment named in this specification, contractor shall bear all additional cost and responsibility associated with all additional electrical, mechanical, structural, Title-24 energy calculations. Contractor shall be responsible for resubmitting and obtaining DSA approval for all such changes. Contractor shall provide As-built drawing based on the Alternate equipment information at the project closeout.

F. Carrier units are used as the basis of design and their efficiencies are the bases of energy calculations for Title-24 compliance. Contractor submitting units by other manufacturers named in this specification as alternate shall provide the required Title-24 calculations demonstrating compliance. This effort shall be at no cost to the owner, and all required calculations shall be submitted within 14 calendar days after the award of contract. Job will be awarded on basis of specified product. Alternates must comply with the performance and features as specified within these specifications and indicated on the design documents. Any, and all additional cost due to submission of alternate units for redesign and/or increase in construction cost of other trades and/or re-submittal fee to DSA and authorities having jurisdiction shall be borne by the contractor.

2.02 OPERATING CHARACTERISTICS

A. Unit shall be capable of starting and running at 125°F. (52°C.) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at ± 10% voltage.

B. Compressor with standard controls shall be capable of operation down to 30°F. (-1°C.), ambient outdoor temperatures. Accessory Low Ambient controls are available if mechanically cooling at ambient temperatures below 30°F. (-1°C.).

C. Unit shall be capable of simultaneous heating duty and defrost cycle operation when using accessory electric heaters.

D. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.

E. Unit shall be factory configured for vertical supply & return configurations.

F. Unit shall be field convertible from vertical to horizontal configuration.

G. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

H. Electrical Requirements.
1. Main power supply voltage, phase, and frequency must match those required by the manufacturer.

2.03 CONTROLS

A. Control Module: Unit-mounted digital panel for interlock with the energy management system for heating, cooling, and fan operation. Include the following features (Refer to specification section 23 09 23 and construction document drawings for additional requirements):
1. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg. F. outdoor air temperature.
2. Temperature-Limit Control: Prevents occupant from exceeding preset setup temperature.
3. Building Automation System Interface: Allows remote on-off control with setback temperature control.

2.04 UNIT CABINET

A. Unit cabinet shall be constructed of galvanized steel and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.

B. Unit cabinet exterior paint shall be, film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.

C. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 or 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 1/2 Lb. density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

D. Base of unit shall have a minimum of three locations for thru-the-base electrical connections (factory-installed or field-installed), standard.

E. Base Rail
   1. Unit shall have base rails on a minimum of 2 sides.
   2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
   3. Holes shall be provided in the base rail for moving the rooftop by fork truck.
   4. Base rail shall be a minimum of 16-gauge thickness.

F. Condensate pan and connections:
   1. Shall be a sloped condensate drain pan made of a non-corrosive material.
   2. Shall comply with ASHRAE Standard 62.
   3. Shall use a 3/4-in. -14 NPT drain connection, possible either through the bottom or end of the drain pan. Connection shall be made per manufacturer's recommendations.

G. Top panel:
   1. Shall be a single piece on all 04 to 09 models. Two-piece on size 12 models.
   2. shall be removable for coil removal.

H. Electrical Connections
   1. All unit power wiring shall enter unit cabinet at a single, factory prepared, knock-out location.
   2. Thru-the-base capability.
      a. Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit base-pan.
      b. Optional, factory approved, watertight connection method must be used for thru-the-base electrical connections.
      c. No base-pan penetration, other than those authorized by the manufacturer, is permitted.

I. Component access panels (standard).
   1. Cabinet panels shall be easily removable for servicing.
   2. Unit shall have one factory-installed, tool-less, removable, filter access panel.
   3. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have molded composite handles.
   4. Handles shall be UV modified, composite, permanently attached, and recessed into the panel.
   5. Screws on the vertical portion of all removable access panels shall engage into heat resistant, molded composite collars.
   6. Collars shall be removable and easily replaceable using manufacturer recommended parts.

2.05 COILS

A. Standard Aluminum/Copper Coils: on all models.
   1. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
   2. Evaporator coils shall be leak tested to 150 PSIG. Pressure tested to 450 PSIG and qualified to UL 1995 burst test at 1775 PSIG.

3. Condenser coils shall be leak tested to 150 PSIG. Pressure tested to 650 PSIG and qualified to UL 1995 burst test at 1980 PSIG.

B. Optional Pre-coated aluminum fin condenser coils: on all models.
1. Shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal environments.
2. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube.
3. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.

