Specifications for:

Mechanical Systems Upgrades
Wentworth Hi-Rise

Prepared for:

Greater Dayton Premier Management

400 Wayne Avenue
Dayton, Ohio 45410
937.910.7500

Website posting at www.gdpm.org

Prepared by:

RDA GROUP ARCHITECTS
7662 PARAGON ROAD | DAYTON, OH 45459 | 937.610.3440

Bid / Construction Set

January 23, 2026

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SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 DESCRIPTION OF THE PROJECT DOCUMENTS / SCOPE OF WORK

A. The work covered by these specifications consists of furnishing all labor, materials, and equipment necessary in connection with mechanical systems upgrades at Wentworth Hi-Rise as indicated for Greater Dayton Premier Management.
   1. Work includes items as shown, subject to the terms and conditions of the contract, specifications and the drawings as listed.
   2. It is anticipated that the Mechanical Contractor will be the lead contractor this project.

B. Provide all materials and labor for work as noted herein for a complete project.
   1. IMPORTANT: Field verify all existing conditions, and coordinate all applicable requirements as related to the scope of the work.
   2. Drawings indicate general diagrammatic areas/extent of work, but in no way indicate the intricate nature of the work required for the successful completion of the project.

C. Provide any and all ancillary work related to the above work scope including repair of any Contractor damaged finishes within the work area.

D. Perform Work of Contract under a stipulated sum contract with Owner in accordance with Conditions of Contract.

1.2 CONTRACT / TEAM IDENTIFICATION

A.	Project Identification:	Mechanical Systems Upgrades
B.	Project Location:	Wentworth Hi-Rise 2765 Wentworth Avenue Dayton, OH 45406
C.	Owner:	Greater Dayton Premier Management [GDPM] 400 Wayne Avenue Dayton, OH 45410 937.910.7550 phone
D.	Architect:	RDA Group Architects, LLC 7662 Paragon Road Dayton, OH 45459 937.610.3440 phone
E.	PME Engineer:	Helmig Lienesch, LLC 410 S. Jefferson Street Dayton, OH 45402 937.228.4007 phone

1.3 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

B. The term ‘RDA’ or ‘Architect’ as referenced in these contract documents is RDA Group Architects.

C. The term ‘Owner’ as referenced in this specification is Greater Dayton Premier Management.

1.4 SCOPE OF WORK

A. Work of the Project includes the building mechanical systems upgrades to the heating boilers, domestic hot water boilers, chiller, and make up air unit. The work includes all ancillary

architectural repairs, electrical improvements, etc. which are required to provide a fully complete project.

1.5 CONTRACTOR'S USE OF SITE[S] / SITE CONTROL

A. Provide and maintain a safe living environment for Residents of each of the buildings at all times during the course of work. Each of the dwelling units / buildings will remain OCCUPIED throughout the duration of the work.

B. Coordinate work to allow continued Occupancy of all dwelling units, adjacent parking lots, driveways, access points, etc. throughout the duration of the project. Minimize impact to Owner / Resident. Sequence the project to allow continued occupancy of all dwelling units. Develop a plan and strategy to accomplish the goal. Include all additional efforts, scheduling, construction duration, etc. in the bid amount.

C. All units will be OCCUPIED throughout the duration of the project. Take all measures necessary to minimize the impact on the residents, provide protective measures at areas of work.
   1. Work must be undertaken and scheduled to allow continued occupancy.
   2. All existing work removed in a day must have new work installed completely the same day as required to maintain life safety systems in place.
   3. The logistics of executing the work shall be coordinated by the Contractor and are to include any and all measures to minimize any system downtimes, in particular with the building domestic hot water systems. Provide temporary [rented equipment] when required to allow execution of the work.

D. Assist in relocation of Resident equipment and furnishings, etc. as is applicable to the scope of the project and to allow the scheduled work.

E. Provide temporary protection to minimize the spread of dust, dirt, and debris to other portions of the building, in particular during dusty activities such as core drilling concrete floors, concrete / concrete block walls, etc.

F. Provide temporary protection of adjacent finishes at the work areas as well as any areas traversed to the building entrances, etc.

G. Coordinate with Owner any activities which have the potential to affect continued operations of the facilities or impact life safety, security, etc.

H. Work Schedules: Perform all work between the hours of 8 AM and 5 PM Monday through Friday, unless work outside these hours and days is requested and granted.
   1. No work outside these hours is permitted without explicit Owner approval.
   2. Utility outages must be coordinated and scheduled in advance. These outages may be required to occur during overnight or off-shift hours.
   3. Coordinate and schedule all aspects of the work, including how various disciplines work together, are sequenced, etc.
   4. Weekend and overtime work or increasing crew size may be required by the Owner at no additional cost if the Contractor fails to meet projected dates as prescribed in the contract and the progress schedule.
   5. Coordinate schedule / activities so as not to inconvenience the Owner unnecessarily.
   6. Coordinate schedule / activities with holidays, etc. so as not to inconvenience the Owner or Residents unnecessarily over holidays, weekends, etc.

I. Provide appropriate notification of Owner and Residents prior to starting work and throughout the duration of the project.
   1. Resident notification to provide directive to have Resident relocate any resident belongings, furniture, etc. away from the work areas if they are able as necessary to facilitate the work of the contract. Notify Owner of any concerns or conflicts received. Assist in relocation of resident belongings as necessary.

J. Daily work wrap up:
   1. Plan the work and provide enough manpower to this contract to ensure that work progresses in an orderly manner and the existing systems remain in operation until such time of the system changeover. All life safety systems shall continue to be in operation throughout the duration of the project.
   2. Plan the work and provide enough manpower to this contract to ensure that the work is accomplished and life safety systems are in full operation at the end of each day's work.
   3. Functional use shall mean that the bathroom, kitchen, living room, and bedrooms are usable at the end of the day. Functional also means the ability to secure the unit.

K. Staff project every day with a full crew capable of timely completion of work. Confirm that all materials, accessories, and other components are on-site and ready for installation prior to beginning work for each work day. Advise project team if there are issues with scheduling prior to starting of work.

1.6 CONTRACT PERIOD / TIME OF COMPLETION

A. Notice to Proceed: anticipated award in **March 2026** from the Owner.
   1. Architect will issue notice to proceed with the agreed upon dates / contract period.

B. Date of Commencement: to be determined.
   1. Owner-Contractor Agreement or Notice to Proceed will be issued establishing the agreed upon construction start date.
   2. Final schedule will be coordinated with the Contractor.

C. Contract Period: **ONE HUNDRED EIGHTY [180] Calendar Days** from Date of Commencement.
   1. Provide a work start date within [7] calendar days upon issuance of the Owner-Contractor Agreement. A start date and completion date will be negotiated and a notice to proceed will be issued stating those dates.
   2. Consideration of material lead-times and fire alarm permit issuance will be given for establishing the NTP dates as applicable.
   3. Notify the RDA, in writing, upon determination of any delay in material delivery or the issuance of building permits.
   4. Coordinate schedule, phasing, and implementation of the work.

D. A contract will be issued in **March 2026**, after approval of the project by the Owner.
   1. The Contractor will be responsible to execute the project to allow shop drawings and product submittals to be prepared as quickly as possible such that the materials can be ordered with sufficient lead time to permit the work to be executed as scheduled prior to the date of substantial completion.

E. Notify Owner in writing fourteen [14] days prior to the Contract Completion date if an extension of contract time is necessary with a request for the extension and the reasoning for such request.

F. Liquidated Damages will be enforced for the failure to complete work in the specified contract period per Owner requirements.

1.7 WORK BY THE OWNER

A. Owner will separately contract for the following: **None / Not Applicable**

B. Coordinate any / all aspects of Work by Owner as they interface with Work.

1.8 PERMITS

A. Apply for applicable building and trade permits as applicable to the work scope.

B. Pickup and pay for all applicable building and trade permits.
   1. Refer to Project Allowances for applicable permit allowance.

C. Furnish all required contractor trade permits as well as any other required permits for work in the right of way, etc.

1.9 APPLICABLE REFERENCES AND CODES

A. References will be found in each section that applies to that section.

B. Conform to reference standards by date of issue current as of date of Contract Documents.

C. When specified reference standard conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with Ohio Building Code 2024 requirements as they relate to the work.

1.10 CONTRACTOR / GENERAL REQUIREMENTS

A. Protect all finishes and equipment scheduled to remain.

B. Commence and complete work as noted in the contract.

C. Coordinate equipment delivery and equipment staging with Owner prior to start of project. Anticipate no on-site storage being provided by Owner.

D. Pre-determine work phases with Owner to minimize disruption to operations.

E. Furnish labor, materials, equipment, and management required to complete the project.

F. Furnish all required logistics required to accomplish the work – including lifts, scaffolding, ladders, trash chutes, safety equipment, temporary protection, daily night seals / weather protection, etc.
   1. Coordinate and receive Owner approval for all staging and laydown areas, contractor parking, etc. prior to the start of work.
   2. Provide protection of all existing pavement, turf, landscaping, etc. from damage during construction. Restore site to original / like new condition upon completion of the work.

G. Visit the site to become thoroughly familiar with all working conditions, check and verify all dimensions, and site conditions. Any dimensions given or referred to in the specification or drawing are to be used purely as approximate and not as a basis for exact amounts for bidding. Promptly advise Architect of any discrepancies, errors with the specifications and drawings before bidding the work.

H. Provide a valid Certificate of Insurance, follow all Workman's Compensation requirements and regulations.

I. Provide all bonds, payment schedule, insurance as noted in the contract documents.

J. Pay for all building permits, trade permits, ROW permits, and any other required permits and inspections necessary to complete all work related to these specifications. Comply with Federal, State, and Local Codes.

K. Provide dumpsters or trash containers needed for construction purposes. Do not use Owner dumpsters or trash containers at any time for removal of materials, trash, or debris related to the Contractor's work. Remove debris from the site regularly and be placed within appropriate trash receptacles. Keep all work areas neat at all times. Take all considerations for safety. Do not leave trash or debris on the ground / around the project site.
   1. Run magnet around work areas daily to pickup stray nails, etc. when appropriate.

L. Take special care not to allow dust and debris to fall onto any equipment, material, personnel, or any room below the deck.

M. Safety: Take all safety precautions necessary or directed to ensure public safety.
   1. Neither Architect nor Owner are safety consultants. Any and all safety provisions shall be managed and coordinated by the Contractor.

2. Safety is paramount and all personnel on site must wear appropriate personal protection equipment [PPE]. The Contractor is responsible for means and methods to ensure that proper PPE is provided. Failure to comply may result in dismissal from site.
3. Barricade work area with appropriate construction grade barriers to establish boundaries of work area and assure safety for all workers and general public. All work areas must be properly barricaded from the general public prior to starting any work.
4. Maintain job site in a neat and orderly fashion at all times.

N. Conduct all work according to OSHA recognized safe work practices. **COMPLY WITH APPLICIBLE OSHA STANDARDS, INCLUDING 1926 – REGULATIONS FOR CONSTRUCTION.**
1. Non-compliance shall be a basis for making a bid non-responsive.
2. If Contractor or sub-contractor is found to be in **VIOLATION (NON-COMPLIANCE) AT ANY TIME**, this could be a basis for termination of the purchase order/contract.

O. IMPORTANT: Failure to show or mention petty details shall not be warranted for the omission of anything necessary for the proper completion of the work.

P. The plans and specifications are intended to depict the general scope, layout and quality of workmanship required. The documents are not an "instruction manual" to execute the work nor are they intended to show or describe in detail every item necessary for the proper installation of the work. The means and methods required to execute the work described is the sole responsibility of the Contractor. The Contractor shall include the ancillary work required, whether explicitly stated or not, for the proper completion of the work as intended. The Contractor is required to meet or exceed building code requirements, applicable industry standards, ASTM standards, and/or manufacturer installation requirements as they relate to the work.

Q. The plans and specifications represent a single complete design package indicating the intended scope of the project in its entirety. As such, the project is structured to be awarded to a single Prime Contractor. The documents do not delineate bid packages or assign responsibilities to any subsequent subcontractors, dictate construction sequencing, nor provide coordination between any "trades". Such activities are the responsibility of the holder of the construction contract. In the event of a discrepancy within the drawings or between the drawings and the specifications, the more stringent requirement represented in the documents shall prevail.

R. Do not take advantage of any clerical errors, omissions, contradictions, or conflicts that may develop in plans, specifications, or details. Report such errors, ambiguities and discrepancies to the Architect immediately for clarification, revision, or correction prior to the submission of bids. If no notification is given, it shall be assumed that all specifications and conditions will be met.

S. Submission of a bid shall be considered the Contractor's Certification that the bid is based upon equipment and/or materials that meet or exceed the standards set forth by specification or equipment and/or materials identification. Should a Contractor's product be determined not equal to that specified, the Contractor shall be required to provide and install a product acceptable as equal by the Architect at no additional cost to the Owner.

T. The submission of a bid shall indicate that the Contractor has visited the project sites and is familiar with the conditions as they exist, and the modifications that may be necessary to provide a complete and professional finished project.

U. There is a strict **NO SMOKING** policy for all work. Any worker found smoking on the jobsite will be subject to removal from the project. No exceptions. Habitual offenders may be subject to a fine in the amount of $500 per occurrence.

V. Security: Contractor's Liability for Vandalism

1. Secure and protect the project which is under the control of the Contractor. Include all such expenses for the securement and protection of the project, and for the repair and replacement of the work until that portion of the work is accepted as complete by the Owner. Take all measures necessary to provide such security.
2. Promptly repair or otherwise remedy any and all damages, at Contractor's expense, to said portion of the project and of the accepted construction work caused by vandalism.
3. Indemnify and hold the Owner harmless from and against all damages, liabilities, costs and expenses, including, without limitation, reasonable attorney fees, which may be imposed upon or incurred by the Owner as a result of the Contractor's failure to comply with the requirements of this section.

W. Insurance: **Refer to GDPM Terms and Conditions.**
1. Provide copy of Certificate of Insurance to Owner.
2. Submit evidence of Worker's Compensation Insurance coverage
3. Submit evidence of Builder's Risk Insurance.

X. Damages: Any and all damages to Owner Property or resident property shall be repaired equivalent to the existing by the Contractor at no cost to Owner. NO EXCEPTIONS.

1.11 CONTRACTOR QUALIFICATIONS

A. Establish and provide qualifications to Owner for their ability to complete this type of work. Qualifications may be established by:
1. Provide references of similar projects, past performance, financial disclosures, etc. in the interest of selection of the lowest and best bidder for the project.
2. Provide a letter of approval for the installation of the products from the manufacturer.
   a. Contractor must be properly trained and approved by the manufacturer for the installation of the products.
3. Provide a recommendation from the supplier of the products.
4. Demonstrating to Owner the capability to do the work. Contractor must have a minimum of five years documented experience in similar work.

B. Contractor is responsible for all work performed by the Sub-contractors.

C. Owner has the final authority to request a particular sub-contract not be engaged in the project. If this occurs, Owner and Contractor shall determine if there is an impact to the Contract amount, and negotiate, if necessary, to an adjustment in the Contract amount.
1. No change to the Contract amount will be permitted if there is a change to the sub-contractor due to them utilizing alternate manufacturers or products that were not approved substitution requests.

1.12 JOB SUPERINTENDENT/EMPLOYEES

A. Each prime contractor and subcontractor shall have a qualified foreman on the project at all times when work is being accomplished.

B. Refrain from fraternization with building occupants other than specifically designated Owner's representatives.

C. Furnish the Owner with a list of personnel with phone numbers that will be working on the project and emergency contacts names and numbers that has the authority to handle emergencies on a 24 hour/seven days a week.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Follow all applicable requirements of HUD-5370 General Conditions for Construction Contracts and Owner's Terms and Conditions. If there should be a conflict between the Owner Requirements and those herein, the higher standard shall apply.

PART 3 EXECUTION

3.1 CONTRACT ADMINISTRATION

A. Architect is providing contract administration services for this project to the Owner. However, it shall be the responsibility of the Contractor and Owner to coordinate the proposed work, schedules, installations, permits, inspections, etc. as Architect is not on-site every day.

B. Contact Architect for clarification should there be questions regarding the interpretation or intent of the documents, field discovery, etc. that would impact or affect the work as proposed. Architect shall not be liable for deviations, field changes, and Owner changes during construction.

C. Field confirm all existing conditions, proposed installations and how they interface to ensure the systems can be installed per the intent of the documents and to meet applicable building and zoning codes, local requirements, Owner requirements, provide a watertight detail, meet aesthetic requirements, etc.

D. Meet all applicable building and zoning codes requirements whether specifically noted herein or not. Building codes represent the minimum acceptable standard.

E. Install all products, materials, installations, and the like in accordance with applicable industry standards, applicable manufacturer's details and instructions, in accordance with best practices, and building code provisions. The manufacturer details / requirements are the minimum acceptable standard, Architect’s drawings may require additional work.

3.2 GENERAL PROJECT REQUIREMENTS

A. Safety is paramount and all personnel on site must wear appropriate personal protection equipment [PPE]. The Contractor is responsible for means and methods to ensure that proper PPE is provided. Failure to comply may result in dismissal from site.

B. Barricade work area with appropriate construction grade barriers to establish boundaries of work area and assure safety for all workers and general public. All work areas must be properly barricaded from the general public prior to starting any work.

C. Job sites will be maintained in an orderly and neat fashion at all times.

END OF SECTION

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SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Schedule of values.

B. Applications for payment.

C. Change procedures.

D. Unit prices.

E. Alternates.

F. Project Allowances.

G. Defect assessment.

1.2 PREVAILING WAGE / PAYROLL REPORT REQUIREMENTS

A. The work of this project is subject to Davis-Bacon Prevailing Wages and applicable reporting requirements. Include in the bid amount all applicable prevailing wages.

B. Refer to the Prevailing Wage Rates included with the Bid documents. Certified Payroll Reports will be required.

C. Provide Certified payroll reports indicating compliance to the Owner on a monthly basis.
   1. Pay Applications will not be processed without approved payroll reports submitted to the Owner.

D. Employee interviews to confirm compliance with the prevailing wage requirements may be accomplished at any time by the Owner. Do not obstruct or otherwise prevent employee interviews.

1.3 TAXES

A. Pay all applicable taxes, including applicable sales and use taxes, and other taxes as required by governing law.
   1. Owner is a tax-exempt entity.
   2. Owner will provide tax exempt forms upon request.
   3. Owner will not compensate or reimburse Contractor for any taxes paid on the project.

1.4 RETAINAGE

A. Owner will withhold retainage in the amount of ten percent [10%] from the payment otherwise due [for both labor and materials] of each progress Application for Payment up to a total project completion of 50%, after which no further retainage will be withheld providing work is performing satisfactorily. Refer to HUD Form 5370.

B. Retainage will be released in accordance with the Terms of HUD Form 5370.

1.5 STORED MATERIALS [ON OR OFF SITE]

A. Owner will pay for materials stored on-site.

B. Owner will pay for materials stored off-site providing proper documentation of the stored materials is provided, including documentation of location of stored materials, supporting invoices, shipping / bill of lading, photo documentation, and proper insurance [paid for by the Contractor] is in place at the location of stored materials.

1.6 SCHEDULE OF VALUES

A. Submit schedule of values on HUD Form 51000 or AIA G702 / G703 forms.

B. Submit Schedule of Values three [3] days prior to the Pre-Construction meeting for approval by Architect and Owner.

C. Approved Schedule of Values will be signed at the Pre-Construction meeting.

D. Format:
   1. Utilize Table of Contents of this Project Manual [CSI Divisions].
   2. Identify each line item with number and title of major specification Section.
   3. Identify each applicable CSI division / defined work scope / component.
   4. Identify site mobilization, general conditions, bonds and insurance.
   5. Identify separate line item for each allowance and alternate [as applicable]

E. Schedule of values should be broken down by building / address.

F. Revise schedule to list approved Change Orders, with each Application for Payment.

1.7 APPLICATIONS FOR PAYMENT

A. Submit each application for payment on HUD Form 51001 or AIA G702/G703 forms.
   1. Provide an invoice number on the application for payment, or provide a cover letter invoice on company letterhead with an invoice number.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
   1. Complete every entry, notarize and execute by a person authorized to sign document on behalf of the Contractor. Include amounts for work completed following previous Application for Payment whether or not payment has been received, include amounts of Change Orders issued before last day of construction period covered by application.
   2. Stored materials included in application must have supporting documentation that verifies amount required, do not include overhead and profit on stored material.
   3. Each application for payment following the initial Application for Payment shall be consistent for payment with previous applications.

C. Payment Period: Monthly.

D. "Pencil Copy": Submit one week prior to application for payment for review and approval by Architect and Owner. Submit Electronically to Architect in PDF format unless directed otherwise.

E. "Application for Payment": Upon acceptance of the "Pencil Copy", submit the "Application for Payment. Submit Electronically to Architect in PDF format unless directed otherwise. Architect will review, certify for payment, and submit to Owner.
   1. Submit updated construction schedule with each Application for Payment as applicable to the work.
   2. Submit all required waivers of lien / partial release of lien [including applicable subcontractors] in accordance with Owner requirements.
   3. Submit certified payroll reports for all contractors.

F. Failure to submit required paperwork, including supporting documents can delay the processing of the Application for Payment.

1.8 CHANGE PROCEDURES

A. Construction Bulletin: Architect / Owner may issue a Construction Bulletin [Proposal Request] including a detailed description of proposed change with supplementary or revised Drawings and specifications. Prepare and submit estimate within 7 days.

B. Stipulated Sum/Price Change Order: Based on Proposal Request / Construction Bulletin and Contractor's fixed price quotation.

C. Unit Price Change Order: For contract unit prices and quantities, the Change Order must be executed prior to beginning any work. The Change Order will be based on fixed unit price basis provided in the Bid Form.

D. Architect will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on Architect's approved forms.

E. Architect will issue a Change Order for all changes to Contract Sum and for all changes to the Contract Time upon Owner's approval of a proposal from Contractor.

F. Change Order Forms: HUD / AIA G701 or other approved forms with all required backup documentation.
   1. No "change order" will be prepared for costs expended from project allowances which do not require a change to contract sum or time.

G. Correlation Of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
   2. Promptly revise construction progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
   3. Promptly enter changes in Project Record Documents.

H. Important: All change orders must be fully executed prior to beginning any work. Failure to comply will result in contractor request being denied and completed at no cost to Owner.

1.9 UNIT PRICES

A. Document unit price quantities. Architect / Owner will confirm quantities as required. Contractor may not be paid for unit cost work without documentation of the work accomplished.

B. Unit Price Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.

C. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Architect / Owner multiplied by unit price for Work incorporated in or made necessary by the Work.

1.10 UNIT PRICE SCHEDULE

A. None

1.11 ALTERNATES

A. Alternates listed on Bid Form will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work.

1.12 SCHEDULE OF ALTERNATES

A. None

1.13 PROJECT ALLOWANCES

A. Contingency Allowance:
   1. Provide in bid a draw down allowance in the amount of **$50,000 [fifty thousand dollars]** for use as a project contingency allowance.

B. Building Permit Allowance:
   1. Provide in bid a draw down allowance in the amount of **$15,000 [fifteen thousand dollars]** for securing applicable building / fire alarm permits.

C. Contractor's costs for Products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit are included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

D. Do not expend or proceed with work outside of the scope of the project which utilizes the contingency allowance without authorization and approval of Architect and Owner.

E. Identify and track actual expenditures as they occur over the duration of the project not afterward. Any work commenced without Owner approval is at Contractor's risk. Maintain a running tally of the remaining balance of each allowance.

F. Credit back to the Owner any unused funds at the end of the project via a Change Order.

1.14 FINAL APPLICATION FOR PAYMENT

A. Refer to provisions in Section 01 77 00 for Application for Payment at Substantial Completion.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Architect / Owner, it is not practical to remove and replace the Work, the Architect / Owner will direct appropriate remedy.

C. Authority of Architect / Owner to assess defects and identify payment adjustments is final.

D. Non-Payment For Rejected Products: Payment will not be made for rejected products.

END OF SECTION

SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 WORK INCLUDES

A. Includes administration and procedural requirement for Substitutions.
   1. Substitutions' for Cause: Changes due to project conditions, such as unavailable of product.
   2. Substitutions' for Convenience: Changes that may offer advantages to the Owner.

1.2 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.

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

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions / Approved Equal: Submit request for substitution as outlined in this section for manufacturers not named.
   1. Architect / Owner is the decision maker if the proposed "approved equal" is in fact equal and approved. Any decision rendered is final.
   2. Any Contractor, Sub-contractor, or Supplier who makes their own judgement as to "approved equal" and includes within their bid without a formal approval is doing so at their own risk.

1.3 SUBSTITUTIONS PROCEDURES

A. The materials, products, and equipment described in the Bid Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The burden of proof of the merit of the proposed substitution is upon the Bidder. Absolutely no substitutions shall be considered after the Contract award unless specifically noted in the Contract Documents. All substitution requests must come from a bidding Contractor [not materials suppliers, etc].

B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

C. A request constitutes a representation that the Bidder:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.

D. Substitution Procedure
   1. **Submit copy of request for Substitution for consideration to Architect no later than seven [7] days before bid opening date**.
   2. Submit shop drawings, product data, and applicable certified test results attesting to proposed product equivalence. Burden on proof is on proposer.
   3. Architect will notify Contractor in writing of decision to accept or reject request within five [5] days of receipt of request or request additional information or documentation for evaluation.
   4. Limit each request to one proposed Substitution.
   5. Requests shall include the name of the material or equipment for which it is to be substituted and a completed description of the proposed substitution.
   6. Architect/Owner will notify Contractor in writing of decision to accept or reject request.
   7. Substitution requests shall only be submitted by registered bidders for the project.

E. Substitutions will not be considered when they are indicated or implied on Submittals, without written request or when acceptance will require revision to the Contract Documents.

F. If the Substitution requires modifications to the Contract / Bidding Documents, the cost for updating the documents shall be paid by the Contractor making the request.

G. Substitutions will not be considered after award of the project without justification.

H. Approved substitutions will be identified by Addenda.
   1. Bidders shall not rely upon approvals made in any other manner.

I. In submission of substitutions to Products specified, Bidders shall include in their Bid, changes required in the Work and Contract Price to accommodate such approved substitutions. Later claims by the Bidder for an addition to the Contract Time or Contract Price because of changes in Work necessitated by use of substitutions will not be considered.

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Construction Progress Schedules

C. Preconstruction meeting.

D. Progress meetings.

E. Pre-installation meetings.

F. Daily Job Logs.

G. Cutting and patching.

H. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual / Specifications and Drawings to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
   1. Coordination Drawings: Prepare as required to coordinate all portions of Work.
   2. Coordination Meetings: In addition to other meetings specified, hold coordination meetings with personnel and subcontractors to ensure coordination of Work.

D. In finished areas, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements. Coordinate rough in locations for accessibility, clearances, maneuvering, etc.

E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD VERIFICATION

A. Prior to ordering materials, verify the actual dimensions of existing conditions and assume responsibility for workable solutions for all new work. Verification that new work and items are workable for existing conditions while providing adequate clearances is the responsibility of the Contractor.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Illustrate order and interdependence of activities and sequence of work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities. Illustrate complete sequence of construction by activity.

Arrange schedule on a weekly basis identifying the first work day of each week. [Critical Path Schedule]

1. Work Sequences, order of operations, constraints, and milestones for the project, including all applicable Subcontract Work.
2. Material / equipment lead times.
3. Punchlist Activities
4. Substantial Completion and Contract Completion Dates.
5. Move-in and other preliminary activities.
6. Equipment and equipment system test and startup activities.
7. Project closeout and cleanup.

B. Submit initial progress schedule within seven [7] days after date of Owner-Contractor Agreement for Architect / Owner review.
   1. Include written certification that major subcontractors have reviewed and accepted proposed schedule.

C. Submit revised and updated schedules with each Application for Payment and as appropriate throughout the duration of the project.
   1. Indicate estimated percentage of completion for each item of Work at each submittal.

D. Review and Evaluation
   1. Participate in joint review and evaluation of schedules with Architect / Owner at each submittal.
   2. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.
   3. Indicate changes required to maintain Date of Substantial Completion.
   4. After review, revise schedules incorporating results of review, and resubmit within three [3] days.

E. Distribute copies of updated schedules to Subcontractors, suppliers, Architect, Owner, and other concerned parties.

1.5 PRECONSTRUCTION MEETING

A. Architect / Owner will schedule preconstruction meeting after Notice of Award for affected parties.

B. Attendance: Architect, Owner, Contractor Project Manager, Foreman / Superintendent

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, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing parties in Contract, and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.
   8. Use of premises by Owner and Contractor.
   9. Owner requirements for procedures and inspections
   10. Construction facilities and controls provided by Owner.
   11. Security and housekeeping procedures.
   12. Application for payment procedures.
   13. Procedures for maintaining record documents.
   14. Requirements for start-up of equipment.
   15. Inspection and acceptance of equipment put into service during construction period.

D. Architect will record minutes and distribute copies via email after meeting to participants and those affected by decisions made.

1.6 PROGRESS MEETINGS

A. Architect will be providing periodic observation of the work. Architect will issue field reports at each site visit. Architects will be observing the work for compliance with the specifications and will not be responsible for the ways, means and methods of constructing the project or managing the day to day operations.

B. Schedule and administer meetings throughout progress of the Work at bi-weekly intervals.
   1. Provide suitable accommodations for holding meetings on-site with a layout table, chairs, etc.

C. Architect will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

D. Attendance Required: Job superintendent, major subcontractors and suppliers, Architect, Owner, as appropriate to agenda topics for each meeting.

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

F. Architect will record minutes and distribute copies via email after meeting to participants and those affected by decisions made.

1.7 PRE-INSTALLATION MEETINGS

A. Determine any and all necessary pre-installation meetings and schedule the same.

B. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

C. Require attendance of parties directly affecting, or affected by, Work of specific section.

D. Notify Architect / Owner one week in advance of meeting date.

E. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation and installation procedures.
   2. Review coordination with related work.

F. Record minutes and distribute to participants after meeting, and those affected by decisions made.

1.8 DAILY JOB LOGS

A. Maintain a daily job log that indicates the personnel on-site and activities performed (including all sub-contractors)

B. Indicate any safety concerns and incidents.

C. Indicate weather conditions.

D. Indicate any visitors or other personnel visiting the project site.

E. Job log shall be accessible to Architect / Owner upon request.

F. Coordinate activities / work progress with Architect / Owner.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching; restore Work with new Products.

B. Submit written request in advance of cutting or altering elements affecting:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching [including excavation and fill,] to complete Work, and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and non-conforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.

E. Cut masonry and concrete materials using masonry saw or core drill.

F. Restore Work with new products in accordance with requirements of Contract Documents.

G. Fit Work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

H. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

J. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated materials, to full thickness of penetrated element. Follow applicable UL assemblies.

K. Refinish surfaces to match adjacent finishes.
   1. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
   2. For painted surfaces, paint entire wall from corner to corner, floor to ceiling.

L. Identify hazardous substances or conditions exposed during the Work to Architect for decision or remedy.

3.2 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to permit installation of new work and finishes.

G. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.

H. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.

I. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

J. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect for review.

K. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

L. Finish surfaces as specified in individual product sections.

END OF SECTION

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Proposed products list.

C. Product data.

D. Shop drawings.

E. Samples.

F. Safety Data Sheets

G. Manufacturer's Instructions

H. Manufacturer's Certificates

I. Construction Photographs

1.2 SUBMITTAL PROCEDURES

A. Submit product data and shop drawings for all applicable components of the project. Refer to individual sections for additional requirements.
   1. Provide a submittal log at the beginning of the project for review by Architect / Owner. Identify proposed submittals by Spec Section.
   2. Architect / Owner review of the submittals will be general in nature and does not relieve the Contractor in any way of the responsibility in compliance with the contract requirements, manufacturer requirements, and/or applicable codes.

B. Accomplish all submittals in a digital [PDF format].
   1. Any hard copies received will be scanned and returned electronically.
   2. Provide those submittals required to maintain orderly progress of the work and those required for early lead time for manufacturer fabrication.
   3. Do not simply download information directly from a manufacturer’s website without a review of the information and **identifying the particular products being utilized**.
   4. Mark each component to identify applicable products, models, options, and other data. Supplement manufacturer’s standard data to provide information unique to this project. Non-identified submittals will be rejected.

C. Provide a Submittal form / cover sheet to identify Project, Contractor, subcontractor or supplier; and pertinent Contract Document references.
   1. Allow space on submittal form / cover sheet for Contractor and Architect review stamps.
   2. Sequentially number transmittal forms.
   3. Mark revised submittals with original number and sequential alphabetic suffix.
   4. Sign off on submittals indicating Contractor review of the data provided.

D. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of completed Work.

F. Revise and resubmit submittals as required; identify changes made since previous submittal.

G. Schedule / complete all submittals at the beginning of the project / with adequate time to allow the proper ordering of materials for the project.

1. Failure by the Contractor to provide submittals in a timely fashion does not change the project start date nor contract period.
2. Failure by the Contractor to order materials timely is not a reason for selection of an alternate material.

H. Any materials on the job site that have not been reviewed as part of the submittal process are subject to rejection / removal from the job-site. Any work undertaken without review of the submittal data is at the Contractor's risk and subject to rejection or replacement at no cost to the Owner if submittals are not in conformance with the project documents.

I. For each submittal for review, allow seven [7] days excluding delivery time to and from Contractor.

J. Architect will return the annotated submittal file via email as PDF electronic files.

K. Submittals will be marked as follows:
1. NO EXCEPTIONS TAKEN: Distribute copies to subcontractors and related trades.
2. NOTE MARKINGS: Final Release; Proceed with fabrication, taking into account the necessary corrections on submittal and with Contract Documents.
3. NOTE MARKINGS/RESUBMIT: Proceed with fabrication, taking into account the necessary corrections. Resubmit corrected shop drawings before fabrication of this work is complete to obtain a different action marking. Do not allow drawings marked "Resubmit" to be used in connection with installation of the Work.
4. REJECTED: Resubmit shop drawings in their entirety. No fabrication or installation shall be started until shop drawings so marked have been completely revised, resubmitted, and marked by Architect according to preceding Paragraphs.

L. Distribute copies of reviewed submittals as appropriate [electronically as appropriate]. Instruct parties to promptly report inability to comply with requirements.

1.3 PROPOSED PRODUCTS LIST

A. Within fourteen [14] days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.4 SUBMITTALS / PRODUCT DATA / SHOP DRAWINGS

A. Product Data/Shop Drawings:
1. Submitted to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
2. All shop drawings shall be to scale, submit drawings on sheets no larger than 24-inch x 36 inch, all other product data can be on 8 ½ X 11-inch sheets.

B. Samples for Review:
1. Submitted to Architect for review and selection for aesthetic, color, or finish.
2. Submit samples of finishes from full range of manufacturer's standard colors, textures, and patterns for Owners selection.
3. Submit samples to illustrate functional and aesthetic characteristics of Product.

C. Personnel/Other Contractors
1. Submit a list of all subcontractors and on-site personnel with the list of lead contact and associated phone numbers.
2. Submit emergency contact sheet with contacts for an emergency – 24/7 call list.

D. Contract Items:

1. Submit Certificate of Insurance, Worker's Comp Certificates as required by Owner.
2. Submit bonds if applicable to the contract.
3. Submit a written Construction Schedule / Implementation and Sequencing Plan outlining starting points and length of time to complete work in each section.

E. Site Specific Safety Plan
   1. Provide to Owner for their Review.

F. Site Logistics Plan
   1. Provide to Owner for their Review.

1.5 SAMPLES

A. Physical Samples: Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
   1. Physical samples are required to allow Architect to make selections for color and finish. Electronic images of colors/finishes, etc. are not sufficient.

B. Samples For Selection as Specified in Product Sections:
   1. Submit to Architect for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect selection.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit 2 copies of each sample, Architect will retain 1 copy.

F. Reviewed samples which may be used in the Work are indicated in individual specification sections.

1.6 SAFETY DATA SHEETS

A. Submit Safety Data Sheets [SDS] on all products directly to the Owner – DO NOT submit to Architect.
   1. Safety Data Sheets [SDS] shall not be submitted to the Architect for review.
   2. Any SDS submitted to Architect will be returned with no action taken. Architect does not review / approve any SDS sheets. Any submittals provided to Architect with SDS will be rejected, or have the SDS removed / crossed out from the submittal.

B. Safety Data Sheets relate directly to construction safety, which is the sole responsibility of the Contractor.

C. In compliance with the OSHA Hazard Communication Standard (1910.1200, 08-24-1987), Post at the site SDS [Safety Data Sheets] for ALL products classified as hazardous that their firm has knowledge that they will be furnishing, using, or storing on the jobsite during the duration of this Project in accordance with OSHA standards.

1.7 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit manufacturer printed instructions for delivery, storage, assembly, installation, [start-up,] adjusting, and finishing, in quantities specified for Product Data.

B. Indicate special procedures, conditions requiring special attention, and special environmental criteria required for application or installation.

1.8 MANUFACTURER'S CERTIFICATES

A. When specified in individual specification sections, submit certifications by manufacturer to Owner, in quantities specified for Product Data.

B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Products, but must be acceptable to Architect / Owner.

1.9 CONSTRUCTION PHOTOGRAPHS

A. Provide digital photographs of construction throughout progress of Work as taken by project superintendent as applicable to document the existing conditions, work in progress, completed work, project wrap up, etc. It is in the best interest of the contractor to document the conditions as this is an occupied unit project.

B. Deliver photographs to Architect / Owner upon request. Catalog and index in chronological sequence with date indexed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Submittal / Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
   1. Use of files is solely at receiver's risk. Architect does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Architect of discrepancy and use information in hard-copy Drawings and Specifications.
   2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
   3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
   4. Receiver shall not hold Architect responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
   5. Receiver shall understand that even though Architect has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
   6. Receiver shall not hold Architect responsible for such viruses or their consequences, and shall hold Architect harmless against costs, losses, or damage caused by presence of computer virus in files or media.
   7. Architect reserves the right to assess a fee for the release of the electronic CAD files. Coordinate with Architect as appropriate.

END OF SECTION

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control.

B. Construction Procedures

C. Tolerances

D. References.

E. Labeling

F. Mock-up requirements.

G. Examination & Inspection.

H. Testing and Inspection Services [Special Inspections]

1.2 QUALITY CONTROL

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. When 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. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

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

1.3 CONSTRUCTION PROCEDURES

A. Architect / Owner intends to routinely monitor the Contractor’s work and progress. Quality control is an important element which is the responsibility of the Contractor. Provide full cooperation with all inspection steps through the construction process and include such coordination in the base bid of the project.

B. Provide accessibility to the work, including but not limited to ladders, scaffolding, hoisting, etc in order to make all areas of the work available to Architect / Owner. Provide staffing to support these operations.

C. Inspect the Work prior to requesting a punchlist inspection. Address / correct any deficiencies and provide written confirmation of such with the request to schedule the punchlist inspection by the Architect / Owner. Refer to Section 01 77 00.

D. Owner will coordinate and schedule an anniversary inspection for the one year interval following acceptance of the project.

1.4 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.5 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.6 LABELING

A. Attach label from agency approved by Authority having Jurisdiction for products, assemblies, and systems required to be labeled by Applicable Code.

B. Label information: include manufacturer’s or fabricator’s identification, approved agency information, and the following information, as applicable, on each label.
   1. Model number
   2. Serial number
   3. Performance characteristics

C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.7 MOCK-UP REQUIREMENTS

A. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes as directed by Architect / Owner.

B. Accepted mock-ups shall be comparison standard for remaining Work follow requirements of individual sections.

C. Where mock-up has been accepted by Architect / Owner and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.

1.8 TESTING AND INSPECTION SERVICES [SPECIAL INSPECTIONS]

A. Owner will employ and pay for specified services of on an independent firm to accomplish Third Party Special Inspections as outlined on the Drawings.

B. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify independent firm **24** hours before expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

C. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.

D. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Architect. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum.

E. Agency Reports: After each test, promptly submit an electronic copy of report to Architect, Contractor, and Owner. When requested by Architect, provide interpretation of test results.

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

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify 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. Verify utility services are available, of correct characteristics, and in correct locations.

E. Contact Utility Protection Services [Call 811] a minimum of 48 hours prior to beginning work to verify location of existing utilities, coordinate requirements as applicable.
   1. Contact private utility locating services as required by the conditions. Locate all public and private utilities that may be impacted by the work.

3.2 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 new material or substance in contact or bond.

END OF SECTION

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities

B. Construction Facilities

C. Temporary Controls

D. Removal of utilities, facilities, and controls

1.2 TEMPORARY ELECTRICITY

A. Refer to GDPM's Terms and Conditions

B. Utilize existing utilities at the building as required to facilitate work. Maintain existing utilities operational throughout the duration of the project. If systems need to be out of service, schedule this work for off-hours, coordinate with Owner.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide temporary lighting for construction operations as required by conditions and where existing lighting has been removed to facilitate work.

1.4 TEMPORARY HEATING / COOLING / VENTILATION

A. Shut down HVAC systems during dusty activities. Provide and maintain filtration media at all HVAC systems.

B. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Provide temporary fan units as required to maintain clean air for construction operations.

1.5 TEMPORARY WATER SERVICE

A. Not Applicable.

1.6 TEMPORARY PROTECTION OF FIRE SPRINKLER / FIRE ALARM SYSTEMS

A. Coordinate with fire sprinkler system and fire alarm system / monitoring company to maintain systems operational. This includes temporary protection and coordination of monitoring company to put system in test mode as applicable to the work.
   1. Provide and maintain a proper fire watch within the building at any time when systems are in test mode.

1.7 TEMPORARY SANITARY FACILITIES

A. Provide temporary sanitary facilities for use during construction. Maintain daily in clean and sanitary condition.
   1. Do not use building toilet facilities for temporary facilities unless specifically authorized.
   2. Do not use new plumbing fixtures for temporary facilities.
   3. Do not use other Owner facilities without explicit approval.
   4. Protect temporary facilities from vandalism.

B. Provide potable drinking water for workers.

1.8 TEMPORARY BARRICADES

A. Erect temporary barricades as applicable to the work to maintain security, dust control, protect residents, etc.

B. Provide additional barricades, barriers, or protection necessary to protect work areas at traffic lanes, parking lots, etc.

C. Provide all applicable signage to limit non-construction personnel from entering the construction area.

D. Provide temporary emergency egress and exit signage as required by conditions and where existing has been temporarily removed to facilitate work.

1.9 STAGING AREA / MATERIAL STORAGE

A. Coordinate with Owner on acceptable location of project staging and material storage area.

B. Do not anticipate any space for storage of materials in the building / work areas or adjacent building areas.

C. Provide secured, portable storage containers for temporary / construction storage as required by the Contractor.
   1. Do not anticipate any space for storage of materials in the building / work areas or adjacent building areas.
   2. Coordinate location of storage containers with Owner.
   3. Protect / restore site as applicable to the conditions to original conditions.

D. Owner will make reasonable effort to provide suitable space on the site for the Contractor to set up operations. Moving from this space may be necessary when instructed by the Owner and shall be accomplished without charge to the Owner. Cooperate with Owner to minimize conflict from Owner's operations.

1.10 FIELD OFFICE

A. Provide securable on-site space for storage as required by the Contractor. Coordinate with Owner for approved location of such storage space.

B. Provide field office for construction operations as deemed necessary by Contractor. Pay for field offices and related expenses.

1.11 VEHICULAR ACCESS

A. Utilize existing street parking / driveways / parking areas for construction activities. Do not block or prohibit vehicular access to adjacent buildings / parking areas. Do not allow driving/parking in turf areas.

B. Provide unimpeded access for emergency vehicles. Maintain 20 feet wide driveways with turning space between and around combustible materials.

C. Provide and maintain access to fire hydrants and control valves free of obstructions.

1.12 CONSTRUCTION ACCESS DRIVE

A. Not Applicable.

1.13 PARKING

A. Park Contractor vehicles in areas designated by the Owner. Construct temporary gravel parking areas as necessary to accommodate construction personnel.

B. Use of designated existing on-site driveways, parking areas, and / or street parking used for construction traffic is permitted. Tracked vehicles not allowed on paved areas.
   1. Do not block access to existing parking lots, driveways, etc. with construction equipment, material laydown, or storage areas.
   2. Do not block resident vehicles or those of adjacent buildings with a shared driveway.

C. Do not allow heavy vehicles or construction equipment in parking areas.

D. Maintenance:
   1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
   2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

E. Removal, Repair:
   1. Repair existing and permanent facilities damaged by use, to original or specified condition.

1.14 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition to the satisfaction of the Owner. Clean up shall occur on a DAILY basis.
   1. Failure to provide routine and daily cleanup may result in a back charge from the Owner to accomplish this work.

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

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 rubbish from site daily and dispose off-site. Sort and recycle as applicable.

E. Provide dumpsters or trash containers needed for the proper removal of project materials, trash, or debris related to the work. Keep all work areas and project sites neat and free of trash and clutter at all times. Project site consists of occupied apartment units. Do not leave trash around the project site. Take all considerations necessary for safety.

1.15 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections. Restore any damaged work to new condition.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Protect finished pavement, concrete, stairs, finish flooring, 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, finished surfaces, etc as is applicable to the work. When traffic or activity is necessary, obtain recommendations for protection from the material manufacturer and provide all required protection as determined necessary. Any damage caused shall be repaired to like new condition.

E. Prohibit traffic from landscaped areas.

1.16 FIRE PREVENTION FACILITIES

A. Prohibit smoking within building or on site under construction. **NO SMOKING IS PERMITTED ON HUD PROPERTY [INTERIOR OR EXTERIOR]. NO EXCEPTIONS.**
   1. Contractor / Crew found to be smoking will be subject to a $500 fine per occurrence. Any habitual offenders will be dismissed from the project.

B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Portable Fire Extinguishers: NFPA 10; 10 pound capacity, 4A-60B: C UL rating.
   1. Provide one fire extinguisher at each building under construction.
   2. Provide minimum one fire extinguisher in storage shed.
   3. Supplement as necessary per the local fire department requirements for construction operations.

1.17 BARRIERS

A. Provide barriers [construction fencing] to prevent unauthorized entry to construction areas.

B. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

C. Protect Work existing premises from theft, vandalism, and unauthorized entry.

1.18 SECURITY

A. Security Program:
   1. Protect Work and existing premises from theft, vandalism, and unauthorized entry.
   2. Maintain program throughout construction period until Owner occupancy

B. Entry Control:
   1. Restrict entrance of persons into Project site.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors, make available to Owner on request.