C. Optional Copper-fin evaporator and condenser coils: on all models.
1. Shall be constructed of copper fins mechanically bonded to copper tubes and copper tube sheets.
2. Galvanized steel tube sheets shall not be acceptable.
3. A polymer strip shall prevent coil assembly from contacting the sheet metal coil pan to minimize potential for galvanic corrosion between coil and pan.

D. Optional E-coated aluminum-fin evaporator and condenser coils: on all models.
1. Shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins.
2. Coating process shall ensure complete coil encapsulation of tubes, fins, and headers.
3. Color shall be high gloss black with gloss per ASTM D523-89.
4. Uniform dry film thickness from 0.8 to 1.2 mil on all surface areas including fin edges.
5. Superior hardness characteristics of 2H per ASTM D3363-92A and cross hatch adhesion of 4B-5B per ASTM D3359-93.
6. Impact resistance shall be up to 160 in.-lb (ASTM D2794-93).
7. Humidity and water immersion resistance shall be up to minimum 1000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92).
8. Corrosion durability shall be confirmed through testing to be no less than 1000 hours salt spray per ASTM B117-90.

2.06 BI-POLAR IONIZATION

A. Each piece of air conditioning unit, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator, and the required transformer with bipolar ionization output as noted below.

B. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).

C. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.

D. Reducing space static charges and space particle counts

E. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition as noted below. Manufacturers not providing the equivalent space kill rates shall not be acceptable.

1.	MS2 Bacteriophage (COVID):	99.0% in 10 minutes or less
2.	MRSA:	99.5% in 60 minutes or less
3.	E. Coli:	99.4% in 30 minutes or less
4.	H1N1:	86.6% in 60 minutes or less
5.	H1N5:	99.0% in 60 minutes or less
6.	Staphylococcus Aureus	91.5% in 60 minutes or less
7.	Aspergillus Niger:	97.1% in 60 minutes or less
8.	Candida Albicans:	36.0% in 30 minutes or less
9.	Pseudomonas Aeruginosa	99.9% in 60 minutes or less
10.	Cladosporium	97.7% in 60 minutes or less
11.	Dichobotrys Abundans	90.0% in 60 minutes or less

12.	Penicillium	95.0% in 60 minutes or less
13.	Bacillus Subtilis var Niger	89.3% in 60 minutes or less

F. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.

G. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.

H. Ionization Equipment Requirements:
1. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
3. Ionization output when tested in the occupied space shall be between 800 to 1200 ions/cm3.
4. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum. Exposed needles protruding into the air steam will not be accepted.

I. RTU Installation:
1. Ion generators for DX packaged rooftop units shall be brush type needlepoint units, similar, to Plasma Air PA600/660 series is designed to be mounted at the fan inlet.
2. The unit shall be rated to treat up to 2,400 CFM or 6 tons nominal capacity. For airflows greater than 2,400 CFM, multiple units shall be utilized.
3. The PA600/660 housing is made from ABS plastic, contains an LED ionization output indicating LED, and an in-line 1 Amp fuse.
4. The unit shall contain two (2) mounting feet and shall be configured so the needles are oriented perpendicular to the flow of air entering the fan wheel.
5. Plasma Air 660 series include integral dry contacts which indicate ionizer functionality to a Building Automation System (BAS).

J. Certifications:
1. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners and/or UL 2998 - Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners.

K. Electrical Requirements:
1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply shall not be accepted.
2. Wiring, conduit, and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

L. Bipolar Ionization Control Requirements:
1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
2. Plasma ion generator shall include an external BMS interface to indicate ion generator status and alarm.

M. BMS Controls: RTU manufacturer shall provide a BACnet MS/TP Communication Interface

2.07 REFRIGERANT COMPONENTS

A. Refrigerant circuit shall include the following control, safety, and maintenance features:
1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb, without removing the valve body.
2. Refrigerant filter drier on each refrigerant circuit.
3. Service gauge connections on suction and discharge lines.

4. Pressure gauge access through a specially designed access port in the top panel of the unit.
5. Suction line accumulator to provide protection in all operating modes from cooling, heating and reverse cycle switching, standard on each refrigerant circuit.

B. There shall be gauge line access port in the top of the rooftop, covered by a black, removable plug.
1. The plug shall be easy to remove and replace.
2. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
3. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
4. The plug shall be made of a leak proof, UV-resistant, composite material.