1.19 DAILY JOB LOGS

A. Maintain a daily job log that indicates the personnel on-site and activities performed (including all sub-contractors)

B. Indicate any safety concerns and incidents.

C. Indicate weather conditions.

D. Indicate any visitors or other personnel visiting the project site.

E. Job log shall be accessible to Owner and Architect upon request.

1.20 DUST CONTROL

A. Execute work by methods to minimize raising dust from Construction operations.

B. Provide positive means to prevent air-borne dust from dispensing into atmosphere and to other areas of the project as applicable.

C. Provide temporary visqueen dust control measures to minimize the spread of dust and debris. Provide drop cloths, protective coverings as necessary.

D. Provide protection of existing HVAC / distribution systems.

1.21 POLLUTION AND ENVIRONMENTAL CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Provide dust control, erosion and sediment control, etc. to allow for proper execution of the Work.

C. Provide protective coverings, etc. as necessary to protect work.

1.22 EROSION AND SEDIMENT CONTROL

A. Not Applicable.

1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove existing utilities, connections, finishes, etc. as applicable to the work. Remove back to the nearest termination, junction box, etc. as applicable to the work. Coordinate with requirements on the drawings.

B. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Product requirements.

B. Product options and substitution procedures.

C. Equipment electrical characteristics and components.

1.2 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
   1. All products used on this project shall be new, unless otherwise noted on the drawings or as specified herein as salvaged or reused.

B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by the Contract Documents.

C. Provide interchangeable components of same manufacturer for components being replaced.

D. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

E. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

F. Furnish interchangeable components from same manufacturer for components being replaced.

G. **Order Products in the first 30 days of the contract**. **Provide documentation of orders upon request.**

H. **It shall be solely the Contractor's responsibility to order products to allow timely delivery for installation. The failure to order materials early in the project shall not be a reason for a contract time extension or additional costs related to expedited shipping and/or delivery. Nor shall this be a reason for a product substitution.**

1.3 BUILD AMERICA, BUY AMERICA [BABA] REQUIREMENTS

A. BABA is the Build America, Buy America Act. BABA requires any "infrastructure project" funded by any "Federal Financial Assistance" (FFA) apply a domestic content procurement preference, meaning that all iron, steel, manufactured products, and construction materials used in the infrastructure project have been produced int eh United States, unless the awarding agency has issued a waiver of this requirement. This is called the "Buy American Preference" (BAP)

B. HUD Hyperlink: https://www.hud.gov/program_offices/general_counsel/build_america_buy_america

C. BAP is not applicable to projects less than $250,000.

1.4 LABELING

A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
   1. Model number.

2. Serial number.
3. Performance characteristics.

1.5 PRODUCT DELIVERY REQUIREMENTS

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

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

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

D. Coordinate material delivery to minimize Owner involvement.

1.6 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.
   1. Remove any damaged materials from the site.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

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

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

F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

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

H. Secure all products to prevent blow off / blow over during weather events, wind, etc.

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

1.7 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.

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

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions / Approved Equal: Submit request for substitution as outlined in this section for manufacturers not named.
   1. Architect / Owner is the decision maker if the proposed “approved equal” is in fact equal and approved. Any decision rendered is final.
   2. Any Contractor, Sub-contractor, or Supplier who makes their own judgement as to “approved equal” and includes within their bid without a formal approval is doing so at their own risk.

1.8 PRODUCT SUBSTITUTION PROCEDURES – REFER TO SECTION 01 25 00

PART 2 PRODUCTS

2.1 EXTRA MATERIALS

A. Provide attic stock of finish materials totaling 5% [or as noted herein] of the total installation.

B. Provide minimum of [1] gallon of each finish paint color.

C. Coordinate turnover of extra materials to Owner, assist in placing materials in a location suitable to the Owner.

2.2 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Owner and place in location as directed; obtain receipt prior to final payment. Items shall be boxed and labeled with contents.

2.3 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.

B. Cord and Plug: Furnish minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.4 TOLERANCES

A. Monitor fabrication and installation tolerance control of installed Products over suppliers, manufacturers, Products, site conditions, and workmanship, to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply fully with manufacturer’s tolerances.

C. Adjust products to appropriate conditions. Position before securing products in place.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01 73 00 - EXECUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction Safety / Safety Program

B. Construction Layout

C. General Installation of Products

D. Starting of Systems

E. Demonstration and Training

F. Removals and Cleanup

G. Protection of Installed Construction

1.2 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

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

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturers written recommendations and instructions for installation of products and equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. **Beginning new Work means acceptance of existing/job-site conditions.**

B. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

C. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping.
2. Verify the location of underground electrical services, natural gas piping and other utilities.
3. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

D. Contact OUPS a minimum of 48 hours prior to beginning work to verify location of existing utilities, coordinate requirements as applicable.
   1. Contact private utility locating services as required by the conditions. It is the Contractor's responsibility to locate all public and private utilities that may be impacted by the work.

E. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

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

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Architect / Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a RFI request to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

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

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

3.3 FIELD VERIFICATION

A. Prior to ordering materials, Contractor shall verify the actual dimensions of existing conditions and assume responsibility for workable solutions for all new work. Verification that the new work and items are workable for existing conditions while providing adequate clearances is the responsibility of the Contractor.

3.4 CONSTRUCTION SAFETY / SAFETY PROGRAM

A. Develop, implement, and maintain a written safety program for all operations/ work performed on this project. Keep these documents at the job site and make available to the Architect / Owner upon request.

B. Assume all responsibility for project safety, ways, and means and methods of constructing the project. Engage safety consultant as may be necessary for the execution of the work.

C. In addition, the Owner may require special safety requirements to be performed by the Contractor, these requirements will be provided prior to commencement of work.

3.5 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect / Owner promptly.
   1. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction. Do not change or relocate benchmarks or control

points without prior written approval. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grades or locations.

2. Promptly replace lost or destroyed project control points. Base replacements on the original survey control points.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
   1. Establish permanent benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Verify setbacks and esasements.
   3. Establish limits on use of Project Site.
   4. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   5. Inform installers of lines and levels to which they must comply.
   6. Check the location, level and plumb, of every major element as the Work progresses.
   7. Notify Architect / Owner when deviations from required lines and levels exceed allowable tolerances.
   8. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

3.6 INSTALLATION, GENERAL

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Maintain minimum headroom clearance, coordinate with Architect.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Contract Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
   1. Mounting Heights: Coordinate with Architect as applicable.
   2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
4. Electrical wiring and associated metallic conduit shall not be embedded within roof assemblies or placed directly below roof decks. Electrical wiring or metallic conduit located near roof assemblies shall be positioned and supported at least 10 inches away from the bottom side of the metal roof deck or other substrate to which a roof system has been or will be applied.
5. Suspension wires, straps, chains, and metal framing such as those used to support the following shall not be attached to or through steel roof decks.
    a. Bulkheads.
    b. Suspended ceilings.
    c. Fire-suppression systems.
    d. Ductwork.
    e. Lighting.
    f. Similar items.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

3.7 PROTECTION

A. Accomplish all work in accordance with the provision of Federal, State American Standard Safety Code for Building Construction and OHSA safety requirements.
    1. Provide all aspects of project safety including protective railings and guards, tie-offs, fall protection, and other safety measures as required by OSHA, even if not specified. Fall protection is required. Architect is not a safety consultant and as such does not direct the means and methods of compliance with safety regulations.

B. Protect and maintain all building entrances, interior contents, building exterior and grounds.
    1. Return all surfaces to their original condition after all work is complete.

C. Replace / Repair any damages [including interior or exterior equipment / finishes] at no expense to the Owner in the event of damages of any kind caused by improper protection.

D. Comply with all regulations of the Local Fire Department and the Owner's requirement regarding storage and handling of flammable materials, etc. Comply with the safety provisions of the National Fire Code pertaining to such hot work. Contractor is responsible for all damage or fines resulting from failure to comply.

3.8 STARTING OF SYSTEMS

A. Coordinate schedule for startup of various equipment and systems.

B. Notify Architect / Owner seven [7] days prior to startup of each item.

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

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

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

F. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

G. Adjust operating components for proper operation to ensure smooth and unhindered operation in accordance with manufacturer requirements.

H. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.9 TESTING, ADJUSTING, AND BALANCING

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

3.10 DEMONSTRATION AND TRAINING

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner’s personnel in detail to explain all aspects of operation and maintenance.
   1. Prepare and insert additional data into the operations and maintenance manuals when the need for additional data becomes apparent during instruction.

3.11 REMOVALS AND CLEANUP

A. Remove and demolish of items that are required for proper completion of the work as applicable in each section. All debris resulting from the work not designated for reuse becomes the property of the Contractor unless stated otherwise.

B. Keep all work areas and project sites neat and free of trash and clutter at all times.

C. Maintain the work areas, including all subcontractor’s work, clean of all debris to the satisfaction of the Owner at the completion of each work day [daily cleanup].

D. Provide dumpsters or trash containers needed for the proper removal of project materials, trash, or debris related to the work.
   1. No Debris, materials, etc. may be left unprotected on the grounds.
   2. All exterior staging / dumpster areas must be fenced / protected.

3.12 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Contract Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

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

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

F. Prohibit traffic or storage upon waterproofed or roofed surfaces, finished surfaces, etc as is applicable to the work. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer and provide all required protection as determined necessary. Any damage caused shall be repaired to like new condition.

G. Prohibit traffic from landscaped areas.

3.13 CORRECTION OF WORK

A. Repair or remove and replace damaged, defective, or nonconforming work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with watching materials, and properly adjusting operating equipment.

B. Repair work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 77 00 - CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 WORK INCLUDES

A. Punchlist Requirements

B. Substantial Completion

C. Final Contract Completion

D. Project Record Documents

E. Warranties

F. Final Cleaning

G. Repair of Work

1.2 PUNCHLIST REQUIREMENTS

A. Review and inspect all Work prior to notifying Architect / Owner for a Punchlist inspection of the work.
   1. Provide seven [7] day notice prior to work being complete to establish desired inspection date. Architect / Owner will either proceed with the inspection or notify Contractor of unfulfilled requirements.
   2. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for punch list inspection.

B. Architect / Owner will inspect the completed project and notify the Contractor of any deficiencies. Deficiencies will form 'punch list' for final acceptance.

C. If work is clearly not complete, the Punchlist will be suspended until such time that it is evident that the Contractor has completed and reviewed / inspected their own work.
   1. Architect anticipates [1] punchlist inspection and [1] back-punch / final inspection as part of services to the Owner.
   2. Failures by the Contractor to complete the work, complete punchlists, etc. may result in a backcharge to the Contractor for the additional time to closeout the project.

D. Review and provide the noted repairs and corrective work necessary at each of the Punchlist inspections to allow project close out.
   1. Back-punch walk through may result in additional punchlist items which need to be addressed by the Contractor.

E. Provide / allow adequate time in the construction schedule to accomplish punchout work within the overall contract period indicated within the bid documents.

F. The failure to identify any punchlist item during a walk through / inspection does not release the Contractor from contractual responsibility to address any item during the warranty period.

1.3 SUBSTANTIAL COMPLETION

A. A Certificate of Substantial Completion [AIA Form G704] will be issued upon completion of all the work. Certificate of Substantial Completion will set forth the date of warranty commencement, work yet to be completed, timeline for completion of that incomplete work, and value of that incomplete work.

1.4 FINAL CONTRACT COMPLETION

A. Provide the following items to the Owner prior to acceptance and final payment
   1. Evidence that any open claims or disputes are resolved.

2. Notarized affidavit of waiver of liens [contractor of record], sub-contractors and material suppliers
3. Final Permit approval / inspection / Certificate of Occupancy from authorities having jurisdiction
4. Final Application for Payment.
   a. Submit a final Application for Payment according to Section 01 29 00, Payment Procedures.
5. Documented evidence of completing 'punch list' as applicable.
6. Manufacturer's original warranties, including contractor maintenance agreements and warranties as applicable.
7. O+M Manuals
8. Manufacturer's maintenance and repair instructions.
9. As-Built / Record Drawings.
10. Final cleaning.
11. Restore all work staging and lay-out areas to pre-construction conditions, including but not limited to, removal of debris, temporary facilities, grading and grass seeding and cleaning or repair of impacted structures.

1.5 PHOTOGRAPHIC DOCUMENTATION

A. When requested by the Owner, photos of the completed punch list along with any supporting documentation can be submitted, in lieu of a final walkthrough.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Construction Bulletins / Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

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, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction as follows:
   1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
   2. Include locations of concealed elements of the Work.
   3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
   4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
   5. Identify and locate existing buried or concealed items encountered during Project.
   6. Measured depths of foundations in relation to finish first floor datum.
   7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
9. Field changes of dimension and detail.
10. Details not on original Drawings.

G. Submit documents to Architect / Owner upon completion of Work.

1.7 WARRANTIES AND GUARANTEES

A. Refer to Owner Contract Requirements / Terms and Conditions for Additional information and requirements.

B. General: The warranty and guarantee provisions of the General Conditions apply to all work of the contract, including but not limited to the following specific categories related to individual units of work specified in various sections of these specifications:
1. Special Project Warranty (Guarantee): A warranty specifically written and signed by the Contractor for a defined portion of the work, and, where required, countersigned by sub-contractor, installer, manufacturer, or other entity engaged by the Contractor.
2. Specified Product Warranty: A warranty which is required by the contract documents, to be provided for a manufactured product incorporated in the Work, regardless of whether manufacturer has published a similar warranty without regard for specific incorporation into the work, or has written and executed a special project warranty as a direct result of contract document requirements.
3. Coincidental Product Warranty: A warranty which is not specifically required by the Contract Documents (other than as specified in this Section); but which is available on a product incorporated into the work, by virtue of the fact that the manufacturer of the product has published a warranty in connection with purchases and users of the product without regard for specific applications except as otherwise limited by terms of the warranty.

C. All work undertaken as part of the project shall be warranted for a period of not less than [1] year. Individual sections / products may have specific additional warranty requirements.

D. Provide notarized copies of warranty documents to the Owner.
1. Execute and assemble transferable warranty documents from subcontractors, suppliers, and manufacturers.

E. Original warranties are required to be provided to the Owner prior to final payment.

PART 2 PRODUCTS

Not Required

PART 3 EXECUTION

3.1 FINAL CLEANING AND SITE REPAIR

A. Provide final cleaning of all work areas:
1. Execute final cleaning prior to final inspection.
2. Clean Project site, yard, and grounds in areas disturbed by Construction activities.
3. Sweep paved areas broom clean. Remove all spills, stains, and foreign deposits.
4. Rake grounds that are neither planted or paved to a smooth, even textured surface.
5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
6. Remove debris and surface dust from roofs, plenums, values, attics, and similar spaces.
7. Sweep concrete floors broom clean in non-occupied spaces.
8. Vacuum carpet and soft surfaces to remove debris. Shampoo if conditions warrant.

9. Clean transparent materials including glass in doors and windows. Remove glazing compounds.
10. Remove all labels which are not permanent.
11. Clean plumbing fixtures to sanitary condition, free of all stains.
12. Replace air filters.
13. Clean ductwork if utilized during construction without proper protection.
14. Clean light fixtures, globes, reflectors.
15. Clean interiors of all cabinetry.
16. Remove waste and surplus materials, rubbish, and construction facilities from site.

B. Restore all work staging and lay-out areas to pre-construction conditions, including but not limited to, removal of debris, temporary facilities, grading and grass seeding and cleaning or repair of impacted structures.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Contract Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION

SECTION 01 78 00 – OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Operation and Maintenance Manuals.

1.2 OPERATION AND MAINTENANCE MANUALS

A. Organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system.

B. Binder cover: printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project. Label on the front and spine of the binder.

C. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name and contact information for Contractor.
   6. Name and contact information for all Sub-Contractors.
   7. Name and contact information for all Major Suppliers.
   8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

E. Manual Organization:
   1. Organize into sets of manageable size. Arrange contents by CSI division. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   2. Internally subdivide binder contents with permanent page dividers, logically organized, with tab titles legibly printed under reinforced laminated plastic tabs.

F. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents.

G. Submit O+M manuals prior to Contract Completion.
   1. Bind one [1] hard copy in 8-1/2 x 11 inch text pages, three D side ring binders with durable plastic covers.
   2. Create [2] digital copies in PDF format in a format and organization to match the hard copy.

H. Content:
   1. Title Page
   2. Table of Contents
   3. Permit and Inspection Information
   4. Project submittals, organized by CSI division
   5. Operation and maintenance instructions, arranged by CSI division and system.
      a. Building Products, Equipment, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.

b. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
c. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.
d. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
e. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; service schedule, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
f. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
g. Spare Parts List and Source Information.
h. Maintenance Service Contracts.

6. Project documents and certificates.
   a. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers.
7. Colors / finishes / samples
8. Other documentation required.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02 41 16 - SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolishing designated building equipment and fixtures.
   2. Demolishing designated construction.
   3. Cutting and alterations for completion of the Work.
   4. Removing designated items for salvage by Owner.
   5. Protecting items designated to remain.
   6. Removing demolished materials.

1.2 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of capped utilities, concealed utilities, discovered during demolition and any subsurface obstructions or conditions that require noting.

1.3 QUALITY ASSURANCE

A. Conform to applicable code for demolition work, dust control, protection, products requiring electrical disconnection and re-connection

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

1.4 SCHEDULING

A. Schedule Work to coincide with proposed alterations and improvements.

B. Coordinate Work with Work by Others and Work by Owner as needed.

C. Coordinate utility and building service interruptions with Owner.
   1. Do not disable or disrupt site fire or life safety systems without three days prior written notice to Owner.

D. Schedule tie-ins to existing systems to minimize disruption.

1.5 PROJECT CONDITIONS

A. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Call Local Utility Line Information service not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas. Supplement with private locator company as is applicable and required to fully locate and identify existing underground utilities, including both public and private.

C. Mark location and termination of utilities.

D. Erect, and maintain temporary barriers and security devices including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.

E. Erect and maintain weatherproof closures for exterior openings as applicable to work/scope.

F. Erect and maintain temporary partitions.

G. Prevent movement of structure; provide temporary bracing and shoring as required.

H. Provide appropriate temporary signage.

I. Do not close or obstruct building egress path.

J. Do not disable or disrupt building fire or life safety systems without **three** days prior written notice to Owner. Coordinate with Fire Department / Building Official.

K. Protect existing structure / items to remain.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove building components and equipment indicated to be salvaged.

E. Disassemble as required to permit removal from building.

F. Package small and loose parts to avoid loss.

G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to location identified by Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Provide all demolition and removals necessary for the proposed work. Field coordinate all conditions with the design intended on the drawings.
   1. Drawings are diagrammatic and may not reflect the full extent of demolition / removals required to accomplish the proposed scope of work.
   2. The Contractor shall coordinate design intent and verify that all demolition work and restoration / repair work required is included in the scope of the project, regardless of specifically being noted on the drawings.
   3. Work includes abandoned furnishings, equipment, and building components that are required to be removed to render rent ready.
   4. Confirm with GDPM personnel prior to demolition to verify any items to be salvaged and turned over to GDPM.

B. Provide abatement of hazardous materials from the buildings as applicable for the completion of the work.

C. Conduct demolition to minimize interference with adjacent and occupied buildings/units.

D. Maintain protected egress from and access to adjacent existing buildings/units at all times.

E. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer.

F. Disconnect and remove utilities within demolition areas, refer to Drawings.

G. Cap and identify abandoned utilities at termination points when utility is not completely removed.

H. Do not close or obstruct roadways or sidewalks without permits.

I. Demolish in orderly and careful manner. Protect existing improvements.

J. Carefully remove building components indicated to be reused.

K. Disassemble components as required to permit removal.

L. Box and label contents for all items scheduled to salvage. Obtain sign off.

M. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

N. Remove materials as Work progresses.

O. Upon completion of Work, leave areas in clean condition.

P. Remove temporary Work.

3.4 CLEAN UP

A. Remove demolished materials from site as work progresses.

B. Leave areas of work in clean condition.

END OF SECTION

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SECTION 02 50 00 - HAZARDOUS MATERIALS SPECIFICATIONS

PART 1 GENERAL

1.1 SAMPLING

A. The Owner contracted with a third party environmental consultant, Turn-Key Environmental Consultants to provide sampling and analysis of various existing building materials in the area of work of this project. Copies of these reports are available for review and are attached herein.

B. While no materials were determined to contain ACM content greater than 1%, the Contractor is cautioned that there may be conditions or other materials which may vary in the field or are concealed. Take appropriate measures if any materials are encountered which are suspected to contain ACM.

1.2 SUMMARY

A. Provide the appropriate abatement of the identified materials per the specifications prepared by Turn-Key Environmental Consultants that follow this section, using industry standard practices as identified for the proper execution of the proposed renovations to the buildings. Provide all necessary protection, air testing, removal, and disposal.

B. Comply with Occupational Safety and Health Administration regulation 29 CFR 1926.62 “Lead in Construction Standard” as well as the Environmental Protection Agency Lead, Renovation, Repair and Painting Rule.

C. Follow all applicable EPA rules and regulations when working with hazardous materials. Remain in compliance at all times during the project.

D. Hazardous materials exist at various areas of the project site as identified.

E. If any work person encounters any material which they suspect may be hazardous or toxic, they shall immediately advise the Owner. The contractor shall take immediate and appropriate action to protect the building users and workers in accordance with federal, state, and local laws, codes and regulations. The architect and architect's consultants shall have no responsibility for the discovery, presence, handling, removal or disposal of or exposure of persons to hazardous materials in any form at the projects site, including but not limited to asbestos, asbestos products, polychlorinated biphenyl (pcb) or other toxic substances.
   1. The contractor is hereby advised that RDA Group Architects, LLC is not a design professional in the determination of the presence of hazardous materials, nor is RDA a design professional involved in making recommendations regarding the testing, removal, encapsulation or other corrective measures pertaining to hazardous materials.
   2. If the work which is to be performed under the contract interfaces in any way with the existing components which contain hazardous materials, it is the contractor’s responsibility to contact the owner's environmental consultant regarding the proper means & methods to be utilized in dealing with hazardous materials.
   3. By execution of the contract for construction, the contractor hereby agrees to bring no claim for negligence, breach of contract, indemnity or otherwise against the architect, his principles, employees, agents or consultants if such a claim in any way would involve the investigation of or remedial work related to hazardous materials in the project.
   4. By execution of the contract for construction, the contractor further agrees to defend, indemnify and hold the architect, his principles, employees, agents or consultants harmless from any such asbestos or other hazardous materials related claims that may be brought by the contractor's subcontractors, suppliers or other third parties who may be acting under the direction of the contractor pursuant to this project.

1.3 EXECUTION

A. Contractor shall be fully responsible for the proper removal and disposal of materials. All work shall be performed by trained individuals in accordance with the requirements of this Section, all current Federal, State, and Local laws/regulations.

END OF SECTION

Turn-Key Environmental Consultants, Inc.
790 Barnhart Rd. 31 S. Main St., STE 214 Phone: 937-335-8807
Troy, OH 45373 Dayton, OH 45402 Fax: 937-339-4882

February 5, 2026

Mr. Kevin Arnold
Greater Dayton Premier
Management 400 Wayne Ave,
Dayton, OH 45401

RE: Sampling and Analysis of Suspect Material for Possible Asbestos Content at 2765 Wentworth Ave, Dayton, OH 45406

Turn-Key Environmental Consultants, Inc. (TKEC) was contracted by you to perform a limited asbestos inspection and to sample suspect materials in the residence located at 2765 Wentworth Ave, Dayton. On January 29, 2026, TKEC's Mr. Noah Perez, OEPA accredited Asbestos Hazard Evaluation Specialist (#ES550995) traveled to the subject property to collect representative samples of suspect materials. The bulk samples of suspect asbestos materials were sent to SanAir Technologies Laboratory for analysis.

The bulk samples were analyzed for asbestos content by method Asbestos Bulk PLM EPA 600/R-93/116. A sample is determined to be Asbestos-Containing Materials (ACM) when the asbestos content is **greater** than one percent (>1%). ACM must be abated by a licensed asbestos abatement contractor. The results of the laboratory analysis are attached and summarized below:

- The Thermal System Insulation (TSI) jacket puddy on 2",6",8" and 18" piping located in the boiler room are not an asbestos containing materials.

TKEC makes no warranty; either expressed or implied, that this site is free from other Asbestos-Containing Materials. Turn-Key Environmental Consultants, Inc. is not responsible for conclusions, recommendations, determinations, or data interpretations that may be made by other parties, based on the information provided in this report.

Sincerely,

Noah Perez,
Environmental Technician
OEPA Asbestos Hazard Evaluation Specialist
No. ES550995, Exp. Date 12/12/2026

SanAir Technologies Laboratory

The Identification Specialists

Analysis Report
prepared for
Turn-Key Environmental Consultants, Inc.

Report Date: 2/3/2026

Project Name: 2765 Wentworth

Project #: 26121

SanAir ID#: 26005113

NVLAP TESTING

NVLAP LAB CODE 600227-0

11709 Chesterdale Road, Cincinnati, Ohio 45246
888.895.1177 | 513.438.6006 | LabReports@SanAir.com | SanAir.com

SanAir Technologies Laboratory

SanAir ID Number
26005113
FINAL REPORT
2/3/2026 5:20:27 PM

Name: Turn-Key Environmental Consultants, Inc.
Address: 790 Barnhart Road
Troy, OH 45373
Phone: 937-335-8807

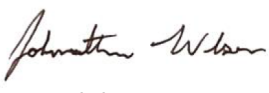
Project Number: 26121
P.O. Number:
Project Name: 2765 Wentworth
Collected Date: 1/29/2026
Received Date: 1/30/2026 12:25:00 PM

Analyst: Poeppelman, Dustin

Asbestos Bulk PLM EPA 600/R-93/116

	Stereoscopic	Components		
SanAir ID / Description	Appearance	% Fibrous	% Non-fibrous	Asbestos Fibers
1-1 / 26005113-001 TSI Jacket Putty-18", Boiler	Various Non-Fibrous Heterogeneous	10% Cellulose 10% Glass	80% Other	None Detected
1-2 / 26005113-002 TSI Jacket Putty-18", Boiler	Various Non-Fibrous Heterogeneous	10% Cellulose 10% Glass	80% Other	None Detected
1-3 / 26005113-003 TSI Jacket Putty-18", Boiler	Various Non-Fibrous Heterogeneous	10% Cellulose 10% Glass	80% Other	None Detected
2-1 / 26005113-004 TSI Jacket Putty-6", Domestic Water	Various Non-Fibrous Heterogeneous		100% Other	None Detected
2-2 / 26005113-005 TSI Jacket Putty-6", Domestic Water	Various Non-Fibrous Heterogeneous		100% Other	None Detected
2-3 / 26005113-006 TSI Jacket Putty-6", Domestic Water	Various Non-Fibrous Heterogeneous		100% Other	None Detected
3-1 / 26005113-007 TSI Jacket Putty 8", Air Handler	Various Non-Fibrous Heterogeneous		100% Other	None Detected
3-2 / 26005113-008 TSI Jacket Putty 8", Air Handler	Various Non-Fibrous Heterogeneous		100% Other	None Detected
3-3 / 26005113-009 TSI Jacket Putty 8", Air Handler	Various Non-Fibrous Heterogeneous		100% Other	None Detected
4-1 / 26005113-010 TSI Jacket Putty 6", Boiler 1	Tan Non-Fibrous Homogeneous	5% Wollastonite	95% Other	None Detected

Analyst: 
Analysis Date: 1/30/2026

Approved Signatory: 
Date: 2/3/2026

SanAir Technologies Laboratory

SanAir ID Number
26005113
FINAL REPORT
2/3/2026 5:20:27 PM

Name: Turn-Key Environmental Consultants, Inc.
Address: 790 Barnhart Road
Troy, OH 45373
Phone: 937-335-8807

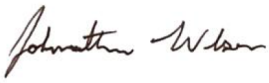
Project Number: 26121
P.O. Number:
Project Name: 2765 Wentworth
Collected Date: 1/29/2026
Received Date: 1/30/2026 12:25:00 PM

Analyst: Poeppelman, Dustin

Asbestos Bulk PLM EPA 600/R-93/116

	Stereoscopic	Components		
SanAir ID / Description	Appearance	% Fibrous	% Non-fibrous	Asbestos Fibers
4-2 / 26005113-011 TSI Jacket Putty 6", Boiler 1	Tan Non-Fibrous Homogeneous	5% Wollastonite	95% Other	None Detected
4-3 / 26005113-012 TSI Jacket Putty 6", Boiler 1	Tan Non-Fibrous Homogeneous	5% Wollastonite	95% Other	None Detected
5-1 / 26005113-013 TSI Jacket Putty 2", Make Up Water	Various Non-Fibrous Heterogeneous	10% Cellulose 10% Glass	80% Other	None Detected
5-2 / 26005113-014 TSI Jacket Putty 2", Make Up Water	Various Non-Fibrous Heterogeneous	10% Cellulose 10% Glass	80% Other	None Detected
5-3 / 26005113-015 TSI Jacket Putty 2", Make Up Water	Various Non-Fibrous Heterogeneous	10% Cellulose 10% Glass	80% Other	None Detected
2-3 / 26005113-016	Various Non-Fibrous Heterogeneous		100% Other	None Detected

Analyst: 
Analysis Date: 1/30/2026

Approved Signatory: 
Date: 2/3/2026

SanAir Technologies Laboratory

10501 Trade Ct., Suite 100
N. Chesterfield, VA 23236
804.897.1177 / 888.895.1177
Fax 804.897.0070
sanair.com

Asbestos Chain of Custody

Form 140, Rev 7, 10/20/2022

SanAir ID Number
26005113

Received by RB on 1/30/26 at 12:25 PM

Company: Turn-Key Environmental Consultants, Inc.	Project #: 26121	Collected by: Noah Perez	
Address: 790 Barnhart Road	Project Name: 2705 Wentworth	Phone #: 937-335-8807	
City, St., Zip: Troy, OH 45373	Date Collected: 1-29-26	Fax #: 937-339-4882	
State of Collection: OH Account#: 1549	P.O. Number:	Email:	

Bulk

ABB	PLM EPA 600/R-93/116	X
	Positive Stop	
ABEPA	PLM EPA 400 Point Count	
ABB1K	PLM EPA 1000 Point Count	
ABBEN	PLM EPA NOB**	
ABBCH	TEM Chatfield**	
ABBTM	TEM EPA NOB**	
ABQ	PLM Qualitative	

** Available on 24-hr. to 5-day TAT

Water

ABHE	EPA 100.2	

Air

ABA	PCM NIOSH 7400	
ABA-2	OSHA w/ TWA*	
ABTEM	TEM AHERA	
ABATN	TEM NIOSH 7402	
ABT2	TEM Level II	
Other:		

New York ELAP

ABEPA2	NY ELAP 198.1	
ABENY	NY ELAP 198.6 PLM NOB	
ABBNY	NY ELAP 198.4 TEM NOB	
	Positive Stop	

Soil

ABSE	PLM EPA 600/R-93/116 (Qual.)	

Vermiculite

ABB	PLM EPA 600/R-93/116	
ABEPA3	PLM EPA 400 Point Count	
ABCM	Cincinnati Method	

Dust

ABWA	TEM Wipe ASTM D-6480	
ABDMV	TEM Microvac ASTM D-5755	

Matrix	Other	

Turn Around Times				
	3 HR (4 HR TEM) ☐	6 HR (8HR TEM) ☐	12 HR ☐	1 Day ☐
	☐ 2 Days	☐ 3 Days	☐ 4 Days	☒ 5 Days

Special Instructions

Sample #	Sample Identification/Location	Volume or Area	Sample Date	Flow Rate*	Start – Stop Time*	
1.	See attached Sample Log					

Relinquished by	Date	Time	Received by	Date	Time
	1-29-26	1700			

If no technician is provided, then the primary contact for your account will be selected. Unless scheduled, the turnaround time for all samples received after 3 pm EST will be logged in the next business day. Weekend or holiday work must be scheduled ahead of time and is charged at 150% of the 3hr TAT or a minimum charge of $150. A courier charge will be applied for same day and one-day turnaround times for offsite work. SanAir covers Ground and Next Day Air shipping. Shipments billed to SanAir with a faster shipping rate will result in additional charges.

Page_____of_____

SanAir ID Number
26005113

ASBESTOS BULK SAMPLE LOG

Project - 26121

TKEC Project: ~~25~~ 2765 Wentworth

Received by RB on 1/30/26 at 12:25 PM
Page 2 of 2

Sample #	Date	Color	Type	Location	Condition
1-1	1/29/26	White	TSI Jacket Puddy - 18"	Boiler	
1-2		"	"	"	
1-3		"	"	"	
2-1		"	TSI Jacket Puddy 6"	Domestic water	
2-2		"	"	"	
2-3		"	"	"	
3-1		"	TSI Jacket Puddy 8"	Air handler	
3-2		"	"	"	
3-3		"	"	"	
4-1		"	TSI Jacket Puddy 6"	Boiler 1	
4-2		"	"	"	
4-3		"	"	"	
5-1		"	TSI Jacket Puddy 2"	Make up water	
5-2		"	"	"	
5-3		"	"	"	

12/3/2025

Noah Perez
Turn-Key Environmental Consultants, Inc.
790 Barnhart Rd
Troy, OH 45373

RE: Evaluation Specialist
Certification Number: ES550995
Expiration Date: 12/12/2026

Dear Noah Perez:

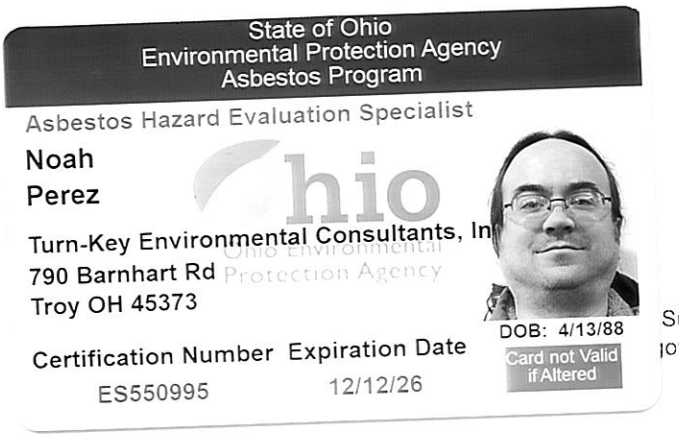
This letter and enclosed certification card approves your request to be certified as an asbestos Evaluation Specialist. You must present your card upon request at any project site while performing duties. Copies of cards are not acceptable as proof of certification.

This certification may be revoked by the Director of the Ohio Environmental Protection Agency (EPA) for violation of any of the requirements of 3745-22 or 3745-20 of the Ohio Administrative Code.

If you have any questions, please contact the Asbestos Program at 614-644-0226 or by email at asbestoslicensing@epa.ohio.gov.

Sincerely,

Brandon M. Schwendeman
Brandon Schwendeman
Manager, Business Operations Support Section
Ohio EPA - Division of Air Pollution Control



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MECHANICAL

SECTION 15500

INDEX

MECHANICAL

SECTION 15500

1. NOTE

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

2. SCOPE

   A. The work included under this section shall consist of the furnishing of all material, equipment and labor required to install the heating, ventilating and air conditioning work indicated on the drawings and as specified hereinafter, including the balancing, testing, and adjustment of same.

3. DESCRIPTION OF WORK

   A. The following is a summary of the principal categories of work under this section. Note, however, that this listing is for general information only and work will not necessarily be limited to these categories. The detailed drawings and the following specifications cover the full extent of the work.

   B. The plans show the approximate location of the equipment, piping and ductwork systems, etc. involved under this section. All such work shall be performed and completed in the required manner in accordance with the contract documents.

   C. Demolition:

      1. Perform all demolition work as shown on the drawings and as specified herein or as may otherwise be required.

         a. Where items of equipment are to be removed, all incidental piping, fittings, ductwork, accessories, etc. shall be included (removed) where such items will no longer be operational.

         b. Where piping removal is indicated or required, the line shall be removed back to a main or a main branch whenever possible. At the termination point the remaining pipe shall be capped or plugged and insulated to match existing. Removal shall include associated hangers, supports, etc.

         c. Where ductwork is to be removed, all supports, hangers, etc. are to be included. The resulting ductwork openings shall be covered, sealed and insulated to match adjacent surfaces.

2. Piping and/or ductwork penetrating walls that are to be demolished shall be supported and shall have insulation patched as required. In cases where piping is running within the wall, such piping shall be removed and capped as described above.

3. Note that proper and legal disposal is considered to be part of the demolition / removal process referred to above.

D. Construction:

1. Demolition and removals
2. Duct cleaning (mechanical room)
3. Sheetmetal and air devices
4. Miscellaneous heaters
5. Fans
6. Glycol
7. Chemical treatment
8. Make Up Air Unit
9. Pipes, Valves and Fittings
10. Air Cooled Chiller
11. Pumps and hydronic accessories
12. Rigging
13. Balancing
14. Concrete Pads
15. Temperature Controls
16. Insulation
17. Check, test, startup and warranty

4. SITE INVESTIGATION

A. Prior to bidding, it is strongly recommended that the contractor visit the job site and investigate all details which may have any effect on the installation, progress or completion of the project.

B. When a bid is received, it will be assumed that the contractor has made the job site visit(s) and is familiar with the conditions as they exist and any adjustments and/or modifications that may be necessary in order to perform and complete the work as specified.

C. At project start-up, certain areas will be designated for the storage of materials and equipment and cooperation with the Owner in minimizing interference with existing operations will be mandatory.

5. WORK DONE BY OTHER TRADES

A. The bidder for this section of the work shall become familiar with all bid documents for the entire project as the Mechanical Contractor will be the prime contractor.

B. Portions of the work on this project that are covered elsewhere by a sub-contractor to the Mechanical Contractor includes the following:

C. All plumbing work as shown and called for.

D. All electrical work (unless specifically covered under this section) which shall include providing power to all externally wired equipment installed for this project. Work to be performed by the Electrical Subcontractor is indicated on the electrical drawings.

E. Cutting, patching, rigging, roofing, structural, etc.

6 . INTERLOCK AND CONTROL WIRING

A. Unless otherwise indicated on the drawings or elsewhere in the specifications, all required and/or referenced interlock and control wiring involving equipment and systems installed under this section of the work shall be provided (furnished, installed, wired, etc.) by this contractor.

B. Low voltage wiring in concealed areas shall be run in EMT conduit. In mechanical/boiler rooms conduit shall also be EMT. Control wiring in conduit must be color coded and all conductors shall be tagged or otherwise identified. Unless specifically called for by the equipment manufacturer, all such wiring shall be minimum 20 gauge, 150 volt, type TW or rubber insulated jacketed type. An exterior control wiring shall be in EMT with liquid-tight fittings and boxed.

C. Line voltage wiring shall be in accordance with applicable requirements of the National Electric Code. As specified above for low voltage applications, all wiring must be color coded with all conductors tagged.

7. MAINTENANCE OF EXISTING FACILITIES

A. To the extent possible, maintenance of existing facilities for the present building(s) will be required. The actual length of time for any interruption shall be held to an absolute minimum. At least 72 hours in advance of the severance of any services or facilities due to modification of pipe, ductwork and/or equipment, submit the plan to the Engineer and the Owner, detailing the nature and estimated duration of the interruption and the method of procedure. Do not, under any circumstances, proceed with an interruption of service without the Owner's authorization.

B. Where alterations or additions to the existing building(s) are indicated, this work shall include all removal, rerouting, or replacement of all existing facilities located in pipe spaces or walls being removed, as may be necessary to permit operation of a complete working system or systems where applicable to the trade jurisdictions involved in this section of the specifications.

C. Where an item of equipment is to be removed, all incidental piping, fittings, ductwork, accessories, etc., associated with the equipment shall also be included where it will no longer function as part of the operating system.

1. All piping, ductwork, etc. that has been re-routed or otherwise disturbed shall be insulated as required to match existing.

D. Where existing facilities are permanently abandoned, each outlet branch, etc. shall be removed completely (back to the main, when possible) and plugged or capped. All abandoned services shall be terminated well behind adjacent finished surfaces.

E. Unless otherwise mentioned, all material, equipment, etc. removed under this contract heading shall be disposed of in a proper and legal manner.

8. BIDDING

A. All bids shall be based upon furnishing and installing the make of materials and apparatus specified herein WITHOUT SUBSTITUTION, in order that all bids may be properly compared.

B. Other materials, equipment or systems that the bidder may desire to use as a substitute for that specified will be considered IF PROPOSED AT THE TIME OF BIDDING and shown on the substitution sheet of the proposal. Such alternate items shall be of equally high quality with all safeguards, design features and operational requirements as shown on the drawings and/or as specified herein.

C. It is understood that proposals to use such substitutes shall be made in addition to and separate from the base bid in order to receive consideration and the addition to or deduction from base bid, if any, shall be duly noted on the bid form.

D. Regarding substitutes, note that any deviations from the following specifications or any special equipment requirements (ambient conditions, utilities, power conditioning, etc.) necessary for full time operation shall be clearly stated and completely itemized. Failure to meet these stipulations could result in additional expense that would be assigned to this section of the work and not considered as an extra.

E. If no proposals for substitutes are listed on the bid form, no such proposals will be permitted for later consideration unless delivery schedules or other factors beyond the Contractor's control justify same.

F. If more than one make of material or equipment is specified, the proposed manufacturer, brand, type, etc. shall be identified. If this provision is not complied with, the Owner may then make this selection without change in contract price.

G. Note that in the following specifications, where more than one manufacturer is listed for a particular item of operating equipment, the design will be based on the first named. If equipment by the other named manufacturer(s) or a proposed substitute requires redesign work, revised/modified services, or specific additional field work by other trade(s), the price submitted for providing this equipment must include the required additional amount to cover such work.

9. DRAWINGS

A. The drawings prepared for this project are an outline to show where pipes, ducts, apparatus, equipment, etc., should generally be located in order to fit within the confines of available space and minimize conflicts with other trades. All work must be installed in accordance with the drawings insofar as possible. All drawings shall be carefully checked during the course of bidding and construction. If any discrepancies, errors or omissions or overlaps with other trades are discovered prior to or during the construction phase, notify the Engineer immediately for interpretation or correction. Note that an overlap with another trade does not relieve the contractor from the obligation of performing the work indicated on the drawings for this section of the project unless written notification stating such is obtained from the Engineer.

B. Take all necessary measurements and be responsible for same, including clearances for all materials and equipment that will be furnished. The Architect/Engineer shall reserve the right to make minor location changes of piping and/or equipment where such adjustments are deemed desirable from an appearance or operational standpoint. Such changes will normally be anticipated sufficiently in advance to avoid extra work or unduly delay progress on the project.

C. The general building drawings shall be used to obtain dimensions and exact locations and as a check with other disciplines to avoid interferences. Prior to making any layout drawings refer to applicable drawings on all branches of the work where other trades are involved on the project. Also, consult with the other trades in producing coordination/erection drawings so that added field work and/or job delays resulting from conflicts between crafts can be avoided. Piping that has been prefabricated before coordinating with the other trades will have to be re-done at no additional cost to the Owner if conflicts are encountered.

D. Note that the piping shown on the drawings shall be considered as diagrammatic for clearness in indicating the general run, connections required, etc. and may not in all cases be shown in its true position. The piping and equipment may have to be offset, lowered or raised as required or as directed at the site in order to properly accommodate field conditions.

10. SPECIFICATIONS

A. Specifications shall be interpreted in conjunction with the drawings hereinbefore described and if anything is shown on the drawings and not mentioned in the specifications or vice versa, it is to be included in the work the same as though clearly set forth by both.

B. Furthermore, all materials or labor obviously required to fully complete the work shall be included in the bid, even though each item necessarily involved is not specifically mentioned or shown. Such work and/or material shall be furnished and shall be of the same grade or quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

C. Should an overlap of work between the various trades become evident, the Engineer shall be notified. Such an event shall not relieve any trade of the responsibility for the work called for under his branch of the specifications until a written clarification or directive is issued concerning the matter.

D. When selecting equipment to be used on this project, refer to Item CLEARANCES AND INSTALLATION REQUIREMENTS in these specifications.

E. Note that all systems and items of equipment involved under this contract heading shall be furnished and installed in accordance with applicable requirements of federal, state and local codes including the ADA (Americans with Disabilities Act) and specifically referenced portions of NFPA Standard 90A and ASHRAE 90.1. This shall include adhering to the requirements governing mounting heights for occupant operable controls.

F. All references made to codes, standards, etc. in these specifications or on the drawings shall be taken to mean the latest edition, amendment and/or revision of such reference in effect as of the date indicated on the Bid Documents.

11. PERMITS, FEES, INSPECTIONS, LAWS & REGULATIONS

A. Obtain and pay for all required permits. In addition, pay all necessary inspection fees or similar charges. Laws, codes and regulations which bear upon or affect this work shall be complied with and are hereby made a part of this specification. All work which such laws require to be inspected shall be shown to the proper public

officials for their inspection. In no case shall work be installed contrary to or below the minimum legal standards or in violation of applicable code requirements.

B. At completion of the project furnish to the Owner, at no additional charge, a certificate(s) of inspection issued by the authorized agency (or agencies) having jurisdiction over this portion of the project, verifying that all work executed under this section complies with applicable code requirements.

C. Note that additional fees, charges, etc. imposed by sub-contractors and/or tradesmen, professional consultants, etc., for services rendered in connection with performing or completing any portion of the project shall be included, as part of the work, at no added cost.

12. SHOP DRAWINGS

A. Prepare or obtain from the manufacturer, certified shop or erection drawings of all items of equipment to be furnished under this section and submit copies of same as required for review. This shall be done as soon as possible, well prior to proceeding with installation or construction and in the proper sequence to avoid delays in the work, the work of the Owner or other contractors. Unless otherwise indicated, a minimum of six (6) hard-copy sets OR one (1) electronic copy shall be submitted. These drawings shall be complete in every respect, showing pertinent details of size, capacities, arrangement, fittings, piping, kinds and thickness of materials, weight, loading required, clearances for service, maintenance, etc. Departures or deviations, if any, from the specifications, listed performance data, etc., shall be called out on the submittals. Note that in the following items of this specification, where more than one equipment manufacturer is listed, the first named has been used as the basis for design. All departures or deviations in material, performance, service requirements, size, construction, etc. from first named by the make submitted shall be noted on the shop drawings. **NOTE:** Where departures or deviations from the specifications do occur, the contractor shall additionally itemize same on the cover sheet that accompanies the submittals. Failure to do so will risk subsequent rejection at the job site. (With regard to voluntary substitutions, refer also to Item BIDDING in this specification.)