C. Compressors
1. Unit shall use one fully hermetic, scroll compressor for each independent refrigeration circuit.
2. Models shall be available with single compressor designs on 04-07 models, plus additional 2 compressor (stage) models from 08-12 sizes.
3. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
4. Compressors shall be internally protected from high discharge temperature conditions.
5. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
6. Compressor shall be factory mounted on rubber grommets.
7. Compressor motors shall have internal line break thermal, current overload and high-pressure differential protection.
8. Crankcase heaters shall be utilized on all models to protect compressor with specific refrigerant charge.
9. Compressors shall have a 5-year warranty.

D. Filter Section
1. Filters access is specified in the unit cabinet section of this specification.
2. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
3. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.
4. Filter media shall provide minimum efficiency reporting value of MERV 8.
5. Filters shall be standard, commercially available sizes.
6. Only one size filter per unit is allowed.

2.08 EVAPORATOR FAN AND MOTOR

A. Evaporator fan motor:
1. Shall have permanently lubricated bearings.
2. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
3. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.

B. Electric Drive (Direct Drive) X13 – 5 Speed/Torque Evaporator Fan:
1. Multi speed motor with easy quick adjustment settings.
2. Blower fan shall be double inlet type with forward curved blades.
3. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.
4. Standard on all 04-06 models.

C. Belt-driven Evaporator Fan:
1. Belt drive shall include an adjustable pitch motor pulley.
2. Shall use sealed, permanently lubricated ball-bearing type.
3. Blower fan shall be double inlet type with forward curved blades.
4. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

5. Standard on all 07-12 size models, optional on all 04-06 3-phase models.

2.09 CONDENSER FANS AND MOTORS

A. Condenser fan motors:
   1. Shall be a totally enclosed motor.
   2. Shall use permanently lubricated bearings.
   3. Shall have inherent thermal overload protection with an automatic reset feature.
   4. Shall use a shaft down design on all sizes.

B. Condenser Fans:
   1. Shall be a direct driven propeller type fan.
   2. Shall have aluminum blades riveted to corrosion resistant steel spiders and shall be dynamically balanced.

2.10 SAFETIES

A. Compressor overtemperature, overcurrent.

B. Loss of charge switch.
   1. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 loss of charge switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   2. Loss of charge switch shall use different color wire than the high-pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.

C. High pressure switch.
   1. Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
   2. High pressure switch shall use different color wire than the low-pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.

D. Freeze protection thermostat, evaporator coil.

E. Automatic reset, motor thermal overload protector.

2.11 ELECTRONIC CONTROL

A. Shall be complete with self-contained low voltage control circuit protected by a resettable circuit breaker on the 24-V transformer side. Transformer shall have 75VA capability.

B. Shall utilize color-coded wiring.

C. Shall include a central control terminal board to conveniently, and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, economizer, thermostat, DDC control options, loss of charge, freeze switch, high pressure switches.

D. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.

E. Shall include integrated defrost system to prevent excessive frost accumulation during heating duty, and shall be controlled as follows:
   1. Defrost shall be initiated on the basis-of time and coil temperature.
   2. A 30, 60, 90, 120-minute timer shall activate the defrost cycle only if the coil temperature is low enough to indicate a heavy frost condition.
   3. Defrost cycle shall terminate when defrost thermostat is satisfied and shall have a positive termination time of 10 minutes.

F. Defrost system shall also include:
   1. Defrost Cycle Indicator LED.
   2. Dip-switch selectable defrost time between 30, 60, 90 and 120 minutes. Factory set at 30 minutes.

3. Molded plug connection to insure proper connection.

2.12 ROOF CURB

A. General: Roof Curb shall be of down-shot arrangement and shall be of an approved manufacturer as indicated on the drawings and specification section 230548 and shall include an insulated panel under compressor section to prevent condensation forming on the bottom. Dimensions shall be provided to allow for each duct location and connection to roof curb prior to unit placement. Roof curb shall be a minimum of 14 in. high, except otherwise noted on drawings. Curb design shall comply with National Roofing Contractors Association requirements. Roof curb must be a manufactured pitched roof curb when applicable. If the manufacturer of the roof curb cannot provide a pitched roof curb due to the excessive slope of the roof, provide a structural leveling platform, then install a level roof curb at no additional cost to the owner. Coordinate this effort with work of all other trades involved.

B. Isolation Roof Curb Type: Roof Curbs shall be of Prefabricated Isolation Curb type. Unit manufacturer shall furnish spring isolation curbs specifically designed for the air conditioning units. Isolation curb isolators must be pre-approved OSHPD (HCAi). Pre-approval number must be included with the submittal. OSHPD (HCAi) approval Numbers must be included with the submittal. Numbers subject to approval will not constitute pre-approval. Springs must be a minimum of 2" deflection with seismic restraint. Curb shall have access doors for easy inspection and adjustment of each spring without dismantling any portion of the unit or curb assembly. Isolation curb must include a vandal-proof, galvanized steel counter-flashing skirt to assure long-term air and water seal integrity. Exposed rubber skirt seals are not acceptable. Curb and flashing shall be fully welded. Field assembled and bolted construction not acceptable. Seismic attached (hold-down) clips with certified calculations by a registered California Structural Engineer shall be furnished with the isolation curb. Installation prior to submittal approval by mechanical engineer shall be subject to removal without any cost or obligation to the Owner. The contractor shall not install any unit without written approval.

C. Roof curb must be a manufactured pitched roof curb when applicable. It the manufacturer of the roof curb cannot provide a pitched roof curb due to the excessive slope of the roof, provide a structural leveling platform at no additional cost to the owner, then install a level roof curb. Coordinate this effort with work of all other trades involved.

2.13 POWER EXHAUST AND ECONOMIZER

A. Power exhaust shall have a modulating centrifugal blower provided with variable frequency drive (VFD). Economizer control (Down-shot) shall include return air (R.A.) and outdoor air filter and hood, and fully modulating electric control system with O.A. thermostat and mixed air thermostat. Economizer control shall be capable of introducing up to 100% outdoor air. Power Exhaust shall be capable of relieving 100% of system air. The control changeover from mechanical cooling to economizer operation shall be fully automatic through an adjustable integrated control sensing pre-assigned outside air requirements. Economizer shall be integrated type capable of simultaneous compressor and economizer operation for maximum benefit of outdoor air. Economizer shall utilize low leakage, opposing blade, gear driven dampers with UL approved gears.

B. Provide economizer control for all units unless specifically indicated otherwise. Economizer shall incorporate a full-sized barometric relief that has the same face area as the outside air inlet. The relief shall be sized to relieve up to 100% relief air.

2.14 THERMOSTAT SHALL:

A. Have capability to energize 2 different stages of cooling, and 2 different stages of heating, manual and automatic changeover, fan control and integrated time delay protection.

B. Include capability for occupancy scheduling.

2.15 MANUFACTURERS

A. Subject to compliance with the requirements project documents provide packaged rooftop air conditioning unit of one of the following manufacturer’s:

1. Carrier Corporation (Basis of Design).
2. Trane.
3. York.

B. Carrier Corporation units are used as the basis of design and their efficiencies are the bases of energy calculations for Title-24 compliance. Contractor submitting units by other manufacturers named in this specification as alternate shall provide the required Title-24 calculations demonstrating compliance. This effort shall be at no cost to the owner, and all required calculations shall be submitted within 14 calendar days after the award of contract. Job will be awarded on basis of specified product. Alternates must comply with the performance and features as specified within these specifications and indicated on the design documents. Any and all additional cost due to submission of alternate units for redesign and/or increase in construction cost of other trades and/or re-submittal fee to City authorities shall be bonded by the contractor.

2.16 CONTROLS

A. Control Module: Unit-mounted digital panel for interlock with the energy management system for heating, cooling, and fan operation. Include all the following features:
   1. All requirements set forth in Control Drawings.
   2. All requirements set forth in Specification Section 23 09 23 “Direct Digital Control System for HVAC.”
   3. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg. F. outdoor air temperature.
   4. Temperature-Limit Control: Prevents occupant from exceeding preset setup temperature.
   5. Building Automation System Interface: Allows remote on-off control with setback temperature control.

B. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage adjustable thermostat with heat anticipator, heat-off-cool-auto switch, and on-auto fan switch.

2.17 CAPACITIES AND CHARACTERISTICS

A. Outdoor Air-Intake Rate: Unit outdoor air-intake rates shall be per equipment schedules on contract document drawings.

B. Cooling Capacity: Unit cooling capacities shall be per equipment schedules on contract document drawings.

C. Energy-Efficiency Ratio: Minimum unit Energy-Efficiency (EER) or Seasonal Energy Efficiency (SEER) Ratios shall be per equipment schedule on contract document drawings.

2.18 BI-POLAR IONIZATION

A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as noted below.

B. Effectively killing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).

C. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.

D. Reducing space static charges and space particle counts.

E. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition as noted below. Manufacturers not providing the equivalent space kill rates shall not be acceptable.