B. By submitting such drawings, the Contractor represents that he has selected and verified conformance of the proposed materials and equipment to the specifications, has verified the adequacy of the space available and/or taken necessary field measurements, and has noted field construction criteria, etc. related thereto, or will do so. In addition, it will be assumed that the Contractor has checked and coordinated the information contained within such submittals with the requirements of the Work and the Contract Documents as noted in the previous paragraph.

C. Materials and equipment to be furnished for this project shall be of current production by manufacturers regularly engaged in the manufacture of such items.

When two or more similar items are required, they shall be the product of one manufacturer.

D. The review of shop drawings shall not be construed as a complete check but will indicate only that the capacity, general method of construction and/or detailing is satisfactory. It does not involve determining the accuracy or completeness of such particulars as dimensions or quantities or indicating full and complete compliance with the specifications. In addition, it does not deal with the means, methods or procedures of construction or installation. The Contractor shall carefully check and verify dimensions for installation and service requirements before ordering equipment for the project.

E. The Contractor is advised to request submittals from all other trades before proceeding with any piping connections, etc. on equipment furnished by them.

F. Submittals shall be itemized on a standardized shop drawing submittal form stating the name of the project, specification section, paragraph and/or drawing numbers applicable to submittal and shall bear the contractor's review stamp as evidence that the items have already been checked for compliance with Contract Documents as stated above.

G. After review, shop drawings will be returned five (5) hard-copy sets OR one (1) electronic set, marked in one of the following ways:

1. "NO EXCEPTIONS NOTED" - Copies may be distributed as required for construction, shipment, etc. to proceed.

2. "EXCEPTIONS NOTED" - Contractor may proceed with and/or authorize construction, shipment, etc. taking into account the necessary corrections.

3. "EXCEPTIONS NOTED - REVISE AND RESUBMIT" - Contractor will be required to resubmit shop drawings in their entirety. No fabrication, erection or installation shall be authorized or initiated until shop drawings so marked have been completely revised, resubmitted and subsequently marked in accordance with either of the two preceding subparagraphs. Only shop drawings officially marked "NO EXCEPTIONS NOTED" or "EXCEPTIONS NOTED" will be permitted on the jobsite.

H. Upon return of submittals take appropriate action as specified above. Note that any shop drawing copies received beyond the number required will be destroyed (not returned).

I. Where resubmittal is required, four (4) hard-copies OR one (1) electronic copy will be so noted by the reviewer, of which two (2) hard-copies OR one (1) electronic

copy will be returned for corrections (one (l) hard-copy for the contractor and one (l) hard-copy for the supplier/subcontractor).

J. The following is a list, where applicable, of items requiring submittals. Items marked with an asterisk (*) must be provided with a basic demonstration of operation by factory authorized service personnel. See Item INSTRUCTIONS, MANUALS, ETC.

1. Air Devices
2. Make Up Unit
3. Chiller
4. Dampers
5. Pumps / Pumping Systems
6. Boilers
7. Flues, Vents, and Chimney Automation System
8. Domestic Water Heat Exchanger and Tank
9. Temperature Controls
10. Variable Frequency Drives

K. Submittals and Shop Drawings for manufactured items shall be manufacturer's printed listed literature. Equipment selections shall be within manufacturer's published recommended ratings.

L. Performance curves or charts shall be submitted for each air handling unit fan and for each separate centrifugal fan. They shall show static pressure (inches of water) and horsepower versus CFM for total RPM range of fan. Operating point shall be indicated on the performance curve at 100% and 125% of design static pressure for each air handling unit fan and at 100% for the other fans. Note that fan motors shall be selected/sized to be non-overloading at these listed maximum conditions.

1. Forward curved fans shall be selected to the right hand side of the peak pressure point on the fan curve. Backward inclined and/or airfoil fans shall normally be selected near point of maximum static efficiency. Vane axial fans shall be selected for optimum operating point / range.

M. Performance curves shall be furnished for each pump. Curves shall show discharge pressure (feet of water), horsepower and efficiency versus GPM for a series of impellers. Performance curve shall slope up to shut-off. Pump shall be selected to operate near point of maximum efficiency and/or to meet efficiency indicated on the drawings.

N. Shop drawings will be provided by the Owner for any Owner furnished equipment requiring connections under this section.

O. A complete set of shop drawings, officially marked in the prescribed manner noted previously, shall be filed on the job site. Such drawings shall be kept together, maintained in good condition, and shall be readily available for reference.

13. MATERIALS AND WORKMANSHIP

A. Materials used in this contract shall, in all cases, be those specified herein unless proposals for the use of alternate materials have been submitted and accepted in writing, as provided hereinbefore. All materials shall be strictly first grade of their kind and shall be new and in first class condition when installed. All materials damaged in transit or otherwise will be rejected, and must be replaced by proper and acceptable materials. Materials shall, in all cases, be similar and in accordance with the provisions of this specification.

B. Workmanship thruout shall conform to the standards of best practice, and all labor employed must be competent to do the work required. Tool marks will not be permitted on any exposed materials, fixture or fitting. For work not shown on the drawings or where changes are required to harmonize with the work of other trades, consult the Engineer for instructions.

C. Exact locations of electric outlets, piped equipment, piping, lighting fixtures, ducts, etc., shall be coordinated as described in Item DRAWINGS, so there will be no interference at installation.

D. Locate and install piping and ductwork so that l/2" minimum clearance is maintained after insulation is applied.

E. Rigid metal ducts shall be installed with support systems as indicated in Tables 4-1 to 4-3 and Figures 4-1 to 4-8 of the SMACNA HVAC Duct Construction Standards. They shall be installed as required to maintain alignment. Upper attachment to structures shall have an allowable load not more than one-fourth of the failure load of the method utilized. Hangers shall be strips of galvanized steel or round, uncoated, hot-rolled steel rod. Note that in a humid and/or non-conditioned environment, hanger rods shall be electro-galvanized all-thread rods. Hanger spacing shall not exceed 10 foot intervals and shall be closer as required to avoid any sagging of the horizontal duct runs.

F. Piping systems shall be installed with approved hangers and supports (see Item SUPPORTS, HANGERS AND BRACKETS) in a manner that will prevent sagging, warping, sway or vibration. Hangers, supports, etc., shall be properly located to allow for expansion and contraction and to accommodate concentrations of weight such as from heavy equipment and/or valves, etc., when supporting large pipe.

G. All rigid pipe shall run straight between fittings and all work shall be run in straight horizontal and vertical lines which shall be parallel to the building lines wherever possible. Ream ends of all pipes to remove fins, burrs, etc., to full inside diameter and see that insides of pipes are clean before being installed. Open ends of pipe lines or equipment shall be properly capped or plugged until final connection to keep dirt or other foreign material out of the system.

H. Where expansion joints or compensators are indicated, pipe alignment guides shall be provided as recommended by the manufacturer in order to avoid any non-axial pipe movement and resulting premature failure.

I. Valves and specialties shall be so placed as to permit ease of operation and access and all valves shall be regulated, packed and/or adjusted as required at the completion of the work before final acceptance. Also, with regard to valve sizing in piping runouts to coils, equipment, etc., note that valves shall be full line size unless specifically indicated otherwise.

J. Valves shall be installed in a horizontal or upright position only. Control valves and other miscellaneous regulating valves, equipment items, etc. shall be adjusted as necessary for the setting required by job conditions and/or as stipulated by the equipment manufacturer.

K. Flange joints shall be made with welding neck flanges, slip-on flanges, or threaded flanges where threaded connections are permitted, making a tight joint without peening. All flanges shall be faced perfectly true and joints shall be made with the proper gasket. RE: Item GASKETS.

L. All welding shall be done by a qualified welder certified per procedure suggested by published AWS Specifications and required by enforcing bodies. Welding and all procedures shall be in conformance with Section IX of the ASME Boiler and Pressure Vessel Code and ANSI B3l.l. Ends of pipe shall be properly bevelled where assembled by butt welding. Welding of all bevelled end steel pipe and/or butt welding fittings for systems with a safety/relief valve setting in excess of 100 psig shall be accomplished using groove type welding rings with knock-off spacer pins.

M. All piping intersections and changes in direction of rigid pipe lines shall be made with standard, specification type fittings as required and as called for under Item FITTINGS. Mitering of pipe to form elbows, or any similar procedure will not be permitted.

N. Joint preparation for copper piping installations shall be in accordance with IAPMO Installation Standard IS3. All solder joints shall conform to the requirements of ANSIB9.1. They shall be made using tin-silver solder (Fed. Spec.#QQ-S-571E, Class SN96) for smaller sizes thru 1-1/4" and solder with high elongation properties

and a liquidus rating in excess of 600F with a wide plastic range such as Harris Co. "Stay Safe Bridgit" for piping sizes 1-1/2" and over. Note, however, that all copper piping joints over 3" in size shall be brazed. Brazing operations shall be in accordance with the Copper Development Association Copper Tube Handbook using an ANSI / AWS listed nonferrous brazing alloy (BAg-1 or a BCuP series brazing material) containing at least 15% silver, having a melting point in excess of 1,000ºF and recommended for the specific application. In addition, the brazing process must be performed utilizing a secondary pressurized gas in order to insure having a sufficient flame temperature to achieve a satisfactory joint.

1. Where the use of pre-cleaned copper pipe and fittings is required, all joints shall be brazed, regardless of size. During the brazing operation, nitrogen shall be continuously bled through the lines to minimize oxidation formation.

O. Valves to be installed with a welding or brazing operation shall have all internals removed, prior to installation, where required to avoid the possibility of damage.

P. The pressure rating requirements for fittings shall be as indicated under Item PIPE FITTINGS and the pressure rating requirements for valves shall be as listed under Item VALVES.

Q. Miscellaneous piping items such as expansion joints, strainers, etc. shall be rated in accordance with applicable code requirements but in no case less than Class 12sp or less than 50psi above the highest safety/relief valve setting or design operating pressure of the system, whichever is greater. Where higher pressure ratings are called for, then those requirements shall govern.

R. All piped equipment, coils, control valves, etc., shall be either flange or union connected, as determined by construction. Flanges or flanged fittings shall be used where indicated or specified.

S. Where piping of dissimilar metals is joined, insulating fittings or dielectric unions shall be provided.

T. Where the use of grooved end pipe and grooved mechanical couplings is specified (see Item PIPE AND PIPING), the requirements with respect to installation include strictly following manufacturer's recommendations regarding pipe and pipe preparation, lubrication of gaskets, and the assembly of couplings, fittings and flanges.

U. Piping and ductwork shall be concealed in shafts, furred spaces, etc., where possible. Take steps to insure that adequate space has been allowed for pipes and exercise care in locating same in accordance with the requirements of the finish of the various rooms. No pipes, ducts, etc., shall be placed where they will block

access doors or in any way interfere with the swing of the other doors or the operation and normal maintenance of equipment.

V. Installation of piping directly over electrical switchgear and similar equipment shall be avoided. In elevator equipment rooms, only pipe specifically designated for heating and/or cooling equipment serving that room may be installed there. Such piping shall not be located over the hoistway or any electrical equipment.

W. Coils, control valves, heat exchangers, miscellaneous other piped equipment, etc., shall be installed with isolating valves and unions or flanges. For closed loop hydronics systems the return connections at coils and heat exchangers shall be installed with either balancing valves or flow-control units as indicated. Main and branch return lines of these systems shall also be installed with balancing valves. These valves shall be combination balancing and shut-off type as described in Item VALVES.

X. Where pipes pass thru floors, rated walls or partitions, provide an approved fire, smoke and water seal as required. Fire-stop material shall be tightly packed and shall completely fill the annular opening between pipe and sleeve. Re: Item INSERTS AND SLEEVES.

Y. On pump installations, furnish and install a pressure gauge assembly consisting of a single gauge with yoke piping connections thru ball valves to pump suction and discharge tappings. In addition, install a union between each valve and the pressure gauge tee. Each base mounted packing gland type pump shall have a drain line extending from the tapped drain outlet on the base to the nearest floor drain.

Z. Base frame mounted pumps shall be carefully set, grouted and piped in such a manner that stress is not transferred to the impeller housing resulting in misalignment. After installation the impeller-shaft assembly shall rotate without binding.

AA. Lubricate all rotating and/or reciprocating equipment according to manufacturer's directions before operation, during the course of operation and as required at the completion of work or at the time of Owner acceptance, whichever occurs first. Where lubricating points are not easily accessible, provide extensions as required for such maintenance. Belts shall be checked for defects and adjusted to proper tension. See Item DRIVES AND GUARDS.

AB. Note that the piping contractor shall provide a pair of 3/4" valved and capped connections into each separate hydronics system to accommodate chemical feed requirements. Where not specifically shown, these connections shall be located as directed by the engineer.

AC. Take precautions when operating any air handling equipment to insure that approved filters are installed in place as designed. No equipment shall be operated at any time without these filters. When the job is completed and turned over to the Owner, all filters shall be new, clean, and in perfect operating condition.

AD. All apparatus installed under the contract shall operate within the normal sound range for similar equipment and without vibration transmission to the structure. In

case excessive noise and/or vibration occurs, make the necessary modifications, adjustments, etc. to correct the condition(s) or replace the objectionable equipment. The Engineer will judge the severity of the problem and make the final determination on acceptance. In situations where compliance is questionable, provide instrumentation, etc. as required for verification that equipment operation is within manufacturer's norm and/or in code compliance.

AE. Before equipment furnished under this contract heading is turned over to the owner it shall be demonstrated to meet acceptable sound power levels for the particular installation involved while operating under normal conditions. Certification of compliance to OSHA standards will be required from all equipment suppliers. In addition, actual sound levels for mechanical equipment or devices shall not exceed the maximum permissible noise levels listed by OSHA for a continuous 8hour period of exposure.

AF. A more specific description of materials and workmanship relating to ductwork as well as the insulation portion of the project is contained elsewhere in this section of the specifications under the heading of that particular item.

14. HAZARDOUS MATERIALS

A. This item of the specifications is designed to address the potential problem or problems occurring when hazardous materials (asbestos type insulations, etc.) are encountered on a project involving work in an existing structure and/or an existing system. Since the extent to which hazardous materials may have to be dealt with or whether, in fact, they will even be present on the site cannot always be determined prior to the actual demolition/construction phase of the project the Owner will have the responsibility for dealing with the situation, should it arise.

B. If, during the course of the project, it is suspected that hazardous materials have been encountered or are present, contact the Engineer immediately and cease work in the area(s) of concern. After consultation with the parties involved, the Owner can elect to have verification testing performed by a duly authorized and licensed organization. If it is determined from these tests that hazardous materials are actually present, the Owner will deal with the situation in an appropriate manner before work in the affected area(s) resumes.

15. CLEARANCES, INSTALLATION REQUIREMENTS, ETC.

A. The contractor shall be responsible for verifying compliance with the specifications for all materials and equipment provided under this section of the work. In addition, all materials and equipment shall be installed in strict accordance with applicable code requirements as well as the manufacturer's recommendations, instructions, installation/shop drawings, etc. The recommended clearances for service, maintenance, etc., as well as for proper operation, shall be observed and provided in all cases.

B. For certain items of operating equipment described in this section of the specifications several manufacturers may be listed. In these instances, the first named is the make on which the design was based with regard to performance, space requirements, service access, etc.

C. Due to the possibility of restrictions imposed by space limitations, the responsibility for resolving conflicts resulting from the use of equipment other than first named or of alternate equipment shall rest with the equipment supplier and the Contractor. Submittals for this equipment will be considered as a statement that clearances for installation, access, service, maintenance, etc. have been checked and found adequate.

D. Alternate equipment or the equipment of additional manufacturers named in these documents shall meet all base bid specifications. In the event such equipment, or any equipment which the bidder proposes to furnish, deviates from the requirements of equipment first named regarding electric service, power wiring, control wiring, plumbing and/or piping, sound attenuation, vibration damping, etc., it shall be the responsibility of the bidder to include in his price a sufficient sum to cover the additional costs or charges resulting therefrom.

E. Note that in all cases the contractor is responsible for checking the entrance access/clearance requirements for the equipment being furnished under this section and making the necessary provisions to accommodate the moving of such equipment to its final location. This is of particular importance when an existing structure is involved and, therefore, will probably involve either partial equipment disassembly, temporary openings, window removal, etc. as deemed appropriate under the circumstances.

F. With regard to running pipe, the Contractor is cautioned that such pipe may not be installed over, or run directly above, electrical switch gear. Where this situation is determined to be unavoidable, liquid tight sheet metal troughs shall be provided under the piping to afford the necessary protection. Additional protection, sensors, alarms, etc., shall be provided where and as required by local authorities.

G. Note that where safety / relief valve discharge piping to a floor drain is involved on the project, the discharge line can incorporate no more than one 90° ell. Additional ells in the line must be preceded by a funnel drain installation.

16. PROTECTION

A. Provide proper protection to the building, equipment, etc., during the execution of all work involved under this contract heading.

B. This protection shall include the covering all apparatus, building surfaces and / or other materials to protect same from dirt; providing adequate temporary connections to protect apparatus from damage of any sort; and providing the required shielding to protect finished parts of the building. The following stipulations shall be adhered to:

1. Protection of finished floors from chips and cutting oil by the use of metal chip receiving pans and oilproof floor covers . . .

2. Protection of equipment and finished surfaces from welding and cutting spatters with baffles and spatter blankets . . .

3. Protection of equipment and finished surfaces from insulation adhesive, sizing droppings, etc., by the use of drop cloths . . .

C. All pumps, motors, fans and other rotating/reciprocating equipment stored for this project shall be adequately protected with openings, bearings, etc., covered to exclude dust and moisture. All stock piled pipe, valves, fittings, ductwork, etc. shall be placed on dunnage and protected from weather and from entry of foreign material.

D. During installation and until final connections are made, all piping and ductwork shall be protected against entry of foreign matter. Equipment connections shall be carefully sealed until the actual time of system tie-in.

E. As ductwork is erected, all duct openings shall be kept clean and be shielded from the entrance of dirt, dust, debris, etc. In addition, air handling units shall not be operated during the construction period with out the specified or approved air filters in place and any return air openings completely covered with MERV 4 filter material

F. A 50 lb. CO_2 extinguisher on wheels shall be provided at all times in the immediate vicinity of any welding or similar operations. Additional Federal, State and/or local regulations that are applicable shall be complied with as required.

17. PAINTING

A. Scope of Work: Provide all labor, tools, materials and equipment necessary to complete all painting as hereinafter described. All ferrous metal shall be clean and free from rust, scale and grease and sanded before applying primer or finish coats. Colors will be selected by the Owner. Cleaning methods shall comply with recommendations of the Steel Structures Painting Council.

B. Prior to proceeding with any painting, all shop applied prime coated surfaces shall be touched-up wherever damaged or bare. Touch-up to match existing.

C. Exterior and Interior Iron and Steel Work: Apply one (1) coat of synthetic, rustinhibiting primer and two (2) coats of high gloss alkyd enamel, carefully sanded between each coat.

D. Sheet Metal Work: All exposed metal work, ductwork, etc., except copper, stainless steel or aluminum shall receive one (1) coat of galvanized iron primer and two (2) coats of high gloss alkyd enamel.

E. Ferrous Metal Plumbing and/or Heating Pipes: Apply one (1) coat of synthetic, rustinhibiting primer and two (2) coats of high gloss alkyd enamel, carefully sanded between each coat. (Painting requirements apply to non-insulated lines only).

F. Paints, enamels, etc. shall be based on the use of Benjamin Moore products. Subject to compliance with requirements, provide "Moorecraft Professional Coatings". Materials shall be delivered to the job site in original containers. All paints, etc. shall be evenly spread and shall be free from runs, sags or other defects. All adjacent work and materials shall be adequately protected with suitable covers during all phases of the work.

18. PIPE MARKING

A. Properly color code and identify all piping in mechanical equipment rooms, exposed piping and all piping above accessible ceilings using an approved type of selfadhesive pipe marker. These markers shall occur at approximately 25 ft. intervals and adjacent to a main valve or fitting, at connections to pumps, chillers and other equipment, at entrances into shafts and near access doors to pipe spaces. Pipe markers shall be by Seton, Brady or Thomas & Betts and shall be guaranteed for applications with constant surface temperatures up to 175° F. They shall be accompanied by a like color banding of flow arrows. The identification system shall meet OSHA requirements and shall comply exactly to ANSI A-13.1 with legend superimposed on the appropriate background color.

B. Banding and identification markers shall be applied after all surface finish work has been completed. Surfaces shall be clean and dust free at application. Additional locations for identification markers may be required because of job site conditions.

19. EQUIPMENT LABELING AND IDENTIFICATION

A. Where an item of equipment or appliance is specified to meet the requirements of a referenced agency, conformance shall be evidenced by attachment of the agency seal, label or stamp of Underwriter's Laboratories, Factory Mutual Laboratories, AGA, ASME, or other suitable, nationally recognized testing laboratory listed by NFPA and will be accepted as evidence that the item furnished conforms to the standards.

B. Before completion, each major system component such as central station air handling units, exhaust fans, pumps, etc. shall be identified by means of an engraved nameplate with adhesive backing. Nameplates shall have 1-1/2" high subsurface black Helvetica letters and numbers on a white plexiglass or acrylic background.

C. Equipment identification shall be in agreement with the identification shown on the contract drawings and/or as directed by the Owner. In addition, all systems of identification shall meet the requirements of ASME A13.1.

D. Exhaust fans handling air from sources considered hazardous or potentially hazardous (such as negative pressure rooms, fume hoods, ETO sterilizers, etc.) shall be provided with the appropriate “HAZARDOUS” identification labels as required to meet applicable OSHA Standards. Such labels shall be self-adhesive markers by Seton, Brady or Thoms & Betts.

20. CONCEALED EQUIPMENT - ACCESS AND MARKING

A. Where mechanical equipment, valves, control dampers, fire dampers, etc. are located in walls, shafts, inaccessible furred spaces and/or chases or above fixed (nonaccessible) ceilings, adequately sized access doors of the appropriate type shall be provided.

B. Reach-in access doors for valves, unions, etc., shall be minimum 8" X 12" and crawlin access doors shall be minimum l8" X 24" or larger as required for access.

C. General purpose access doors shall be flush mounted. They shall have a 16-gauge steel frame with 1" flange and a 14-gauge steel door with concealed continuous piano hinge. Doors shall have a stainless steel allen head cam latch unless otherwise indicated. The assembly shall be treated with a rust inhibitor and given a baked-on primer.

D. Access doors in rated walls and plastered or gypsum board ceilings utilized as fire protection for the structure shall be fire rated. They shall meet NFPA requirements and shall carry the UL l-l/2 hour "B" label. Construction shall incorporate a 16gauge steel mounting frame and minimum 20-gauge steel insulated panel door that is self-closing and self-latching with key operated lock and continuous concealed hinge. The assembly shall be treated with a rust inhibitor and given a baked on primer. All locks shall be fire rated and work with a common key.

E. Access door for other plastered surfaces shall be flush mounted with 16-gauge steel frame and l4-gauge steel panel door with continuous concealed hinge and stainless steel allen head cam latch. A 22-gauge plaster casing bead shall surround the frame. The unit shall be treated with a rust inhibitor and given a baked-on primer.

F. Access doors meeting the above specifications shall be as manufactured by Acudor, Cierra, Karp, Larsen's or Milcor.

21. PREPARATION OF SYSTEMS

A. Boilers and/or building piping systems installed under this section shall be prepared for initial operation as described in the following paragraphs.

B. In preparing the boiler(s) for initial operation the Contractor shall make provisions for the removal of all mill scale, oil and foreign matter from the boiler(s) by "boiling out" in accordance with the manufacturer's published startup instructions. Furnish all required chemical compounds and prepare the boiler(s) for service as required (following the step-by-step procedure recommended). Finally, after performing the proper drain and flush procedure, fill for service with softened water (when available) and set into operation for demonstration purposes. See Specification Item BOILER EQUIPMENT CHECK-OUT AND START-UP with regard to boiler wiring, interlock wiring, etc.

C. The hydronics system(s) shall be initially flushed to remove loose dirt, mill scale, metal chips, weld beads, etc. Protect factory cleaned equipment, isolate pumps and pressure vessels, and remove any components which may be damaged. Open all valves, drains, vents, strainers, plugs, etc. to facilitate discharge of debris.

D. After the initial flushing of closed loop piping systems, they shall be cleaned with a solution to remove adherent oil, hydrocarbons, flux, varnish, pipe joint compounds, etc. The cleaning agent shall be added to the system fill in strict accordance with the manufacturer's recommendations. Unless otherwise noted it shall be a commercially prepared, liquid alkaline cleaner designed specifically for the purpose.

E. The water temperature shall be raised to 100°F and circulated for a minimum of 3 days with a temporary pump. The screening element in all strainers shall then be

removed and cleaned. Following this, the lines shall be purged with fresh water until clean. Finally, strainer screens shall be installed again before final connections to the permanent pump are made. Temporary bypasses shall be provided for all system

coils, pressure vessels, chillers, control valves, etc. Note that all system cleaning solutions shall be properly neutralized prior to disposal.

F. The final fill of hot water and chilled water systems shall incorporate an approved, commercially available corrosion inhibitor added at the rate required by local conditions but not exceeding the rate recommended by the manufacturer.

G. Glycol-water systems shall be cleaned using a heated tri-sodium phosphate solution prior to purging and the introduction of the glycol-water mixture. No water treatment shall be used with these systems.

H. At the completion of the job, all equipment involved in this contract shall be thoroughly cleaned, removing all traces of oil, grease, dust, dirt, etc. Equipment touch-up paint shall be applied where required to restore to factory finish.

I. Supply air handling unit(s) shall not be operated for any purpose, temporary or otherwise, until the specified filters are in place, fan bearings are lubricated, and the equipment has been test run under observation. Note that unless otherwise specified, air handling units designed to incorporate two sets of filters need only be fitted with the upstream set until system component cleaning, as described below, is performed. Also note that if, during operation of any supply air system air handling equipment, the filters become loaded to the maximum recommended pressure drop as stated in the manufacturer's literature, they shall be replaced in order to avoid any possibility of downstream unloading.

J. Before final air system balancing is initiated, fan wheels and air handling unit housing interiors shall be vacuumed and wiped clean and all required filters shall be in place. Such filters shall be clean and installed properly. In addition, dust, dirt, debris, etc. shall be completely removed from the ductwork, plenums and other air distribution components. All ducts shall be clean and dust free when terminal devices or outlet faces are installed. Supply ducts serving finished areas shall be brush vacuumed and have a final cleaning with dampened rags. Note that where supply ductwork is to serve clean rooms, computer rooms, or similar areas, the final cleaning of the duct interiors shall be performed using clean rags dampened with an 80% ethyl alcohol solution.

22. TESTING

A. A complete test or tests of all work under this contract shall be conducted as soon after completion as practicable. Representatives of the manufacturers who

furnished major items of equipment for the job shall be present at the time their apparatus is being tested. Prior notification of all tests shall be made to the Engineer.

B. Primary / major items of mechanical equipment shall be checked, started and test run in strict accordance with manufacturer's published start-up and testing procedures by factory authorized personnel. A complete operational report on each item of equipment shall be submitted on manufacturer's standard forms (in triplicate)

to the engineer. Said reports shall be completed, signed and dated by the technician performing this work.

C. Apparatus furnished under this contract heading which fails to deliver its full rated capacity, or which is defective or unacceptable in other ways, shall be replaced or adjusted as required to comply with the intent of the specifications.

D. Unless otherwise mentioned, all steam and / or hydronic piping systems involved under this contract heading shall be tested and made tight at a minimum 150 psi hydrostatic pressure or at a pressure 20% above system safety/relief valve setting or boiler/convertor pressure rating, whichever is greater. This shall be done before any equipment is connected and before any work is concealed. Finally, all hydronic system piping so tested shall be left under pressure of the domestic water system (or a min. 40 psig) for the balance of the construction period unless the risk of freezing exists. Note that the hydrostatic test pressure for heating boilers shall be 50% above the relief valve setting on the boiler.

E. All near ductwork shall be leak-tested according to industry-accepted test procedures. The actual duct leakage, as determined by the test, shall not exceed the value obtained when applying the formula listed in the current ANSI / ASHRAE Energy Standard under “Duct Leakage Tests”.

F. Note that the testing of piping and ductwork systems shall be performed prior to the application of any specified insulation. Where applicable, certificates of approval shall be furnished to the Owner as noted in Item PERMITS, FEES, INSPECTION, LAWS AND REGULATIONS.

G. Calibrated instruments, meters, equipment, facilities, and labor required to properly conduct tests shall be provided as required. If system testing results or equipment performance does not meet specifications or capacity requirements, the necessary corrective measures shall be taken and the testing shall be repeated until requirements are met.

23. BALANCING

A. The following described balance work shall be performed by a member of the Associated Air balance Council or the National Environmental Balance Bureau.

B. Balancing the hydronics system(s) shall be accomplished by measuring, adjusting and recording the flow at the balancing valve of each element, coil, etc. using the necessary instrumentation as specified by the valve manufacturer. Final adjustments shall be made as required to meet job conditions and performance specifications. Instrumentation required in conjunction with the work.

1. Where flow rates are not indicated, coil output shall be set by regulating the flow to achieve the required temperature drop and/or rise corrected for actual entering conditions.

C. All belt drive fan units shall be checked for alignment, belt tension, etc. and then adjusted to the speed required to meet the specified conditions of the system prior to balancing air delivery and air terminal settings to meet individual requirements. Any subsequent final balancing shall be done first by adjusting or changing fan drives and / or setting dampers where and as required.

D. At the completion of the job or at such time as the various systems are completed and balanced, perform the following operations where applicable:

1. On all belt drive air handling equipment, a fan motor amperage draw reading and a fan wheel RPM reading shall be taken. Note ambient air temperatures when readings are taken..

2. Amperage draw readings shall be taken on all pump motors after final system balance.

E. All data shall be plotted against performance curves obtained from the manufacturer in order to establish actual system and equipment performance.

F. All balance data and equipment performance data shall be listed by category for this submittal. Each category of balance data shall be assembled in tubular form.

1. The actual flow through all hydronics system coils shall be indicated along with the specified flow requirements. All air devices shall be listed, either by room or by device number where such devices have individual numbers, and their actual performance shall be listed along with specified performance requirements.

G. Three complete reports containing all required information shall be submitted for review prior to or at the completion of the project. Such reports shall be typewritten,

with cover sheet listing the job name, date, contractor, etc. and shall be looseleaf bound.

H. All instrumentation, meters and miscellaneous equipment required in performing the balancing operations specified above shall be furnished as part of this item. This shall include any special equipment, proprietary software, cables etc., that may be needed due to specific requirements that may be inherent within a particular specified vendor's control system.

24. INSTRUCTIONS, MANUALS, SPARE PARTS, ETC.

A. Provide the Owner with three (3) complete equipment brochures in hard-backed binders. These assembled manuals shall contain all operating, servicing, and maintenance information as well as parts lists for the equipment furnished and installed under this contract. Where diagrams are too large for the binder, arrange manila pockets with reinforced holes to hold folded drawings. Binders shall also contain complete valve charts.

B. Each equipment room shall have all system automation and/or temperature control diagrams applicable to the equipment therein permanently sealed to durable transparent plastic and posted where directed. In addition, a valve chart applicable to that particular room shall be posted adjacent to the diagram.

C. Arrange for technical instruction of the Owner's maintenance personnel for such time as would be reasonably required to acquaint them with their duties. In addition, deliver to the Owner all special tools or equipment required for making normal adjustments on any equipment or apparatus furnished under this contract heading.

D. The spare parts and other items listed below, where applicable, shall be turned over to the Owner at the completion of the project.

1. One set of pump gaskets for each pump...

2. Pump packing or mechanical seal for each pump...

3. Unless otherwise mentioned, one spare set of air filters for each filter bank and / or filter unit installation...

E. Technical instruction involving the mechanical systems installed under this section shall include a demonstration of the operating system with a description of same explained to the Owner's representatives, as well as all involved contractors, subcontractors, and major equipment manufacturers. The demonstration shall be held after installation of all work under this section has been essentially completed including all testing and balancing. In addition, all written reports of such work

shall have been submitted as required. The time at which the satisfactory completion of the technical instructions and demonstration occurs will establish the date of final acceptance of the system unless otherwise stipulated.

F. Note that the specifications may indicate certain items of equipment be provided with a demonstration of operation. (See Item SHOP DRAWINGS.) This demonstration requirement applies to all major items of mechanical equipment and shall include technical instructions covering proper start-up procedure and normal maintenance routines recommended by the manufacturer.

25. RECORD DRAWINGS

A. Provide and keep on the job site two complete print sets of the contract working drawings on which shall be legibly recorded any variations or alterations from such contract drawings made during construction. Record prints shall show location of all piping system drains as well as changes in:

1. Size, type, capacity, etc., of any material, device or item of equipment...

2. Location of devices or equipment...

3. Location of outlet or source in building service systems...

4. Routing of piping, ducts, or other building services...

5. Schedule data...

B. These prints shall indicate the location of all concealed storage vessels, water and electric services, water piping, ducts, flues, vents and other miscellaneous piping and services, by field measured dimensions from readily identifiable and accessible walls, columns, or corners of the building. In addition, the location and identification number of each tagged valve shall be recorded. The record set shall also include the updating of equipment schedule sheets.

C. During the course of the project these prints shall be updated weekly and kept clean and undamaged. They shall not be used for any purpose other than as described above and shall be available at all times for inspection.

D. When the job is completed, these prints shall be submitted to the Engineer for review and analysis before electronic updating is performed by the Engineer’s office.

26. CLEANUP

A. All rubbish resulting from the work herein specified shall be removed from the premises at the end of each working day.

B. Upon completion of the work, remove from the project site all tools, equipment, surplus materials and all remaining rubbish pertaining to the work under this contract heading. Responsibility for this shall include all related costs for such removal and disposition including hauling, dumping, etc.

C. By this time all extraneous labels, tags, etc., as well as other markings on equipment and ductwork not field insulated shall be removed.

27. WARRANTIES

A. Provide warranties to the Owner that all materials and equipment furnished are new, unless otherwise specified, and that all work is of good quality, free from faults and defects and in conformance with the Contract Documents.

B. Warranties on all work and equipment shall commence on the date of substantial completion of the work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. These warranties and all related documents shall be submitted, in accordance with the front part of the specifications, prior to the issuance of any certificates of acceptance. Warranties shall include equipment manufacturers' written certificates warranting the equipment furnished complies with all requirements of the drawings and specifications including any extended warranties as well as the contractor's warranty statement for the project. This documentation shall be submitted in an appropriately marked, 3-ring hard cover binder.

C. If, within one year after the date of substantial completion of the work or within one year after acceptance by the Owner or within such longer period of time as may be prescribed by the terms of any applicable special warranty specified for a particular equipment item, any work is found to be defective or not in accordance with the Contract Documents, it shall be promptly corrected upon receipt of official notification to do so. In addition, latent defects in materials, equipment or workmanship that are not discovered until sometime during the second year following acceptance, shall remain the contractor's responsibility to correct. This obligation shall survive termination of the contract.

28. MOTORS AND STARTERS

A. Unless otherwise shown or specified, provide the required electric motors for equipment furnished under this contract heading. All power wiring and associated electrical connections will be under the electrical section. However, control and/or interlock wiring shall be under this section of the work. See Item INTERLOCK AND CONTROL WIRING.

B. Motors:

1. All standard motors shall conform to UL, CSA and NEMA MG1 and be name plated and installed in accordance with NFPA National Electrical Code requirements.

2. Unless otherwise indicated, ac motors shall be industrial quality open dripproof with grease lubricated ball bearings having a minimum L-10 bearing life of 80,000 hours when used with minimum pitch diameter sheaves as defined by NEMA Table 14-1. Motors shall be sized and rated for continuous duty at 40ºC ambient temperature and shall have a minimum 1.15 service factor. Insulation shall be rated Class F and all motors shall be protected against current overload and excessive temperature with internal thermal overload protection. Windings and leads shall be 100% copper, 200 deg. C magnet wire and rotors shall be solid-cast aluminum. Motor frame shall be of aluminum alloy with steel bearing seats. The motor shall have a sealed conduit box and shielded ball bearings for all-position operation. Rotor shall be dynamically balanced to industry standards and shrunk fit to shaft. Where totally enclosed fan cooled motors are specified, such motors rated two horsepower and over shall have fans positively engaged and clamped to the motor shaft. Note that motor starting torque characteristics shall be suitable for the application.

3. Single phase motors 1/6 HP and above shall be either permanent splitcapacitor or capacitor-start/capacitor-run type. Polyphase motors shall be general purpose squirrel cage induction type and, unless otherwise specified, shall be NEMA design B. Fractional horsepower motors in 42, 48 and 56 frames may have permanently lubricated, double-shielded or sealed bearings. Integral horsepower open and totally enclosed motors in 143T thru 449T frames shall have bearing systems capable of being re-lubricated without disassembly.

4. Polyphase motors shall meet or exceed NEMA Premium efficiency standards and shall be tested in accordance with IEEE Standard 112, test method B, using accuracy improvement by segregated loss determination including stray loss improvement as specified in NEMA standard MG1-12.53a. Minimum full - load efficiencies shall meet or exceed all published NEMA minimum efficiencies as listed in MG 1-12.54.2, table 12.6A. In addition, labeling of efficiency shall be in compliance with NEMA MG 1-12.54.2.

    a. Polyphase motors shall be designed and built for across-the-line starting unless specifically indicated otherwise with a particular item of equipment and all motors shall exceed NEMA Torque standards.

5. Motors designated for service with invertor controls (IGBT - based variable speed drives) shall be built in accordance with NEMA standards as they

apply to "Definite-Purpose Invertor-Fed Polyphase Motors" and shall carry a 3-year warranty from the manufacturer.

6. Note that in addition, such motors shall be provided with a factory installed shaft grounding ring (SGR) in order to prevent drive-induced electrical damage to motor bearings. The ring, designed to continuously discharge VFD induced rotor shaft currents to the motor frame, shall incorporate conductive micro-fiber brush technology as the grounding means and have a projected operational life of at least 200,000 hours. It shall normally be installed with a rigid mounting plate at the drive end of the shaft.

7. Motors shall be as manufactured by G.E., Baldor, Allis-Chalmers, Gould, Lincoln, or U.S. Motor. Note that where equipment is direct-driven, make of motor may be as recommended and/or normally furnished as part of the package by the equipment manufacturer, but shall be in accordance with the requirements of these specifications.

C. Starters:

1. The Electrical Contractor will furnish fractional HP manual starters required for all manually operated single phase, single speed motors less than l HP unless otherwise mentioned in the following specifications or indicated on the drawings for a particular item of equipment. In addition, refer to Item WORK DONE BY OTHERS for additional starters that may be furnished under the electrical section. All other starters (motor controls), regardless of size, as well as variable speed drives for mechanical equipment shall be furnished under this section of the work either separately or as an integral part of the equipment supplied.

2. All separately mounted motor controls, with the exception of variable frequency drives, shall be magnetic starters mounted in a rated enclosure. Units shall be rated in accordance with NEMA Standards.

3. All starters under this section, except those provided as an integral part of a specific item of equipment, shall be by the same manufacturer. These units shall be as manufactured by Cutler-Hammer, Allen Bradley, General Electric or Square D.

4. Unless otherwise indicated, the enclosure shall be NEMA type 1 (or NEMA 3R where exposed to the elements).

5. Required magnetic starters for motor driven equipment shall be across-theline type and microprocessor based. Motor controls shall meet all applicable code references to Underwriters Laboratories (UL) and the

National Electrical Manufacturers Association (NEMA) and shall have the following features:

a. Contactors shall have NEMA size 1 thru 6 ratings as required. They shall have replaceable fixed and movable contacts. Contactors shall be designed to accommodate two auxiliary contact blocks, each capable of a combination of up to 4 normally closed or 4 normally open auxiliary contacts. Auxiliary contact blocks to be of a design that is capable of fitting NEMA 1 through 6 contactors. Contacts to be color-coded, black designating NC and silver designating NO. Contacts to be rated 10 amperes continuous, make 7200 VA, break 720 VA for 120 though 600 volts AC and 69 VA Make and Break for 125 through 300 volts DC. Provide a minimum of (1) spare NO contact and one (1) spare NC contact in addition to any auxiliary contacts called for on the drawings.

   1. Provide one current sensor located in each phase monitored by the microprocessor to furnish motor running overload protection that yields a time-current curve closely paralleling that of motor heating damage boundary, accurate to 2%. Running overload protection shall be DIP switch selectable for the specific motor full load amperes within the starter range. Provide DIP switches selectable overload trip class of 10, 20 and 30.

   2. Motor starters shall monitor current in each phase in order to provide phase loss and phase unbalance protection such that if the unbalance of any of two phases is greater than 30% of the DIP switch selected trip rating, a phase loss/unbalance trip occurs. Provide phase loss/unbalance protection which requires no time delay for reset.

   3. Motor starters shall be furnished with Class II ground fault protection. Ground fault protection shall be set at 20% of maximum continuous ampere rating and shall have a start delay of 20 seconds as well as a run delay of 1 second to prevent nuisance trip on starting.

b. Magnetic starters shall be similar to Cutler-Hammer and shall incorporate the following features:

   1. They shall have a Hand-Off-Auto selector switch mounted in the face of the starter enclosure. The selector switch shall be wired so that when it is in the Hand or Auto position, all safety controls are in series with the switch. All control

devices shall be wired for operation in the Auto position only.

2. They shall be provided with an encapsulated control circuit transformer. Primary and secondary fusing shall be provided. Unless otherwise specified, the secondary shall be 120 Vac.

3. They shall incorporate oiltight, flange-mounted pilot devices with LED type pilot lights indicating motor operating status mounted in the face of the enclosure. Pilot device nameplates shall be engraved phenolic or aluminum.

c. Miscellaneous:

1. Starters for motors 5 HP and above shall be provided with three auxiliary terminals, installed between power contacts and overload devices, to facilitate field connection of power factor correction capacitors.

d. Deliver all starters up to size 3 to the Electrical Contractor's project site office or storage room and deliver all size 3 starters or larger to the room in which they are to be installed.

6. Consult the motor schedule on the contract drawings as a cross-check of electrical characteristics for all motors and starters to be furnished under this contract heading. Starters individually furnished shall be minimum size 1.

29. DRIVES AND GUARDS

A. Furnish drive sheaves as required for each item of belt driven equipment. Sheaves shall be statically and dynamically balanced and mechanically trued. They shall be made of pressed steel or of die cast or close grained cast iron free from sand holes or other defects.

B. Drive assemblies for motors 3/4 HP and over shall have at least two belts and all multiple belt sets shall be matched. Drive selection shall be based on a service factor of 1.5 as applied to the motor nameplate rating. Belt tension shall be set in strict accord with manufacturer's recommendations.

1. Fixed sheaves shall be used for all installations requiring more than 2 belts, for motors 30 HP and over and for installations incorporating a variable frequency drive to regulate motor speed. All other drive assemblies shall incorporate an adjustable pitch sheave selected so that final setting is at the approximate mid-point of adjustment range.

2. Belt speed shall be between 1,000 and 5,000 feet per minute. Center line distance shall be well within manufacturer's recommended limits. The angle of belt contact on the smaller sheave shall not be less than 120°.

3. Allow for sheave changes as necessary to meet the job requirements with each belt drive installation. On adjustable drive units, furnish and install fixed sheaves of same diameter as correct adjustment after air balance is complete. Leave adjustable sheave at motor location and secure to unit.

C. Belts, couplings, motor shafts, gears, etc., shall be fully guarded in accordance with OSHA 1910.219. Guards shall be cast iron, formed steel, expanded metal or wire mesh. They shall be rigid and suitably secured and shall be readily removable without disassembling the guarded unit.

D. Each belt drive guard shall have openings with covers at drive and driven sheave centers for taking tachometer readings. Guards for field erected air handling units shall also conform to applicable SMACNA standards.

E. For each direct drive item of equipment under this section which is not of extended shaft or close coupled design, furnish an approved type flexible coupling.

F. Furnish a typed index of belt drives, listing each separate item. Include data regarding belt size, bore size, keyway dimensions, etc., of each sheave, as well as the number of belts and manufacturer's replacement belt numbers. Bind this compiled data in the Operating Instruction Brochure described under Item INSTRUCTIONS, MANUALS, ETC. in this section of the Specifications.

30. ALIGNMENT OF ROTATING EQUIPMENT

A. All pumps or similar equipment directly connected to motors by means of flexible couplings must be perfectly aligned after installation by the use of a dial indicator. The alignment shall be performed by a mechanic skilled in this work. Make arrangements for and insure that the manufacturer of the equipment provides the services of a factory trained representative to supervise aligning and start-up and notify the Engineer when this has been accomplished.

B. Belted equipment shall be installed so that the grooves of the driver pulley are truly aligned with those of the driven sheave. In addition, the belts must be in the proper tension, free from flutter. In multi-belt drives, all belts must be operated in the same plane. Flutter in any one belt will be cause to reject the entire set, as the original installation of belts must be in matched sets as elsewhere specified. (See Items DRIVES AND GUARDS).

C. Before any rotating equipment is put in operation for testing purposes, it shall be properly lubricated with lubricants only as recommended by the equipment

manufacturer. Additional lubrication shall be provided before equipment is turned over to the Owner. Prior to completion of the project, provide the Owner with a complete schedule of lubrication for all rotating equipment installed under this section.

31. CUTTING AND PATCHING

A. All cutting and / or drilling of walls, slabs, structural members, etc., required in conjunction with the project shall be performed in accordance with the following. Work shall be neatly done, without unnecessary removal of material. Holes, openings, etc. shall be located where they will not weaken the structure.

B. Prior to the cutting of any slab-on-grade floors or similar type of demolition work, the contractor shall consult with the Owner, or individual(s) designated by the Owner, to determine whether buried utility lines may be in the vicinity and possibly at risk of being damaged or severed by the operation. Also, at this time, locations of appropriate isolation valves, disconnects, switches, etc. should be determined.

C. Cutting of round openings in concrete and/or masonry walls, etc. shall be performed with a core drill to minimize spalling, etc. Locations shall be accurately determined and checked and the appropriate drill bit shall be used to minimize hole size. Required square or rectangular openings shall be cut neat with no over-cut on either side of wall. Remove any anchors used during cutting operation and patch holes.

D. Openings made for penetrations in walls, partitions, etc., shall be carefully cut/drilled and accurately sized for the penetrating item.

E. Sleeves or thimbles as well as escutcheons and trim plates for cut holes shall be provided as described in Item INSERTS AND SLEEVES. Installation shall permit free movement of pipe.

F. NOTE: Cutting of water lines, electric conduit or similar service lines in the course of work performed under this section shall be immediately repaired as part of the work of this section.

G. Patching and / or repairing of all work, including finished surfaces, necessitated by the demolition or installation of the work shall be included. It shall, however, be performed by mechanics of the appropriate trade in order to achieve a workmanlike job. This shall include, but not be limited to, all items of concrete and masonry work, millwork, gypsum board and/or plaster work, painting, floor finishes and ceiling finishes as well as all other surface finishes.

H. When the need for such patching or repairs arises, immediate arrangements shall be made with the appropriate trade(s) to perform the necessary work at no additional

cost to the Owner. The final responsibility for acceptance of such work by the Owner's representative shall reside with the prime contractor.

32. INSERTS AND SLEEVES

A. Inserts (concrete expansion anchors) shall conform to applicable requirements of Federal Specification FF-S-325. Embedment, anchor length and size shall be in accordance with manufacturer's recommendations. Anchors 3/8" thru 3/4" shall be U.L. listed for pipe hangers.

B. In general, pipe sleeves thru outside walls shall be of minimum 16 gauge galvanized steel or PVC pipe and shall be large enough to permit packing with picked oakum. The final 3" from the inside and outside faces of the wall shall be caulked with lead or waterproof plastic. Note that sleeves are not required for holes drilled in poured concrete walls.

C. Sleeves shall be provided for pipe and duct openings cut in masonry walls as well as for similar openings in non-masonry walls, partitions, etc. Sleeves shall be of galvanized sheet metal with flanged ends and shall be securely mounted in place. Voids between masonry and sleeve shall be filled with mortar. In rated walls, openings between pipes and/or ducts and structure, wall or sleeve shall be filled with firestop sealant to produce a fire, smoke, and water barrier as referenced below.

D. Provide thimbles wherever exposed pipes, tubing, conduit, etc., pass thru interior non-masonry walls, partitions, etc. They shall be telescoping type, made from 22 ga. galvanized sheet metal and of minimum size. Thimble ends shall have cast or stamped metal plates attached thereto. Floor penetrations shall be provided with sleeves extending at least 1/4" above the floor line.

E. Pipe, tubing, conduit and small round duct penetrations of walls, floors, etc. in exposed areas shall be provided with escutcheons. They shall have concealed hinge and set screw and shall be securely attached. In finished areas, escutcheons shall be polished brass or chrome plated steel. In mechanical or service areas, escutcheons shall be galvanized cast iron. Floor penetrations shall be provided with deep pattern floor plates set flush with the floor and designed to cover the entire sleeve projection. Note: Where required by code considerations, non-metallic sleeves shall be covered by escutcheons.

F. Openings cut thru roof structures shall be carefully made (see Item CUTTING AND PATCHING) and located in designated areas only. Pitch pockets shall be utilized as required to eliminate any chance of moisture penetration. Pitch pocket liner shall be made from 16 oz. sheet copper (ASTM B 370, temper H00) and shall extend approximately 4" above the finished roof.

G. In all cases where ducts, pipes, etc., pass between floors, rated walls, and/or rated partitions, the spaces between the structure or sleeve and the penetrating member shall be provided with an approved firestop sealant to produce a fire, smoke, and water barrier. Sealant material and installation shall be as described in Item FIRESTOPPING.

33. FIRESTOPPING

A. Furnish and install the required firestopping as referenced in the item of the specifications covering inserts and sleeves. Materials, installation, etc., shall be as described below. Products shall be as manufactured by Hilti Inc., Specified Technologies Inc. or United States Gypsum Co.

B. Definition:

1. Firestopping is defined as the material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies.

C. Application:

1. Tested firestop systems shall be used for all penetrations for the passage of ductwork and piping through floors, fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

D. Quality Assurance:

1. A manufacturer's direct representative (not distributor or agent) shall be on site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

2. Firestop system installations must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated. In addition, proposed firestop materials and methods shall conform to applicable governing codes having jurisdiction.

3. For those firestop applications that occur for which no UL tested system is available through any manufacturer, a drawing representing the manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted to local authorities having jurisdiction for review and approval prior to installation. Engineer judgment

drawings must follow current requirements set forth by the International Firestop Council.

E. Submittals:

1. Manufacturer's submittals shall include specifications and technical data for each type of material including its composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300. The submittal shall also include material safety data sheets as well as any engineering judgement drawings previously approved by local authorities. F. Installer Qualifications:

1. The firestop system installer must be certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements as previously stated in Quality Assurance.

G. Requirements:

1. All holes, voids, miscellaneous openings, etc., made by penetrations in floor slabs (above grade) for systems provided under this section shall be completely sealed to insure water tight integrity. Installation of firestopping shall be scheduled after completion of penetrating item installation but prior to covering or concealing of openings.

2. Provide firestopping utilizing components that are compatible with adjacent surfaces, the substrates forming openings, and the items penetrating the firestopping under conditions of service and application as demonstrated by the firestopping manufacturer, based on testing and field experience. Note that materials containing flammable solvents shall not be used.

H. Materials:

1. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each specific application.

2. For penetrations by combustible items (penetrants consumed by high heat and flame) including insulated metal pipe that is PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems), an Intumescent material is required to maintain fire rating of the assembly penetrated.

3. A firestop system with an "F" rating as determined by UL 1479, ASTM E814 or UL 2079, which is equal to the time rating of the construction being penetrated, must be utilized.

I. Preparation:

1. Surfaces to which firestop materials will be applied shall be examined for detrimental conditions. They shall be free of any substances that may effect proper adhesion.

2. Observe and comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

J. Installation:

1. Firestop materials shall be installed in accordance with published recommendations listed under the heading "Through-Penetration Firestop Systems" in the UL Fire Resistance Directory. In addition, the manufacturer's instructions for installation of through-penetration materials shall be strictly followed.

2. Consult with the engineer prior to installation of any UL firestop systems that might hamper the performance of fire dampers as they pertains to duct work.

K. Miscellaneous:

1. Sealed penetration areas shall be checked thoroughly to ensure proper installation before concealing or enclosing said areas.

34. SUPPORTS, HANGERS AND BRACKETS

A. All hangers, brackets, etc. for supporting material and equipment included under this section of the work shall be furnished and properly installed as required and as specified in the following. Material shall be as furnished by Anvil, Crane, Elcen, or Fee and Mason.

B. Pipe support spacing shall be in accordance with ANSI B3l.l.0. Piping shall be installed in such a manner that , where movement due to expansion and contraction could occur, it can freely take place except at anchor points. Supports shall be capable of vertical adjustment after erection of pipe. Pipe hangers, U-straps, clamps, pipe rolls, etc. shall be carried by threaded rods of a size determined by the support item locking device but in no case less than the size called for in the carrying capacity table for threaded rods listed in the ASME code for pressure piping.

Supports and parts shall conform to the latest requirements of ANSI B3l.l.0 and MSS Standard Practice SP-58, except as supplemented and/or modified herein.

C. Where required hanger spacing does not correspond with structural joist and/or rib spacing, or where the placement / location of suitable structural members will not accommodate this required spacing or hanger location, attach supporting steel members to the structure in order to properly carry the lines.

D. Where three or more uninsulated lines are installed in parallel, trapeze hangers may be used. The horizontal support shall consist of formed steel channel members with the appropriate pipe supports, hanger rods and accessories as listed below. Hanger rod size, beam loading, etc., shall be in accordance with manufacturer's recommendations.

E. Vertical lines shall be guided or supported at the mid-point of riser and not over 12 ft. on centers with riser clamp lugs and shall be supported at base of riser on a securely mounted base elbow or, where shown, with pipe stand.

F. Wall brackets or floor supports for hot lines 3" and over shall utilize adjustable rollers with base plate. In lieu of rollers, lines may be supported by weld type Tcradle guides with bonded graphite bearing surfaces. Securely fasten base plate to bracket or floor slab after alignment. Install lines with insulation protection saddles or pre-compressed insulation segments and shields at the support points as required and as described in the following.

G. Suspended cold lines with compressible insulation as well as non-insulated lines shall be supported by adjustable clevis hangers with standard additional components as required. Suspension supports for insulated lines shall have galvanized steel insulation protection shields that are the recommended size per manufacturer's published data. The clevis shall be properly sized to accommodate the insulation with protection shield. Rigid preformed and pre-compressed insulation segments will be furnished by the insulating contractor as required for the support points. See
Item INSULATION.

H. For steel piping installations, suspended hot lines 2½" and over shall be supported with adjustable steel yoke pipe rolls with pipe covering protection saddles (pipe shoes) tack welded to pipe and with standard additional components as required. Saddles shall be made from curved carbon steel plate with steel stiffeners. On lines 2" and below, use adjustable clevis hangers with formed galvanized steel protection shields. For copper piping installations, all hot lines shall be suspended in a similar manner. However, for lines 2 ½" and over, preformed and pre-compressed insulation segments shall be utilized at support points in lieu of pipe covering protection saddles.

I. Pipe support loops, U-straps, rollers, etc. shall be of the proper size to fully accommodate the piping including insulated lines with insulation installed.

J. On lines where supports come in direct contact with the piping, avoid the use of dissimilar metals at the area of contact...i.e. supports for copper lines shall be copper plated, etc.

K. All manufactured support items such as brackets, clamps, hangers, etc shall comply with the ANSI code for Pressure Piping or Manufacturers Standardization Society Standard Practice SP-58 as well as other applicable federal specifications and the imposed loads shall not exceed the manufacturer's published maximum recommended load listings.

L. Supporting and / or framing members, racks, etc. shall consist of an arrangement of cold-formed structural steel channel sections, fittings, bolt and nut assemblies, etc. as required by job conditions. Double channel combinations shall be spot welded. Member sizing shall insure that beam loading, etc. does not exceed manufacturer's allowances. Nuts shall be made from steel bars and thoroughly case hardened after machining. All structural members and miscellaneous parts shall be bonderized or otherwise treated to resist corrosion. Provide plastic end caps or other, similar, colored “safety caps” for all structural elements where the possibility of injury to maintenance personnel exists. The above described materials shall be as manufactured by Unistrut, Anvilstrut, Hilti or Van Huffel Tube.

M. Where structural steel shapes such as beams or angles are indicated or required, they shall be supplied with a steel primer shop coat. In addition, they shall be spot primed as required at installation. Fabrication by welding shall be as described in Item MATERIALS AND WORKMANSHIP. Where bolting is used in fabrication or erection, they shall be A325 high strength steel bolts with size and number as required to fully develop the strength of the structural member.

N. Piping and duct work systems shall be supported independently from each other. In addition, the utilities and mechanical services shall be separate installations from the ceiling grid system and shall be independently supported from the building structure. Where interferences occur, trapeze hangers or supports shall be employed. Care shall be taken to avoid blocking access to terminal air boxes, fire dampers, valves, etc.

35. HOUSEKEEPING PADS AND BASES

A. Provide concrete housekeeping pads for all floor mounted equipment furnished under this contract heading. Unless otherwise detailed, pads shall be nominally 4" high with edges chamfered 1". Concrete shall be min. 2500 psi test and all surfaces shall be free of voids and rubbed smooth. Provide at least 2 dowel rods into floor for anchorage. Pad top shall be dead level and shall have a steel trowel finish

B. Equipment anchor bolts shall be installed in accordance with manufacturer's recommendations. Equipment bases, bed plates, sole plates, etc., shall be exactly aligned, shimmed and leveled. Finally, a commercially available non-shrink grout shall be carefully placed under the entire contact area

36. HOISTS, RIGGINGS, TRANSPORTATION AND SCAFFOLDING

A. Provide all necessary scaffolding, staging, cribbing, tackle, hoists and rigging to locate the material, equipment, etc. of this section in its proper place on the project. All such temporary work shall be removed from the premises when no longer required.

B. Pay all costs related to the transportation of materials and equipment to the job site. These costs shall be covered in the bid as no additional allowance will be made by the Owner.

C. Scaffolding and hoisting equipment shall fully comply with requirements of all pertinent Federal, State and Local Laws and Codes.

37. EXPANSION, ANCHORS AND GUIDES

A. All piping shall be installed with due regard for expansion to prevent damage to the building, equipment and piping. Provide anchors and loops, connectors or expansion offsets or approved type expansion joints where indicated or required for the accommodation and/or control of movement. Note that piping shall be secured and anchored as required, in order to preclude possible damage caused by thermal expansion at piping connections to any stationary equipment.

B. Branch connections from horizontal mains to heating risers, radiation, etc. shall be made with a minimum of two 90° elbows.

C. Bullhead connections in any piping service are expressly prohibited.

D. All continuous wall radiation covers shall be attached thru elongated holes or by other approved means to prevent buckling.

E. All expansion joint and/or expansion compensator installations shall be supplemented with adequate guides as close to the units as possible and additionally at recommended intervals in order to preserve alignment and pitch. Guides shall be rigidly secured to the structure and shall permit axial movement only.

F. Expansion loops or connectors shall be flexible type manufactured units, of the size and movement capability noted on the drawings, and designed so that no pressure thrust load is imparted to the connecting pipe. They shall consist of two or three flexible sections of bronze or stainless steel annular corrugated flexible hose and

braid, with connecting fittings. The hose and fittings shall correspond to adjacent pipe size and end connections shall be sweat, threaded or flanged in accordance with specification item FITTINGS. Allowable working pressure shall be at least 150 psig at 250° F, or greater as required by design conditions. Loops shall be installed in strict accordance with manufacturer's recommendations.

G. Unless otherwise noted, expansion joints for pipe lines shall be packless type and of fabricated steel with multiple stainless steel bellows and external equalizing or reinforcing rings. Design working pressure, traverse, etc. shall be as indicated on the drawings. However, where pressure/temperature ratings permit, lines 2" and smaller may incorporate internally guided, seamless bellows type expansion compensators. On copper lines, compensators shall be of all-bronze construction.

H. All expansion joints and compensators shall be line pipe size and shall be installed in strict accordance with manufacturer's recommendations.

I. Expansion joints and/or loops 2-1/2" and over in size shall have standard ANSI flanged end connections; expansion joints and/or loops 2" and under, as well as all expansion compensators, shall have thread-end or sweat-end connections unless otherwise indicated.

J. Where joint data is not listed, each expansion unit shall be selected for compression traverse at least l-l/2 times the possible expansion that can occur in the particular sections being served. (Assume that the piping is installed at 40°F. ambient air temperature with no cold springing).

K. Expansion joints and/or compensators shall be as manufactured by Adsco, Badger, Flexonics, Hyspan or Metraflex and shall be designed for an allowable working pressure of 150 psig or higher as determined by system requirements and an allowable operating temperature of 300° F or higher as determined by system requirements.

L. Pipe alignment guides shall be provided in accordance with the expansion absorbing device manufacturer’s recommendations. They shall be the spider and sleeve type as manufactured by Adsco, Flexonics, Hyspan or Metraflex. They shall consist of a steel segmented spider, sized to the nominal O.D. of the pipe and free to move axially in a segmented steel cylinder. The sleeve or cylinder shall have an integral steel base designed for attachment to the structure. The spider shall have an appropriate liner, where required, to avoid pipe contact with a dissimilar metal.

1. On chilled water lines, or other pipe subject to sweating, the pipe guides shall be sized to accommodate insulating thermal barriers. These barriers shall consist of split, waterproof, thermal units which shall be installed in accordance with manufacturer's instructions.

M. Pipe anchors shall be furnished and installed where required to secure the pipe and totally eliminate movement. They shall be fabricated from structural steel shapes and shall be securely attached to both pipe and structure as required. Avoid direct anchor-to-pipe contact involving dissimilar metals. Note that where expansion joints are utilized in the piping system, the associated anchors must be of sufficient strength to withstand the pressure thrust as well as the force of joint compression and any alignment guide friction.

N. Where the structure is of steel, the means of attachment shall be welding, and where the structure is concrete, the means of attachment shall be anchor bolts and heavyduty sleeves.

O. All welding shall be performed in accordance with applicable provisions of the AWS Code with finish welds clean, showing good fusion and 100% penetration. Structural steel anchors shall be fabricated and installed using minimum 1/4" fillet welds. Allowable weld stress shall be 3,000 lbs. per lineal inch parallel to the longitudinal axis and 1,500 lbs. per lineal inch normal to this axis.

P. Bolts used for anchor attachment shall be minimum 5/8" diameter high-strength carbon steel bolts. A minimum of 3 bolts shall be utilized at each anchor attachment.

38. HEATING AND COOLIN G SYSTEM PIPE AND PIPING

A. Piping shall be designed, fabricated and installed in accordance with applicable portions of the ANSI Codes for Pressure Piping, as well as the requirements of the state piping and welding codes. Selection of pipe shall be in accordance with the following:

Service/System	Pipe/Tubing
Heating Hot Water:	
2" and Under	Copper (Type "L")
2-1/2" and Over	Black Steel
Glycol-Water:	
2" and Under	Copper (Type "L")
2-1/2" and Over	Black Steel

1. Piping may be roll grooved and assembled with mechanical couplings.

B. Steel Piping:

1. All steel piping shall be made up using specified grade carbon steel pipe, either ASTM A-53 or A-106. Unless otherwise indicated, pipe shall be standard weight**. For systems designed to operate beyond 50 psig (steam)

or 60 psig (water), pipe shall be either A-53 Grade B, Class S or E or A-106 Grade B. Note, however, that pipe shall be used within the range of temperatures and allowable stresses listed within the ANSI Code. All steel pipe shall have at least one identifying mark or legend per length.

2. Standard weight shall be Schedule 40.

3. Black steel pipe 2" and over in size, except where connected to equipment or otherwise shown or specified, shall be assembled by welding. Black steel pipe under 2" as well as all galvanized steel pipe may be assembled with thread-end couplings and fittings unless otherwise indicated. For requirements on welding, refer to Item MATERIALS AND WORKMANSHIP.

4. Where steel pipe or tubing is threaded and used for steam service above 125 psig or water service above 100 psig at temperatures above 220°F, it shall be seamless and equal to Schedule 80 weight.

5. Where pipe is required to be of Schedule 80 weight, it shall be made up with the appropriate couplings, etc. Piping shall be in accordance with ANSI/ASME B31.1.

6. With the exception of glycol-water system piping, threaded connections shall be made using either PTFE tape or oil and graphite pipe joint compound on male threads only. On glycol-water piping, threaded connections are prohibited.

7. Note that on piping systems where all fittings are to be weld-end type, pipe lengths thru 1-1/2" size shall be assembled using socket weld couplings. On sizes 2" and above, pipe lengths shall be assembled by butt welding.

C. Copper Piping:

1. Non-ferrous (copper) piping shall consist of hard temper seamless copper tube conforming to ASTM B-88. Piping shall be made up with sweat and/or brazed joints as described in Item MATERIALS AND WORKMANSHIP.

2. Miscellaneous drain lines within mechanical rooms shall be Type "K" hard copper.

D. Grooved End Piping Installations:

1. On piping systems where mechanical couplings are permitted, the assembly shall incorporate grooved end pipe and UL listed mechanical couplings with resilient elastomeric gaskets as the means of fabrication. Couplings for steel

pipe shall be standard, general purpose type with resilient gasket, 2-part ductile or malleable iron housing and trackhead type zinc electroplated carbon steel retaining bolts with hex nuts, per ASTM A 183. Allowable design working pressure, thru 12" size, shall be at least 750 psig. Couplings for copper tubing shall be sized specifically for this application and shall have an alkyd enamel coating. Maximum design system temperature may not exceed 210°F for this type of installation...Unless otherwise indicated, housings for service with galvanized steel pipe shall be hot-dipped galvanized and housings for all other pipe shall be dip-coated with enamel.

2. Ends of pipe for systems utilizing mechanical couplings shall be hydraulically roll grooved. All grooving shall be accurately done in accordance with the coupling manufacturer's current listed standards and groove dimensions shall be within specified tolerances. (See Item MATERIALS AND WORKMANSHIP).

3. Coupling gaskets shall be the type recommended by the manufacturer for the application and shall be made of molded synthetic elastomer with properties as designated by ASTM-D-2000. Unless otherwise indicated, gaskets shall have a listed temperature range of -20° to 230°F or greater and shall be recommended by the manufacturer for water service within these limits.

E. Miscellaneous Installation Requirements:

1. Special connections are required at locations where steel and copper piping are joined. These connections shall be as described in Item UNIONS. They shall be placed in accessible locations and each installation on closed loop systems shall incorporate a system isolation valve at the connection. The necessary precautions shall be taken when employing welding operations, brazing operations, etc. to protect fitting components from heat damage.

2. All hydronic system lines shall be sufficiently pitched so they will completely evacuate by gravity to valved drains. On multi-floor installations, drains shall be provided for each level. In addition, risers serving three or more floors shall be provided with a valved drain at the base. Drains shall be 3/4" in size and shall incorporate a ball valve and a hose-end connection...Cooling coil condensate drain piping shall pitch not less than one inch in 40 feet.

F. Testing and Final Connections:

1. Piping system(s) shall be tested as described in Item TESTING before connecting to equipment. Said equipment and piping shall then be connected as described under Item MATERIALS AND WORKMANSHIP.

2. Provide all small piping required in connection with the installation of instruments, gauges, reducing valves, traps, etc. involved under this section of the work. Sensing lines on steel pipe systems shall be of intermediate alloy seamless steel tubing - ASTM A 335, Grade PF and on copper pipe systems shall be of Type "K" hard copper. Provide necessary drains, shut-off valves and cocks, syphons, pulsation dampers, etc.

39. HEATING AND COOLING SYSTEM PIPE FITTINGS

A. Fittings for all piping systems shall be of the appropriate type and shall conform to the following unless described elsewhere in the specifications.

B. Steel Piping:

1. Unless otherwise specified, fittings on black steel pipe 1-1/2" in size and under may be gray iron thread-end, minimum Class 125. They shall be manufactured according to ANSI B16.4 with material used conforming to ASTM A 126 (A). In lieu of this, thread-end fittings may be malleable iron or forged steel. Malleable iron fittings shall be manufactured according to ANSI B16.3 with the material used conforming to ASTM A 197. Forged steel fittings shall be manufactured according to ANSI B16.11 with material used conforming to ASTM A 105. All of the above described fittings shall be threaded in accordance with ANSI B2.1 for taper pipe threads. Note that malleable iron or steel thread-end fittings shall be used where specified below and/or as required by applicable codes.

2. Except as noted below, fittings on black steel pipe 2" in size and over shall be carbon steel buttweld type, made from ASTM A 106 Grade B seamless pipe. Fittings shall correspond to ANSI B16.9 with standard bevel ends and shall be in accordance with the Verification and Identification program accepted by ASME. Where lines are coated and wrapped, fittings shall be covered in a similar manner. Note that where small steel lines are required to be welded, appropriate socket weld fittings may be used.

3. Where flanges, flanged fittings, etc., other than steel are shown or otherwise indicated, they shall be cast iron, minimum Class 125, conforming to ASME B16.1 or ductile iron, minimum Class 150, conforming to ASME B16.42. Steel flanges and flanged fittings shall be minimum Class 150 and shall be in accordance with ASME B16.5. Fittings, flanges, etc., shall be manufactured in accordance with applicable ASME requirements. Threaded flanges shall have taper pipe threads in accordance with ANSI B2.1.

4. In lieu of welding tees, branch connections may be made using equivalent schedule welding outlet fittings provided the nominal diameter of the branch

line is less than ½ the diameter of the run line and does not exceed 6" in size. Branch outlet fittings shall be integrally reinforced connection adapters forged of ASTM A 105 steel with funneled (tapered) inlet design shaped to fit the run pipe and butt weld, socket or threaded outlet as determined by size and/or service. Fittings shall be manufactured in accordance with the requirements of ANSI B16.9 for Steel Butt Welding Fittings and applicable requirements of the ANSI B31.1 Power Piping Code.

5. Except where otherwise indicated, connections at valves, unions, etc. shall be screwed or flanged as determined by size and/or service. Where flanged connections occur, the use of screwed companion flanges will be allowed in lieu of weld-neck flanges on lines thru 3" except for high pressure service, where specified to the contrary or where threaded joints are otherwise prohibited.

6. Bolting shall utilize only carbon steel machine bolts and bolt studs, threaded in accordance with ANSI B1.1, coarse thread series. Bolt stud length to allow no more than two thread extensions.

C. Pressure Ratings:

1. Water (Maximum 100 psig - not to exceed 250°F)

a. Threaded Fittings...gray iron - minimum Class 125; malleable iron minimum Class 150; Flanges, flanged fittings, etc....cast iron minimum Class 125.

D. Copper Piping / Tubing:

1. Solder-joint wrot copper, cast copper alloy and cast bronze pressure fittings shall be used on copper tube piping. Wrot copper fittings shall be in accordance with ANSI B16.22 and shall be made from commercially pure copper and red bronze mill products per ASTM B75. Cast copper fittings shall be in accordance with ANSI B16.18 and shall be made from Copper Alloy C84400 per ASTM B584.

2. Cast bronze threaded fittings shall be made to the requirements of ANSI B16.18 and material composition shall be in accordance with ASTM Specification B584. Flanges for copper lines shall be cast copper alloy pipe flanges, minimum Class 150, and shall comply with ASME B16.24. Cast copper alloy flared tube fittings shall be in accordance with ANSI B16.26.

3. Engineered press fittings with O-ring seal may be utilized on copper piping installations. They shall meet the material and sizing requirements of ASME B16.18 or ASME B16.22 and the O-ring seal shall be of EPDM. The

mechanical method of joining shall be recognized by BOCA, SBCCI and IAMPO as well as applicable state and local codes. The fittings shall be designed for use with K, L, and M hard copper tubing and shall be rated for service to 200 psi or above at 250°F.

4. In general, connections to equipment, equipment isolation valves, control valves, etc., shall be made utilizing flanges or cast copper alloy (bronze) unions, as determined by size and/or equipment construction.

E. Grooved End Piping:

1. Fittings used with grooved-end pipe shall be standard full flow type, made with grooves or shoulders designed to accept gasket and coupling. They shall be of malleable iron, ductile iron, wrought steel (seamless or fabricated) or wrot copper. Allowable working pressure for these fittings shall at least equal coupling working pressure...Unless otherwise indicated, fittings used with galvanized steel piping shall be hot-dipped galvanized and fittings with all other steel pipe shall be dip-coated with enamel.

2. Where a manufactured grooved-end fitting pattern is not available, such fittings may be machined or roll-grooved from Schedule 40 seamless steel pipe, standard wall seamless welding fittings or solder-joint wrot copper fittings as described elsewhere in this item of the specifications.

3. Gaskets and couplings shall be as described in Item PIPE AND PIPING.

F. Dissimilar Metal Piping:

1. Where piping systems of dissimilar metal are joined, dielectric fitting assemblies shall be provided. Refer to Item UNIONS in this section of the specifications. Note that shut-off (ball) valves shall be installed on the system side of and adjacent to the dielectrics on closed loop systems.

40. HEATING AND COOLING SYSTEM VALVES

A. Valves of each type furnished on this project shall be of one make and each valve shall have manufacturer's name and trademark together with design working pressure (Class) clearly indicated on the body. Underwriters approved valves shall bear the U.L. label. Note that valves shall be full line size unless specifically indicated otherwise.

B. Gate valves, globe valves, swing check valves and needle valves shall be in accordance with the following paragraphs where applicable. In addition, gate valves and globe valves 4" and over that are installed 8 feet or more above floor

level shall be provided with babbit adjustable sprocket rim assemblies with non-corroding chains.

C. General:

1. Steel Piping Systems...Unless otherwise indicated, valves 2" and under shall be bronze with thread ends and valves 2-1/2" and over shall be iron body, bronze mounted, with flanged ends or all steel with flanged or welding ends.

2. Copper Piping Systems...Unless otherwise indicated, valves 3" and under shall be bronze and generally with solder ends. Valves 4" and over shall be iron body, bronze mounted, with flanged ends.

D. Materials:

1. Bronze castings shall meet ASTM B-61 or B-62 specifications. Iron castings shall meet ASTM A-126, Class B specifications. Steel castings shall conform to ASTM specification A-216, Grade WCB.

2. Packing for shut-off valves shall be of a non-asbestos type, suitable for its designated service.

3. Shut-off valves shall have stems designed for ample strength and machined to function easily. Bronze shut-off valves shall have malleable iron or aluminum alloy handwheels and stems with corrosive resistant properties per ASTM B-62.

E. End Connections:

1. Thread-end connections for bronze and/or iron valves shall conform to the requirements of ANSI B2.1 and solder-end connections for bronze valves shall conform to the requirements of ANSI B16.18.

2. End flanges of cast iron valves shall be faced and drilled to conform to requirements of ANSI B16.1.

3. End connections on steel valves shall conform to the applicable requirements of ANSI B16.5 and B16.10 for flanges, ANSI B1.20.1 for thread ends and ANSI B16.25 for butt weld ends.

F. Standards Compliance:

1. The following additional standards shall apply to the valve types referenced above.

a. Cast Iron Gate Valves.....MSS SP-70
b. Cast Iron Globe Valves.....MSS SP-65
c. Bronze Gate and Globe Valves....MSS SP-80

G. Design:

1. Bronze gate valves shall have a solid wedge disc, union bonnet and rising stem.

2. Bronze globe and angle valves shall have union bonnet and regrinding seat and disc.

3. Bronze swing check valves shall have screwed bonnet or cap, bronze disc and regrinding seat. Valve body shall display an arrow indicating direction of flow.

4. Cast iron gate valves shall be OS&Y design with rising stem, bolted bonnet, and solid wedge disc.

5. Cast iron globe valves shall be OS&Y design with rising stem, bolted bonnet and beveled disc.

6. Cast iron swing check valves shall have bronze trim, bolted bonnet, flanged ends, and replaceable seat rings and hinge pin.

7. Steel gate valves shall have straight-thru ports and shall be OS&Y design with rising stem, bolted bonnet and seal-welded seat rings. Valves shall have standard CR-13 and stainless disc and trim unless otherwise mentioned.

8. Steel globe valves shall be OS&Y design with bolted bonnet and standard trim. Steel swing check valves shall have bolted cap and standard trim and shall be suitable for use in vertical as well as horizontal lines.

9. Gate valves 3" and over in size on steam lines 100 psig and above shall have an integral bypass with globe (warm-up) valve.

10. Needle valves shall be all bronze with rising stem, union bonnet and conical seat opening.

11. Other valves shall be as described below under their specific heading.

H. Duty:

1. The pressure - temperature ratings (non-shock) for all valves shall comply with the pressure class specified for the system(s) listed. In addition, ratings

for steel valves shall conform to the Standard Class Valve ratings shown on ANSI Standard B16.34.

2. Pressure - temperature ratings shall be adjusted as required when valves are solder-end type. The adjustment made shall be based on the solder used as specified in Item MATERIALS AND WORKMANSHIP. Maximum system temperature for solder-end valves shall not exceed 250°F.

I. Note that all valves within the ASME code jurisdictional limits of power boilers (Re: specification item MATERIALS AND WORKMANSHIP) shall have a steam working pressure rating at least 50% higher than the maximum rated pressure for the boiler.

J. The minimum rating (Class) for bronze, iron and steel valves for other than ASME code jurisdictional limit piping shall be as indicated for the following listed hydronics piping system(s):

SYSTEM PRESSURE	BRONZE	IRON	STEEL
Under 100 PSIG	150	125	-

K. Manufacturer:

1. The above described valves shall be as manufactured by Crane, Hammond, Jenkins, Kitz, Milwaukee, Nibco, Powell or Vogt.

2. Other, miscellaneous types of valves shall be in accordance with and as described in the following paragraphs.

L. Ball Valves:

1. Valves shall be in accordance with following and shall incorporate a noncorroding mirror finished ball, multiple rings of Teflon impregnated packing and high tensile blow-out proof stem with insulation accommodating extension handle and memory stop. Body shell/wall thickness to be in accordance with requirements of ANSI B16.34. Lever handle shall be of nickel plated or stainless steel with plastic grip. Quarter turn of handle shall rotate ball from full open to full closed position.

2. On lines 2" and under, valves shall be of bronze, forged brass or carbon steel with standard port and Type 316 stainless steel ball and stem. They shall be rated minimum 600 psig WOG, cold non-shock and 150 psig saturated steam. Body shall be single piece with threaded ends or two piece with solder ends and shall incorporate an adjustable packing gland and reinforced Teflon seat. Valves shall be in conformance with Federal Specification

WWV-35C. For higher pressure steam applications (50 psig and above), valves 1-1/2" and 2" in size shall be as described below.

3. On lines 2-1/2" and over, valves shall be standard port with adjustable packing gland and minimum ANSI Class 150, carbon steel split body with ANSI B16.5 flanged ends or 3-piece bronze solder end body. Valves shall be rated minimum 600 psig WOG and 150 psig saturated steam. Ball and stem shall be Type 316 stainless steel and bearing sleeve and seat shall be of reinforced Teflon. All manually operated valves 4" and over shall be provided with a hand-wheel type gear operator and locking device. In addition, where these valves are installed 8 feet or more above floor level, they shall be fitted with chain operators and non-rusting chains.

4. The following additional standards shall apply to ball valves for sizes 2 ½" and over:

   a. Bronze.....WW-V-35B

5. Valves shall be as manufactured by Apollo, Flow-Tek, Jamesbury, Kitz, Milwaukee, Nibco, Watts, W-K-M or Worcester. Install in accordance with manufacturer's recommendations including disassembly of sweat end valves. All ball valves for steam service shall have high temperature packing and seat and, in horizontal lines, shall be full port design. For higher pressure steam applications, valves shall have a carbon steel body unless otherwise indicated, and shall be rated minimum ANSI Class 300. In addition, for sizes 1-1/2" and above, they shall have flanged ends.

6. Note: Metal seated tri-centric valves, as described below, may be substituted for ball valves on lines 6" and above.

M. Balancing Valves:

1. Line size 2" and under - Valves shall be all bronze combination indicating, balancing and shut-off type with thread ends (steel pipe) or sweat ends (copper pipe) and shall be rated for minimum 125 psig service, or higher as required, at 250 deg. F. Valves shall provide bubble tight shut-off and shall be repackable under pressure. They shall be equipped with readout meter ports and shall provide for precise flow measurement and precision flow balancing. Valve body shall incorporate a drain connection. Valves shall be as manufactured by Amtrol, Armstrong, Bell & Gossett, Flow Design, Homestead, Illinois, MEPCO, Sarco, Taco or Tour & Andersson. The manufacturer shall supply published performance data for each valve size.

2. Line size 2-1/2" and over - Valves may be similar to the above or shall be globe style or Y-pattern style design. They shall have bronze, cast iron or

carbon steel body, flanged ends and stainless steel stem with corrosion resistant plug, ball or seat disc and seal. Valves shall provide three functions: (1) Flow Measurement, (2) Flow balancing and (3) Positive bubble-tight shut off. Valve body shall incorporate non-leaking metering ports. The valve shall have a venier-type setting from the number of turns of the hand wheel or stem extension to establish specified flow and shall incorporate a locking feature to achieve a precision, tamper-proof balancing set point. Valves shall be designed for a working pressure of 150 psig or greater, as required to meet design/field conditions, at 250° F. The flanged end balancing valves shall be by Armstrong, Amtrol, Bell & Gossett, MEPCO, Taco, Tour & Anderson or Victaulic. The manufacturer shall supply published flow capacity charts and performance data for each valve size furnished.

N. Silent Check Valves:

1. Unless otherwise indicated, valves shall be globe style center-guided type with bronze or stainless steel trim, renewable bronze or resilient seat and stainless steel spring. Disc to be all bronze and fully guided, top and bottom. Body shall have ANSI drillings and an open area equal to or greater than connected pipe. All parts to be field repairable or replaceable. Valves shall be as manufactured by Hammond, Metraflex, Miller, Mueller, Victaulic or Williams-Hager and shall be a minimum 125 lb. class or greater as required to meet design/field conditions.

2. Valves size 2" and under shall have bronze or cast iron body with thread, sweat or flanged ends and valves size 2-1/2" and over shall have carbon steel or cast iron body with flanged ends. Flanges shall conform to ANSI B16.1 for cast iron or B16.5 for steel.

3. In lieu of the above, wafer style check valves may be utilized where space is limited. A stainless steel spring shall close the discs when no-flow conditions exist. Valves shall be minimum ANSI 125 and shall conform to ANSI B16.34 as it applies to check valves. Wafer style check valves shall be as manufactured by Miller, Mueller, Proquip or Williams-Hager.

O. Butterfly Valves:

1. Unless otherwise indicated, butterfly valves shall be water service type with self-adjusting stem seals; machined and streamlined disc; full diameter stem and replaceable, resilient reinforced seat. Valves shall be guaranteed bubble tight at design pressure. Body shall be cast iron, ductile iron or carbon steel and shall be full lug style with tapped lugs for end of line service at full rated pressure. Design shall accommodate ANSI standard flat or raised face flanges. Disc shall be bronze, bronze alloy or stainless steel and stems shall

be stainless steel with corrosion resistant bearings. Valves 6" and under shall have a locking type handle operator with adjustable open position stop. Valves 8" and over shall have hand wheel operated worm gear actuators. Where necessitated by insulation thickness, provide extended neck and stem. Valves shall be as manufactured by Centerline, Grinnell, Hammond, Keystone, Jamesbury or Nibco and shall be rated at 150 psig working pressure or above, as required. The seat and seals shall consist of an elastomer recommended for water service at temperatures of 250°F continuous, at full rated pressure for hot water applications and shall have an elastomer recommended for service from 10°F to 180°F at full rated pressure for cold water applications.

2. Where butterfly valves are installed in grooved end piping systems they shall have the appropriate gaskets and end connections designed to accommodate the couplings specified for these systems. Grooved valves, conforming to applicable portions of the above specifications, including disc and service temperature requirements, shall be as manufactured by Victaulic or Grinnell.

41. DOMESTIC WATER AND FUEL GAS TESTING AND INSPECTION

A. Test all systems, equipment or apparatus installed under this contract as required, in the presence of the certified plumbing inspector for the jurisdiction involved. Witnessing and approval in writing (sign-off) shall be required on all of these tests. Representatives of manufacturers who furnished major items of equipment for the project shall be present at the time their apparatus is being tested. Repairing or replacing defective work shall be done immediately. Give prior notification of all tests to the Engineer. Where notification is not received, the Engineer reserves the right to have the test(s) repeated. The required inspection tags furnished by the plumbing inspector shall be recorded and subsequently turned over to the Owner.

B. Apparatus provided under this contract heading which fails to deliver its full rated capacity, or which is defective or unacceptable in other ways, shall be promptly replaced or made good. Performance of equipment shall be witnessed and validated by the manufacturer's representative in the presence of the Owner's duly authorized agent.

C. Test drainage system(s) in accordance with the instructions of the plumbing inspector, using air, water or smoke as required.

D. Hydrostatically test water supply system(s) at 150 psig in accordance with stipulated AWWA procedures and leave said system in perfect working order after satisfactory completion of the test.

E. The fuel gas piping system shall be tested, using air, in accordance with procedures outlined herein. The test duration shall be not less than 30 minutes for each 500

cubic feet of pipe volume or fraction thereof. A soap test shall be made, at operating pressure, of all exposed fittings in service or house lines which were not included in the pressure drop test. Piping shall be tested at the following pressures:

F. Steel Pipe: Piping to operate at less than 1 psig shall be given a pressure test of not less than 5 psig without showing any drop in pressure. Piping to operate at a pressure of at least 1 psig, but not more than 40 psig shall be given a pressure test of not less than 50 psig or 150 percent of maximum operating pressure, whichever is greater, without showing any drop in pressure.

G. All systems, in addition, shall be tested as required by governing Federal, State and/or local authorities. Note that the testing of piping systems shall be performed prior to the application of any specified insulation or backfilling. Where applicable, certificates of approval shall be furnished to the Owner.

H. Calibrated instruments, meters, equipment, facilities, and labor required to properly conduct tests shall be provided as required. Tests shall be repeated, if failures occur, until satisfactory performance is established.

42. DOMESTIC WATER PIPING

A. Piping shall be designed, fabricated and installed in accordance with applicable portions of ANSI Codes for Pressure Piping, the Ohio Plumbing Code and the state piping and welding codes.

B. Piping systems shall be installed with approved hangers and supports (see item SUPPORTS, HANGERS AND BRACKETS) in a manner that will prevent sagging, warping, sway or vibration. Hangers, supports, etc., shall be properly located to allow for expansion and contraction and to accommodate concentrations of weight such as from heavy equipment and/or large valves.

C. Pipe shall run straight between fittings and in straight horizontal and vertical lines, and parallel to building lines wherever possible. Ream ends of pipes to remove fins, burrs, etc., to full inside diameter and see that insides of pipes are clean before being placed in position. Open ends of pipe lines or equipment shall be properly capped or plugged until final connection to keep dirt or other foreign material out of the system.

D. Changes in direction and intersections of pipe lines shall be made with standard, specification type fittings as required and as called for hereinafter. Mitering of pipe to form elbows, notching straight runs to form tees or any similar procedure will not be permitted unless specifically mentioned in these specifications.

E. Solder-joint wrot copper pressure fittings shall be used on copper tube piping and pipe shall be made up with sweat or brazed joints. Filler metal, brazing material, etc., shall be as described in Item PIPE JOINTS. Note: All products used in the potable water system shall be “lead-free’ and comply with NSF 61-G.

F. Consideration of and provisions for expansion and contraction in pipe lines thruout the system shall be part of this section of the work. Expansion loops, offsets, etc. which will properly care for the expansion may be used.

G. Locate and install piping so 1/2" minimum clearance is maintained after insulation is applied.

H. Connection to plumbing equipment shall be made using the proper method to eliminate strain due to expansion.

I. All water risers shall have accessible drain valves with capped hose thread connections at the base of the risers. Piping shall be pitched conveniently so all systems will completely evacuate by gravity to drain valves.

J. Pipe shall be tested as described in Item TESTING AND INSPECTION before connecting to equipment. Said equipment and piping shall then be connected as described in Item PIPE JOINTS.

K. Bullhead connections in any piping system are expressly prohibited.

L. Reductions in pipe sizes shall be made with reducing fittings and not with bushings.

M. Provide small piping required in connection with instruments, gauges, reducing valves, and other mechanical items not specifically shown on the drawings. Sensing lines shall be of intermediate alloy seamless steel tubing ASTM A335, Grade PF. Provide drains, shut-off valves and cocks, syphons, pulsation dampers, etc.

N. All piping materials used on this project shall be those approved for use by the authorities having jurisdiction. Specific materials may have certain restrictions or exclusions as to their usage, including where they may or may not be located. All such regulations shall be adhered to where applicable.

O. Specific piping materials shall be called out under sections covering each specific service and/or system.

43. DOMESTIC WATER PIPE STERILIZATION

A. Sterilize the entire domestic water distribution system prior to completion of the project. Sterilization shall be by means of chlorine solution injection into the system in an approved manner, at/or near the source. Outlets thruout the system

shall be tested to prove presence of minimum requirements. The sterilizing solution shall remain in the system for a period of 24 at least hours. Sterilization procedure shall be witnessed by the Architect/Engineer or other qualified representative of the Owner.

B. The sterilizing solution shall contain not less than 50 parts per million of chlorine. Chlorinating material shall be either liquid chlorine conforming to U.S. Army Specifications 4 - 1, or a sodium hypochlorite solution conforming to Federal Spec. O.B. 441a, Grade D.

C. After the sterilization procedure has been completed, the system shall be flushed with clean water until the chlorine content is not greater than 0.2 parts per million, or until approved by the State Health Department.

D. The system shall then be tested for quality. Samples shall be collected at an assortment of outlets within the system and sent to an approved laboratory for testing. Test report shall be forwarded to the design team. If report shows bacteriologic contamination the process shall be repeated until test reports it removed.

E. Unless the Contractor can establish proof of expertise to the Owner's satisfaction for handling the above described operation, the Contractor shall hire, at his own expense, a company specializing in this procedure to perform the work.

44. DOMESTIC WATER PIPE FITTINGS

A. Fittings for work thruout the project shall be of the type designed for the pipe on which they are to be used and shall conform to the general specifications outlined below.

B. Dielectric unions or couplings shall be used where dissimilar metals are joined and shall be located in accessible areas and/or where indicated on the plans.

C. Copper Piping:

1. Solder-joint wrot copper and cast bronze pressure fittings shall be used on copper tube piping. Wrot copper fittings shall be in accordance with ANSI B16.22 and shall be made from commercially pure copper and red bronze mill products per ASTM B75, Alloys 120 and 122.

2. Cast bronze fittings shall be made to the requirements of ANSI B16.18, material composition shall be in accordance with ASTM Specification B584 and comply with NSF 61-G. Flanges shall be minimum Class 150 and shall meet ANSI Standard B16.24 dimensions.

3. In lieu of wrot copper tees for copper tube piping at size reduction branch lines, mechanically formed tee connections may be utilized. The mechanically extracted collars for joining must be formed in one continuous operation. This shall consist of drilling a pilot hole and drawing out the tube surface to form a collar with a height of at least three times the thickness of the tube wall. The collaring device shall be fully adjustable to insure proper tolerance and complete joint uniformity.

    a. The joining branch lines shall be notched and dimpled in a single process with two dimple/depth stops. The first depth stop insures proper penetration into the collar for brazing and the second dimple, 1/4" above the first, serves as a visual inspection point. Dimple/depth stops shall be in line with the run of the tube. All such joints shall then be brazed. (Soldered joints will not be permitted).

    b. All mechanically formed branch collars shall meet the requirements of applicable sections of ANSI/ASME B31 and their use shall be approved by the local and/or state inspecting agencies having jurisdiction.