1.	MS2 Bacteriophage (COVID):	99.0% in 10 minutes or less
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3.	E. Coli:	99.4% in 30 minutes or less
4.	H1N1:	86.6% in 60 minutes or less

5.	H1N5:	99.0% in 60 minutes or less
6.	Staphylococcus Aureus	91.5% in 60 minutes or less
7.	Aspergillus Niger:	97.1% in 60 minutes or less
8.	Candida Albicans:	36.0% in 30 minutes or less
9.	Pseudomonas Aeruginosa	99.9% in 60 minutes or less
10.	Cladosporium	97.7% in 60 minutes or less
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12.	Penicillium	95.0% in 60 minutes or less
13.	Bacillus Subtilis var Niger	89.3% in 60 minutes or less

F. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.

G. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.

H. Ionization Equipment Requirements:
   1. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
   2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
   3. Ionization output when tested in the occupied space shall be between 800 to 1200 ions/cm3.
   4. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum. Exposed needles protruding into the air steam will not be accepted.

I. RTU Installation:
   1. Ion generators for DX Packaged Rooftop Units shall be brush type needlepoint units similar-to Plasma Air PA600/660 series is designed to be mounted at the fan inlet.
   2. The unit shall be rated to treat up to 2,400 CFM or 6 tons nominal capacity. For airflows greater than 2,400 CFM, multiple units shall be utilized.
   3. The PA600/660 housing is made from ABS plastic, contains an LED ionization output indicating LED, and an in-line 1 Amp fuse.
   4. The unit shall contain two (2) mounting feet and shall be configured so the needles are oriented perpendicular to the flow of air entering the fan wheel.
   5. Plasma Air 660 series include integral dry contacts which indicate ionizer functionality to a Building Automation System (BAS).

J. Certifications:
   1. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners and/or UL 2998 - Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners.

K. Electrical Requirements:
   1. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply shall not be accepted.
   2. Wiring, conduit, and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

L. Bipolar Ionization Control Requirements:
   1. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
   2. Plasma ion generator shall include an external BMS interface to indicate ion generator status and alarm.

M. BMS Controls: RTU manufacturer shall provide a BACnet MS/TP Communication Interface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractors Association (NRCA) installation recommendations and ship drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.
   1. Provide substructure as required to set curbs plumb and level.

C. Electrical Connections: Refer to Section "Electrical Connections for Equipment" for final connections to equipment and installation of loose shipped electrical components.

D. Unit protection: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, or the period of rough installation, or during storage on the construction site and until final startup of the heating and cooling equipment, provide temporary closure of duct openings and protection of mechanical equipment during construction. All duct and other related air distribution component openings shall be covered with polyethylene film, tape, plastic, sheet metal or other methods acceptable to the enforcing agency which will prevent entrance of dust and debris.

3.03 DEMONSTRATION

A. Start-Up Services:
   1. Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements.
   2. Replace damaged or malfunctioning controls and equipment. Provide written start-up report for each unit.

B. Operating and Maintenance Training:
   1. Provide two (2), four-hour training classes by manufacturer's service representative to instruct Owner's personnel on how to operate and maintain the rooftop unit.
   2. Video Tape each class and provide three (3) digital copy of each class to the Owner at the end of each class.
   3. Training provided by manufacturer's service representative to instruct Owner's personnel in operation and maintenance of rooftop units shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and trouble-shooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division One.

END OF SECTION

SECTION 23 81 26
SPLIT AIR CONDITIONING SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Split DX cooling only and heat pump system with indoor split DX fan coil and outdoor cooling/condensing unit.

1.02 RELATED SECTIONS

A. Related sections include but are not limited to the following:
   1. Division 23
      a. Section "Common Work Results for HVAC."
      b. Section "Common Motor Requirements for HVAC Equipment."
      c. Section "Testing, Adjusting and Balancing."
      d. Section "Power and Gravity Ventilators."
   2. Division 26
      a. Section “Electrical General Provisions.”

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:
   1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop cooling/condensing and DX fan coil units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   2. Submit shop drawings detailing the mounting, securing, and flashing of the outdoor unit to redwood sleepers and sleepers to the roof structure. Indicate coordinating requirements with roof membrane system.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each split cooling system, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual in accordance with requirements of Division 01, Section 01 78 00 “Closeout Submittals.”

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. Refrigerating system construction of split cooling system shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration.”
   2. Seasonal Energy Efficiency Ratio (SEER) of split cooling system shall be equal to or greater than prescribed by Title 24 California Administrative Code "Building Energy Efficiency Standards.”
   3. Split cooling system shall be designed, manufactured, and tested in accordance with UL requirements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Handle split cooling system and components carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store split cooling system and components in clean dry place, off the ground, and protect from weather, water, and physical damage.