4. Machine crimp press fittings, where referenced in Item PIPE JOINTS, shall be engineered press fittings that meet the material requirements of ASME B16.18 or ASME B16.22. The O-ring seal shall be of EPDM. The joining method shall be recognized by the ICC International Plumbing Code and BOCA National Plumbing Code as well as state and local codes. The fittings shall be designed for use with K, L and M hard copper tubing and shall be rated

45. DOMESTIC WATER PIPE JOINTS

A. Installation of pipe joints shall be in accordance with accepted engineering practice and in conformance with all applicable standards

B. Joints in copper tube domestic water piping and other copper pressure piping installations shall be made using tin-silver solder (Fed. Spec. #QQ-S-571E, Class SN96) for smaller sizes thru 1-1/4"and solder with high elongation properties and a liquidus rating in excess of 600° F with a wide plastic range for piping sizes 1-1/2" and 2". Note, however, that all copper piping joints 2-1/2" and over shall be brazed. Brazing operations shall be in accordance with the Copper Development Association Copper Tube Handbook recommendations using an ANSI/AWS listed nonferrous brazing alloy (BAg or BCuP series filler metal) containing at least 5% silver, having a melting range (solidus) of approximately 1,200° F and listed for the specific application. In addition, the brazing process must be performed utilizing a secondary pressurized gas in order to insure having a sufficient flame temperature to achieve a satisfactory joint.

C. In lieu of the joining method using standard fittings with solder joints for domestic water lines, copper piping installations 2" and below may be installed using a machine crimp press fitting system utilizing engineered copper fittings and bronze unions. On lines 2 ½" thru 4", a similar system utilizing engineered bronze fittings may be used in lieu of standard fittings with brazed joints. The press fittings, which shall incorporate a fitting bead and an elastomeric O-ring seal, shall have a listed temperature range of 0°F to 250°F at 200 psi and may be used with system pressures rated to 200 psi. Installation shall be in strict accordance with manufacturer's recommendations.

D. Joints shall be made using compression joints… The joint shall be of the groove retained O-Ring gasket type using a flexible, watertight, rubber type gasket conforming to ASTM C443 standards.

E. All piped equipment, control valves, etc. shall be flange or union connected. Flange joints may be made with screw flanges in lieu of flanged welding fittings on lines thru 3". Flanges shall be faced perfectly true and joints shall be made with 1/16" ring gaskets. Universal adapter flanges as manufactured by Uni-Flange will be acceptable.

F. Joints between tube and threaded pipe shall be made by use of adapter fittings. Joints between the tube and fittings shall be properly flared, soldered, brazed or welded, and the connection between the threaded pipe and the fitting shall be made with a standard screw joint.

G. No paint, varnish, or other coating shall be permitted on the jointing material until after the joint has been tested and approved.

H. Joints of any materials not mentioned herein shall be made in accordance with accepted engineering practice. Conformity to applicable standards will be considered prima-facie evidence of conforming to accepted engineering practice.

46. DOMESTIC WATER VALVES

A. Valves of each type furnished on this project shall be of one make and each valve shall have manufacturer's name and trademark together with design working pressure (Class) clearly indicated on the body. Valves required to be Underwriters listed shall bear the U.L. label. Note that all valves shall be full line size unless specifically indicated otherwise.

B. All valves shall be compatible with the type of piping material installed in the system. In addition, valves intended to supply drinking water shall meet the requirements of NSF 61, Annex G and NSF 372.

C. Gate valves, globe valves, swing check valves and needle valves shall be in accordance with the following paragraphs where applicable.

D. General:

1. Copper Piping Systems...Unless otherwise indicated, valves 3" and under shall be lead free bronze with solder ends and valves 4" and over shall be iron body, bronze mounted, with flanged ends.

E. Materials:

1. Bronze castings shall meet NSF 61 and 372 specifications. Iron castings shall meet ASTM A-126, Class B specifications. Steel castings shall conform to ASTM specification A-216, Grade WCB.

2 Packing for shut-off valves shall be of a non-asbestos type, suitable for its designated service.

3. Shut-off valves shall have stems designed for ample strength and machined to function easily. Bronze shut-off valves shall have malleable iron or aluminum alloy handwheels and stems with corrosive resistant properties per ASTM B-371.

F. End Connections:

1. Thread-end connections for bronze and/or iron valves shall conform to the requirements of ANSI B2.1 and solder-end connections for bronze valves shall conform to the requirements of ANSI B16.18.

2. Press-end connections shall conform to the testing requirements of ASTM B16.51 - “Copper and copper alloy press-connect pressure fittings.”

G. Design:

1. Bronze gate valves shall have solid wedge disc, threaded bonnet and rising stem.

2 Bronze globe and angle valves shall have union bonnet, renewable composition disc and rising stem.

3. Bronze swing check valves shall have screwed bonnet or cap with renewable bronze disc and seat. Valve body shall display an arrow indicating direction of flow.

4. Other valves shall be as described under Miscellaneous.

H. Duty:

1. Pressure ratings for bronze valves shall be for cold working pressure (CWP); adjust pressure/temperature rating as required for solder end valves.

2 All piping systems with a maximum operating pressure and/or relief valve setting below 100 psig, valves shall be rated minimum 200 psig cold water.

I. Manufacturer:

1. The above described valves shall be as manufactured by Crane, Hammond, Jenkins, Kitz, Milwaukee, Apollo, Nibco, Powell or Watts.

J. Ball Valves (Domestic Water System):

1. Valves shall be in accordance with the following and shall incorporate a stainless steel ball, multiple rings of Teflon impregnated packing and high tensile stem. Body shell/wall thickness to be in accordance with requirements of ANSI B16.34. Lever handle shall be of nickle plated or stainless steel with plastic grip. Quarter turn of handle shall rotate ball from full open to full closed position.

2 On lines 2" and under, valves shall be bronze with 316 stainless steel ball and blow-out proof stem. They shall be rated 600 psig WOG, cold non-shock. Body shall be two piece with threaded or solder ends and shall incorporate an adjustable packing gland and reinforced Teflon seat. Valves shall be in conformance with Federal specification WW-V-35C.

3. On lines 2-1/2" and over, valves shall be standard port with blow-out proof stem, adjustable packing gland, and minimum ANSI Class 150 carbon steel split body with ANSI B16.5 flanged ends or 3-piece solder end bronze body rated 600 psig WOG, cold non-shock and 150 psig saturated steam. Stem shall be 316 stainless steel. Ball shall be 316 stainless steel thru 8" and nickle plated carbon steel 10" and above. Bearing sleeve and seat shall be of reinforced Teflon. Manually operated valves 4" and over shall be provided with hand wheel type worm gear actuators.

4. Valves shall be as manufactured by Apollo, Flow-Tek, Grinnell, Hammond, Jamesbury, Kitz, Milwaukee, Nibco, Victaulic, Watts, W-K-M or Worcester. Install in accordance with manufacturer's recommendations including disassembly of sweat end valves. Note that valves for steam service shall be full port type and rated for 150 psig. saturated steam.

K. Balancing Valves:

1. Balancing valves for domestic hot water low flow return line applications (1/2 gpm) shall be globe style valves designed for precise regulation and

control at flow rates below 1 gpm and rated 240 psi for bronze at 250º F. Valves 1/2" shall be constructed of dezincification resistant brass (DZR) or bronze alloy. Each valve shall have two metering/test ports with internal check valves and with attached protective caps. All valves must equipped with visual position readout and concealed memory stops for repeatable regulation and control. Valves shall be Nibco T or S1810LLF or approved equal globe style valve.

2 Balancing valves for domestic hot water return line applications shall be globe style valves for precise regulation and control and rated 175 psi for iron and 240 psi for bronze at 250º F. Valves 1/2" to 2" shall be constructed of dezincification resistant brass (DZR) or bronze alloy. Valves over 2-1/2" will be constructed of iron with ANSI Class 125/150 flanged or grooved ends. Each valve shall have two metering/test ports with internal check valves and protective caps. All valves must be equipped with visual position readout and concealed memory stops for repeatable regulation and control. Valves shall be Nibco T or S1810LF (1/2" - 2"), or approved equal globe style valve.

L. Non-Slam Check Valves:

1. Unless otherwise indicated, valves shall be center-guided type with bronze or s/s trim, renewable or resilient seat and s/s spring. Disc holder shall be stainless steel with PTFE disk fully guided, top and bottom. Body shall have an open area equal to or greater than connected pipe. All parts to be field repairable or replaceable. Valves shall be Nibco lead free bronze ring check valve #T/S 480-Y-LF or as manufactured by Watts or Milwaukee.

2. Valves size 2" and under shall have bronze or semi-steel body with threaded or flanged ends and valves size 2-1/2" and over shall be wafer style with steel or cast iron body and flanged ends. Flanges shall conform to ANSI B16.1 for cast iron or ANSI B16.5 for steel.

M. Valves for specific service shall be as follows:

1. Fuel gas shut-off valves shall be constructed of materials compatible with the piping and comply with the standard applicable to the pressure and application in which the valve is used per the IFGC.

2. Appliance shut-off valves used in applications with a pressure up to 1/2 psi shall have a forged brass body with a chrome plated brass ball, PTFE seat, lever handle and be CSA certified to ANSI Z21.15. The valve shall be a Nibco #GB10/GB1A or Engineer approved equal.

3. Shut-off valves used in applications with a pressure up to 5 psi and size 2" and under shall be 2-piece, threaded, full port, forged brass with a chrome plated brass ball, PTFE seat, lever handle and comply with ASME B16.44 standards. The valve shall be a Watts #FBV-3C series or Engineer approved equal. Shut-off valves used in applications with a pressure up to 125 psi and in sizes 2-1/2" and above shall be carbon steel ASME class 150 flanged with a 316 stainless steel ball and stem, RPTFE seat, lever handle and comply with ASME B16.33 standards. The valve shall be an Apollo #88A-140 series or Engineer approved equal.

N. Lubricated plug valve: Wrench operated regular gland design with separate retainer and adjusting gland. Design shall incorporate pressure sealed lubrication with sealant fitting and well. Body shall be cast iron with flanged or threaded ends and shall be rated at 200 psig CWP. Valve shall be suitable for natural gas service and shall be as manufactured by Nordstrom, Powell or Walworth.

47. FUEL GAS PIPING SYSTEM

A. Furnish and install fuel gas piping as indicated on the drawings and in these specifications. The work shall consist of new fuel gas piping from the point of connection to the gas supply main and extending to all points of use as required. All piping to be in accordance with applicable portions of ANSI B31.2.

B. All branch lines shall be taken off of the top of the main and dirt legs shall be provided on all pipe drops to equipment.

C. Fuel gas piping above grade shall be:

1. Piping 2" and under shall be Schedule 40, welded or seamless black carbon steel pipe conforming to ASTM A53, type E or type S standards with threaded ends. Fittings shall be gray iron minimum Class 125 or malleable iron minimum Class 150 threaded in accordance with ASME B1.20.1 Standard for tapered pipe threads.

2. Piping 2-1/2" and above shall be Schedule 40, welded or seamless black carbon steel pipe conforming to ASTM A53, type E or type S standards with factory beveled ends. Fittings shall be standard weight carbon steel, butt-welding type, made from ASTM A106, Grade B seamless pipe conforming to ANSI B16.9 standards with a standard bevel.

3. Apply joint compound sparingly, and only to male threads, when making pipe connections. Use only joint compound that is resistant to action of liquefied petroleum gases as specified by local and/or national codes. The use of Teflon coated tape is prohibited

D. All Schedule 40 piping shall be assembled by fusion welding. Where threaded joints are necessary or permitted by code, pipe shall be Schedule 80 weight

E. Furnish and install insulating fittings where required. Insulating fittings shall be:

1. Insulating Union: Threaded insulating unions may be used on interior or above grade piping of 2" size or smaller. Insulated unions shall be composed of ground joint, precision machined black malleable iron castings with molded nylon insulation rated at 175 psi WOG as manufactured by Central Plastics Company or approved equal.

48. UNIONS

A. Unions shall be provided wherever necessary to facilitate connecting to apparatus and installing necessary fittings. In addition, unions shall be provided at the following locations:

1. Adjacent to and downstream of any valve not flanged.

2. At the final connection to any item of equipment not flanged.

B. Except as noted in the following, thread-end unions shall be used for all steel piping 1-1/2" and under. They shall be carbon steel with ball-to-cone joint and shall be rated Class 2000 or above. Unions shall conform to MSS SP-83 and ends shall be threaded to ANSI B2.1.

C. Flange unions shall be used for steel piping 2" and over and shall be cast iron, minimum Class 125 or higher as required, conforming to ANSI B 16.1 or ductile iron, Class 150 or higher as required, conforming to B16.42. They shall be complete with suitable gasket and bolts. Note that galvanized unions with cadmium plated bolts shall be used on galvanized steel piping.

D. Copper lines shall, in general, utilize sweat-end copper alloy unions. They shall be cast pressure fittings manufactured in accordance with ANSI B16.18. On copper lines 4" and above, however, flange unions shall be used, with minium Class 150 cast copper alloy flanges complying with MSS SP-106 and ASME B16.24.

E. Where dissimilar metals are involved, minimum Class 150 bronze flange dielectric piping connections incorporating non-metallic bolt sleeves and isolating washers shall be utilized on lines 2-1/2" and over. For dissimilar piping 2" and under, connections shall incorporate thread-to-sweat, Class 150 brass union couplings. Note that temperature and pressure ratings, etc.,of these connections shall be comparable to the ratings specified for other components of the piping system.

F. Where a dissimilar metal piping connection is installed on a closed loop system runout, provide a shut-off (ball) valve on the main side of and adjacent to the connection to permit isolation from the system for service.

49. GASKETS

A. Gaskets for bolted joints shall be suitable for pressure and temperature at design conditions, and shall be impervious to fluid being conducted. Gaskets shall not be thicker than required for the condition of the installation. Flat faced, cast iron, brass and bronze flanged joints shall be made with full face gaskets. Ring gaskets shall be used for raised face flanged joints. Outside diameter of ring gasket shall be equal to inside diameter of bolt hole circle. Inside diameter of flange gaskets shall not be less than ID of pipe. Mechanical joint, O-ring and nonstandard gasketing shall be as recommended by the manufacturer.

50. STRAINERS

A. Piping strainers, where called for in the specifications and/or shown on the drawings, shall be Y-Type or Tee-Type line strainers as manufactured by Armstrong, McAlear, Mueller, Sarco, Victaulic, Yarway or equal.

B. Construction, end connections, materials, etc., shall be as described in Item VALVES. Unless otherwise indicated, strainers shall have a 20-mesh stainless steel screen. Design working pressure shall be in accordance with system requirements. See Item PIPE FITTINGS.

C. At installation provide a nipple and valve assembly on all blow-off covers. Valves shall be ball type. The blow-off assembly on closed hydronic system applications shall have a line extension to a floor drain. As an alternate, blow-off connections thru 1-1/4" in size may be provided with a 3/4" valve with quick coupling hose-end connection in lieu of a line extension.

51. EXPANSION TANKS

A. Furnish and install, where shown on the drawings, a pre-pressurized diaphragm type expansion tank(s) as manufactured by Amtrol, Bell & Gossett, Taco or Thrush.

Capacity, etc. shall be as indicated on the drawings. Tank assembly shall incorporate an integral floor stand for vertical installation or horizontal mounting saddle supports, as indicated on the drawings, as well as miscellaneous tappings, charging valve, and a pressurized air chamber isolated and sealed by an elastomer diaphragm.

B. The tank shall be of steel, designed and constructed per Section VIII of the ASME Boiler and Pressure Vessel Code for a working pressure of 125 psig or higher as required and shall bear the ASME stamp. It shall have a Polypropylene liner and

shall be rated for an operating temperature of 240º F. The diaphragm shall be of heavy duty Butyl rubber or other suitable material and the system connection shall be of stainless steel.

C. All exposed metal surfaces shall have a standard, shop applied coat of rust-inhibiting primer.

52. RELIEF VALVES

A. Furnish and install, where shown on the drawings, a pressure relief valve for closed loop hydronic system(s). It shall have lifting lever, iron body and non-corrosive trim. Opening water pressure shall be as indicated on the drawings. Valve shall be manufactured by McDonnell and Miller, B & G, Conbraco or Kunkle and shall bear the ASME label. All valves for heating system application shall be BTU rated by the manufacturer.

53. WATER PRESSURE REDUCING VALVE

A. Furnish and install, where shown on the drawings, a line size water pressure reducing valve to regulate make-up water as required for each closed loop hydronic system by maintaining a minimum preset downstream line pressure.

B. The valve shall be a direct operated, spring loaded, diaphragm type regulator with bronze body and renewable composition disc. Thread-ends shall conform to ANSI B2.1; solder-ends shall conform to ANSI B16.1 and design working pressure shall be at least 150 psig at 100°F. Valve(s) shall be Boylston, Fisher, Leslie or Spence.

54. HYDRONIC SYSTEM SPECIALTIES

A. There indicated for equipment piping, furnish and install hydronic system specialties as herein described. Installation shall be in accordance with manufacturer's recommendations.

B. Suction diffuser...to be the size and type indicated on the drawings and designed to provide optimum flow conditions at pump inlet. It shall consist of an angle pattern minimum ANSI Class 125 body with flanged ends, flow straightening vanes and a removable element serving as a combination diffuser - strainer - orifice cylinder with pump protection openings. An upstream tapping shall be provided for a pressure gauge connection. The orifice cylinder and strainer shall be designed for maximum free area. The unit shall be furnished with a bronze or stainless steel startup strainer and the body shall have an access flange for element removal. The orifice cylinder shall be stainless steel and designed to withstand a pressure differential equal to pump shut-off head.

C. The above described unit shall be as manufactured by Bell & Gossett, Taco, Victaulic or approved equal. Body construction shall be of cast iron or ductile iron and flanges shall be in accordance with ANSI B 16.l. Design working pressure shall be at least 175 psig at 250°F.

D. The installation shall include an adjustable foot support and a ball valve/blow-down line run to a floor drain or terminated with hose end connection as indicated on the drawings. Line shall be sized equal to the blow-down tapping size.

E. Triple duty valve...to be a combination vertical lift non-slam check, calibrated balance, and positive shut-off valve. It shall have a non-ferrous seat and shall be designed to permit repacking under full line pressure. The assembly shall incorporate a stainless steel stem, a spring-loaded, bronze disc and an adjustable flow calibration stop. The valve shall be as manufactured by Bell & Gossett, Taco, Victaulic or approved equal. Body construction shall be of cast iron or ductile iron and flanges shall be in accordance with ANSI B 16.l. Rated working pressure shall be at least 175 psig at 250°F.

F. Flexible metal hose connectors...to be lengths of braided flexible metallic hose designed to isolate piping from equipment vibration. They shall consist of a corrugated metal inner tubing (Type 321 stainless steel) and an outer shield consisting of a stainless steel wire braid. End connections 1-1/2" and below shall be threaded carbon steel and 2" and above shall be flanged. Flanges shall be forged steel, minimum Class 150 and connector rated working pressure shall be at least 150 psi at 250°F. Connectors shall be as manufactured by Metraflex, Minnesota Flexible or Proco Products, and shall be medium length classification where a length is not specified.

55. COIL ISOLATION / FLOW BALANCE ASSEMBLIES

A. In lieu of individual components, contractor may furnish and install the following described coil connection assemblies for terminal air unit coils as indicated on the drawings.

B. The supply side assembly shall incorporate a full port ball valve and a union fitting with pressure-temperature readout port. The return side arrangement shall consist of a dielectric union fitting with pressure-temperature readout port and a separate assembly consisting of a high signal-low loss venturi with differential pressuretemperature readout ports and a balance type ball valve with integral air vent tapping, memory stop lever handle and indicator pad.

C. All items shall be of forged brass and rated for at least 400 PSI WOG service at 250ºF. Valves shall have a repackable blowout-proof stem and shall be furnished with a chrome plated forged brass ball, Viton O-rings and virgin PFTE seats and packing. The manufacturer shall attach a balance data plastic tag to each valve

indicator pad stating the balance valve model number, the design flow rate and differential pressure, and the manufacturer's designated venturi number. A space shall be provided on the tag to record the final valve setting when system balance is complete.

D. The above described integrated piping assemblies shall be as furnished by Hydronic Components, Inc.

56. AIR VENTS

A. Air vents shall be installed on each hydronics system coil. Unless furnished by the unit manufacturer, vents shall consist of a 3/4" dia. X 4" long nipple, 3/4" to l/4" reducer, a 1/4" ball valve with necessary nipples, etc., a 90° ell and flexible copper bleed tubing.

B. Main air vents shall be float type air eliminators installed at the vent connection of air separators, at the top of all main risers and at other points as necessary to keep the system free from air at all times. These units shall have a cast iron body with bolted cover and 3/4" N.P.T. bottom inlet connection, hardened stainless steel valve head and seat, and a stainless steel float and lever assembly. Design working pressure shall be at least 150 psig at 250°F. Vents shall be B & G Model 107A, Amtrol Series 720, Armstrong No. 21-AR, Hoffman No. 792 or Sarco Type 13W and shall be installed as required and/or as detailed on the drawings.

C. Furnish and install a ball valve on the system side of each vent. Run a full, outlet sized vent line from the unit to waste.

57. AIR SEPARATOR

A. Furnish and install, where shown on the plans, an external air separation unit consisting of a steel tank with tangential inlet and outlet connections, an internal perforated stainless steel air collector tube and a removable stainless steel strainer appropriately sized. Bottom of tank shall be provided with a blow-down connection.

B. The unit shall have the capacity indicated on the drawings and shall be equipped with flanged inlet and outlet connections as required. The air collector tube shall terminate with an appropriately sized air outlet connection at the top of the tank. Design and construction shall be in accordance with ASME Code requirements for at least a 125 psig working pressure at 375°F and the vessel shall bear the ASME "U" symbol. Flanges shall be in accordance with applicable ANSI requirements.

C. The above described separator unit shall be as manufactured by Amtrol, Bell and Gossett, Taco or Thrush . The manufacturer shall have published figures with regard to pressure drop and air removal efficiency for equipment furnished.

58. THERMOMETERS, GAUGES, ETC.

A. Thermometers shall be as manufactured by Ashcroft, Marshalltown, Trerice or Weksler. Furnish with elongated stem and install in brass or carbon steel well with lagging extension.

1. Thermometers shall be bi-metal, every angle type with all stainless steel construction and adjustable, anti-parallax, 5" diameter dial.

2. Dial range shall be such that normal operating temperatures will read near midpoint of dial. Listed accuracy shall be within 1% of scale range.

3. All thermometers shall be installed so that dials can be read from a point 5'6" above the floor.

4. Note: At the completion of the job all thermometers shall be calibrated against a master thermometer that has had its accuracy verified.

B. Pressure gauges shall be as manufactured by Ashcroft, Marshalltown, Trerice or Weksler.

1. Gauges shall have Bourdon tube pressure element, rotary geared movement, micrometer adjustable pointer and plastic coated metal dial. Tube and movement shall be of stainless steel and case shall be of cast aluminum or polished stainless with 4½" diameter dial. Accuracy shall be within l% of scale range.

2. All gauges shall be selected for a midpoint scale reading at normal operating pressure. Hydronic system gauges shall be installed with a bar stock needle valve. Steam gauges shall be installed with brass coil syphon and lever handle cock (250 psi steam design w.p.).

C. Gauge plug fittings shall be provided where shown for insertion of test thermometer or pressure gauge stems. They shall be furnished with the appropriate body extension as determined by piping insulation requirements.

1. Units shall be of all brass construction with dual seal cores of Nordel and shall be rated for operation to 275°F at 500 psig. Cores shall be sized to accept a 1/8" O.D. probe.

2. Fittings shall be furnished with color coded and marked caps with gasket seal.

59. CHIMNEY AUTOMATION SYSTEM

A. GENERAL

1. SUMMARY

   a. The intent of this specification is to provide an efficient mechanical venting system that will function over variable flow and maintain specified draft at all times. The following are components of the system:

      1. ENERVEX CASI, Chimney Automation System, listed to UL378, Standard for Draft Equipment and UL705, Standard for Power Ventilators and UL60947, Standard for Low-Voltage Switchgear and Controlgear.

      2. Electrical Connections.

      3. Double Wall Special Gas Vent and Pressure Stack.

      4. Stack Connections.

2. CODES AND STANDARDS

   a. The following published specification standards, tests, or recommended methods of trade, industry or governmental organizations apply to work in the section:

      1. UL – Underwriters Laboratories.

      2. National Electrical Code.

3. SUBMITTALS

   a. System vendor shall coordinate equipment product data submittal sheets and shall provide a comprehensive set of interfaced drawings and stack design calculations, which shall serve as the basis for system evaluation by consulting engineer.

   b. Submit the following to the Owner’s Representative.

      1. Comprehensive set of mechanical venting calculations based on the Chimney Design Equation published in the ASHRAE Handbook. Calculations must show flue gas volumes, pressure losses, fluctuations in natural draft at different loads and seasonal temperatures as well as estimated temperatures in each venting section to assure compliance with fan temperature rating and detect potential condensation issues. The total draft range must be documented by mechanical venting calculations based on the actual ASHRAE degree range for the geographical location of the installation. The

calculations must show the draft over the entire firing range at low, medium and high design temperatures.

2. Power Venter descriptive literature, dimensional diagrams, and electrical diagrams.

3. Control descriptive literature, dimensional diagrams, and electrical diagrams.

4. Specification review with respect to submitted equipment identifying all areas of compliance and exceptions.

5. Certification of listing for the actual application by recognized testing laboratory.

c. Manufacturers not named in these specifications, but those that have received prior approval by the consulting engineer as required within 10 days prior to bid date, shall be permitted one opportunity to receive formal submittal approval. If the consulting engineer does not grant this approval, the contractor shall submit on the manufacturer's name in these specifications only or the contractor will be charged for the submittal review time for alternate manufacturers.

d. In the event the Contractor wishes to submit an alternate mechanical draft system manufacturer for consideration by the Engineer/Owner, the Contractor shall submit to the Engineer/Owner, a minimum of 14 days prior to bid date, a complete technical proposal based on the alternate system, including equipment brochures, detailed technical data sheets, detailed drawings, detailed wiring diagrams, detailed operational description, comprehensive set of mechanical venting calculations based on the Chimney Design Equation published in the ASHRAE Handbook, evidence of manufacturing capability and evidence of third-party listing. If any of the above materials specified for the product substitution proposal are not included in the product substitution proposal, those proposals shall be considered non-responsive and incomplete and shall be rejected by the Engineer/Owner.

4. QUALITY ASSURANCE

a. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture and shall be of a standard catalog product.

b. Mechanical draft system guaranteed to operate satisfactory and efficiently and to provide a constant draft that does not fluctuate more than +/- 0.01" W.C. under stable load conditions.

c. Scheduled equipment performance is minimum capacity required.

d. Scheduled electrical capacity shall be considered as maximum available.

5. MANUFACTURER WARRANTY

a. All equipment is to be guaranteed against defects in materials and/or workmanship for a period of 24 months from the date of installation, or 30 months from date of shipment, whichever occurs first. The warranty shall be provided by the equipment vendor and shall include the parts necessary to repair or replace all defective parts and materials.

6. OPERATING AND MAINTENANCE MANUALS

a. Provide to Owner's Representative complete Operation and Maintenance manuals with product literature on the power venter and controls, dimensional and wiring diagrams.

B. PRODUCTS

1. MANUFACTURERS, CHIMNEY AUTOMATION SYSTEM

a. Furnish ENERVEX Chimney Automation System with design volume and design pressure as scheduled on the drawings and specified. The entire system must conform to UL378, Standard for Draft Equipment, UL705, Standard for Power Ventilators and UL60947, Standard for Low-Voltage Switchgear and Controlgear.

2. DESCRIPTION, CHIMNEY AUTOMATION SYSTEM

a. The power venter design shall be of a true inline design with intake and exhaust centered on a horizontal axis centerline. The power venter housing shall be type 316L stainless steel with a minimum thickness of 0.063". The power venter shall be of the direct drive design and rated for use with temperatures up to 1400ºF. The drive unit consisting of the impeller and the motor shall be removable from the housing without having to remove the entire fan from the chimney system. The power venter must be listed for use with all types of heating appliances and this shall be acknowledged in the installation manual.

b. The backward inclined impeller shall be constructed of 316L stainless steel. It must be balanced statically and dynamically with balancing weights being an integral and non-removable part of the impeller.

c. The motor must be an air-cooled, maintenance-free variable speed EC permanent magnet motor with pre-lubricated and sealed ball bearings. It must have an integrated insulated rotor and shaft system that protects the bearings from damages by keeping discharge voltage peaks on a bare shaft surface below 4 volts. The motor must be sensorless and rated at 92% efficiency (motor and controller) and able to operate as low as 50 RPM when controlled via an externally mounted motor controller to allow operation at elevated temperatures. The motor has integrated protection against overloading, blocking over and under voltage and over-heating.

d. The modulating fan control, EBC31, must be a true PID-based control with infinitely variable speed settings and in a NEMA 1 rated enclosure. It shall interfere with the operation of the heating appliances by preventing burner operation during emergencies where a mechanical or electrical problem occurs.

e. The features must be part of the compliance with UL378, Standard for Draft Equipment and UL60947, Standard for Low-Voltage Switchgear and Controlgear:

    1. 128 x 64 pixel LCD screen.

    2. 32-Bit microcontroller with internal 512 kB FLASH-memory, 32 MB External SPI FLASH.

    3. Two RS485 ports for expandable functionality and connectivity.

    4. Able to control three functions (Exhaust Fan, Supply Fan, and Overdraft Damper) simultaneously via a single control.

    5. Integrated BUS interface to allow for future expansion.

    6. Programmable microprocessor for selective programming of, but not limited to, draft, intermittent vs. continuous fan operation, purge times, sensor sensitivity, alarm limits and delays, manual overrides, low/high limit fan speeds via the operating panel.

7. A standard board that interlocks from any boilers/appliances so a call for heat activates the power venter and releases the individual burner once the pre-set draft has been established.

8. “Plug-and-Play” self-check that detects connections, setting requirements and accessories during each start-up.

9. An integrated and programmable proven draft function that can be set for automatic and manual reset.

10. An integrated Operating Priority option, which allows one or more appliances to operate during electrical or mechanical failure of the fan, provided the draft requirement can be met and safe operation assured. Set up of a default Operating Priority must be possible, so the most important appliance(s) have highest priority during calls for heat. It must automatically check for fan operation every two hours and go back to normal operation if appropriate.

11. Bearing cycle activation every 7 days if the power venter has not been operating during the past 7 day period.

12. A normally open (NO) contact is available within the control to activate a visual or audible alarm (by others), or to interlock with a Building Management System.

13. An alarm function that will display the fault code on the LCD display and signal an audible alarm (by others). The control shall log the last 10 fault codes.

14. Ethernet port for TCP/IP networking

    i. Graphical web interface for monitoring the 0-10V in/outputs, alarms, and set points.

    ii. Upgrade of firmware can be done via the web interface to ensure controller is always up to date.

    iii. Remote monitoring and management capabilities standard, including the ability to adjust system configuration remotely.

    iv. Ability to upload or download configuration file via web interface or USB.

15. Relay board for additional appliances in system. Board will fit inside control housing and interlock appliances with safety features of control.

16. Adjustable pre-purge, so the control will allow the power venter to prime the mechanical room prior to appliance startup.

17. Adjustable post-purge, so the control will allow the power venter to operate for up to 3 minutes after the burner has shut down.

18. English, Spanish, and French Language display options.

19. USB port for firmware upgrade and data logging.

20. BACnet interface through RS485 module.

f. The pressure sensor, XTP, shall be certified for use with gas-fired appliances and shall include a chimney probe along with tubing for installation in the chimney or stack as shown on the manufacturer's submittal and feature:

1. The range of operation shall be -1.0 - +1.0 inWC, with a minimum accuracy of +/-0.25% of span.

2. The pressure drift shall be less than +/- 0.25% full scale, the offset longtime drift (1 year) shall not exceed +/- 0.005 inWC and the sensor response time shall be less than 0.25 seconds.

g. Motor speed controller (MSC), ENERVEX EDrive, must be factory programmed and provide with the following specifications:

1. All features shall be included in the motor controller enclosure, which shall be NEMA 1 rated.

2. Sensorless Vector Control type that is suitable for all types of high-efficiency Permanent Magnet Motors as well as standard induction motors.

3. Internal Category C1 EMC filter and brake chopper and have flying start capability.

4. Analog input.

5. Built-in keyboard and Bluetooth connectivity. Programmable via PC with OptiTools Studio.

6. Able to operate in environments of up to 50°C.

7. Rated for 150% overload for 60 secs and 175% for 2 secs.

8. Able to communicate via Modbus RTU (EIA-485).

9. Optional control of single phase motors.

3. PERFORMANCE, CHIMNEY AUTOMATION SYSTEM

a. The Chimney Automation System will ensure that the draft set-point (in. W.C.) is reached and maintained within 20 seconds of burner light-off. This can be measured with an external manometer at the appliance outlet.

b. Ramp-up and ramp-down time of the fan will be no more than 20 seconds.

c. The control will shut down the appliances within 15 seconds if draft is not maintained as stated above.

4. SEQUENCE OF OPERATION

a. Each heating appliance must be interlocked with the control. Upon a call for heat, the control will activate the power venter to establish draft in the chimney system. Once the draft set-point is reached, the control will enable the appliance(s) calling for heat to fire. This sequence is repeated every time an appliance calls for heat without the control interrupting the sequencing of the heating appliances.

b. When an appliance shuts down, the power venter will adjust its speed to satisfy the draft set-point. Once the last appliance has shut down, the power venter will continue to run in post-purge mode for a set period of time to remove residual flue gases.

c. If proper draft cannot be maintained because of a mechanical or electrical failure, the control will go into alarm mode and the integrated proven draft function will shut down all appliances within 15 seconds. While in alarm mode, the control constantly monitors the draft. If the failure corrects itself or is corrected via intervention, the system will restart automatically.

1. If the failure is not corrected, the control will utilize the integrated Operating Priority function. During a following call for heat, the control determines if one or more appliances can operate safely at the given draft conditions. If so, the heating appliance(s) will be able to operate without chimney fan operation. After two (2) hours, the control verifies chimney fan operation and, if present, the control will go back to normal operation. Otherwise, the control will continue to operate in Operating Priority mode. The self-check is repeated every two (2) hours infinitely. During a

period without power venter operation, the control is in alarm mode to notify the Building Management System.

d. If the power venter is out of commission for seven (7) consecutive days, the Bearing Cycle Activation function will allow the fan to operate at a low speed for a short time. This is automatically repeated every seven (7) consecutive days the chimney fan does not operate.

5. STACK CONNECTION

a. Furnish U-band or ANSI flange connection type as required.

6. BALANCING BAFFLES & BAROMETRIC DAMPER

a. Furnish balancing baffles, type BBF is constructed of 316L stainless steel housing for each boiler/appliance where specified by manufacturer if applicable. The BBF is UL listed for UL 378 Draft Equipment and in Canada for ULC/ORD-C378 Draft Equipment. Any alternate baffles shall carry the same listings.

b. Furnish barometric camper, type BDR constructed of 316L stainless steel housing. Barometric damper must be UL 378 listed for Draft Equipment.

7. ELECTRICAL REQUIREMENTS

a. Power supply shall be:

1. To the EBC31 control: 1x120V AC, 60 Hz.

2. To the motor speed controller: As shown on schedule.

b. All wiring shall be in accordance with the National Electrical Code.

8. ALTERNATE MANUFACTURES

a. All product substitution proposals on the basis of alternative mechanical draft system manufacturers must include detailed information regarding product performance and include a listing report by a nationally recognized testing laboratory that verifies that the entire system is in compliance with UL378, Standard for Draft Equipment, UL705, Standard for Power Ventilators and UL60947, Standard for Low-Voltage Switchgear and Controlgear and meets all the specifications listed. It is the Contractor's responsibility to assure that a substituted system meets the complete detailed functions specified herein. If a substituted system does not provide all these functions, the Contractor will be fully liable for bringing the

installed system into compliance or replacing it with the originally specified manufacturer's system.

9. SCHEDULE

Unit Tag	Servicing	Manufacturer	Model No.	Electrical Data			RPM	HP (kW)	Notes
				Amps	Volts	Phases			
Example	CF-1	ENERVEX	TDF 400	12.1	208-240	3	1950	2.2 (3.0)	1, 2, 3 ,4

a. Fan must be rated to 1400F and feature EC permanent magnet motor.

b. Furnish with EBC31 Modulating Draft Controller and bi-direction XTP pressure transducer.

c. MSC to be provided by fan manufacturer per UL listing.

d. Provide fan disconnect.

C. EXECUTION

1. INSTALLATION

a. Complete structural, mechanical, and electrical connections in accordance with manufacturers' printed instructions.

b. Installing contractor shall install all Chimney Automation System components as indicated on drawings, including low voltage shielded wiring from XTP sensor to EBC31 controller and line voltage wiring from EBC31 to the power venter. He must ensure the following.

1. Allow satisfactory arrangement in the space available.

2. Verify fan operating voltage is the equivalent to the supply voltage AND rated voltage of the MSC.

c. Connecting to stack:

1. Install per plans and in accordance with manufacturer's printed instruction.

2. OPERATING TEST, START-UP, AND ON-SITE SERVICES

a. System vendor's service organization shall employ senior service technicians having experience in all aspects of trouble shooting, corrective service, and preventive maintenance O&M reporting.

b. After installation is completed:

1. Test the operation of the chimney automation system and:

i. Increase and decrease draft setting to verify the mechanical draft system reacts as specified.

ii. Increase and decrease firing rate to verify the mechanical draft system reacts as specified.

iii. Verify that the ramp-up time during start up does not exceed 20 seconds. This is defined as the time from the burner is released until the draft settles at the specified draft value.

iv. Use an external manometer (draft gauge) to verify that the draft does not drift more than +/- 0.01" W.C. during a stable load.

2. Test safety control by firing boiler and:

i. Shut off the power venter.

ii. Shut off the control.

c. Provide services of factory representative of chimney automation system manufacturer to:

1. Confirm proper installation of power venter and controls.

2. Start-up and adjust control and balancing baffles.

3. Test individual controls for proper operation.

4. Set draft for specified operation.

5. Test safety system.

d. Submit a written report signed by manufacturer's authorized representative, confirming that safety and operating controls have been properly installed.

3. OPERATING INSTRUCTIONS

a. Instruct Owner's Representative and designated personnel in the proper operation and maintenance of the packaged system.

D. DOUBLE WALL SPECIAL GAS VENT & PRESSURE STACK

1. GENERAL

a. Provide factory-built double-wall, modular connector, manifold and stack system that is tested and listed by the Underwriters' Laboratories, Inc. (UL) for use on Category I, II, III, IV appliances with building heating equipment and appliances which produce exhaust flue gases at a temperature not exceeding 1400˚ F (Fahrenheit) under continuous operating conditions when burning gaseous or liquid fuels as described in NFPA-211. The vent system shall comply with NFPA-211 and be listed in accordance with:

1. UL 1738 Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV, with operating flue gas exhaust temperatures up to 480˚ F continuous, and up to 60 inches internal water column pressure.

2. UL 103 Standard for Building Heating Appliance Chimneys, with optional Positive Pressure Listing, which may produce exhaust gas at temperatures exceeding 1400˚ F under continuous operating conditions when burning gaseous or liquid fuel.

3. UL 2561 Standard for 1400°F Factory-Built Chimneys intended for venting gas, liquid, and solid-fuel-fired appliances in which the maximum continuous flue-gas temperatures do not exceed 1400°F.

b. The vent system and all components with exposure to flue gases, including adjustable lengths shall be listed for positive internal pressure to 60 inches internal water column pressure. If adjustables are not listed to 60 inches of pressure, fixed sections shall be provided. Additionally, the UL listed flue gas vent system shall have skin temperatures that have been obtained by UL test procedures. The published surface temperatures shall be the result of the UL 103 1400˚ F chimney test.

c. ALL dampers, including isolation, balancing, and barometric must be constructed of 316L Stainless Steel and listed to UL 378 Standard for Draft Equipment.

d. When a mechanical draft system is required, fans, draft controllers, and flue components shall be provided by a single manufacturer.

2. CONSTRUCTION

a. The double wall flue system shall have a 316L-PCM stainless steel inner liner (24 GA minimum) and a 304 stainless steel outer jacket (24 GA minimum) separated by 1" air gap. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL listing.

b. The vent sections and fittings shall be joined by clamping a U Band over the mating male/female flanges of adjacent components to compensate for thermal expansion of the flanges, other clamping systems shall provide suitable solutions to address thermal expansion. The male flange connection shall have an integrated graphite seal. The inner liner shall be the structural load bearing component and expansion of the liner due to changes in gas temperature shall be catered for by adjustables fitted, as necessary, throughout the system.

c. Roof and wall penetrations shall be suitable for the specified roof/wall construction and shall comply with the manufacturer's installation instructions.

d. The exhaust system shall be designed to compensate for all flue gas induced thermal expansion through the vent material itself and any mating components.

3. INSTALLATION

a. When installed according to the manufacturer's installation instructions, the flue system and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions of the system.

b. The prefabricated flue system shall be installed according to the manufacturer's installation instructions and shall conform to all applicable state and local codes.

c. Provide all modular straight sections, fittings, supports, guides, expansion joints, guy sections, guy tensioners, roof thimbles, wall fire stops, roof flashings, storm collars and stack terminations as required to provide a complete system per the manufacturer's installation instructions.

d. The vertical stack termination shall be no less than two feet above any portion of the building within ten feet of the stack penetration (see NFPA-211) unless stated otherwise by local code.

e. Roof and wall penetrations shall comply with the manufacturer's installation instructions.

4. WARRANTY

a. The prefabricated flue system shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of 15 years from date of installation or 30 days after delivery, whichever comes first.

b. The prefabricated flue system shall be warranted against leaks due to defects in material and manufacturer's workmanship for a period of 5 years from date of installation or 30 days after delivery, whichever comes first.

c. The inner diameter of the flue system shall be verified by the manufacturer's venting computations. The computations used shall be technically sound, follow ASHRAE calculation methods and shall incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact operating characteristics of all equipment to the factory representative.

d. The manufacturer shall provide "to scale" drawings depicting the actual layout. The prefabricated flue system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's warranty and in conjunction with sound engineering practices.

e. The factory built modular flue system shall be furnished by a vendor organization that assures design, installation and services coordination. As well as, providing "in-warranty" and "post-warranty" unified responsibility for owner, architect, consulting engineer and contractor.

5. MANUFACTURERS

a. When a mechanical draft system is required, fans, draft controllers, and flue components shall be provided by a single manufacturer.

b. Product specification requirements shall be met by using ENERVEX Commercial/Industrial Model EPSA exhaust flue and mechanical draft system or equivalent and as approved by the engineer. Equivalent submittals shall specify manufacturer's model number, and other pertinent identification, and attest that the alternate material is in compliance with all specification requirements.

60. HOT WATER BOILER

A. GENERAL

1. SUMMARY

a. This section includes condensing hot water boiler for indoor space-heating and domestic water.

2. REFERENCES

a. Intertek (ETL)

1. Certified to UL 795/CGA 3.1 Standards for Commercial-Industrial Gas Heating Equipment

2. Certified to ANSI Z21.13/ CSA 4.9 Standards for Gas-Fired Low Pressure Steam And Hot Water Boilers

b. American Society of Mechanical Engineers:

1. ASME Section IV - Boiler and Pressure Vessel Code - Heating Boilers

2. ASME CSD-1 – Controls and Safety Devices for Automatically Fired Boilers]

c. American Society of Heating, Refrigeration and Air Conditioning Engineers

1. ASHRAE: Standard 90.1 Energy Standard for Buildings

d. Hydronics Institute, Division of Air Conditioning, Heating & Refrigeration Institute (AHRI):

1. AHRI1500: Testing Standard to Determine Efficiency of Commercial Space Heating Boilers as defined by Department of Energy in 10 CFR Part 431.

e. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code (ANSI Z223.1)

f. [Relevant local and/or project specific Codes and Standards]

3. SUBMITTALS

a. In accordance with Contract Documents. Minimum product data to include:

1. Capacities, accessories and options included with boiler.

2. General layout, dimensions, size and location of all required connections.

3. Electrical characteristics

4. Weight and mounting loads.

5. Manufacturer's installation and start-up instructions.

6. Equipment Operation and Maintenance Manuals.

4. QUALITY ASSURANCE

a. Use an adequate number of skilled workers, trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements, pertinent contract documents, and methods needed for proper performance of the work described therein.

b. Provide the services of a manufacturer's factory-authorized representative to inspect and verify proper installation of this equipment, and to provide equipment start-up and operator training.

5. DELIVERY, STORAGE, AND HANDLING

a. In accordance with Contract Documents.

b. Accept equipment and accessories in Factory shipping packaging. Inspect for damage. Keep boiler in a horizontal position from time of delivery to final installation.

c. While stored, all equipment must be protected from external elements such as inclement weather, job site construction activity, etc. Protect equipment from damage by leaving packaging in place until installation.

6. WARRANTY

a. The boiler shall come with the warranties stated below from date of original installation.

1. Heat Exchanger: 10-year pro-rated warranty.

2. All other parts: 1-year limited warranty.

B. PRODUCTS

1. ACCEPTABLE MANUFACTURERS

a. Bryan “Bfit” Condensing Boiler, Model BFIT 2000. Refer to the Equipment Data in the Contract Drawings for the specific design and performance criteria.

b. It shall be the responsibility of the Contractor to insure that any substituted equipment is equivalent in fit, form and function to the specified equipment. The cost of any additional work caused by the substitution of equipment shall be borne by the Contractor.

c. Thermal Solutions is considered equal.

2. GENERAL REQUIREMENTS

a. Boiler

1. The boiler shall be assembled, firetested and shipped as a factory-packaged unit, complete with jacket, gas manifold, burner and controls mounted & wired, with boiler connections specified in this Section.

2. The boiler shall be constructed in conformance to ASME Section IV, ASME CSD-1 and UL 795. The boiler shall bear the ASME “H” stamp with a maximum allowable working pressure (MAWP) of 160 PSI. Pressure vessel shall be subjected to a hydrostatic pressure test of 240 PSIG at the factory.

3. The boiler shall be an ultra-high efficiency condensing boiler with a pressure vessel, constructed of 316L stainless steel and of water tube design, which shall not require a refractory combustion chamber. Pressure vessel shall have a minimum heat transfer area of 153 square feet and a waterside pressure loss no more than 11 feet of head at a 30°F temperature difference between the supply and return water temperatures. Pressure vessel shall be capable of handling water flow rates between 71 gpm and 194 gpm.

4. The boiler shall be equipped with an integral pre-mix, stainless steel forced draft burner for natural gas firing incorporating full modulation with 5:1 turndown. The burner shall be of high flame retention design and have a static swirl device to get uniform flame stability all around the combustion surface. Burner shall be equipped with a

sliding guide rail with hinged door to gain full access and inspection of the burner and combustion chamber.

5. The boiler gas valve will be designed with zero pressure regulation and equipped with a variable speed blower system to precisely control the fuel/air mixture, providing fully modulating firing rates for maximum efficiency.

6. Water connections shall be located at the top of the boiler; flue gas exhaust, combustion air intake and condensate drain connections shall be located in the rear of the boiler and incoming gas connection shall be located on the left side of the boiler. A factory supplied oversized ASME relief valve shall be provided with the boiler(s).

7. The flue passages and combustion chamber shall be accessible from the front of the boiler for cleaning.

8. The boiler shall be provided with a heavy duty 16 gauge steel jacket with a rust resistant powder coat finish. Jackets made of plastic or resin material shall not be acceptable. The boiler jacket shall contain an internal electrical cabinet for power and limit circuit wiring, providing a clean finished look when the jacket is installed. Electrical connections shall be accessible from top and/or left-side of the boiler on five (5) printed circuited boards (120VAC high and 24VAC/5VDC low voltage) with fused connections for protection and clear labeling for simple and accurate wiring.

    i. The electrical components shall be separated from incoming combustion air gas, which may contain excess humidity, dust and other contaminants brought through ducted combustion air.

9. A polypropylene condensate trap with a float-actuated shut-off switch shall be supplied with the boiler.

10. Electrical input to the boiler shall be 208v/3ph/60hz.

11. The boiler shall be of compact design with no more than 49 cubic/ft and a footprint no larger than 16 sq/ft.

12. The boiler shall be of low profile type to allow the boilers to be stacked on a stand less than 120” in overall height.

13. Boiler shall be capable of variable primary or primary/secondary piping arrangements.

14. The boiler shall come on a base with forklift opening all sides and lifting lugs for ease of moving and rigging.

b. Boiler Control System

1. Scope of Supply

Boiler Control System shall provide safety interlocks and water temperature control. The control system shall be fully integrated into the boiler control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of up to eight (8) fully modulating hot water boilers and circulation pumps. The control system shall simply control boiler modulation and on/off outputs based on the boiler water supply temperature and an operator-adjusted setpoint. However, using parameter menu selections, the control system shall allow the boiler to respond to remote system water temperature and outside air temperatures with domestic hot water priority (DHWP) and warm weather shut down (WWSD) or energy management system (EMS) firing rate demand, remote setpoint or remote start/stop commands. In order to support large domestic demands it shall be parameter selectable to start two boilers simultaneously in response to a DHWP demand.

2. Boiler Control

Using PID (proportional-integral-derivative) based control, the remote system water temperature shall be compared with a setpoint to establish a target boiler firing rate. If the secondary loop flow speed is greater than the primary loop flow speed, firing rate is increased in response to the decrease in secondary loop temperature. When the remote system temperature is near the boiler high limit temperature, the boiler supply sensor shall limit the maximum boiler supply temperature to prevent boiler high limit events. Alternately, using parameter menu selections, the control system shall allow the boiler to respond directly to boiler supply temperature and setpoint to establish a target boiler firing rate while remote system water temperature is used for display purposes only. Each boiler's fuel flow control valve shall be mechanically linked to the air flow control device to assure an air rich fuel/air ratio. All the automated logic required to ensure that pre-purge, post-purge, light-off, and burner modulation shall be provided.

3. Hot Water Temperature Setpoint

When the controller is in the local control mode, the control system shall establish the setpoint based on outside air temperature and a reset function curve, or be manually adjusted by the operator. When enabled, the setpoint shall be adjusted above a preset minimum setpoint upon sensing a domestic hot water demand contact input.

4. Multiple Boiler Sequence

The controller shall incorporate its peer-to-peer communications on each connected boiler (up to eight [8] units) by using standard RJ45 ethernet cables. The control system shall allow the connected boilers to exchange signals as required to provide coordinated fully modulating lead/lag functions. It shall not be required to wire individual control signals between boilers. Multiple boilers shall be modulated in "Unison" (all at the same firing rate). To increase operational efficiency, the control system shall utilize both water temperature and firing rate based boiler sequencing algorithms to start and stop the boilers and shall minimize the total number of boilers in operation. The control system shall start and stop boilers when the water temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize temperature deviations, the control system shall start and stop the next boiler when the "lead" boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The boiler shall be run at low fire for warm-up for a preset low fire hold time. When enabled, warm weather shut down control logic shall prevent boiler operation. The controller shall also be capable of auto-rotation of the boilers based on user-selected run time hours.

5. User Interface

A touch screen message display shall be provided to display real time BTU/hr, numeric data, startup and shutdown sequence status, alarm, system diagnostic, first-out messages and boiler historical information. In the event of a fault condition, the display shall provide help screens to determine the cause of the problem and corrective actions. Historical information shall include graphical trends, lockout history, boiler & circulator cycle counts and run time hours.

6. Circulator Control

The controller shall be capable of sequencg the boiler, domestic hot water or system circulators. Simple parameter selections shall allow all three pumps to respond properly to various hydronic piping arrangements including either a boiler or primary piped indirect water heater. The controller shall perform circulator exercise to help prevent pump rotor seizing.

7. External Data Transfer
The control system shall include the ability to transfer parameters from boiler to boiler. Upon completion of commissioning the first boiler, a USB flash drive shall allow settings to be "downloaded" from one boiler and "uploaded" into the next. Additionally, these files shall be able to be sent via email and "uploaded" to a remote technical support system. Additionally, it shall be possible to restore parameters to the "as shipped state" by selecting a "Factory Default" Button.

8. Archive History
All hard lockouts, soft lockouts (holds), sensor faults, signal faults, sequencer faults and limit string faults shall be recorded with a time and date stamp. The time and date log shall stores up to 3000 alarm & events even after power cycle." The alarm & event log must be downloadable to a USB thumb drive. The control shall include collect and store supply & return temperature, flame intensity and firing rate for at least 4 months. It shall be a simple matter to page through the boiler's operation using the boiler mounted display or download the historical data to a USB thumb drive for off-site analysis. All data must be stored in standardly compatible CRV files.

9. Quality Assurance
The boiler control system shall be supplied as part of a factory-assembled and tested burner control cabinet.

c. Boiler Trim

1. Combination pressure-temperature gauge, 3-1/2 inch diameter.

2. Supply and return temperature sensors - shall be mounted on the supply and return connections outside of the boiler jacket. Each sensor shall be accessible from the top of the boiler. The boiler control shall measure supply and return

temperatures and notify the operator if the direction of flow is reversed.

i. The boiler control shall adjust to impending temperature changes in such a way to minimize fuel consumption and maximize efficiency. The control shall measure temperatures and the rate of change in those temperatures and respond early, rather than waiting for temperatures to exceed limit control settings.

3. Flue gas temperature sensor shall be mounted in the flue vent connector to monitor flue gas temperatures and reduce the blower speed when flue gas temperatures exceed 189°F. If the flue temperatures exceed 195°F, a forced boiler recycle results.

4. ASME Section IV safety relief valve sized to exceed the gross output of the boiler which shall be factory set to relieve pressure at 150 psig water working pressure.

5. Water flow switch to prevent the burner operation during low water flow conditions.

6. High Temperature Limit, automatic and manual reset, to prevent burner operation if water temperature conditions rise above maximum boiler design temperature, wired to put the boiler into a hard lockout, requiring manual reset of the boiler primary control.

7. High and low gas pressure switches with manual reset and a range of 4 - 14 in W.C., wired to put the boiler into a hard lockout, requiring manual reset of the boiler primary control.

8. Low water cutoff (LWCO) device with manual reset. Boiler shall be fitted with a probe type LWCO located above the lowest safe permissible water level established by the boiler manufacturer. LWCO shall be UL listed and suitable for commercial hydronic heating service.

d. Vent & Intake Air Connections

1. The exhaust vent must be UL 1738 listed for use with Category II and IV appliances and compatible with operating temperatures up to 210°F, positive pressure, condensing flue gas service. UL certified vent material shall be as described in the contract documents.

2. The exhaust vent system shall be in accordance with National Fuel Code, NFPA 54/ANSI Z221.3, or applicable provisions of local building codes.

3. Combustion air intake shall be capable of drawing air from inside the room or ducted from outdoors.

4. Boiler shall be capable of common venting with an engineered vent system.

3. PERFORMANCE

a. Boiler thermal efficiency shall be certified with no less than 97.0%.

b. The burner shall emit low NOx (corrected to 3% O_2) emissions at all firing rates.

c. Provide services of a manufacturer's authorized representative to perform combustion test including boiler firing rate, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

C. EXECUTION

1. INSTALLATION

a. In accordance with Contract Documents and boiler manufacturer's printed instructions.

b. Flush and clean the boiler upon completion of installation in accordance with manufacturer's start-up instructions. The boiler must be isolated when any cleaning or testing of system piping is being performed.

c. Install skid plumb and level, to plus or minus 1/16 inch over base.

d. Maintain manufacturer's recommended clearances around and over equipment, and as required by local Code.

e. Arrange all electrical conduit, piping, exhaust vent, and air intake with clearances for burner removal and service of all equipment.

f. Connect exhaust vent to boiler vent connection.

g. Connect fuel piping in accordance with NFPA 54. Pipe size to be the same, or greater, than the gas train inlet connection.

h. Use full size (minimum) pipe/tubing on all gas vent connections.

i. Connect water piping, full size, to supply and return connections.

j. Install all piping accessories per the details on the contract drawings.

k. Install discharge piping from relief valves (open termination for viewing) and all drains to nearest floor drain.

l. Provide necessary water treatment to satisfy manufacturer's specified water quality limits.

61. DOMESTIC HOT WATER HEAT EXCHANGERS

A. Furnish and install hot water heat exchanger designed for instantaneous and continuous heating of cold water traveling through multiple coiled copper tube bundles using hot boiler water as the heat source. The hot boiler water shall be injected into the tank from the top in a spiral formation causing turbulence that allows for maximum thermal transfer efficiency, which shall be no less than 99%, that minimizes stratification and thermal stresses. These specifications are based on equipment manufactured by H2OMax, Model No. H119.

B. Cold water shall enter ½" Type L copper coil bundle near the bottom of the tank and shall extend upwards in a counterflow motion with the hot water outlet located at the top of the tank. The copper coil bundles shall have no less than 47 Sf. of heat transfer area and shall be designed to produce turbulent flow within the coils to increase heat transfer and limit the potential for lime scaling. All copper coil bundles and components shall meet the low-lead requirements of the 2014 U.S. Safe Drinking Water Act and shall be NSF/ASNI 61 compliant. Coil bundle rated for 150 psig maximum allowable working pressure. Double-wall coil bundles shall not be permitted.

C. The heat exchanger shall have a compact, vertical construction, 31" maximum width/depth x 60" maximum height with a capacity of 119 gallons. The assembly shall have a continuous rating of 845 gallons per hour based on: 40 °F Cold Water Inlet Temperature, 140 °F Hot Water Outlet Temperature, 180 °F Boiler Supply Water Temperature, 160 °F Boiler Return Water Temperature.

D. The tank shall be constructed from AS 36 steel and shall be certified in accordance with ASME Boiler and Pressure Vessel, Section VIII,

Div. 1 with a minimum ¼" shell thickness. The tank shall have a maximum temperature rating 190°F. The tank design shall be maintenance and corrosion-free design; sacrificial anodes or interior lining shall not be permitted. The tank shall be furnished with two (2) 2" NPT connections for boiler supply and return piping and two (2) 2" NPT connections for cold water inlet and hot water outlet piping.

E. The tank shall be equipped with an ASME safety relief valve, temperature/pressure gauge, temperature well and four (4) adjustable legs to level the tank.

F. The tank exterior shall be furnished with a factory installed 22 gauge steel jacket, finished with powder coated paint containing Teflon, and insulated with a minimum "R" factor of 15 to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and shall reduce heat loss less than ½°F per hour.

G. Heat Exchanger shall come with a minimum ten-year limited warranty against tank or copper coil assembly failure resulting from defects in materials and workmanship (see warranty for details).

62. IN-LINE CIRCULATING PUMPS

A. Where line mounted pumps are shown on the drawings, furnish a single stage, vertical in-line, split- coupled centrifugal pump with capacity, characteristics, etc., as called for on the drawings. The pump volute shall be of Class 30 cast iron construction with flange connections and shall be fitted with a dynamically and hydraulically balanced cast bronze impeller. The pump arrangement with split coupling shall permit ready seal access for maintenance without disturbing pump or motor and shall be fully enclosed with a coupling guard. The guard shall be in conformance with applicable ANSI and OSHA requirements.

B. The pump shall be provided with shaft sleeve, stainless steel shaft and a liquid cavity heavy duty mechanical seal. The casing shall have a machined mounting surface and shall be constructed for an operating pressure to 150 psig at 250° F. The design shall provide for internally flushed seal faces and the flushing line shall incorporate a filter for maximum seal life. The volute shall be provided with suction and discharge gauge tappings and the flange connections shall be faced and drilled to minimum ANSI 125 lb. Standards. Note that for hot water applications, the mechanical seal shall be rated for continuous duty with water at 250°F. at specified pressure.

C. Casing vent plug and drain plug shall be provided as well as a diffuser section designed as part of the discharge. Motor shall be NEMA rated, classified as Premium Efficiency and specifically designed for quiet operation. It shall be of the

vertical, solid shaft design with speed characteristics as indicated on the drawings. Three-phase motors shall be tri-voltage (200/230/460-volt). See Item MOTORS AND STARTERS.

D. Pump shall be selected so maximum impeller diameter does not exceed 90% of volute cut-water diameter and shall operate at a point within 10% of maximum efficiency. Motor shall be non-overloading along entire performance curve and readily removable for servicing.

E. Furnish one spare mechanical seal for each size pump.

F. The above described equipment shall be Bell and Gossett, Grundfos, Armstrong or Taco. The pump shall be factory tested, thoroughly cleaned and then painted with high-grade machinery enamel prior to shipment.

G. Note that higher horsepower pumps (15 hp. and above) should be mounted near the floor. Support suction diffuser and discharge elbow or triple duty angle valve using steel pipe and floor stand with isolation pad. For pumps having a motor 20 hp. and above, provide pedestal support at base of pump volute also.

63. BASE-MOUNTED CIRCULATING PUMPS - END SUCTION

A. Furnish and install pumps with performance characteristics as shown on plans. Pumps shall be base mounted, single stage, end suction design with a foot mounted volute to allow removal and service of the entire rotating assembly without disturbing the pump piping, electrical motor connections or pump to motor alignment.

B. Pump volute shall be Class 30 cast iron with integrally-cast pedestal support feet. The impeller shall be a cast stainless steel enclosed type, balanced to ANSI/HI 9.6.42009 balance grade G6.3 and secured to the shaft by a locking capscrew or nut.

C. The liquid cavity shall be sealed off at the pump shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225ºF. A replaceable stainless steel shaft sleeve shall completely cover the wetted area under the seal.

D. Pump shall be rated for minimum of 175 psi working pressure. Volute shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom.

E. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 9.6.42009 for recommend acceptable unfiltered field vibration limits (as measured

per ANSI/HI 9.6.4-2009 Figure 9.6.4.2.3.1) for pumps with rolling contact bearings.

F. Baseplate shall be of structural steel or fabricated steel channel with fully enclosed sides and ends, and securely welded cross members. Grouting area shall be fully open. The combined pump and motor baseplate shall be sufficiently stiff as to limit the susceptibility of vibration. The minimum baseplate stiffness shall conform to ANSI/HI 1.3.8.2.1-2009 for grouted Horizontal Baseplate Design standards.

G. A flexible type, center drop-out design coupling, capable of absorbing torsional vibration, shall be employed between the pump and motor. Pumps for variable speed application shall be provided with a suitable coupling sleeve. The coupling shall be shielded by a dual rated ANSI B15.1 & OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling.

H. Motor shall meet NEMA and EISA 2007 (where applicable) specifications and shall be of the size, voltage and enclosure called for on the plans. Pump and motor shall be factory aligned, and shall be realigned by the contractor per factory recommendations after installation.

I. The pump(s) selected shall conform to ANSI/HI 9.6.3.1-2012 standards for Preferred Operating Region (POR) unless otherwise approved by the engineer.

J. Each pump shall be factory hydrostatically tested per Hydraulic Institute standards. It shall then be thoroughly cleaned and painted with at least one coat of high grade paint prior to shipment.

K. The pump(s) shall be manufactured, assembled and tested in an ISO 9001 approved facility.

L. Pumps shall be Series e-1510 as manufactured by Xylem Bell &Gossett, Taco or Armstrong.

64. AIR PURGER

A. Furnish and install, where shown on the drawings, an in-line cast iron air scoop type purge unit as manufactured by Amtrol, B & G, Taco or Thrush. Unit shall be line size, internally baffled and shall have flanged or thread-end connections as determined by size. It shall be designed to continuously separate air from circulating water and shall be constructed for an operating pressure of 125 psig at 300º F or greater to meet system pressure requirements.

65. MISCELLANEOUS BOILER ROOM PIPING

A. Piping in the boiler room shall be provided as shown and as necessary to insure proper functioning of the equipment. If additional miscellaneous valves, vents, piping, apparatus, etc., are required for greater flexibility and/or better operation of the system or to meet specific code requirements, they shall be provided as part of this contract.

B. In lines 8 feet or more above floor level, gate valves 4" and over, as well as ball or disc type valves 3" and over, shall be chain operated.

C. Where the gas valve train and piping at the boiler is to be field installed, it shall be made up as indicated by the burner manufacturer. Install with line strainers on both the main gas line and pilot line downstream from the shut-off valves or cocks.

D. Separate vent lines for main gas and pilot regulators, check gauge test vent, etc., shall be run to the outside and terminated with a weatherproof head and screen, all in accordance with code requirements. Note that for multiple boilers, vent lines may not be combined. Vent lines shall be aluminum or stainless steel tubing with the proper fittings including weatherproof head and screen. They shall be sized as required to be in accordance with burner manufacturer's recommendations and the mandates stipulated by the inspecting authority. Note that lines 3/4" and above may be Schedule 40 black steel but must be primed and painted with an alkyd enamel.

66. CHEMICAL POT FEEDER

A. Furnish and install, as indicated on the drawings a pot type by-pass chemical feeder. It shall be of welded steel construction with a rated working pressure of at least 125 psi at 250ºF and a container capacity of 2 gallons or more. The feeder shall be by A & F Machine, BFS or Mitco and shall be furnished with drain and vent petcocks, fill valve and funnel. It shall be installed and piped complete with inlet and outlet isolation valves, drain valve, and hose end adapter.

67. MAKE-UP AIR DUCT CLEANING

A. The air duct / system cleaning portion of the project is governed by this item of the specifications. The following covers the scope, specific cleaning and performance requirements, detailed procedures, verification of cleanliness, applicable reference standards, etc., as well as the qualification requirements of the Cleaning Contractor. B. Qualification of the Duct System Cleaning Contractor (the Contractor):

1. Membership: The Duct System Cleaning Contractor shall be either a certified member of the National Air Duct Cleaners Association (NADCA) or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of Duct systems.

2. Certification: The Duct System Cleaning Contractor shall have a minimum of:

    a. At least one 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 Duct systems.

3. 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.

4. Experience: The Duct System Cleaning Contractor shall submit records of experience in the field of Duct system cleaning as requested by the Engineer/Owner. Bids shall only be considered from firms which are regularly engaged in Duct system maintenance with an emphasis on Duct system cleaning and decontamination.

5. Equipment, Materials and Labor: The Duct System Cleaning Contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.

    a. The Contractor shall warrant that its employees have received safety equipment training, medical surveillance programs, 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.

    b. 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 and this specification.

6. Licensing: The Duct System Cleaning Contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. In addition, the Contractor shall comply with all Federal, state and local rules, regulations and licensing requirements.

C. Standards for Contractor

1. NADCA Standards: The Duct System Cleaning Contractor shall perform the services specified in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

a. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.

D. Scope of Work

1. This section defines the *minimum* requirements necessary to render Duct components clean, and to verify the cleanliness through inspection and/or testing in accordance with these specifications and applicable NADCA Standards.

2. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the Duct system in strict accordance with these specifications.

3. The Duct system encompasses any interior surface of the facility's make-up air distribution system for conditioned spaces and/or occupied zones. This includes the entire make-up air system from the points where the air enters the system to the points where the air is discharged from the system.

E. Duct System Inspections and Site Preparations

1. Duct System Evaluation: Prior to the commencement of any cleaning work, the Contractor shall perform a visual inspection of the Duct system(s) to determine appropriate methods, tools, and equipment required to satisfactorily perform this project.

a. Damaged system components found during the inspection shall be documented and brought to the attention of the Engineer.

2. Site Evaluation and Preparations: The 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. F. General Duct System Cleaning Requirements

1. Containment: Debris removed during cleaning shall be collected as described below. Precautions must be taken to ensure that debris is not otherwise dispersed outside the Duct system during the cleaning process.

2. 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 Duct system. Also, when this equipment is exhausting

outside the building, precautions shall be taken to locate the equipment so that the discharge is down wind and away from all air intakes and other points of entry into the building.

3. Controlling Odors: All reasonable measures shall be taken to control offensive odors and/or mist vapors that may occur during the cleaning process.

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

5. Service Openings: The Contractor shall utilize service openings, as required for proper cleaning, at various points of the Duct system for physical and mechanical entry, and inspection.

    a. Contractor shall utilize the existing service openings already installed in the Duct system where possible.

    b. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.

    c. Closures must not significantly hinder, restrict, or alter the air-flow within the system.

    d. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.

    e. Openings must not compromise the structural integrity of the system.

    f. 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.

    g. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.

        1. 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 Engineer in project report documents.

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

6. Duct Systems: The Contractor shall:

a. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.

b. Mechanically clean all duct systems to remove all visible contaminants to the degree that the systems are capable of passing Cleaning Verification Testings (see NADCA Standards).

G. Health and Safety

1. Safety Standards: The Contractor shall comply with all applicable federal, state, and local requirements for protecting the safety of the contractors' 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.

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

3. Disposal of Debris. All debris removed from the Duct System shall be disposed of in accordance with applicable federal, state and local requirements.

H. Mechanical Cleaning Methodology

1. Source Removal Cleaning Methods: The Duct system shall be cleaned using source removal mechanical cleaning methods designed to extract contaminants from within the Duct system and safely remove contaminants from the facility. It is the Contractor's responsibility to select source removal methods which will render the Duct system visibly clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the Duct system or negatively alter the integrity of the system.

a. 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 sufficient negative pressure so that containment of debris and the protection of the indoor environment is assured.

b. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including handheld vacuums and wet vacuums.

c. All vacuum devices exhausting air outside the facility shall be equipped with particulate collection capability including adequate filtration to contain debris removed from the Duct 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.

d. All methods require mechanical agitation devices to dislodge the debris adhered to interior Duct system surfaces, such that said 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.

I. Cleanliness Verification

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

2. Visual Inspection: The Duct system shall be inspected visually to ensure that no visible contaminants are present.

a. If no contaminants are evident through visual inspection, the Duct 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.

b. If contaminants are evident through visual inspection, that portion(s) of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

c. NADCA vacuum test analysis must be performed by a qualified third party experienced in this type of testing procedure.

J. Pre-Existing System Damage

1. The Contractor will not be held responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

K. Post-Project Report

1. At the conclusion of the project, the Contractor shall provide a report to the Engineer indicating the following:

a. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.

b. Areas of the system found to be damaged and/or in need of repair.

L. Applicable Standards and Publications

1. 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:

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

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

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

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

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

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

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

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

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

68. DUCTWORK

A. General:

1. Furnish and install all ductwork and related sheet metal work indicated and/or specified or required for the mechanical system(s) shown on the plans.
Refer to Items PROTECTION, INSERTS AND SLEEVES, GRILLES, DIFFUSERS, ETC. and TEMPERATURE CONTROL for specific items of work that may not be covered on the drawings or in the following, but shall be part of the work under this item of the specifications.

2. Galvanized sheet steel utilized for duct construction and other sheet metal fabrication work under this section shall conform to ASTM A-653 and A924. Where stainless steel ductwork is specified, duct material shall be Type 304 or Type 316 in accordance with ASTM A-240.

3. All ductwork, miscellaneous sheet metal work, etc., shall be fabricated, sealed and erected in a first class and workmanlike manner in accordance with applicable provisions of local and/or state building codes, in accordance with standard practice of the Sheet Metal and Air Conditioning Contractor's National Association as described in applicable SMACNA manuals of construction standards and in accordance with the International Mechanical Code. Where figure numbers in these manuals are mentioned, they shall be referred to as the required method of design and fabrication.

4. Duct connections to flanges of air distribution system equipment shall be sealed and mechanically fastened in accordance with applicable code requirements. Ducts shall be supported from and/or anchored to the building structure as indicated in the manual and shall be so installed as to be completely free from vibration with system mechanical equipment in operation. Note that for all welding operations the processes and practices covered in applicable portions of the AWS D9.1, Code for Welding Sheet Metal, shall be adhered to.

5. Ductwork shown on drawings shall be considered as diagrammatic for clearness in indicating the general run, size, connections required, etc. and may not be shown in its exact position. Ductwork may have to be offset, lowered or raised as required or as directed at the site. The possibility of a requirement for this shall be taken into account when preparing the bid for the work and such adjustments shall be accomplished at no additional cost. Duct sizes indicated are inside dimensions. Where a duct size must be

altered to avoid interferences or because of clearance restrictions, the revised size shall provide approximately the same air handling characteristics.

6. Factory fabricated materials used for installation of air duct systems shall meet the listing requirements of UL Standard181 where applicable.

7. Provide approved type, sight-thru access units in ductwork for inspection of and access to duct mounted fire dampers, smoke dampers, control dampers and filters. (This requirement is not applicable to fire damper installations with air devices installed in a rated ceiling assembly). For low pressure ductwork, access units in general shall be similar and equal to Cesco series CAD-10, Advanced Air series 85 or equal. Care shall be taken to insure that the doors and method of installation are adequate to meet pressure requirements. However, access units similar and equal to McGill Airflow series ARR or series ASR with vacuum relief capability, retaining chain, sealing gasket, insulated frame and transparent window door shall be installed in ductwork for medium and/or high pressure service immediately downstream from all fire dampers and other rapid closing devices such as smoke dampers, etc. All viewing panels shall be of wired glass or of highimpact acrylic where approved. Note that on low pressure systems, access doors may be shop fabricated in accordance with applicable details illustrated in the SMACNA Duct Construction Standards manual.

   a. Properly sized and pressure rated access doors shall also be provided as required for service or inspection at duct mounted air flow monitoring stations, humidifiers, coils, etc. They shall have an insulated frame and door, sealing gasket and bolted cover.

   b. Note that access unit construction shall be of galvanized steel, stainless steel, aluminum, etc., as required to match duct construction.

   c. On low pressure ductwork, vacuum relief units downstream of fire dampers, etc. shall also be provided as mentioned above. They shall consist of adjustable pressure relief doors, Ruskin PRD 18 or equal, installed to open inwardly to relieve a high vacuum condition within the duct. They shall incorporate negator springs for door closure upon relief of vacuum or system shutdown.

   d. Holes punched in uninsulated ductwork for instrument readings or other purposes shall be closed and sealed with lock type plugs which cannot be dislodged by duct pressure or vibration. Similar type openings in insulated ducts shall be provided with instrument test holes, Ventlok No.699 or equal.

e. All ductwork penetrating floors, rated walls and/or smoke partitions or connected to room air devices installed in fire rated ceilings, shall be of not less than No.22MSG galvanized steel construction. Perimeter clearances at penetrations shall be sealed with an approved fire stop in accordance with the requirements of NFPA90A and as required by State and/or local codes. (See Item INSERTS AND SLEEVES.)

f. The use of dissimilar metals between ducts and duct supports shall be avoided unless a coating or tape is applied to both contact surfaces. Galvanized steel hangers with aluminum ductwork need not comply with this requirement.

g. The installation of fire dampers and the installation of ductwork connecting to fire dampers shall be in accordance with applicable installation instructions of the damper manufacturer as well as SMACNA and NFPA standards. In addition, the ductwork installation shall meet applicable requirements of any governing local codes.

8. With installations involving duct mounted control dampers, the contractor shall provide filler sheet metal insert spacers between the perimeter of the damper and the duct to prevent bypass where damper size does not correspond to duct size.

a. Where balancing dampers are to be installed in branch ducts, etc. (see Item GRILLES, DIFFUSERS, ETC.) they shall be placed near the branch take-off in order to minimize any noise carry-over to the conditioned space.

b. Flexible connectors shall be run with as few bends, turns, etc. as possible and connections that are run to terminal air boxes shall have at least three (3) diameters of straight duct ahead of the tie-in. All installations shall be provided with sufficient supports to limit connector sag to 2-1/2 inches maximum. Support bands shall be minimum 1-1/2" inch wide and the final support shall be within 18 inches of the terminal air box/air device. Attachments at both ends shall be made with an approved type of steel draw-bands or fasteners and UL 181 listed duct tape. Note that installations having abrupt turns or sharp bends are not acceptable.

c. Air devices shall be installed in accordance with manufacturer's published instructions. For all ceiling mounted air devices on the project, coordinate the actual model selected with the specific type of ceiling involved. Note that louvers to be furnished and/or set in

exterior walls under this section of the work shall be carefully caulked around the full perimeter when being installed in order to achieve a totally water tight installation.

d. When planning for the installation of a boiler flue(s), coordinate the location and positioning of all draft related equipment (barometric dampers, induced draft fans, flue draft dampers, etc.) with the boiler equipment supplier.

B. Low Pressure:

1. Unless otherwise specified, ductwork shall be constructed from mild steel galvanized sheets of lock forming quality and shall conform to the recommended gauges and construction methods listed in the SMACNA Duct Construction Standards manual for specified pressure requirements. Galvanized coating thickness shall be of commercial designation G 90 (ASTM A 653/A 653M) LFQ chem treat. Ductwork exposed to view shall have a milli-phosphatized finish. Where stainless steel ductwork is specified, ducts shall have a standard finish unless otherwise called for. With regard to fabrication/construction, the pressure-velocity classification for low pressure ductwork shall be for a static pressure rating of 2" w.g. Positive or Negative unless otherwise shown on the drawings.

2. Ducts shall be properly braced and reinforced, and each panel of rectangular ductwork shall be girth beaded or cross-broken where stipulated in the manual. Upper attachment of hanger rods and straps shall be selected for a safety factor of not less than four, based on ultimate loads. For rectangular ducts over 54" in width, hangers shall be angle trapeze type with rod or supports.

3. Factory fabricated "slide-on" transverse joints and components shall be utilized. Note that on rectangular ductwork 42" wide or less, formed-on flanges will be acceptable provided they are constructed as SMACNA T-24 flanges including the use of corners, bolts, cleat and gasketing.

4. All supply, return and exhaust duct systems, including plenums, shall have joints and seams sealed in accordance with the requirements listed under paragraph 6.2.4.2 of ASHRAE Standard 90.1. Sealants shall be formulated for ductwork installations and shall be UL listed. In addition, they shall be LEED compliant with no VOCs or HAPs. The recommended temperature range shall be suitable for the application.

5. On rectangular ductwork, all sub-branch connections to main branch ducts shall be made with branch duct tap-in fittings with 45° entry throat, gasket and volume damper or with straight tap connections utilizing rectangular

bellmouth fittings with gasket and volume damper. On round or flat oval duct runouts as well as small runouts with flexible connectors, provide conical bellmouth take-offs with gasket and damper unless otherwise indicated. Take-off fitting material shall match the duct material (i.e.: galvanized, stainless or aluminum).

6. Provide quadrant locking type splitter dampers where shown or where required to properly apportion system air in main branch supply ducts. Provide the necessary dampers in supply and return sub-branch ducts as required in order to accomplish the balancing process. See applicable portions of appropriate SMACNA manual.

7. Provide air turning vanes in each duct elbow or similar fitting. Turning vanes shall be fabricated and installed as indicated in the manual with double vanes used for longer unsupported lengths.

8. Provide vanes in short radius elbows and where shown on the plans to properly distribute air across entire face of duct. Vanes shall be fabricated and installed in accordance with requirements as shown in the manual.

9. For distribution systems where the diffuser or register is within 24 inches of the trunk duct, provide the supply runout with an equalizing grid in addition to the balancing damper.

10. Where discharge plenums with duct collars are required for terminal air boxes, they may either be furnished by the box manufacturer or fabricated by the sheet metal contractor.

C. Outside Air (Air Intake) Ductwork:

1. Outside air ductwork from wall mounted air intake louvers to air handling units, fans, etc. shall be pitched and of liquid-tight construction with all seams continuously soldered or welded and all joints made up with connecting flanges and gaskets. Galvanized duct weld seams shall be given a coat of Galvinoleum1225 red. Make provisions as required for draining low points.

D. Miscellaneous Duct Joints:

1. All concealed exhaust duct joints shall be sealed with UL listed metal faced duct tape. The tape shall have a published tensile strength of at least 35 lbs/inch width and shall conform to applicable SMACNA standards.

E. Flexible Duct Connectors:

1. Flexible air connectors shall be the pre-insulated type consisting of a corrosion-resistant steel helix permanently bonded to a liner consisting of multiple layers of reinforced aluminum foil/polyester laminate. The assembly shall be covered with a 1-1/2" glass fiber blanket encased in a fire retardant, aluminum metalized, reinforced vapor barrier jacket. Duct connectors shall comply with applicable requirements of NFPA Standard 90A, BOCA and SBBC, and shall be listed as Class1 Connector, UL Standard 181. Rated temperature range shall be 0° to 250° F, UL rated velocity shall be at least 4,000 fpm and UL rated internal working pressure listings shall be at least positive 6" w.g. and negative 4" w.g. thru 16" diameter.

    a. Connectors shall be installed in accordance with manufacturers' recommendations and limited to a maximum length of 8 feet. Unless dimensioned otherwise, supply connectors shall be selected either to match inlet connection size of the air device or to have an air velocity not exceeding 800 feet per minute .

2. Flexible connectors indicated for return or exhaust air service shall meet the above criteria except that they need not be insulated unless specifically called for and shall be sized for an air velocity not exceeding 700 feet per minute.

F. Miscellaneous:

1. The selection of ceiling mounted air devices shall be appropriate for the type of ceiling involved. Where surface mounted installation is required, the devices shall be designed for surface mounting or shall be installed with the proper trim-strip assembly required to achieve a finished appearance.

69. ISOLATING DUCT CONNECTORS

A. Connections of rigid metal duct to individual fans as well as all other motor operated air handling equipment, shall be made using general purpose, air-tight flexible joints. They shall be heavy duty manufactured units utilizing double-folded stainless steel joint seams and shall be made from waterproof and airtight flame retardant material of Neoprene double-coated glass fiber fabric with a tear strength of 25/25 or higher and a tensile strength of 300 / 300 or higher. The fabric shall have a listed temperature range of -40º F to 200º F or above.

B. Units shall be UL listed with a 25/50 rating and shall meet the standards for vibration isolation connectors in duct systems as covered in NFPA 90A and 90B.

C. Isolating connectors shall be installed with the recommended slack and connector length shall not exceed 10". They shall be attached in such a way that the fabric is

shielded with metal at the seams and the installation is completely airtight. Corners and flanges shall be of stainless steel.

D. Flexible joint units shall be by Elgen, Duct Mate or Ward Industries.

E. Note that in lieu of the above, connector material for standard applications may be of flexible, high tear strength Nylon/Polyester base fabric with a vinyl coating where acid or grease resistance is not a requirement. Units shall comply with all of the listed specification mandates with the exception of tear strength rating, which shall be at least 50/40.

70. INSULATION

A. Provide the required insulation for all ductwork, piping, equipment, etc., as described and listed in the following:

1. General Requirements:

a. All insulating materials, linings, tapes, coverings, etc., to be used on this project shall have composite fire and smoke hazard ratings, as tested by procedure ASTM E84, NFPA 255, NFPA 258 and UL 723, not exceeding flame spread 25 and smoke developed 50 unless otherwise noted. Specific items of equipment that are factory insulated are not governed by this item of the specifications. Note, however, that in sealed chases and shafts or other similar concealed and isolated spaces, and in mechanical equipment rooms, it will be acceptable to have pipe insulation and coverings installed with a smoke developed rating as high as 150. (See NOTE at the end of this item.)

b. Insulation Index - Ductwork, Equipment and Piping shall be covered with the classification and thickness of insulation noted in the Insulation Index listed in this item of the specifications.

c. Surface Finish - All field applied surface finish reinforcing mesh, as listed in the index, shall be equal to #10 glass fiber open weave reinforcing mesh (referred to as glass cloth). When tested according to ASTM method D-579, the mesh material shall indicate a tensile strength warp of 75 lbs/sq.in. and fill of 75 lbs/sq.in. Material shall be applied in accordance with manufacturer's recommendations. Refer to “Coverings” at the end of this item for specific requirements regarding factory-applied jackets, field-applied metallic jackets, etc.

d. Miscellaneous - Duct and equipment coverings, linings, etc. shall be interrupted as required by applicable provisions of NFPA 90A, and

similarly, shall not conceal any service openings. Note that unless otherwise specified, lined ductwork need not be externally insulated.

2. General Instructions:

a. Before field insulation is applied, all items to be covered shall have been tested in accordance with requirements of the specifications See Item TESTING. Tests shall be verified by the Engineer before proceeding with the work.

b. Prior to the application of insulation or insulation adhesives, the surfaces to be covered shall be thoroughly cleaned of all dust, dirt, grease and moisture. Also, determine whether any piping systems are to be painted prior to receiving insulation.

c. Where insulation is butted, all laps and joints shall be sealed with adhesive. The use of staples is acceptable only as an installation aid and not as a substitute for adhesive. Where staples are used on pipe covering in exposed locations, care must be taken to locate the staple joints in such a way that they are not in direct view.

d. On steel piping incorporating pipe shoes at support points, insert insulation into the shoe cavities and seal the ends with a mastic or caulking having a suitable temperature rating.

e. Where insulation is applied to flanges on heated lines, the pipe line insulation shall be stopped off a sufficient distance to allow removal of flange bolts without disturbing the insulation. Flanges shall be covered as specified. On lines subject to sweating, all surfaces shall

be covered and joints shall be sealed in a manner to prevent condensation.

f. Where valves are insulated, cover the valve bonnets to a point just below the stuffing box.

g. At steam trap assemblies, do not insulate strainer or trap unless required for personnel protection.

h. Where two layers of insulation are used, stagger all joints both ways. Secure each layer independently.

i. Continue insulation thru walls, partitions, floors and pipe sleeves unless otherwise indicated on the drawings or prohibited by Code requirements.

j. Duct insulation shall be provided as required on all lined ducts where duct liner has been interrupted or terminated.

k. Insulation manufacturer's names and product names that may appear in the specifications have been listed as a guide to make and/or a standard to quality. Products of equal quality and performance by other manufacturers will be considered on approval by the Engineer.
B. Adhesives, Coating, Vapor Barrier Materials:

1. All factory attached vapor barrier materials, and all adhesives, mastics, coatings and insulation materials applied as herein specified shall be acceptable under NFPA standards 90A and/or shall have a dry flame spread index not to exceed 25 when tested in accordance with applicable Federal Standards. In addition, materials shall be in accordance with applicable portions of MIL-A-3316C, Classes 1 and 2, Grade A.

2. The toxicity of the solvents used on the premises must be such that the maximum allowable concentration (MAC) in parts per million (PPM) is 200 or higher according to the latest value published by the American Conference of Governmental Industrial Hygienists.

3. Prior to use, submit certification by the manufacturer for each of the above materials used with respect to the flame index and toxicity.

4. The lap-seal system described in the General Instructions shall only be installed when ambient conditions are within the range stipulated by the manufacturer.

C. Insulating Cements:

1. These materials shall be listed as mineral fiber, hydraulic-setting insulating and finishing cement.

D. Miscellaneous:

1. Exposed pipe risers, where subject to abrasion, shall have insulation covered with a protective aluminum jacket.

E. Equipment/Systems Insulation Index:

ITEM	CLASS	THICKNESS	SURFACE FINISH
Exposed… Supply	A or C	2”	(See Covering)

Equipment (hot) (a)	A or C	2"*	(See Covering) Cloth or Aluminum Jacket
Equipment (cold) (b)	A or C	2"*	Glass Cloth & Lagging

1. Regarding the Insulation Index above, note that where Aluminum Jacket is listed (under SURFACE FINISH), refer to the paragraph headed Metallic Covering / Aluminum Jacket appearing under the section "Coverings" at or near the end of this item.

2. Equipment referenced in Insulation Index above:

   a. Air separators, heat exchangers, air eliminators, expansion tanks. Note that cylindrical vessels 20" and over in diameter shall have the metallic (aluminum) jacket as specified under "Coverings".

   b. Chilled water pump casings, chilled water heat exchangers, chilled water system air separators, chiller surfaces subject to sweating including water boxes. Insulation for pump casings needs only to be 1" thick.

Piping System	Class and Thickness
Chilled water (liquids):	
Indoor	"C", "E" – 1-1/2"
Exterior	"C", "E" – 2-1/2"

* Insulation thickness for all classes in sizes over 2", unless otherwise noted, shall be minimum 1-1/2" for installations subject to high ambient conditions, such as mechanical equipment rooms that are not mechanically cooled, exterior locations, etc.

Hot water (liquids) thru 200° F:	
Thru 1-1/2"	"C", "E" – 1-1/2"
2" and above	"C", "E" - 2"

5. All valves and flanges shall be insulated to thickness of adjacent piping. See specification under Class "C" Insulation. Exception: Hot lines 2-1/2" and below-maximum 180° F. service.

6. All condensate coil drain lines (except short runs to floor drains that are contained within mechanical rooms) shall be insulated with ½" thickness of Class "C" insulation.

7. NOTE: Class "E" insulation may be used in cramped or otherwise inaccessible areas on chilled water lines. Unslit tubing 1-1/2" thick, shall be used on lines thru 5" in size.

G. Materials:

1. Class "A" Insulation

a. Mineral fiber rigid or semi-rigid board with either a factory-applied foil-reinforced kraft facing (similar to a Class "B" facing) or ASJ facing (similar to a Class "A" facing) as manufactured by CertainTeed, Johns Manville, Knauf, Manson, Owens Corning or Schuller. The "k" factor for this insulation shall be 0.23 or less at 75°F mean. Product shall conform to the property requirements of government specifications, HH-1-558B (Amendment 3) Form A, Class 1 and Class 2 and ASTM specification CG12, Type 2. Published temperature range shall extend from -20°F or lower to 400°F or greater.

b. Insulation for rectangular duct or flat areas shall be rigid board (minimum 3 pcf) and shall be fastened to the surface with welding pins and white cup head caps to match facing. Pins shall be spaced not over 12" apart each way with min. 2 rows per side and not more than 3" from each board edge or corner. Care must be taken to insure that no wrinkle is present on facing.

c. Insulation over duct stiffeners and standing seams shall be built-up using a 4" wide strip of insulation adhered to duct insulation.

d. All joints shall be butted tightly and sealed with a 4" wide tape of the same material as the factory applied facing. The tape shall be cemented with adhesive.

e. Corners of apparatus casing and rectangular ductwork at or near floor level shall be protected with 1-1/2" X 1-1/2" metal edge corner, securely fastened. These surfaces shall be finished with adhesive and glass cloth as follows:

1. Apply a flooding brush coat of UL listed lagging adhesive and embed cloth facing into wet coating with a 3" overlap at all seams. Smooth out carefully to avoid wrinkles. Apply a finish coat of lagging adhesive at the recommended rate to entire outer facing surface.

f. NOTE: All duct insulation vapor barrier jacketing shall be noncorrosive.

2. Class "C" Insulation

a. Nominal 4 pound density mineral fiber sectional pipe insulation wrapped with a factory applied ASJ jacket (similar to a Class "C" jacket) as manufactured by CertainTeed, Knauf, Johns Manville, Manson, Owens Corning or Schuller. The "k" factor shall be 0.23 or less at 75°F mean. Product shall conform to ASTM C 1136 (jacketing), ASTM C 547 and shall meet UL 723 ratings. Published temperature range shall extend from 0°F to 800°F or greater. At installation all longitudinal and circumferential (butt) joints shall be closed and sealed in accordance with manufacturer's instructions. The use of staples is permitted only with hot pipe or duct insulation applications in concealed locations at contractor's option. Note that for exterior work, the insulation shall have an all weather (AWJ) jacket consisting of a factory-applied weather-resistant jacket reinforced with fiber glass fabric.

b. On insulated pipe lines, all fittings, flanges, valves, etc. shall be covered with pre-molded / mitered fiberglass insulating units equal to the thickness of adjacent pipe insulation. Note that on lines subject to sweating such as chilled water, etc., all of the above described work shall be given a flooding coat of vapor barrier mastic. Finally, all exposed fittings, valves and flanges shall be provided with preformed molded PVC jacket covers, as manufactured by CertainTeed, Knauf or Johns Manville. Covers shall be white with gloss finish, shall be UL 25/50 rated and shall meet the requirements of ASTM D 1784, Class 14253-C. Mechanical fasteners shall be of stainless steel.

c. Flanges and valves on hot lines 2-1/2" and below - maximum 160°F service) need not be insulated unless otherwise called for or, because of location and/or accessibility, insulation would be required for personnel safety.

d. In general, all heated pipe lines 2-1/2" and larger will be supported by adjustable clevis pipe rolls or double rod trapeze type pipe rolls. Except as noted in the following paragraph, formed galvanized steel protection saddles will be furnished with these supports by the piping contractor where pipe lines are of steel. Where such piping is of copper, furnish rigid preformed and pre-compressed insulation segments to be used at the support points. Unless otherwise called

for, pipe lines 2" and smaller will be supported by adjustable clevis hangers. The above is described more fully under Item SUPPORTS, HANGERS AND BRACKETS.

e. Insulation at support points on all cold lines 1-1/2" and larger shall incorporate water-resistance treated calcium silicate segments or precompressed and preformed segments of molded glass fiber. These inserts shall have sufficient compressive strength to support the pipe without deforming to a thickness less than the adjacent insulation. At support points on all such insulated lines, formed steel protection shields will be provided, along with the support elements, by the piping contractor. See Item SUPPORTS, HANGERS AND BRACKETS.

f. Removable heads on equipment to be insulated shall be covered separately to permit access without disturbing body insulation of the equipment. Insulation shall have a 20 ga. aluminum or galvanized steel lagging. Covers for cold surface removable heads shall be fabricated and installed in a manner that will prevent the formation of condensation at any point including the body insulation joint.