C. Rig outdoor units to comply with manufacturer's rigging and installation instructions for unloading outdoor units and moving them to final location.

1.06 SCHEDULING AND SEQUENCING

A. Coordinate installation of outdoor unit redwood sleepers with roof structure.

B. Coordinate roof-opening locations for mechanical and electrical connections.

1.07 SPECIAL WARRANTY

A. Warranty on Compressor: Provide written warranty, agreeing to replace/repair, including all parts and labor within warranty period, compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform a required provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period.

B. Warranty period shall be for a period of one year from the agreed start of the School District's beneficial use.

C. Extended warranty period. Provide written warranty signed by manufacturer, agreeing to replace components parts only, for an additional four (4) years for all hermetically sealed compressors.

1.08 MAINTENANCE

A. Extra Materials: Furnish to District, with receipt, the following spare parts for each split cooling system:
   1. One set of new filters for each unit set.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide product of one of the following manufacturers:
   1. Carrier Corp.
   2. Mitsubishi.
   3. Trane.

B. Units as manufactured by Carrier are used as the basis of design and their capacities, weights, dimensions, and mechanical, structural, and electrical characteristics, compatibility with existing building and existing ductwork connection point are scheduled on the drawings and contract documents. Use of alternate units named in this spec requires owner approval. Contractor shall include such approval in their bid documents. By submitting Alternate equipment named in this specification, contractor shall bear all additional cost and responsibility associated with all additional electrical, mechanical, structural, Title-24 energy calculations. Contractor shall be responsible for resubmitting and obtaining DSA approval for all such changes. Contractor shall provide As-built drawing based on the Alternate equipment information at the project closeout.

C. Carrier units are used as the basis of design and their efficiencies are the bases of energy calculations for Title-24 compliance. Contractor submitting units by other manufacturers named in this specification as alternate shall provide the required Title-24 calculations demonstrating compliance. This effort shall be at no cost to the owner, and all required calculations shall be submitted within 14 calendar days after the award of contract. Job will be awarded on basis of specified product. Alternates must comply with the performance and features as specified within these specifications and indicated on the design documents. Any, and all additional cost due to submission of alternate units for redesign and/or increase in construction cost of other trades and/or re-submittal fee to DSA and authorities having jurisdiction shall be borne by the contractor

2.02 SPLIT COOLING SYSTEM (GENERAL)

A. Split cooling only and heat pump system shall be factory assembled and tested, consist of an indoor, wall mounted direct expansion fan coil unit and an outdoor roof mounted, air cooled unit with a hermetic compressor, an air-cooled coil, up-blast propeller type blow-through condenser fans, accumulator, holding refrigerant charge, and control box.

2.03 INDOOR UNIT

A. General: Indoor, direct-expansion, wall-mounted or ceiling-mounted fan coil. Unit shall be complete with coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, integral temperature sensing, and a holding charge of R-410A refrigerant. Unit shall be furnished with integral wall-mounting or ceiling-mounting bracket.

B. Unit Cabinet: Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene.

C. Fan: Shall be tangential blower type with air intake at the upper front face of the unit and discharge at the bottom front. Automatic motor-driven horizontal air sweep shall be provided standard.

D. Coil: Shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins will be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate.

E. Motors: Shall be permanently lubricated with inherent overload protection. Fan motors shall be multi-speed.

F. Controls: Shall consist of a microprocessor-based control system that shall control space temperature, determine optimum fan speed, and run self-diagnostics. The unit shall have:
   1. An automatic restart after power failure at the same operating conditions as at failure.
   2. A timer-function to provide a minimum 15-hour timer cycle for system on or off.
   3. Temperature-sensing controls and a high discharge temperature shut down.
   4. Wired control or wireless infrared control to enter set points and operating controls (required accessory).
   5. Filter status indication after 250 hours of indoor fan operation.
   6. Test mode button to run self-diagnostics and aid in troubleshooting.

G. Filters: Unit shall have filter track with factory-supplied cleanable filter.

2.04 OUTDOOR UNIT

A. General: Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, and holding charge of R-410A refrigerant.

B. Unit Cabinet:
   1. Unit cabinet shall be constructed of galvanized steel, bonderized, and coated with a baked enamel finish.
   2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
   3. Compressor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans:
   1. Condenser fans shall be direct-drive propeller type, discharging air horizontally, and blowing air through the condenser coil.
   2. Condenser fan motors shall be totally enclosed, single-phase motors with class B insulation and permanently lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
   3. Shaft shall have inherent corrosion resistance.
   4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
   5. Condenser fan openings shall be equipped with PVC grille cover and screen protection grille.