3. Class "E" Insulation: Flexible, elastomeric cellular insulation (tubular or sheet) - as manufactured by Armacell, IMCOA, Johns Manville or Rubatex. The "k" factor for this material shall be 0.27 or less at 75°F mean and the published temperature range shall extend from -40°F or below to at least 220°F or greater. On thicknesses thru at least 1-1/2" the flame spread rating shall be 25 or less and the smoke developed rating shall be 50 or less based on ASTM E-84. Tubular material for piping shall conform to ASTM C534, Type I and be factory pre-slit longitudinally with mating surfaces adhesive coated and protected by release liners. In addition, all longitudinal joints shall be sealed with a manufacturer’s approved tape. All other joints shall be butted and sealed with the appropriate adhesive. Fabricate segments for valves and fittings and install according to manufacturer's recommendations. Piping exposed in mechanical rooms, etc. shall be given two coats of a white, water-based, semi-gloss latex enamel specifically formulated for this type of application. Note that adhesive shall not be field applied on or with any installation involving plastic pipe or tubing. For chilled water applications, wrap circumferential joints with duct tape.

a. Unless otherwise noted, outdoor piping with Class “E” insulation shall be wrapped with an approved, 5-ply laminate, white covering consisting of alternating layers of aluminum foil and polyester film factory coated with pressure sensitive acrylic adhesive and kraft release liner.

H. Coverings:

1. Weatherproof (Exterior) Duty

a. Piping exposed to weather shall be insulated as previously specified and then covered with an aluminum jacket as described below and having a laminated moisture retarder. Note that this jacketing requirement does not apply to flexible elastomeric foam type insulation.

2. Standard (Indoor) Duty

a. Class "A" - Facing: All service type (ASJ) to be similar to a white, vinyl coated and embossed, vapor barrier laminate. Water vapor perm rating not to exceed 0.02. (ASTM E96, Proc. A) Tensile strength to equal or exceed 75 lbs./in.

b. Class "C" - Jacket: All service type (ASJ) to be a white, embossed foil, vapor-barrier laminate. Water vapor perm rating not to exceed 0.02 perms (ASTM E96, Proc. A) Tensile strength to equal or exceed 75 lbs./in.

3. Metallic Covering/Aluminum Jacket

a. Where a protective metallic covering or aluminum jacket is called for, it shall be an embossed, .016 gauge aluminum jacket, lapped and banded etc., in accordance with manufacturer's recommendations. Back side of jacket to have an inert coating.

4. PVC Jacketing

a. Where PVC jacketing is called for it shall be a 20 mil thick, highimpact, UV-resistant polyvinyl chloride covering designed for insulated pipe. It shall be 25/50 rated, white in color to match the insulated fitting covers and shall be similar and equal to Zeston 2000 jacketing.

b. NOTE: Where a class of insulation listed above does not meet the smoke developed rating criteria of 50 or less, its use will not be permitted in ceiling spaces, shafts, etc., that are to be utilized as a supply or return air plenum. However, such insulation may be used in other locations provided the smoke developed rating does not exceed 150 and the use of this material is approved in writing by the governing agencies having jurisdiction.

71. VIBRATION ISOLATORS, BASES, ETC.

A. All mechanical equipment over one horsepower, unless otherwise noted, shall be isolated from the structure by means of resilient vibration and noise isolators supplied by a single manufacturer to the Mechanical Contractor. The isolator manufacturer's submittal shall include the complete design for the supplementary bases; a tabulation of the design data on the isolators including O.D. as well as free, operating, and solid heights of the springs, free and operating heights of the neoprene or fiberglass isolators; and isolation efficiency based on the lowest operating speed of the equipment supported.

B. Mounts and bases shall be as tabulated on the equipment schedule, and shall be manufactured by Kinetics Noise Control Systems. Equipment as manufactured by Amber/Booth, Mason Industries, or Vibration Mountings meeting these specifications will be considered equal.

C. "N" Mounts: Type RD neoprene mounts, incorporating completely enclosed metal inserts to permit bolting to the supported unit. Where the equipment is not integral or where the overhang is greater than 25% of the bolt span, rigid steel members shall be used to spread the mount spacing to assure stability.

D. "F" Mounts: Type KIP-Q pre-compressed molded fiberglass isolation pads, neoprene-jacketed and stabilized during manufacture. Pads shall be sized for 40 to 60 psi loading and shall be made of glass fibers produced by a multiple flame attenuation process which generates nominal fiber diameters not to exceed .00018 inches. Where the equipment base does not provide a uniform load surface, steel plates shall be bonded to the top of the pads.

E. "S" Mounts: Type FDS freestanding, unhoused stable spring mounts, incorporating leveling bolts and 1/4" thick neoprene-jacketed pre-compressed molded fiberglass noise isolation pads. To assure stability, the outside spring diameter shall be a minimum of 0.8 times the designed spring operating height, and the springs shall have a minimum additional travel of 50% between the design height and the solid height.

F. "L" Mounts: Type FRS freestanding, unhoused stable spring mounts, similar to type FDS, except incorporating vertical limit-stops to assure a constant height if the supported weight is removed, and to reduce movement due to wind loads. The limitstops shall be isolated to prevent mechanical short-circuiting.

G. "H" Hangers: Type SFH combination spring and fiberglass hangers, incorporating 2" thick neoprene-jacketed pre-compressed molded fiberglass inserts in series with springs, all encased in welded steel brackets. The outside spring diameter shall be a minimum of 0.8 times the designed spring operating height, and shall have a

minimum additional travel of 50% between the design height and solid height. Isolators shall be designed to accommodate rod misalignment over a 30 degree arc.

H. "B" Bases: Type SRB or SBB structural steel rail or beam bases, designed and supplied by the isolator manufacturer. The bases shall be designed with isolator brackets to reduce the mounting height of the equipment. To assure adequate stiffness, the height of the members shall be a minimum of 8% of the longest span between isolators (at least 6" or as indicated on the drawings).

I. "I" Bases: Type CIB reinforced concrete inertia bases, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded steel channel frame, incorporating pre-located equipment anchor bolts and pipe sleeves, welded-in ½" diameter reinforcing bars on 8" centers each way, and isolator brackets to reduce the mounting height of the equipment. The thickness of the bases shall be a minimum of 8% of the longest span between isolators(at least 6" or as indicated on the drawings). Where the inertia bases are used to mount pumps, the bases shall be sized to support suction and discharge elbows where applicable.

J. Piping: All piping over 1" diameter in the mechanical equipment room as well as piping three supports away from other mechanical equipment shall be isolated from the structure by means of vibration and noise isolators. Suspended piping shall be isolated with combination spring and fiberglass hangers in the supporting rods. Hangers shall be type "H" as described above. Floor mounted piping shall be supported directly on spring mounts. Mounts shall be type "S" as described above.

K. Vertical pipe risers shall be isolated from the structure by means of vibration and noise isolating expansion hangers, type XH. The hangers shall have a minimum rated deflection of four times the anticipated pipe movement and shall be enclosed in a housing for failsafe operation.

L. Flexible sections shall be incorporated in the piping connected to all reciprocating equipment, and shall be of approved construction. Unless otherwise indicated, they shall be hose type connectors of standard length and designed to withstand the deflections, vibration and operating pressures imposed by the equipment and system. The connectors shall be fabricated from bronze or stainless steel hose with stainless steel braid and carbon steel, minimum 150 lb. flanges, as required for the adjacent piping.

M. Ductwork: Flexible connections shall be incorporated in the ductwork adjacent to all air-moving units. The connections shall be neoprene or canvas of approved construction. See Item ISOLATING DUCT CONNECTORS.

72. CHILLER START-UP AND FIRST YEAR SERVICE

A. The manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Chiller manufacturer shall maintain service capabilities no more than 60 miles from the job site.

B. A standard start-up log shall be furnished by the manufacturer to document the chiller's start-up date and shall be signed by the Owner or the Owner's authorized representative prior to operation/use of the machine. This form shall document that all work and start-up procedures have been properly completed. A copy of this log will be signed by the Owner's authorized representative at the conclusion of the demonstration of operation as verification that all required work has been performed.

C. The manufacturer shall provide one year service and maintenance in addition to the initial start-up in order to keep the equipment in good operating condition. This work is to be performed by the unit manufacturer's service specialist and shall incorporate the items listed below.

D. Conduct regular and systematic maintenance inspections four (4) times during the operating season. Inspections shall include:

1. Check compressor oil (add oil if required)

2. Check tightness of machine / proper refrigerant charge level (tighten bolts and add refrigerant as required)...

3. Mag motor and starter...

4. Check condenser and evaporator circuits pressure drops. Determine if cleaning is required...(Tube cleaning will not be part of this contract - advise owner concerning possible causes of any scale built-up.)

5. Check and calibrate all controls for proper operation...

6. Check lubrication system and adjust as required to insure proper operation...

7. Test run machine and record results...

8. Check interlock(s) to system equipment and advise if operation is satisfactory...

E. Make any minor repairs and/or adjustments required to insure satisfactory operation.

F. Subsequent to the inspection furnish the Owner's maintenance department and the engineer with written recommendations of any necessary repairs, operational changes, and a copy of the inspection report.

G. Instruct and train the operator and also institute a procedure for maintaining a daily operating log. This log is to be reviewed by the manufacturer during each inspection visit.

H. A winter comprehensive inspection shall be provided in addition to the inspection described above. This inspection shall include the performance of all yearly or semiannually manufacturer recommended maintenance procedures such as, but not limited to, changing of oil if required by oil sample analysis; control inspection; etc. The equipment manufacturer's representative shall provide parts and lubricants as required.

I. Provide any required emergency service between regular inspections.

J. All work is to be performed during regular working hours. Overtime differential will be paid by the Owner if service is required outside of normal working hours.

K. The manufacturer's service shall cover one (1) full year of unit operation including spring start-up if machine was initially started in summer or fall.

73. PROPYLENE GLYCOL

A. Provide the chilled water piping system with a special heat transfer medium as described below. Prior to and during the filling process, follow manufacturer's instructions and the procedures outlined in the following paragraphs.

B. The heat transfer medium shall consist of a solution of clean water pre-mixed with the specified percentage (by volume) of an inhibited propylene glycol based industrial heat transfer fluid. This fluid shall be specifically formulated for use in HVAC piping systems and shall contain corrosion inhibitors and buffers as well as an anti-foam agent.

C. **This solution shall be premixed by the chemical manufacturer**, shall have a distinctive color for easy identification, and shall have a pH between 9.0 and 10.5.

D. Preparation For Fill

1. Prior to filling the system it shall be tested, cleaned and flushed as previously specified under specification Items TESTING and PREPARATION OF SYSTEMS. If grease and/or oil was used in fabrication and erection of the piping, trisodium phosphate (TSP) or other

approved cleaning agent shall be used as recommended by the published instructions of the manufacturer/supplier.

E. System Fill

1. After the final flush the glycol solution, as specified above, shall be introduced into the system. It shall be brought to the job pre-mixed in bulk tank truck or storage drums. The contractor shall provide fittings, etc. for the fill procedure as recommended by the fluid supplier and / or as detailed.

2. The contractor shall be responsible for pumping the glycol solution into the system. During the fill process the contractor shall check repeatedly, as required, to insure that all air is forced from the system and that all coils, tube bundles, etc. are completely purged.

3. After the system has been filled, purged of air and the solution circulated for a minimum of twelve hours, a sample shall be taken and submitted to the fluid manufacturer for analysis.

4. The analysis shall include solution quality, concentration of corrosion inhibitors, presence of anti-foam agent and buffers, propylene glycol concentration and absence of contaminants.

F. Miscellaneous

1. The fluid manufacturer's report shall be submitted to the Engineer for review prior to its inclusion in the project submittal records furnished to the Owner.

2. The piping system within the mechanical room(s), etc., shall be clearly labeled, as specified in item PIPE AND DUCT MARKING, including indication of the specified glycol percentage.

G. Manufacturer

1. The heat transfer fluid shall be Dow Chemical Co.; Dowfrost or Engineer approved equal.

74. MAKE-UP AIR UNIT

A. GENERAL

1. WORK INCLUDED

a. Make-Up Air Handling Unit.

2. RELATED SECTIONS

a. Propylene Glycol

b. Temperature Control System

c. Electrical

d. Temporary Heating, Cooling, and Ventilating

e. Expansion, Anchors and Guides

f. Insulation

3. REFERENCES

a. AMCA Publication 99 - Standards Handbook.

b. AMCA Publication 611 - Certified Ratings Program - Airflow Measurement Performance

c. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.

d. ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.

e. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.

f. ANSI/AMCA Standard 610 - Laboratory Methods of Testing Airflow Measuring Stations for Rating.

g. ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.

h. ANSI/AHRI Standard 430 - Central Station Air Handling Units.

i. ANSI/ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

j. ANSI/ASHARE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.

k. ANSI/ASHARE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

l. ANSI/NEMA MG 1 - Motors and Generators.

m. ANSI/UL 900 - Standard for Safety Air Filter Units.

n. AHRI Standard 260 - Sound rating of Ducted Air Moving and Conditioning Equipment.

o. ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

p. ASTM B117 - Standard Practice for Operation Salt Spray Apparatus.

q. ASTM C1071 - Thermal and Acoustic Insulation (Mineral Fiber, Duct Lining Material).

r. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings.

s. ASTM E477 - Standard Test Method for Measure Acoustical and Airflow Performance of Duct Liner

t. NFPA 70 - National Electrical Code

u. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.

v. UL 1995 - Standard for Safety Heating and Cooling Equipment

4. QUALITY ASSURANCE

a. Air Coils: Manufacturer shall certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.

b. Make-up air unit shall be rated in accordance with AHRI Standard 430 for airflow, static pressure, and fan speed performance.

5. SUBMITTALS

a. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the project engineer.

b. MUA manufacturer shall provide the following information with shop drawing/product data submission:

1. Dimensioned arrangement drawings for MUA including a plan and elevation view of the assembled unit with overall dimensions, lift points, unit shipping split locations and

dimensions, installation and operating weights, and installation, operation and service clearances.

2. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.

3. Each component of the unit shall be identified and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.

4. All performance data, including capacities and airside and waterside pressure drops, for components.

5. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.

6. For units utilizing multiple fans in a fan section, a fan curve shall be provided showing the performance of the entire bank of fans at design conditions. In addition, a fan curve shall be provided showing the performance of each individual fan in the bank of fans at design conditions. Also a fan curve shall be provided showing the performance of the bank of fans, if one fan is down. The percent redundancy of the bank of fans with one fan down shall be noted on the fan curve or in the tabulated fan data.

7. A filter schedule must be provided for MUA unit supplied by the unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the MUA, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.

8. A schedule detailing necessary trap height shall be provided. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.

9. A coil valve coordination schedule shall be provided. Schedule shall detail unit tag, coil type and corresponding

section location within the MUA, valve style (e.g. global, ball), valve type (e.g. electronic 2-way/3-way), valve position (e.g. normally open/closed), size, flow coefficient (CV), and close-off pressure.

10. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).

11. Sound data shall be provided using AHRI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000 and 8000Hz.

c. The MUA manufacturer shall provide appropriate sets of submittals as referenced in SHOP DRAWINGS and shall submit to the Engineer electronic copies of the IOM.

d. The MUA manufacturer shall list any exceptions to the specification.

6. REGULATORY REQUIREMENTS

a. Agency Listings/Certifications

1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL or ETL as directed by the engineer, at no additional expense to the owner.

2. Certify air handling unit in accordance with AHRI Standard 430. MUA unit shall be provided with certification label affixed to the unit. If MUA unit is not certified or fans are not rated in accordance with AHRI Standard 430 contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

3. Certify air handling coils in accordance with AHRI Standard 410. MUA unit shall be provided with certification label affixed to the unit. If MUA coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

7. DELIVERY, STORAGE, AND HANDLING

a. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

b. MUA unit shall ship fully assembled up to practical shipping and rigging limitations. Unit not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of MUA section(s).

c. Installing contractor shall be responsible for storing MUA unit in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

8. START-UP AND OPERATING REQUIREMENTS

a. Do not operate unit for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

9. WARRANTY

a. MUA unit manufacturer shall provide, at no additional cost, a 36 month parts and labor warranty that covers a period from unit start-up or 36 months from shipment, whichever occurs first. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

B. PRODUCTS

1. ACCEPTABLE MANUFACTURERS

a. Approved manufacturer shall be Trane, with pre-approved alternates considered. Manufacturers not pre-approved, must obtain pre-approval in writing from consulting engineer a minimum of 14 days prior to bid day. Alternates must comply with all performance and features as called for in this specification. Job awarded on basis of specified equipment. Alternate will be evaluated and considered after job is awarded.

b. Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to consulting engineer prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the consulting engineer. Mechanical Contractor is responsible for expenses that occur due to any exceptions made.

2. GENERAL

a. Unit layout and configuration shall be as defined in project plans and schedule.

b. Manufacturer to provide a full perimeter integral base frame. Base frame will either be bolted construction or welded construction. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

3. UNIT CASING

a. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 125-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

b. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

c. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

d. Under 55°F supply air temperature and design conditions on the exterior of the unit of 95°F dry bulb and 78°F wet bulb, condensation shall not form on the casing exterior. The MUA unit manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

e. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

f. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

g. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

h. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*ºF/BTU.

i. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity

in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

j. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

k. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

l. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

4. OUTDOOR UNIT FEATURES

a. Outdoor Casing Details - In addition to all other details specified within for the make-up air unit, unit that are installed outdoors shall also comply with the following -

1. MUA unit shall have only single door handles for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit and ease of maintenance.

2. Unit Paint - External surfaces of all outdoor unit casings shall be prepared and painted with a minimum 1.5 mil thick water based polyurethane finish or equal. Paint shall be able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours. Paint shall be Manufacturer’s standard color.

3. Unit Base - Outdoor unit shall have a welded base and steel cross members for structural rigidity and supports the full perimeter of the MUA unit. Panels must overhang the primary unit base such that no ledge exists for water to pool. The entire MUA unit perimeter shall be sealed for additional water management protection.

4. MUA Unit Roof - Outdoor unit roofs shall incorporate a standing seam on the exterior to ensure a rigid roof construction and prevent water infiltration . Roof assembly shall overhang all walls by 1.5-inch minimum to prevent sheeting from roof to side panels . Rain gutters shall also be provided over all doors to direct rain away from the door

assembly. Outdoor roofs shall be sloped, not less than 0.125 inches per foot, for water drainage.

5. Factory Supplied Roofcurb - Roof curbs shall be provided and shall be galvanized steel. Roof curb shall support the full perimeter of the MUA unit, including pipe chases. A 2" x 4" nominal wood nailing strip shall be supplied attached to the roof curb. Wood nailing strip shall be of #4 Spruce or #4 Yellow Pine. Roof curb shall include frame work necessary to support supply and return duct installation prior to unit placement. Roof curb shall be shipped loose for field installation prior to unit placement.

6. The MUA unit manufacturer shall provide external pipe cabinet assemblies where required. External pipe cabinets shall be factory assembled and shipped with the units for field mounting. Pipe cabinets shall have a minimum internal depth of 36 inches. Cabinet walls and doors shall be the same double-wall construction and exterior color/finish as the unit wall panels. Cabinet roofs shall be sloped away from the unit for water drainage.

5. ACCESS DOORS

a. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

b. All doors shall be provided with a thermal break construction of door panel and door frame.

c. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

d. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

e. Handle hardware shall be designed to prevent unintended closure.

f. Access doors shall be hinged and removable without the use of specialized tools.

g. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

h. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

i. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

j. A single door handle shall be provided for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit.

6. PRIMARY DRAIN PANS

a. All cooling coil sections shall be provided with an insulated, double-wall, galvanized drain pan.

b. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements.

c. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

d. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

e. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.

f. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

g. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

7. FANS

a. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components.

b. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Fans shall have a maintenance free grounding assembly installed on the fan motor to discharge both static and induced shaft currents to ground.

c. Direct drive plenum fans with integral frame motors, shall be mounted on isolation bases. Fan shall be dynamically balanced throughout the operating range to a BV-3 (0.20 in/s) per AMCA 204 test standard. Fan and motor shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

d. MOTORS AND DRIVES

1. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

2. Fan Motors shall be heavy duty, open drip-proof operable at scheduled voltage. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.

3. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

8. COILS

a. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

b. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

c. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity.

d. Construct coil casings of galvanized steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

e. All coils shall be completely cleaned prior to installation into the MUA unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

f. Hydronic Coils

1. Supply and return header connections shall be clearly labeled on unit exterior such that direction of coil water-flow is counter to direction of unit air-flow.

2. Coils shall be proof-tested to 300 psig and leak-tested to 200 psig air pressure under water.

3. Headers shall be constructed of round copper pipe or cast iron.

4. Tubes shall be 1/2-inch .016 copper, with aluminum fins.

g. Integral Face and Bypass

1. Integral face and bypass coils shall be provided as indicated on the schedule and drawings. Coils shall meet performance as defined on the schedule. Coils shall consist of a built-in series of finned heating, and bypass areas, with mechanically interlocked dampers. Coils to be constructed of 14-gage galvanized steel, with fins shall be no less than .010-inch thick aluminum, and tubing with minimum .035-inch thick copper tubing. Coils shall be certified to, and bear the AHRI 410 Standard label.

2. Dampers shall be arranged to completely enclose and isolate heating elements. Coils shall include mixing baffles to minimize downstream mixing distance to 24-inches. At minimum distance, leaving air temperature shall vary no more than +/- 5 deg F from the average leaving air temperature.

3. Manufacturer shall extend coil connections on horizontal-tube coils through the unit casing wall to facilitate piping. Coil connection penetrations through unit casing shall be provided by unit manufacturer on vertical-tube coils. Installing contractor shall be responsible for providing flexible connector on return header, and supply/return piping through unit casing wall.

9. FILTERS

a. Filter type, MERV rating, and arrangement shall be provided as defined in project plans and schedule.

10. DAMPERS

a. All dampers, shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the plans. Blade arrangement shall be provided as indicated on the drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

11. ACCESS SECTIONS

a. Access sections shall be provided where indicated in the plans to allow additional access for inspection, cleaning, and maintenance of unit components. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be provided in the AHU manufacturer's maintenance manual.

12. Factory Wiring of Lights, VFDs, Motorized Impeller Control Panels, and Combination Starters/Disconnects

a. All power wiring for voltages greater than 24V and traveling through multiple unit sections shall be contained in an enclosed, metal, power-wiring raceway or EMT. Sections less than 6-inch in length may be contained in FMC.

13. FACTORY-ENGINEERED AUTOMATIC TEMPERATURE CONTROLS

a. Unit shall be provided with a factory wired, installed and tested unit controller, capable of standalone unit control, or tied into a building automation system through Bacnet communication. All control points in unit shall be tested at the unit manufacturers facility prior to shipment.

b. Damper actuators shall be selected, provided, and mounted by the MUA unit manufacturer on each damper. Actuators shall be of sufficient size and quantity to ensure complete damper operation. Actuators shall be direct coupled to minimize linkage.

c. Differential pressure switches shall be provided by the manufacturer. Pressure switches shall be factory installed across each filter bank for individual filters to monitor clean/dirty filter status.

d. Differential pressure gauges shall be provided by the AHU manufacturer. Pressure gauges shall be factory installed across each filter bank for individual filters. The gauge shall be diaphragm-actuated dial type.

e. On variable volume units, a discharge temperature sensors shall be provided and mounted on the fans by the manufacturer. Temperature sensors mounted within the MUA unit shall have sensor material selected to integrate with the BAS controller.

f. Valves shall be provided by the MUA unit manufacturer. Valves shall be shipped from the valve manufacturer directly to the job site or Mechanical Contractor for installation. Electrical connections shall be provided on the valves and at the coil section for field connection.

14. Unit DDC Controller

a. One programmable DDC controller shall be provided by the MUA unit manufacturer. Each programmable DDC controller shall use the LonTalk protocol and shall be LonMark certified to ensure open communication with other open BASs. Complete communications and diagnostics including all AI, BI, AO, BO, set points and alarms shall only require a twisted pair of wires between the unit controller

and the BAS. Each unit controller shall be factory wired to the unit end devices. For indoor units, each controller shall have a user display touch screen for user interface. The display on indoor units shall be unit mounted in the factory. For outdoor units, one portable user display touch screen for user interface shall be provided for all controllers. Displays shall give user access to AHU status, set points and alarms.

b. The programmable DDC controller and the control components shall be selected, mounted, wired and tested by the AHU manufacturer to ensure delivery of specified performance and to minimize jobsite startup time. Testing shall be performed to ensure wiring continuity between the controller and all devices, and to ensure proper operation of the end devices. DDC controllers shall be located on unit as indicated on the drawings.

c. Factory mounted controller shall be preprogrammed at the factory to minimize startup delay of the unit at the job site. Controller shall be programmed with manufactures preferred standard basic programming based on unit configuration and options. Any additional programming or custom programming shall be provided at the job site by the unit manufacturer or controls contractor.

C. EXECUTION

1. SHIPPING

a. Paper copies of the IOM shall also be shipped with the MUA unit.

b. The manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are received.

c. After loading the equipment for shipment, the manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

2. ON-SITE STORAGE

a. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the

units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps is not acceptable.

3. FIELD EXAMINATION

a. The Mechanical Contractor shall verify that the mechanical room is ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents.

b. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

4. INSTALLATION

a. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner's selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or welded joints, and all other installation and assembly requirements.

b. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.

c. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU manufacturer's final inspection and start up:

1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.

2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.

3. All water and steam piping connections have been completed and hydrostatically tested and all water flow rates have been set in accordance with the capacities scheduled on the Drawings.

4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.

5. All power wiring, including motor starters and disconnects, serving the unit has been completed.

6. All automatic temperature and safety controls have been completed.

7. All dampers are fully operational.

8. All shipping materials have been removed.

9. All (clean) filter media has been installed in the units.

5. LEVELING

a. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer's instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.

6. FINAL INSPECTION AND START UP SERVICE

a. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.

b. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.

c. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:

1. Record date, time, and person(s) performing service.

2. Lubricate all moving parts.

3. Check all motor and starter power lugs and tighten as required.

4. Verify all electrical power connections.

5. Conduct a start up inspection per the AHU manufacturer's recommendations.

6. Record fan motor voltage and amperage readings.

7. Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.

8. Check fan for excessive vibration.

9. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.

10. Disengage all shipping fasteners on vibration isolation equipment.

11. Check safety guards to insure they are properly secured.

12. Secure all access doors to the fan, the unit and the ductwork.

13. Switch electrical supply "on" and allow fan to reach full speed.

14. Physically check each fan at start up and shut down to insure no abnormal or problem conditions exist.

15. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.

16. Check all control sequences.

75. AIR COOLED CHILLER

A. GENERAL

1. SUMMARY

a. Section includes design, performance criteria, refrigerants, controls, and installation requirements for an air-cooled rotary scroll packaged chiller.

2. REFERENCES

a. AHRI 550/590 - Standard for Water Chilling Packages using the Vapor Compression Cycle

b. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment

c. ASHRAE 15 - Safety Code for Mechanical Refrigeration

d. ASHRAE 90.1 - Energy Efficient Design of New Buildings

e. UL 60335-2-40 - Central Cooling Air Conditioners

f. ASTM B117 - Standard Method of Salt Spray (Fog) Testing

g. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

h. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products

i. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments

j. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings.

k. ISO 9001

3. SUBMITTALS

a. Submit dimensional plan and elevation view drawings, weights and loadings, required clearances, location and size of all field connections, electrical requirements and wiring diagrams.

b. Submit product data indicating rated capacities, accessories and any special data.

c. Submit manufacturer's installation instructions.

4. REGULATORY REQUIREMENTS

a. Comply with codes and standards specified.

b. Chiller must be built in an ISO 9001 classified facility.

5. VERIFICATION OF CAPACITY AND EFFICIENCY

a. All proposals for chiller performance must include an AHRI approved selection method. Verification of date and version of computer program selection or catalog is available through AHRI.

6. DELIVERY, HANDLING AND STORAGE

a. Comply with manufacturer's installation instructions for rigging, unloading, and transporting chillers.

b. Chiller shall be capable of withstanding -40ºF to 158ºF storage temperatures for an indefinite period of time.

7. WARRANTY

a. Provide a full parts and labor warranty for 3 years from start-up or 36 months from shipment, whichever occurs first.

b. 2nd-5th year compressor parts

c. 1st year labor warranty whole unit

B. PRODUCTS

1. ACCEPTABLE MANUFACTURERS

a. Trane Model "ACS."

b. Approved equals are Carrier or York. Chiller shall have scroll compressors and meet the specification including all scheduled performance.

2. CHILLER DESCRIPTION

a. The contractor shall furnish and install air-cooled water chiller with scroll compressors as shown on the contract documents. The chiller shall be installed in accordance with this specification and perform at the specified conditions.

3. CHILLER OPERATION

a. Low ambient operation; Chiller shall be able to start and operate in ambient conditions down to -20ºF and up to 115ºF. Low ambient operation is accomplished with factory installed and tested protection. If field installed low ambient solution is used, it shall be purchased and installed at contractor expense.

b. Chiller shall be capable of starting up with 95ºF entering fluid temperature to the evaporator. Maximum water temperature that can be circulated with the Chiller not operating is 125ºF.

c. Chiller shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the controller shall indicate that the chiller is in adaptive limit. If the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.

d. Rapid Restart™ after power restoration. The Chiller shall be capable of starting in 45 seconds.

4. COMPRESSORS

a. Construct chiller using fully hermetic scroll type compressors with R454B Refrigerant.

b. Provide direct drive motor cooled by suction gas with only three major moving parts and a completely enclosed compression chamber which leads to increased efficiency.

c. Each compressor shall have Intermediate Discharge Valves (IDV) or variable volume ratio technology

d. Each compressor shall have overload protection internal to the compressor

e. Each compressor shall include: oil level sight glass and oil charging valve

f. Each compressor will have crankcase heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

5. EVAPORATOR

a. The evaporator shall be a high efficiency, brazed plate-to-plate type heat exchanger consisting of parallel plates. Braze plates shall be stainless steel with copper braze material.

b. The water side working pressure shall be rated at 150 psig and tested at 1.5 times maximum allowable water side working pressure.

c. The refrigerant side working pressure shall be rated at 650 psig and tested at 1.1 maximum allowable refrigerant side working pressure.

d. Insulate the evaporator with a minimum of 0.75 inch (K=0.28) UV rated insulation. If the insulation is field installed, the additional money to cover material and installation costs in the field shall be included in the bid.

e. Evaporator heaters shall be factory installed and shall protect chiller down to -20ºF. Contractor shall wire separate power to energize heat tape and protect evaporator while chiller is disconnected from the main power.

f. Provide water drain connection, vent and fittings. Factory installed leaving water temperature control and low temperature cutout sensors.

g. Water connections shall be grooved pipe.

h. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

i. Pump package includes: two high head pumps, two VFDs, drainage valves, shut-off valves at entering and leaving connections. The pump package is single point power integrated into the chiller unit power with a separate factory wired control panel. The control of the pump is integrated into the chiller controller. The controller displays both of the evaporator pump starts and run-times. Freeze protection down to an ambient of -20ºF is included as standard. The cold parts of the pump package shall be fully insulated. Designed with redundant pump and VFD, the chiller controls both pumps through a lead/lag and failure/recovery functionality. A variable speed drives are installed in an additional panel to control the pump. The VFD is adjusted upon start up to balance the system flow and head requirements. The purpose is to save on wasted pump energy caused by a traditional balancing valve. The drive shall have inputs to accept a signal from a BAS for variable primary flow.

6. FANS

a. Low sound fans shall be balanced and direct driven.

b. All condenser fan TEAO motors shall have permanently lubricated ball bearings and internal overload protection.

c. All condenser fans are electrically commutated motors to provide variable speed for optimized efficiency and lower part load sound.

7. CONDENSER

a. Condenser coils shall be aluminum brazed fin construction. The condenser coils shall have an integral sub-cooling circuit and shall be designed for at least 650 psig working pressure. Leak tested at 650 psig.

8. ENCLOSURES/CHILLER CONSTRUCTION

a. Unit panels, structural elements and control boxes are constructed of galvanized steel and mounted on a bolted galvanized steel base. Unit

panels, control boxes and the structural base are finished with a baked on powder paint.

b. Control panel doors shall have door stays.

c. Mount starters and Terminal Blocks in a UL 60335-2-40 rated weatherproof panel and shall be provided with full opening access doors. If a circuit breaker is provided, it shall be a lockable, through-the-door type with an operating handle and clearly visible from outside of chiller indicating if power is “on” or “off.”

d. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B117.

9. ELECTRICAL

a. The starter shall be across-the-line configuration, factory-mounted and fully pre-wired to the compressor motor and control panel.

b. Unit shall have a single point power connection.

c. A molded case standard interrupting capacity circuit breaker shall be factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, making it available to disconnect the chiller from main power.

d. A control power transformer shall be factory-installed and factory-wired to provide unit control power.

e. Unit wiring shall run in liquid-tight conduit.

f. High short circuit current rating (SCCR) of 65kA.

10. REFRIGERANT CIRCUIT

a. All chillers shall have 2 refrigeration circuits, each with two or three (manifolded) compressors on each circuit.

b. Provide for refrigerant circuit:

1. Liquid line shutoff valve

2. Discharge service valve

3. Replaceable Core Filter Drier

4. Liquid line sight glass.

5. Electronic expansion valve sized for maximum operating pressure

6. Charging valve

c. Full operating charge of R454B and oil.

11. CONTROLS

a. A color, touch sensitive liquid crystal display (LCD) shall be unit mounted and a minimum of 7" diagonal.

b. Display shall consist of a menu driven interface with touch screen navigation to organized sub-system reports for compressor and evaporator information as well as associated diagnostics.

c. The chiller control panel shall provide password protection of all setpoints with configurable user settings for each user.

d. The controller shall have the ability to display all primary sub-system operational parameters on dedicated trending graphs. The operator must be able to create up to 6 additional custom trend graphs, choosing up to 10 unique parameters for each graph to trend log data parameters simultaneously over an adjustable period and frequency polling.

e. Chilled water temperature control shall be microprocessor-based, proportional and integral controller to show water and refrigerant temperature, refrigerant pressure, and diagnostics. This microprocessor-based controller is to be supplied with each chiller by the chiller manufacturer.

f. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:

1. Run time.

2. Number of starts.

3. Current chiller operating mode.

4. Chilled water set point and set point source.

5. Demand current limit set point and set point source.

6. Entering and leaving evaporator water temperatures.

7. Saturated evaporator and condenser refrigerant temperatures.

8. Evaporator and condenser refrigerant pressure.

9. Phase reversal/unbalance/single phasing and over/under voltage protection.

10. Low chilled water temperature protection.

11. High and low refrigerant pressure protection.

12. Load limit thermostat to limit compressor loading on high return water temperature.

13. Condenser fan sequencing to automatically cycle fans in response to load, expansion valve pressure, condenser pressure, and differential pressure to optimize chiller efficiency.

14. Display diagnostics.

15. Compressors: Status (on/off), anti-short cycle timer, and automatic compressor lead-lag.

g. Weatherproof control panel shall be mounted on chiller, containing starters, power and control wiring, factory wired with terminal block power connection. Provide primary and secondary fused control power transformer.

h. The chiller controller shall utilize a microprocessor that will automatically take action to prevent chiller shutdown due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.

i. Provide the following safety controls with indicating lights or diagnostic readouts:

1. Low chilled water temperature protection.

2. High refrigerant pressure.

3. Loss of chilled water flow.

4. Contact for remote emergency shutdown.

5. Motor current overload.

6. Phase reversal/unbalance/single phasing.

7. Over/under voltage.

8. Failure of water temperature sensor used by controller.

9. Compressor status (on or off).

j. Provide the following operating controls:

1. A variable compressor staffing method to control capacity in order to maintain leaving chilled water temperature based on PI algorithms. Five minute solid state anti-recycle timer to prevent compressor from short cycling. Compressor minimum stop-to-start time limit shall be 2 minutes. If a greater than 5 minute start-to-start, or greater than 2 minute stop-to-start timer is included.

2. Chilled water pump output relay that closes when the chiller is given a signal to start.

3. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance trips.

4. High ambient unloader pressure controller that unloads compressors to keep head pressure under control and help prevent high pressure nuisance trip outs on days when outside ambient is above design.

5. Low ambient lockout control with adjustable setpoint.

6. Condenser fan sequencing which adjusts the speed of all fans automatically in response to ambient, condensing pressure and expansion valve pressure differential thereby optimizing chiller efficiency.

k. Provide user interface on the front of the panel. If display is on the inside of the panel, then a control display access door shall be provided to allow access to the display without removal of panels. Provide user interface with a minimum of the following features:

1. Leaving chilled water setpoint adjustment from the front panel touchscreen display.

2. Entering and leaving chilled water temperature output

3. Pressure output of condenser

4. Pressure output of evaporator

5. Ambient temperature output

6. Demand limit setpoint adjustment from the front panel touchscreen display.

l. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.

m. Service Pump Down Control

n. Configurable Users

o. Multiple Languages Selectable

p. Metric Conversions

q. Customer wired 20amp, 115-volt GFCI convenience outlet shall be factory mounted on the exterior of the control panel.

r. Digital Communications to BAS system shall consist of a BACnet MS/TP interface via a single twisted pair wiring.

s. The chiller control panel shall provide input for leaving chilled water temperature setpoint based upon a 2-10VDC or 4-20mA signal.

t. The chiller control panel shall provide input for demand limit based upon a 2-10VDC or 4-20mA signal.

u. The chiller control panel shall provide an output for chiller Percent Capacity.

v. The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel.

12. SOUND

a. Acoustics: Manufacturer must provide both sound power and sound pressure data in decibels, per AHRI 370. A-weighted sound pressure at 30 feet should be provided at 100%, 75%, 50% and 25% load points to identify the full operational noise envelope.

b. If manufacturer cannot meet the noise levels, sound attenuation devices and/or barrier walls must be installed to meet this performance level.

c. This option includes acoustical treatment for compressor.

d. Condenser fan speed control for sound reduction.

13. ACCESSORIES

a. Chiller shall ship with elastomeric Isolators.

C. EXECUTION

1. INSTALLATION

a. Install in accordance with manufacturer's requirements.

1. Level the chiller using the base rail as a reference. The chiller must be level within 1/2 in over the entire length and width. Use shims as necessary to level the chiller.

2. SERVICE AND START-UP

a. Startup - Provide all labor and materials to perform startup. Startup shall be performed by a factory-trained technician from the original equipment manufacturer (OEM). Technician shall confirm that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty. This shall be done in strict accordance with manufacturer's specifications and requirements. Third-party service agencies are not permitted.

b. A start-up log shall be furnished by the factory approved start-up technician to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

c. Chiller manufacturers shall maintain service capabilities no more than 50 miles from the jobsite.

d. Provide local service agent with direct access to factory support on equipment.

e. During the first 12 months of operation, a factory-trained technician from the original equipment manufacturer (OEM) shall perform quarterly on-site operating inspections to confirm the chiller's operational performance. The manufacturer shall provide the owner with a report describing the condition of the equipment, current operating log, any issues found needing to be addressed, and recommended corrective actions.

76. TEMPERATURE CONTROL SYSTEM

A. Section includes: Temperature Control System, utilizing direct digital controls and touchscreen for alarm enunciation, acknowledgment, and silencing.

B. General: Furnish and install, as hereinafter specified, a temperature control system. The installation shall be performed by mechanics and electricians in the employment of the temperature control contractor (referred to hereinafter as TCC).

C. The Temperature Control System for the project shall be based on the Tridium Niagara 5 framework. The system shall be furnished and installed by one of the two following vendors:

1. Point to Point Systems - 620 East First Street, Dayton, Ohio 45402 (Contact Chris Brown, W: 1-800-685-2082, cbrown@p2psystems.net

2. Waibel Energy Systems - 815 Falls Creek Drive, Vandalia, OH 45377-0670 Contact Rodney Rhoades, W: 937-264-4343, Rodney.Rhoades@Waibelenergysystems.com

D. The Temperature Control Contractor (TCC) shall have a history of performance covering at least five consecutive years for furnishing, installing and servicing items in the area of construction as hereinafter specified. The temperature control system shall consist of all room thermostats and / or sensors, controllers, automatic valves, electric actuators, switches, all necessary electric relays and all other sensors, detectors, devices, software, hardware, programming and miscellaneous controls to fulfill the intent of the following specifications and description of operation.

1. Temperature control system wiring as well as wiring of items furnished and/or installed by the TCC shall be provided by the TCC unless specifically designated, either on the electrical plans or in the electrical specifications, for such work to be done by the electrical contractor. All wiring by the TCC shall conform to the National Electric Code and shall be installed as required by the electrical specifications.

a. Low voltage wiring (less than 50 volts) shall be run with insulated conductors in EMT conduit.

b. Power wiring required for DDC controllers, transformers, actuators, etc. shall be provided by the TCC unless it is called for in the electrical specifications or shown on the electrical drawings.

2. The installation and setting of automatic control dampers furnished by the TCC shall be by the sheet metal contractor. Where dampers, as reviewed by the Engineer, have dimensions that do not correspond to those of the

ductwork, it shall be the sheet metal contractor's responsibility to put filler sheet metal spacers between the outer perimeter of the damper and the ductwork or the framing into which the damper fits. The damper submittal sheets shall be furnished by the TCC to the successful sheet metal contractor for coordination purposes.

3. Bulb wells (for fluidic sensing devices) and automatic valve bodies shall be installed in the pipelines by the piping contractor. Flare nuts required for valve installation will not be the responsibility of the TCC.

4. The TCC shall be responsible for the furnishing of engineering drawings which indicate the interlocking of the external control equipment and also for drawings showing wiring inherent to the temperature control system (including internal wiring diagrams of equipment that is interlocked with the temperature control system). The prime heating, ventilating and air conditioning contractor shall furnish all equipment wiring diagrams to the TCC for inclusion with the temperature control wiring diagrams. A final review will be done by the Engineer. A complete description of operation, keyed to the temperature control wiring and general control diagrams, shall be included with this submittal.

5. No billing that is submitted for services performed, material shipped, stored, delivered and/or installed will be authorized to be paid to the TCC until the completed submittals have been reviewed by the Engineer. This stipulation shall not preclude or interfere with the orderly progression of the project as delineated in the general and/or special conditions portions of these specifications.

E. System Outline: The following is a listing of the various mechanical system equipment and components to be controlled under this section of the work. Other equipment control shall be electric as specified.

1. Air Cooled Chiller
2. Make-Up Air Unit
3. Chimney Automation System
4. Boilers
5. Fans
6. Pumps

F. System Description

1. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Temperature Control (TC) System, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are

diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open BACnet protocol bus.

a. The intent of this specification is to provide a system that is consistent with the Niagara 5 Framework. Tridium Authorized Control Integrator shall provide Honeywell or Vykon compatible components.

b. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor BACnet protocol.

c. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.

d. All control devices furnished with this Section shall be programmable directly from the Niagara 5 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.

e. The server shall host all graphic files for the control system.

f. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the TC System.

g. OPEN NIC STATEMENTS - All NiagaraAX or Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"; "accept.wb.in=*"; "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.

h. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted “safe boot” technology.

2. All products of the TC System shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package.

a. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.

b. FCC, Part 15, Subpart B, Class B

c. FCC, Part 15, Subpart C

d. FCC, Part 15, Subpart J, Class A Computing Devices.

e. UL 504 - Industrial Control Equipment.

f. UL 506 - Specialty Transformers.

g. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.

h. UL 916 - Energy Management Systems All.

i. UL 1449 - Transient Voltage Suppression.

j. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.

k. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.

l. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.

m. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.

n. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

o. NEMA 250 - Enclosures for Electrical Equipment.

p. NEMA ICS 1 - Industrial Controls and Systems.

q. NEMA ST 1 - Specialty Transformers.

r. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-2013.

G. Specification Nomenclature

1. Acronyms used in this specification are as follows:

    a. Actuator: Control device that opens or closes valve or damper in response to control signal.

    b. AI: Analog Input.

    c. AO: Analog Output.

    d. Analog: Continuously variable state over stated range of values.

    e. TC System: Temperature Control System.

    f. DDC: Direct Digital Control.

    g. Discrete: Binary or digital state.

    h. DI: Discrete Input.

    i. DO: Discrete Output.

    j. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.

    k. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.

    l. GUI: Graphical User Interface.

    m. HVAC: Heating, Ventilating and Air Conditioning.

    n. IDC: Interoperable Digital Controller.

    o. ILC: Interoperable Lon Controller.

    p. LAN: Local Area Network.

    q. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.

    r. Motorized: Control device with actuator.

    s. NAC: Network Area Controller.

t. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.

u. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.

v. OSS: Operating System Server, host for system graphics, alarms, trends, etc.

w. Operator: Same as actuator.

x. PC: Personal Computer.

y. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.

z. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.

aa. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).

ab. PICS: BACnet Product Interoperability Compliance Statement.

ac. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).

ad. Point: Analog or discrete instrument with addressable database value.

ae. WAN: Wide Area Network.

H. Submittals

1. Submit full submittal package under provisions of Item SHOP DRAWINGS.

2. Product Data: Manufacturer's data sheets on each product to be used, including:

a. Preparation instructions and recommendations.

b. Storage and handling requirements and recommendations.

c. Installation methods.

3. Three (3) copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed and electronic formats. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.

4. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.

5. Upon completion of the work, provide three (3) complete sets of “as-built” drawings and other project-specific documentation in 3-ring hard-backed binders and on Flash media.

6. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

I. Quality Assurance

1. The TCC shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment. This office will employ a Niagara^{AX} Certified programmers and a NiagaraN4 programmer.