D. Compressor:
   1. Compressor shall be fully hermetic reciprocating or scroll type.

2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and current. Scroll compressors shall also have high discharge gas temperature protection.
3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigeration accumulation in compressor during shut down and to prevent refrigerant dilution of oil.
4. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.

E. Condenser Coil: Shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes that are cleaned, dehydrated, and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include external liquid line service valve with service port, suction line service valve with service gage connection port, service port connections on compressor suction and discharge lines with Schrader-type fittings, 4-way valve on heat pumps, accumulator, filter drier, pressure relief, and a holding charge of refrigerant.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control function shall include:
1. Controls:
a. Time delay restart to prevent compressor short cycling.
b. Automatic restart on power failure.
c. Three-pole contactors on 3-phase units.
d. Safety lockout.
e. High, and low-pressure switches.
f. Automatic fan motor protection.
g. Start capacitor and relay only on single-phase units.
h. When heat pump units are matched with high wall and ceiling suspended units, defrost control shall be based on demand determined by the outdoor air temperature and the coil temperature.
2. Safeties:
a. High temperature protection.
b. System diagnostics.
c. Compressor motor current and temperature overload protection.
d. High-pressure relief.
e. Condenser fan failure protection.

H. Electrical Requirements:
1. Unit electrical power shall be a single point connection.
2. Unit control voltage to the indoor fan coil shall be 24V.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which split cooling system is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install split cooling system in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure redwood sleepers to roof structure, in accordance with National Roofing Contractors Association (NRCA) installation recommendations and shop drawings.

C. Electrical Connections: Refer to Division 26, Section “Electrical General Provisions” for final connections to equipment and installation of loose-shipped electrical components.

3.03 DEMONSTRATION

A. Provide the services of a qualified service representative to start-up split cooling system in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

END OF SECTION

SECTION 26 00 10 ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:

1. Examine all other sections for work related to those other sections and required to be included as work under this section.

2. General provisions and requirements for electrical work.

1.2 SUBMITTALS

A. General

1. Review of contractor's submittals is for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.

2. The Contractor shall review each submittal in detail for compliance with the requirements of the contract documents prior to submittal to the District (or Owner). The Contractor shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS".

3. Where the construction documents indicate specific manufacturer(s) for any given product, it shall be considered a substitution if the contractor proposes to use any manufacturer other than those specifically named. The Contractor shall clearly and specifically identify each individual proposed substitution or proposed deviation from the requirements of the contract documents with a statement "THIS ITEM IS A SUBSTITUTION".

B. Material Lists and Shop Drawings:

1. Submit material list and equipment manufacturers for approval within 35 days of

award of contract. Give name of manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one manufacturer for any one item of equipment, or listing items "as specified", without both make and model or type designation, is not acceptable. Shop drawings shall not be submitted before approval of manufacturers list. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.

2. Within three weeks after approval of the material and equipment manufacturers list, submit shop drawings for approval. Shop drawings shall be submitted in completed bound groups of materials. Shop drawing shall be prepared by factory authorized representatives. Departure from the above procedure will result in resubmittals and delays.

3. Submittals which are intended to be reviewed as substitution or departure from the contract documents must be specifically noted as such or the requirements of the contract documents will prevail regardless of the acceptance of the submittal.

4. Shop drawings shall include dimensioned wiring plans, elevations, details, component wiring diagrams and descriptive literature of components parts where applicable.

5. The Contractor shall verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to clear working space about electrical equipment prior to submitting shop drawings for approval.

6. Shop drawings shall include the manufacturer's projected days for shipment from the factory of completed equipment, after the equipment is released for production by the Contractor. It shall be the responsibility of the Contractor to insure that all material and equipment is ordered and installed in time to provide an orderly progression of the work, and to allow full occupancy and full operation of the facility at the scheduled completion date. The Contractor shall notify the District of any changes in delivery which would affect the project completion date.

C. The Contractor shall be responsible for incidental, direct and indirect costs resulting from the substitution of specified contract materials or work.

D. Portable or Detachable Parts: The Contractor shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of contract work. These parts shall then be delivered to the District or his authorized representative and an itemized receipt obtained, with copies of receipt sent to the Architect.

E. Record Drawings

1. Provide and maintain in good order at the job site a complete set of electrical contract prints. Changes to the contract to be clearly recorded on this set of prints. No pay request by the Contractor will be granted without verification that the jobsite prints are up-to-date and current with the project construction. At the end of the project, the Contractor shall transfer all changes to one set of transparencies to be delivered unfolded to the Architect. Transparency drawings shall be prepared in an organized and clearly legible fashion by persons skilled in drafting techniques.

2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. All measurements shall be witnessed by the job inspector who shall make his own record of the dimensions. Before the inspector signs the record drawings, he shall check his own dimensions against those on the drawings. If any necessary dimensions are omitted from the record drawings, the Contractor shall, at his own expense, do all excavation required to expose the buried work and to establish the correct locations.

3. The Contractor shall keep the "record" prints up to date and current with all work performed.

1.3 GENERAL SUMMARY OF ELECTRICAL WORK

A. The specifications and drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.

B. Refer to the drawings and shop drawings of other trades for additional details which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.

C. Before submitting a bid, the Contractor shall familiarize himself with all features of the building drawings and site drawings which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.

D. If there are omissions or conflicts between the drawings and specifications, clarify these points with the Architect before submitting bid.

1.4 LOCATIONS OF EQUIPMENT

A. The drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper

judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.

B. Where outlets are placed on a wall, locate symmetrically with respect to each other and other features or finishes on the wall.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes made without cost, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.

D. The locations of existing utilities and conduit shown on the drawings is approximate. Verify exact locations and routing of existing systems in the field. Include all costs in contract price for adjustment required to accommodate existing conditions.

E. Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.

1.5 QUALITY ASSURANCE

A. Work and materials in full accordance with the latest rules and regulations of the California Code of Regulations Title 24, Part 3 "California Electrical Codes", Title 8 "Division of Industrial Safety", the National Electrical Code, the National Life Safety Code, and other applicable Federal and State laws and regulations.

B. All material and equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized testing laboratories, where such listings are available. Comply with all installation requirements and restrictions pertaining to such listings.

C. Work and material shown on the drawings and in the specifications is new and included in the contract unless specifically indicated as existing or N.I.C. (not-in-contract).

D. Keep a copy of all applicable codes available at the job site at all times while performing work under this section. Nothing in plans or specifications shall be construed to permit work not conforming to the most stringent of codes.

1.6 CLEANING EQUIPMENT, MATERIALS, PREMISES

All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.7 JOB CONDITIONS - PROTECTION

Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. All electrical equipment shall be stored in a weather-tight structure. Provide for the safety and good condition of all the work until final acceptance of the work by the District and replace all damaged or defective work, materials and equipment before requesting final acceptance.

1.8 CUTTING AND PATCHING

Perform cutting and patching of the construction work which may be required for the proper installation of the electrical work. Patching shall be of the same material, thickness, workmanship and finish as existing and accurately match surrounding work to the satisfaction of the District. Cutting of structural members shall not be done without notifying the Engineer and obtaining approval.

1.9 IDENTIFICATION

A. Cabinets, pull boxes, and other apparatus used shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.

B. Nameplates shall be engraved laminated phenolic. Shop drawings with dimensions and format shall be submitted before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.

C. Provide black-on-white laminated plastic nameplates engraved in minimum 1/4" high letters to correspond with the designations on the drawings. Provide other or additional information on nameplates where indicated.

D. Wire and Cable Identification

1. Provide identification on individual cable.

2. Identification shall be provided at each termination location, junction box and equipment enclosure.

   a. Each identification tag location shall indicate the following information: IDF and Port number.

3. Install identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.

1.10 TESTING

A. The Contractor shall obtain an Bicsi certified testing laboratory that will provide all instrumentation and tests on the Data cables as hereinafter described and further

directed by the District. The test shall be performed after the completion of cable installation. All tests shall be recorded and documented and submitted to the Engineer for review.

1.11 ELECTRICAL WORK CLOSEOUT

A. Prepare the following items and submit to the Engineer before final acceptance.

1. Two copies of all test results as required under this section.

2. Two copies of local and/or state code enforcing authorities final inspection certificates.

3. Copies of as-built record drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.

4. Two copies of all receipts transferring portable or detachable parts to the District when requested.

5. Notify the District in writing when installation is complete and that a final inspection of this work can be performed. In the event any defect or deficiencies are found during this final inspection they shall be corrected to the satisfaction of the Engineer before final acceptance can be issued.

6. All dry wall work and painting shall be completed within the electrical rooms.

END OF SECTION