2. This office will be established as a Honeywell Authorized Controls Integrator.

3. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

J. Pre-Installation Meetings

1. Convene minimum two weeks prior to starting work of this section.

K. Delivery, Storage and Handling

1. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

L. Job Conditions

1. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

M. Sequencing

1. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

N. Manufacturers

1. Acceptable Manufacturer: Honeywell Building Control Systems.

O. General

1. The Temperature Control System (TC System) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

2. The installed system shall provide secure password access to all features, functions and data contained in the overall TC System.

P. Open, Interoperable, Integrated Architecture

1. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system utilizing Open protocols in one open, interoperable system.

2. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system.

Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.

3. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices.

4. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

5. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.

    a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

    b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote connected user interfaces.

Q. Temperature Control System Server Hardware

1. Minimum Computer Configuration (Hardware Independent).

    a. Central Server. **Temperature Controls Contractor** shall provide a dedicated TC System server and display with configuration that includes the following components as a minimum:

        1. Industrial Computer / Display shall be built for harsh, high temperature environments and shall have the following features and capabilities:

            A. 15” LCD Touchscreen Display with 1024 x 768 (XGA) resolution.

            B. Intel 12th Generation i5 processor.

            C. 32GB Memory.

D. Windows 11.

E. Stainless Steel Enclosure.

F. IP69K Waterproof M12 Connectors.

G. 1 x 2.5” SATA Drive Bay for 128 GB SDD/HDD.

H. Operating Temperature: 32 deg. F – 122 deg. F.

I. Touchscreen: Projected capacitive (multi-touch), 5 wire resistive.

J. Two-year Warranty.

2. Computer / Display shall be Tegular Mod. No. TS-7010-15, or engineer approved equal.

R. System Network Controller (SNC)

1. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

2. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.

3. The controllers shall be capable of peer-to-peer communications with other SNC.'s and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.

4. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 5, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

5. The SNC shall employ a device count capacity license model that supports expansion capabilities.

6. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:

    a. BACnet

7. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

8. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.

9. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.

    a. Alarm generation shall be selectable for annunciation type and acknowledgment requirements including but not limited to:

        1. Alarm.

        2. Return to normal.

        3. To default.

    b. Alarms shall be annunciated in any of the following manners as defined by the user:

        1. Screen message text.

        2. Email of complete alarm message to multiple recipients.

        3. Pagers via paging services that initiate a page on receipt of email message.

        4. Graphics with flashing alarm object(s).

    c. The following shall be recorded by the SNC for each alarm (at a minimum):

        1. Time and date.

        2. Equipment (air handler #, access way, etc.).

        3. Acknowledge time, date, and user who issued acknowledgment.

10. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

11. The SNC shall support the following security functions.

    a. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.

    b. Role-Based Access Control (RBAC) for managing user roles and permissions.

    c. Require users to use strong credentials.

    d. Data in Motion and Sensitive Data at Rest be encrypted.

    e. LDAP and Kerberos integration of access management.

12. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:

    a. Metadata: Descriptive tags to define the structure of properties.

    b. Tagging: Process to apply metadata to components

    c. Tag Dictionary

13. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer’s controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD…) shall have an associated template file for reuse on future project additions.

14. The SNC shall be provided with a 5 Year Software Maintenance license. Labor to implement not included.

S. Wiring

1. All electrical control wiring to the control panels shall be the responsibility of the TCC.

2. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.

3. Excess wire shall not be looped or coiled in the controller cabinet.

4. Incorporate electrical noise suppression techniques in relay control circuits.

5. There shall be no drilling on the controller cabinet after the controls are mounted inside.

6. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.

7. Use manufacturer-specified wire for all network connections.

8. Use approved optical isolation and lightning protection when penetrating building envelope.

9. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

T. Acceptance Testing

1. Upon completion of the installation, the TCC shall load all system software and start-up the system. The TCC shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

2. The TCC shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

3. System Acceptance: Satisfactory completion is when the TCC has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

U. Operator Training

1. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the TCC shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

2. The TCC shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the

1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

V. Warranty Period Services

1. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

2. Within this period, upon notice by the Owner, any defects in the TC System due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the TCC at no expense to the Owner.

3. Maintenance of Computer Software Programs: The TCC shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by TCC shall come with a 5 Year Software Maintenance license. All SNC and TC System Servers are included in this coverage. Labor to implement upgrades in years two through five shall be included in standard warranty.

4. Maintenance of Control Hardware: The TCC shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The TCC shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.

5. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

6. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

W. Warranty Access

1. The Owner shall grant to the TCC reasonable access to the TC System during the warranty period. Remote access to the TC System (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

X. Operation and Maintenance Manuals

1. See Item 24. INSTRUCTIONS, MANUALS AND SPARE PARTS, ETC.1 for requirements, three (3) binders inclusive. O&M manuals shall include the following elements, as a minimum:

    a. As-built control drawings for all equipment.

    b. As-built Network Communications Diagram.

    c. General description and specifications for all components.

    d. Completed Performance Verification sheets.

    e. Completed Controller Checkout/Calibration Sheets.

Y. Protection

1. Protect installed products until completion of project.

2. Touch-up, repair or replace damaged products before Substantial Completion.

* * * END OF SECTION * * *

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ELECTRICAL

SECTION 16000

INDEX

ELECTRICAL

SECTION 16000

1. RELATED DOCUMENTS

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

2. SCOPE

A. The work included under this section shall consist of the furnishing of all labor, materials, equipment and incidentals necessary to install the electrical and related work indicated on the drawings and as called out in the following technical specifications. This shall include all testing and adjustments required and/or specified.

3. DESCRIPTION OF WORK

A. The following is a summary of the principal categories of work under this section. Note, however, that this listing is for general information only and work will not necessarily be limited to these categories. The detailed drawings and the following specifications cover the full extent of the work.

B. Power:

1. Standby

C. Demolition:

1. Removal of existing electrical devices that are noted on drawings and those devices in the area of the remodeling that are obviously necessary to be removed or relocated.

D. Lighting:

1. Lighting fixtures including installation, complete with lamps, hangers and accessories.

4. PERMITS, FEES, INSPECTIONS, LAWS & REGULATIONS

A. Obtain and pay for all permits required in connection with this section of the work. In addition, pay all necessary inspection fees or similar charges. Laws and regulations which bear upon or affect this work shall be complied with and are hereby made a part of this section of the work. All work which such laws require to be inspected shall be submitted to the proper public officials for inspection.

B. The requirements of the National Electrical Code (NEC) as well as all local

ordinances and regulations, including those of the local utility company, shall be followed and adhered to with regard to the work under this section. Where the contract documents (plans, specifications, etc.) exceed the minimum requirements of the NEC and/or other regulations, etc., the document requirements shall govern.

C. At completion of the project furnish to the Owner, at no additional charge, a certificate(s) of inspection issued by the authorized agency (or agencies) having jurisdiction over this portion of the project, stating that all work executed under this section complies with the minimum requirements.

D. ote that the General Building Permit will be obtained and paid for by the successful Electrical Contract Bidder. Contractors bidding this section of the work shall make a sufficient allowance in their bid to reimburse the Electrical Prime Contractor for their proportionate share of the permit cost.

E. Additional fees, charges, etc. imposed by other contractors and/or tradesmen, professional consultants, etc. for services rendered in connection with performing any portion of the work under this section shall be included as part of the work. This shall include surveys, profiles and/or other miscellaneous drawings, etc. that may be required in addition to the contract documents by any governing authority.

5. SITE INVESTIGATION

A. Prior to bidding, it is recommended that the contractor visit the job site and investigate all details which may have any effect on the installation, progress or completion of the project.

B. When a bid is received, it will be assumed that the contractor has made the job site visit(s) and is familiar with the conditions as they exist and any adjustments and/or modifications that may be necessary in order to perform and complete the work as specified.

C. At project start-up, certain areas will be designated for the storage of materials and equipment and cooperation with the Owner in minimizing interference with existing operations will be mandatory.

6. DRAWINGS

A. The drawings prepared for this project are an outline to show where conduit, devices and distribution equipment must go in order to harmonize with the building and installations of the various trades. All work must be installed in accordance with the drawings insofar as possible. All drawings shall be carefully checked during the course of bidding and construction. If any discrepancies, errors or omissions or overlaps with other trades are discovered prior to or during the construction phase, notify the Engineer immediately for interpretation or correction. Note that an overlap with another trade does not relieve the contractor from the obligation of performing the work indicated on the drawings for this section of the project unless written notification stating such is obtained from the Engineer.

B. Take all necessary measurements and be responsible for same, including clearances for all equipment that is to be furnished. The Engineer shall reserve the right to make minor location changes of equipment where such adjustments are deemed desirable from an appearance, installation or operational standpoint. Such changes will normally be initiated sufficiently in advance to avoid extra work or unduly delay progress on the project.

C. In general, the conduit and wiring layouts shall be considered as diagrammatic for clearness and legibility and are to be used as a guide. Therefore, it is not intended that the drawings indicate all necessary offsets, junction boxes, pull boxes, etc. Conduit, wiring, fixtures, equipment, etc. may have to be offset, lowered or raised as required or as directed at the site in order to accommodate field conditions. In addition, relocate or shift equipment, fixtures and devices without cost, when so directed by the Engineer, providing such items have not been installed and the revised location is not greater than 10 feet from the location indicated.

D. Note also that electrical connections indicated on the drawings may not be shown in the correct location for the equipment, fixtures, devices, etc., actually selected for the project. Verify all connection locations with shop drawings of the item to be installed or make field measurements before proceeding with any rough-in work.

E. The general building and / or structural drawings shall be used to obtain dimensions and exact locations and as a check with other contractors to avoid interference with their work. Refer to applicable drawings on all branches of the work where other trades are involved on the project so that added field work and/or job delays resulting from conflicts between crafts can be avoided.

7. SPECIFICATIONS

A. Specifications shall be interpreted in conjunction with the drawings hereinbefore described and if anything is shown on the drawings and not mentioned in the specifications or vice versa, it is to be included in the work the same as though clearly set forth by both.

B. Furthermore, all materials or labor obviously required to fully complete the work shall be included in the bid, even though each item necessarily involved is not specifically mentioned or shown. Such work and/or material shall be furnished and shall be of the same grade or quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

C. Should an overlap of work between the various trades become evident, the Engineer shall be notified. Such an event shall not relieve any trade of the responsibility for the work called for under his branch of the specifications until a written clarification or directive is issued concerning the matter.

D. When selecting equipment to be used on this project, refer to Item EQUIPMENT

CLEARANCES AND REQUIREMENTS in these specifications.

E. Note that all systems and items of equipment involved under this contract heading shall be furnished and installed in accordance with applicable requirements of federal, state and local codes including the ADA (Americans with Disabilities Act), OSHA requirements and applicable portions of NFPA. The above includes adhering to applicable requirements governing mounting heights for occupant operable controls.

F. All references made to codes, standards, etc. in these specifications or on the drawings shall be taken to mean the latest edition, amendment and/or revision of such reference in effect as of the date indicated on the Bid Documents.

8. MATERIALS AND WORKMANSHIP

A. Materials supplied under this contract shall be new and in strict accordance with the provisions of these plans and specifications. Any material required which is not specifically represented by a manufacturer's catalog number of quality standard, shall be subject to the approval of the Engineer in all cases. When two or more items of the same equipment are involved, they shall be identical in quality and made by the same manufacturer.

B. Materials shall be the latest design of that manufacturer and shall be shipped to the job in the original container with proper identification as to size, type and dates of inspection and shipment.

C. Electrical work shall be performed by mechanics skilled in their respective trades. Tool marks will not be permitted on any exposed materials, fixture or fitting. In addition, all exposed materials, fixtures, equipment, etc. shall be installed in straight horizontal and/or vertical lines, parallel to the building lines wherever possible. Carelessly executed work as well as workmanship that is determined to be below normal industry standards of best practice, and/or work not conforming to the requirements of this item, shall be redone or repaired as required prior to final acceptance.

9. CUTTING AND PATCHING

A. All cutting and/or drilling of walls, slabs, structural members, etc., required in conjunction with work under this section shall be performed as part of the work and shall be done under the supervision of the General Contractor. Work shall be neatly done, without unnecessary removal of material. Holes, openings, etc. shall be located where they will not weaken the structure. No beams, joists, etc., shall be cut without written authorization from the Engineer.

B. Cutting of holes in masonry and/or concrete shall be performed with a core drill to minimize spalling, etc. Locations shall be accurately determined and checked and the appropriate drill bit shall be used to minimize hole size.

C. Sleeves or thimbles for these holes as well as escutcheons and trim plates shall be

provided as described in Item SLEEVES AND THIMBLES.

D. NOTE: Cutting of water lines, electric conduit or similar service lines in the course of work performed under this section shall be immediately repaired as part of the work of this section.

E. Patching and/or repairing of all work, including finished surfaces, necessitated by the demolition or installation of work under this section shall be considered as part of this work. It shall, however, be performed by mechanics of the appropriate trade in order to achieve a workmanlike job. This shall include, but not be limited to, all items of concrete and masonry work, millwork, gypsum board and/or plaster work, painting, floor finishes and ceiling finishes as well as all other surface finishes.

F. When the need for such patching or repairs arises, immediate arrangements shall be made with the appropriate trade(s) or with the General Contractor to perform the necessary work at no additional cost to the Owner. The final responsibility for acceptance of such work by the Owner's representative shall reside with the contractor for this section of the project.

10. PROTECTION

A. Provide proper protection to the building during the execution of all work involved under this contract heading.

B. This protection shall include covering all apparatus, building surfaces and/or other materials to protect same from dirt; adequate temporary connections to protect apparatus from damage of any sort; and required shielding to protect finished parts of the building. The following shall apply where applicable:

1. Protect finished floors from chips and cutting oil by the use of a metal chip receiving pan and an oil proof floor cover.

2. Protect equipment and finished surfaces from welding and cutting spatters with baffles and spatter blankets.

3. Protect all electrical equipment finished surfaces from paint droppings, insulation adhesive and sizing droppings, etc., by the use of drop cloths.

4. Exercise extreme caution in the handling and storage of tools, material and equipment in order to prevent damage to other contractor's work and/or materials and to avoid repair costs.

C. All switchgear, fixtures and other electrical equipment stored at the site with exposed openings, bearings, etc. shall be covered to exclude dust and moisture. All stockpiled conduit shall be placed on dunnage and protected from weather and from entry of foreign material.

D. Furnish necessary devices, strip heaters, wiring, connections, power, etc. to provide temporary heat to keep moisture out of apparatus and equipment such as

transformers, motors, etc. furnished under this section.

11. PREPARATION OF BIDS

A. All bids shall be based upon furnishing and installing the make of materials and apparatus specified herein WITHOUT SUBSTITUTION, in order that all bids may be properly compared.

B. Other materials, equipment or systems that the bidder may desire to use as a substitute for that specified will be considered IF PROPOSED AT THE TIME OF BIDDING and shown on the substitution sheet of the proposal. Such alternate items shall be of equally high quality with all safeguards, design features and operational requirements as shown on the drawings and/or as specified herein.

C. It is understood that proposals to use such substitutes shall be made in addition to and separate from the base bid in order to receive consideration and the addition to or deduction from base bid, if any, shall be duly noted on the bid form.

D. Regarding substitutes, note that any deviations from the following specifications or any special equipment requirements (ambient conditions, services, power conditioning, etc.) necessary for full time operation shall be clearly stated and completely itemized. Failure to meet these stipulations could result in additional expense that would be assigned to this section of the work and not considered as an extra. These substitute proposals will not, however, be considered as a basis for determining the low bidder unless they are specifically listed by Addendum as alternate proposals. Each substitute proposal offered shall list the manufacturer, the catalog number of the substitute item, and the specified item to be replaced by the substitute. In addition to this information, state the amount to be added to or deducted from base bid in the event the substitute proposal is accepted.

E. If no proposals for substitutes are listed on the bid form, no such proposals will be permitted for later consideration unless delivery schedules or other factors beyond the Contractor's control justify same.

F. If more than one make of material or equipment is specified, the proposed manufacturer, brand, type, etc. shall be identified. If this provision is not complied with, the Owner may then make this selection without change in contract price.

G. Note that in the following specifications, where more than one manufacturer is listed for a particular item of operating equipment, the design will be based on the first named. If equipment by the other named manufacturer(s) or a proposed substitute requires redesign work, revised/modified services, or specific additional field work by other trade(s), the price submitted for providing this equipment must include the required additional amount to cover such work.

H. Lump sum pricing by suppliers on two or more dissimilar classifications of materials, without an accompanying price breakdown on the individual classifications, will not be tolerated. Notify the Engineer, upon receipt of a lump-sum quotation which prevents a legitimate comparison with other competitive

individual quotations.

12. SHOP DRAWINGS

A. Prepare or obtain from the manufacturer, certified shop or erection drawings of all items of equipment to be furnished under this section and submit copies of same as required for review. This shall be done as soon as possible, well prior to proceeding with installation or construction and in the proper sequence to avoid delays in the work, the work of the Owner or other contractors. Unless otherwise indicated, a minimum of ten (10) sets shall be submitted. These drawings shall be complete in every respect, showing pertinent details regarding size, external and internal features, mechanical and/or electrical arrangements, locations of connections, installation and mounting instructions, materials, gauges, electrical characteristics, wiring diagrams, and other information necessary to show compliance with the intent of the contract documents. Note that in the following items of this specification, where more than one equipment manufacturer is listed, the first named has been used as the basis for design. All departures or deviations in performance, service requirements, size, etc. from first named by the make submitted shall be noted on the shop drawings. Where departures or deviations do occur, the contractor shall additionally itemize same on the cover sheet that accompanies the submittals. Failure to do so will risk subsequentrejection at the job site. (With regard to voluntary substitutions, refer also to Item BIDDING in this specification and item EQUIPMENT CLEARANCES AND REQUIREMENTS.

B. By submitting such drawings, the Contractor represents that he has selected and verified the materials and equipment, taken necessary field measurements, noted field construction criteria, etc., related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and the Contract Documents.

C. Materials and equipment to be furnished for this project shall be of current production by manufacturers regularly engaged in the manufacture of such items. When two or more similar units are required, they shall be the product of one manufacturer.

D. The review of shop drawings shall not be construed as a complete check but will indicate only that the capacity, general method of construction and/or detailing is satisfactory. Carefully check and verify dimensions for installation and service requirements before ordering equipment for the project.

E. Submittals shall be itemized on a standardized shop drawing submittal form stating the name of the project, specification section, paragraph and/or drawing numbers applicable to submittal and shall bear the contractor's review stamp as evidence that the items have been initially checked for compliance with Contract Documents as stated above.

F. After review, shop drawings will be returned marked in one of the following ways:

1. "NO EXCEPTIONS NOTED" - Copies may be distributed as required for

construction, shipment, etc. to proceed.

2. "EXCEPTIONS NOTED" - Contractor may proceed with and/or authorize construction, shipment, etc. taking into account the necessary corrections.

3. "EXCEPTIONS NOTED - REVISE AND RESUBMIT" - Contractor will be

required to resubmit shop drawings in their entirety. No fabrication, erection or installation shall be authorized or initiated until shop drawings so marked have been completely revised, resubmitted and subsequently marked in accordance with either of the two preceding subparagraphs. Only shop drawings officially marked "NO EXCEPTIONS NOTED" or "EXCEPTIONS NOTED" will be permitted on the jobsite.

G. Upon return of submittals take appropriate action as specified above. Note that any shop drawing copies received beyond the number required will be destroyed (not returned). Also note that if an insufficient number of copies has been submitted, no review will take place until all required copies have been received.

H. Where resubmittal is required, four (4) copies will be so noted by the reviewer, of which two (2) copies will be returned for corrections (one (l) copy for the contractor and one (l) copy for the supplier/subcontractor).

I. The following is a list, where applicable, of items requiring submittals.

1. Safety / Disconnect Switches

2. Lighting fixtures, Lamps, and Ballasts

3. Wiring Devices and Cover Plates

4. Fuses

5. Dry -Type Transformer

6. Panelboards

J. Note that submittal review is for general construction, detailing and application only. Carefully check and verify dimensions for installation as well as clearance and service requirements before ordering equipment for the project. In addition, where an elevator(s) is involved, verify all equipment specific electrical requirements with the selected equipment supplier in order to verify breaker type, feeder sizing, etc. At completion, the entire installation shall be such that all equipment will function and be serviceable in a normal and satisfactory manner.

K. Shop drawings will be provided by the Owner for any Owner furnished equipment requiring service or connections under this section.

L. A complete set of shop drawings, officially marked in the prescribed manner noted previously, shall be filed on the job site. Such drawings shall be kept together,

maintained in good condition and shall be readily available for reference.

13. WORK BY OTHERS

A. Each bidder shall read the specifications for the other branches of work to clarify the points of division of responsibility between the various trades. The following work will be by others:

1. General construction and site work . . .

2. Fire Protection.. .

3. Heating and air conditioning . . .

4. Painting, except as specifically included in this contract . . .

5. Telephone and network equipment . . .

6. Heating and air conditioning temperature control wiring and interlocks of automatic temperature control equipment not indicated on the electrical drawings . . .

B. The foregoing list of items of work by others constitutes only the major portion of such work, and is intended merely as a guide. Other minor items of such work to be done by others may appear elsewhere in these specifications or on the drawings.

14. SUPPORTING MEMBERS

A. Furnish and install all steel angles, channels, bars or clamps required to support any type of permanent apparatus to be furnished and/or installed under this section.

15. EQUIPMENT IDENTIFICATION

A. Provide nameplates on all items of equipment including those listed below:

1. Safety / Disconnect Switches

2. Control Panels

3. Dry-Type Transformer

4. Panelboards

B. Nameplates shall be laminated phenolic with black surface and white core. Use 1/16" thick material for plates up to 2" X 4". For larger sizes use 1/8" thick material. Attach to equipment by non-rusting screws.

C. Lettering shall include name of equipment, feeder circuit origin and/or what equipment serves..

D. Lettering shall be condensed gothic. The space between lines shall be equal to the

width of the letters. Use minimum l/4" high letters which will print approximately four to the inch. Increase letter size up to 3/4" on larger plates.

E. All cover plates shall have identification with regard to panel number, circuit number, item controlled, etc.

16. CLEAN UP

A. All rubbish resulting from the work herein specified shall be removed from the premises as fast as it accumulates.

B. Upon completion of the work, remove from the project site all tools, equipment, surplus materials and rubbish pertaining to the work under this contract heading. Responsibility for this shall include paying all costs for such removal and disposition including hauling, dumping, proper and legal disposal of hazardous materials, etc.

1. Note that when the work on this project involves replacement of fluorescent fixtures and/or lamps, the proper disposal of these lamps shall be through an EPA authorized lamp recycling center. Prior to completion of the work the Contractor shall furnish the Owner with written documentation from the agency attesting to the fact that a specific number of lamps have, in fact, been delivered for recycling. All associated costs involved with this procedure shall be borne by the Contractor.

17. MAINTENANCE OF EXISTING FACILITIES

A. Prior to the severing of the electrical service to any portion of the existing building, submit a plan to the Engineer and the Owner's Representative, stating the nature and duration of the proposed interruption, as well as the method of procedure. Do not under any circumstances proceed with an interruption of service of any type without the Owner's written authorization.

18. WORK IN EXISTING BUILDING

A. All equipment shown dotted and associated wiring and conduit, etc shall be disconnected and removed.

B. Existing electrical circuits and outlets which are to stay in use shall remain on the existing electrical panels. New work shall be connected to the new panels unless indicated otherwise.

C. All cutting and patching of existing walls, floors and ceilings required for the installation of any and all electrical work in the remodeled portions of the existing building shall be done under this section. (See Item CUTTING AND PATCHING).

D. All electrical work to be installed in finished rooms of the existing building shall be installed concealed unless otherwise noted on the drawings.

E. Painting of all patched work in the existing building will be the responsibility of this Contractor.

F. Provide coverplates on all open boxes discovered in areas being renovated.

19. TESTING, LOAD BALANCE AND ADJUSTMENT

A. Load balancing, adjustments and electrical testing shall be done under this section of the work.

B. A person skilled in the field of electrical testing and operating with proper test equipment shall perform the following:

1. Assure that proper phase relationships are maintained, to prevent reverse rotation of motor-driven equipment.

2. Test each low voltage (600V and less) size #2 conductor or larger in accordance with the following:

a. Perform insulation resistance test at 1000 V.D.C. for at least 30 seconds with respect to ground and adjacent cables.

b. Perform continuity test to insure proper cable connections.

3. Each special system installed under this contract, shall be inspected and operationally tested by a qualified representative of the equipment vendor.

4. Submit a written report of each test to the Engineer immediately following completion of the balance and test procedures.

20. RECORD DRAWINGS

A. Keep a running record of each change and / or deviation from the drawings. This record shall be kept on two clean sets of prints used for no other purpose. The "As-Built" prints shall be available at all times during the project for review by the Owner or Engineer. Before submitting a requisition for final payment, all project modifications, changes and/or deviations must be recorded on these documents, showing the work exactly as installed.

B. Record Drawings shall show deviations / changes with regard to the following:

1. Size, type capacity, etc. of any material, device or piece of equipment.

2. Location of any device or piece of equipment.

3. Location of any outlet or source in building service systems.

4. Routing of any piping, conduit, ducts or other building services.

5. Circuit Number.

6. Schedule modifications.

7. Actual lighting fixtures (by manufacturer catalog number) installed and actual lamps (by ordering code) installed.

C. These sets of record drawings shall also show the location of any concealed electric service, pull boxes, raceways, conduit, etc., obtained by actual field-measured dimensions to these items from readily identifiable and accessible elements of the building such as columns, walls, etc.

D. Record drawings must be complete and accurate. Unless they are sufficiently accurate to permit immediate location and identification of concealed work with a minimum of cutting, such drawings will be considered inadequate and the contract work deemed incomplete. If it is determined that the Contractor has made a good faith effort to compile a complete and accurate set of "As-Built" mark-ups, the Engineer will submit that, subject to the following, the Contractor has fulfilled his obligations with regard to this item of the specifications.

21. INSTRUCTIONS AND MANUALS

A. Provide four (4) complete brochures in hard backed binders, each containing all operating, servicing, and maintenance information as well as parts lists for all equipment installed under this contract. Where diagrams are too large for the binder, arrange manila pockets with reinforced holes to hold folded drawings. The binder shall also contain a title sheet showing the Contractor's name and address and an index sheet listing the contents of the manual. A copy shall be submitted to the Engineer for verification prior to being submitted to the Owner.

B. Information shall be complete, indexed, and bound as described above. The following shall be clearly printed on the front cover of the binder:

1. Project name, address and date.

2. Name and address of Engineer.

3. Section of Work covered, i.e., Electrical

4. Name and address of Contractor.

5. Telephone number of Contractor, including night or emergency numbers.

C. Incorporate, within the binders, individual sections containing an index sheet, written operating instructions, shop drawings, equipment catalog cuts, manufacturer's instructions, and a list of equipment into the binders.

1. First Page - Title of Job, Owner, Address, Date of Submittal, Name of Contractor and Name of Engineer...Emergency operating instructions and/or list of service organizations (including address and telephone numbers) capable of rendering emergency service on 24 hour calls shall be furnished.

2. Second Page - Index/Table of Contents

3. Third Page - Introduction to First Section...This shall contain a complete written description of the system.

4. First Section: A written description of system contents, where the system is actually located in the building, how each part functions individually andhow the system works as a whole...Conclude with a list of the items requiring service and either state the service and frequency needed or refer to the manufacturer's data in the binder that describes the proper service.

5. Second Section: A copy of each approved shop drawing, (clearly marked to identify the item furnished) with an index at the beginning of the section. Provide a separate list of all lighting fixtures and luminaires used on the job. The list shall include but not be limited to fixture type, manufacturer's catalog number and voltage, number of lamps, lamp type, ballast catalog number, manufacturer's name and quantity when required, catalog number and quantity of any replacement glass and/or plastic parts.

6. Third Section: A copy of each manufacturer's operating instructions with an index at the beginning of the section.

7. Fourth Section: A list of all equipment used on the job, Contractor's purchase order numbers, supplier's name and address.

D. Arrange for technical instruction of the Owner's maintenance personnel for such time as would be reasonably required to acquaint them with their duties. In addition, deliver to the Owner all special tools or equipment required for making normal adjustments on any equipment or apparatus furnished under this contract heading.

E. Technical instructions involving installed equipment shall include a demonstration of the equipment and/or the operating system(s) with a description of the operation explained to the owner's representatives. It shall be this Contractor's responsibility to arrange this demonstration with the Owner as well as representatives of suppliers. The demonstration shall take place after all testing and balancing and written reports of such work have been submitted to and accepted by the Engineer. The time when the satisfactory completion of this technical instruction and demonstration takes place will establish the date of final acceptance of the system and/or project unless otherwise stipulated.

22. CONTRACTORS' FOREMAN

A. With reference to the work under this section, a competent foreman shall be assigned to the project. The foreman shall remain on the job during all normal working hours until the project is complete and shall be authorized to act as the Contractor's agent in the absence of said Contractor. This foreman shall not be relieved of his duties on the project except by permission or by request of the Engineer.

23. WARRANTIES

A. Provide warranties to the Owner that the materials and equipment furnished are new,

unless otherwise specified, and that all work is of good quality, free from faults and defects and in conformance with the Contract Documents. Unless otherwise specified, all warrants shall extend for a period of 12 months or greater as notedbelow. However, latent defects in materials, equipment or workmanship that are not discovered until sometime during the second year following acceptance, shall remain the contractor's responsibility to correct.

B. Warranties on all work and equipment shall commence on the date of substantial completion of the work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. These warranties and all related documents shall be presented in writing prior to the issuance of any Certificates. Warranties shall include equipment manufacturer's written certificates warranting the equipment furnished complies with all requirements of the drawings and specifications. This documentation shall be submitted in an appropriately marked, 3-ring hard cover binder.

C. If, within one year after the date of substantial completion of the work or within one year after acceptance by the Owner or within such longer period of time as noted above or as may be prescribed by the terms of any applicable special warranty stipulated in the Contract Documents, any portion of the work is found to be defective, functioning improperly, or not in accordance with the Contract Documents, it shall be promptly corrected upon receipt of official notification to do so. This obligation shall survive termination of the contract.

24. PAINTING

A. The following items of painting work shall be included in this Section:

1. Equipment which has been factory finished but where the finish has become marred or rusted, shall be sanded and refinished equal to the original factory finish.

2. All bare metal items or prime painted items installed as a part of this contract which have not received a factory finish (or otherwise treated to prevent rust such as galvanizing) and which is exposed to view when the building is completed shall be given one coat of primer and two coats of a good grade enamel to inhibit corrosion. This shall include such items as hangers, supports, wireways, gutters, etc., which are exposed in mechanical spaces, closets and utility rooms. Color to be grey unless otherwise directed by Engineer and/or Owner.

3. All patched work in the existing building.

25. HOISTS, RIGGING, TRANSPORTATION AND SCAFFOLDING

A. Provide all necessary scaffolding, staging, cribbing, tackle, hoists and rigging to locate the material, equipment, etc. of this section in its proper place on the project. All such temporary work shall be removed from the premises when no longer required.

B. Pay all costs related to the transportation of materials and equipment to the job site. These costs shall be covered in the bid as no additional allowance will be made by the Owner.

C. Scaffolding and hoisting equipment shall comply with requirements of all pertinent Federal, State and Local Laws and Codes.

26. HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for all floor mounted equipment furnished under this section. Unless otherwise detailed, pads shall be nominally 3-1/2" high with edges chamfered 1". Concrete shall be minimum 2500 psi test and all surfaces shall be free of voids and rubbed smooth. Provide at least 2 dowel rods into floor for anchorage. Pad top shall be dead level and shall have a steel trowel finish.

27. EQUIPMENT PREPARATION

A. At the completion of the job, or at such time as a portion of the work is to be turned over to the Owner, thoroughly clean all equipment installed under this section of the work. This includes switchgear, lighting fixtures, wall plates, etc. and involves the removal of all traces of grease, dirt, dust, etc., as well as temporary labels, shipping tags and the like. Equipment shall be turned over in factory inspected condition. See Item PAINTING.

B. Equipment identification, system testing and balancing, etc., shall be as described elsewhere in these specifications.

28. REMOVALS, ALTERATIONS AND REUSE

A. The demolition drawings may not show all existing walls, lighting fixtures, devices, etc. that are to be removed. Investigate the site and review all currently available drawings of the building to evaluate the work necessary to fulfill the requirements of the contract documents.

B. Conduit:

1. All power and system conduit no longer utilized shall be removed and disposed of.

2. Conduit located in the permanent structure or in unaltered parts of the structure shall remain in place.

C. Boxes:

1. Any box located in an advantageous location and in good condition may be utilized in the new system. Close all unused openings in box.

D. Wire:

1. Wire that is removed may not be reused.

2. All wire that is to be installed shall be new.

3. Existing materials, equipment, lighting fixtures, devices, panelboards, conduit and wiring that is removed and not reused shall be disposed of or placed in storage as directed by the Owner's representative.

29. HAZARDOUS MATERIALS

A. This item of the specifications has been inserted to address the potential problem or problems occurring when hazardous materials (asbestos type insulations, Askarel insulation, etc.) are encountered on a project involving work in an existing structure. Since the extent to which hazardous materials may have to be dealt with or whether, in fact, they will even be present on the site cannot always be determined prior to the actual demolition/construction phase of the project, the Contractor under this section of the work shall file a written request for inspection with the proper government agency or authority as described in the following paragraphs.

B. Regarding contract involvement with equipment utilizing Askarel or similar substances that contain PCB (polychlorinatedbiphenyl) formulations:

1. The inspection request shall be filed with the Owner and the Engineer, listing the equipment involved, its location, and other pertinent data such as size/capacity and manufacturer. A decision concerning the course of action to be taken with regard to this equipment will then be made by the Owner and will become a matter of record.

30. WIRE, CABLE AND CONNECTORS

A. All building feeder and branch circuit wiring not specifically shown or necessarily covered by code, shall be type THHN/THWN 600 volt insulation - 75 deg. C copper conductors, complying, with NEC Standards.

B. Any wire size not specifically noted on the plans shall be at least equal in capacity to the rating of the overcurrent device serving the item to be connected and, in addition, shall be sized in accordance with the requirements of Articles 210.19 (a) and 215.2 (b) of the N.E.C. Note that where wire sizes specifically shown on the drawings have ampacity in excess of the protection device rating, those sizes shall be the minimum provided.

C. Wiring run from fixture junction boxes and in fixture wireways shall be 600 volt, 90°C type THHN wire or RHH.

D. Conductors shall not be drawn into a conduit segment until that segment of the conduit system is complete, with all terminations properly bushed and with the conduit free of moisture, foreign material, etc.

E. All connectors and lugs shall be of the solderless type and large enough to enclose

all strands of the conductors with sufficient mechanical strength to withstand vibration and normal strains.

F. All connectors for conductors sized #10 AWG and smaller shall be 3-M SCOTCHLOK, Ideal Wingnut or Buchanan B-Cap's. Connections for conductors sized #8 AWG and larger shall be made with pressure type mechanical connectors and insulated with electrical tape to 150% of the insulating value of the conductor insulation.

G. Joints or splices in branch circuit wiring and feeders must be located as per NEC. All joints and splices shall be made electrically and mechanically sound in accordance with best practice.

H. All parallel runs of conductors shall be cut to equal length and installed accordingly.

I. Note that common neutrals are prohibited. An individual neutral must be provided for each circuit.

J. Low voltage system wiring shall be sized in strict accordance with the individual equipment and/or system manufacturer's specifications and/or recommendations and shall be plenum rated when not run in conduit. In addition, the wire type utilized shall be as recommended by the equipment manufacturer. Note that where code requirements dictate, or where specified, this wiring shall be run in conduit.

31. CIRCUIT AND CONDUCTOR IDENTIFICATION

A. All branch circuit wiring for this work shall be color coded to match existing. If branch circuit wiring for the existing facility is not color coded, consult the Owner regarding desired color coding for this project. Each phase shall be a different color and the phase color shall be the same thruout the project including branch circuiting.

B. All feeders and conductors not color coded shall be identified with permanent, legibly marked, self-sticking labels stating circuit number, voltage, phasing and circuit origination. Labels shall be as manufactured by W. H. Brady Co. or approved equal. Labels made by embossing machines will not be acceptable.

32. CONDUIT AND OUTLET BOXES

A. All wiring to be installed for this project shall be enclosed in rigid or intermediate metal conduit (RMC or IMC) or electrical metallic tubing conduit (EMT).

B. All metal conduit shall be steel and in strict accordance with applicable ANSI standards for steel conduit. Each length shall bear the UL label.

C. Conduit thruout shall be a minimum 3/4" size except for special connections, as detailed, and flexible runouts to fixtures, motors, etc., which may be 3/8".

D. Flexible Conduit Connections:

1. Flexible runouts shall consist of flexible metal conduit made from square

locked or interlocked galvanized steel strip. The maximum allowable length of a flexible runout shall be 6'-0".

2. Flexible connections to lighting fixtures, motor equipment, etc. shall originate from a conduit and junction box network, pull box, or fused disconnect switch. Fixture-to-fixture flexible connections will not be acceptable.

3. Flexible connections to weatherproof lighting fixtures, motors, equipment, etc. or controls mounted on dynamic equipment located in a damp or dusty location or exposed to the weather shall be made with UL listed liquid and vapor tight flexible conduit. Such conduit shall be designed and catalogued for maximum water resistance and shall be used with the appropriate fittings.

E. All conduit runs located below 8 feet in mechanical rooms or open machine shop areas shall be rigid (RMC) or intermediate (IMC). Terminations adjacent to equipment shall tie into flexible runouts. This requirement shall also apply for conduit installed in damp areas or exposed to the weather or that could be subject to mechanical damage.

F. Unless otherwise specified, conduit imbedded in poured concrete shall be PVC. Note that generally, conduit shall not be run in concrete floor slabs except where surface mounted fixtures are indicated, cast-in-place boxes are indicated, or where specifically directed.

G. All conduit installed on the project shall be concealed, wherever possible, unless otherwise noted or indicated on the drawings or unless permission is obtained from the Engineer to run exposed. Where conduit is exposed, it shall be run parallel or perpendicular to the building lines. (See Item MATERIALS AND WORKMANSHIP).

1. Steel set screw type fittings or compression type steel couplings and connectors shall be used with EMT and may be used with IMC.

H. All empty conduit including conduit installed under this section for others, shall be provided with solid steel pull wire or nylon pull cord.

I. Watertight conduit expansion joints, bonding jumpers, etc., shall be provided wherever the construction dictates such devices.

J. Conduit accessories such as outlet boxes, condulets, bends, fittings, etc.,shall be manufactured by Appleton, Steel City, Russell and Stoll, Raco, Crouse Hinds or Midwest.

K. Fixture outlet boxes shall be standard 4" x 4" x 2" deep and shall be octagonal or square with standard fixture studs.

L. All outlet and device boxes shall be flush mounted in areas with finished surfaces. They shall be rigidly attached to the structure by means of steel straps or channels.

Boxes shall be aligned true to building lines. Listed mounting heights and dimensions shall be to the centerline of the box.

33. EXCAVATION AND BACKFILL

A. Provide all required excavation and backfill, unless otherwise indicated, for the work involved under this section. The excavation shall be carried to the proper depth and grade, and shall form a firm, and proper base as required. Required excavation at critical locations shall be performed by hand. Note that prior to performing any excavation at the project site, the Ohio Utilities Protection Services (1-800-362-2764) shall be contacted by the Electrical Contractor in order that all buried lines in the vicinity of this work can be properly located and marked or otherwise identified.

B. Trenches shall be run in straight lines with all loose materials removed. Unless otherwise indicated, the minimum depth of 30" shall be maintained between top of conduit or encasement and finished grade. Note that required excavation at critical locations shall be performed by hand.

C. Remove any interfering trees, stumps, rocks, etc., in the line of excavation. Written approval of the Owner shall be obtained before any tree is removed unless so indicated on drawings. All stumps, rocks and other debris taken from the excavation shall be removed from project site and legally disposed of.

D. Where rock is encountered, it shall be removed using appropriate methods. Where tree roots are encountered, they shall be carefully protected until backfill is complete.

E. Shoring, bracing, barricades, sheathing, etc., shall be provided as necessary to insure the safety of all personnel.

F. Provide and operate pumping equipment as necessary to keep excavation free of water.

G. After installation has been completed, approved where required by inspecting agencies, and accepted by the Architect, the excavation shall be backfilled. Fillshall be made to the required subgrade level as determined by location and the specifications covering site preparation and grading.

H. Backfill shall be accomplished by placing fill in 8" layers and tamping and shall be done when moisture permits proper compaction. The first layer over piping shall be carefully hand tamped. Compaction operations shall be continued until achievement of the following minimum densities:

1. Under paved areas. 95%

2. General sodded lawn areas. 85%

I. Note that these figures are expressed as percentages of maximum dry density as determined by AASHO T99 or other approved method.

J. In all areas, unless designated otherwise, backfill shall consist of grits and fines or

sand. In no case will the use of large rocks or debris be permitted.

K. Remove and legally dispose of surplus excavation and backfill material. In addition, carefully fill and bring to proper grade all backfill areas which may settle before the project guarantee period has expired.

L. Where excavation is necessary in existing pavement, pay all fees and costs of opening street or pavement and all costs of filling and repaving in accordance with requirements of and to the satisfaction of the Municipality, Utility or other entity having jurisdiction.

M. Where excavation is necessary in sodded areas, replace sod as required to match existing. In these areas, the top 6" of compacted backfill shall be with selected topsoil.

34. JUNCTION BOXES AND ACCESS DOORS

A. Junction boxes, other than those furnished integrally with specific items of equipment or described elsewhere in the contract documents, shall be furnished and installed as required and shall be in strict accordance with NEC guidelines. Boxes shall be of minimum 12 ga. galvanized steel and shall have removable covers fastened with flat head countersunk bolts on maximum 8" centers. Note that where construction conditions dictate, junction boxes shall be watertight.

B. Junction boxes shall be labeled to indicate circuits within. Use black permanent markers with minimum 1" letters. Such markers shall be visible from point(s) of accessibility.

C. All boxes shall be installed in accessible locations or shall be provided with a suitable means of access. Where other acceptable means of access is not available, provide approved access doors of the proper size and type to meet accessibility requirements for the equipment involved.

D. Access doors in rated walls and plastered, gypsum board or similar ceilings that are rated shall be fire rated as required. They shall meet NFPA requirements and carry the UL 1-1/2 hour "B" label. Construction shall incorporate a minimum 20 ga. steel insulated panel door, self-latching lock and continuous hinge. These doors shall be factory treated with a rust inhibitor and given a baked enamel primer.

E. Access doors for other plastered surfaces shall be similar to Milcor Style K or L with 16 ga. steel frame and 14 ga. steel panel. A 22 ga. casing bead shall surround the frame and the unit shall be finished similar to the labeled doors.

F. Access doors for all other construction conditions shall be all aluminum with extruded frame. Doors shall have a continuous hinge and flush latch. The units shall have a brush satin finish and shall be of a model suitable for the type of construction in which they are installed.

G. Access doors shall be as manufactured by Acudor, Cierra, Karp, Larsen’s or Milcor.

35. GROUNDING

A. Provide a complete grounding system as required to conform to the latest standards and to comply with all pertinent articles of the N.E.C.

B. Equipment grounding conductors shall be run with the circuit conductors and shall consist of insulated solid or stranded copper conductors. No conduit grounding methods will be permitted.

C. All grounding system connections shall be exothermically welded. Installation shall be made in strict accordance with manufacturer's instructions, utilizing the proper mold, miscellaneous supplies, etc. for each connection. All material used, including mold, weld material, tools and accessories, shall be supplied by one manufacturer. The connection material shall be by Cadweld, Thermoweld, or approved equal.

D. Submit, for review, a written description of the method or methods to be used for grounding and the extent of the standards being implemented, taking into account the necessity for full compliance to applicable codes, ordinances and utility company requirements.

36. SLEEVES AND THIMBLES

A. In general, sleeves thru outside walls shall be of minimum 16 ga. galvanized metal or PVC pipe and shall be large enough to permit packing with picked oakum. The final 3" from the inside and outside faces of the wall shall be caulked with lead or waterproof plastic.

B. Sleeves shall be set for bus duct openings cut in masonry where required to conceal rough or irregular edges or for openings in non-masonry walls, partitions, etc.Sleeves shall be of galvanized sheet metal with flanged ends and shall be securely mounted in place. Voids between masonry and sleeve shall be filled with mortar. Openings between bus duct and structure, wall or sleeve shall be filled with a sealant as described below.

C. Provide thimbles wherever exposed conduit, etc., pass thru interior non-masonry walls, partitions, etc. They shall be telescoping type, made from 22 ga. galvanized sheet metal and of minimum size. Thimble ends shall have cast or stamped metal plates attached thereto. Floor penetrations shall be lined with thimbles extending above the floor line.

D. In all cases where conduit passes between floors, rated walls, and/or rated partitions, the spaces between the structure or sleeve and the penetrating member shall be provided with an approved firestop sealant to produce a fire, smoke, and water barrier. Sealant material and installation shall be as described in Item FIRESTOPPING.

E. Individual inserts (concrete expansion anchors) shall conform to applicable requirements of Federal Specification FF-S-325. Embedment, anchor length and size shall be in accordance with manufacturer's recommendations. Anchors 3/8" thru

3/4" shall be U.L. listed for conduit hangers.

F. Conduit penetrations of walls, floors, etc. in exposed areas shall be provided with escutcheons. They shall have concealed hinge and set screw and shall be securely attached to the conduit. In finished areas, escutcheons shall be polished brass or chrome plated steel. In mechanical or service areas, escutcheons shall be galvanized cast iron. Floor penetrations shall be provided with deep pattern floor plates set flush with the floor and designed to cover the entire sleeve projection. Note: Where required by code considerations, non-metallic sleeves shall be covered by escutcheons.

G. Penetrations thru the roof structure shall be carefully made (see Item CUTTING AND PATCHING) and located in designated areas only. Pitch pockets shall be utilized as required to eliminate any chance of moisture penetration. They shall be made from 16 oz. sheet copper (ASTM B 370, temper H00) and shall extend approximately 4" above the finished roof.

37. FIRESTOPPING

A. Furnish and install the required firestopping as referenced in the item of the specifications covering inserts and sleeves. Materials, installation, etc., shall be as described below. Products shall be as manufactured by Hilti Inc., Specified Technologies Inc. or United States Gypsum Co.

B. Definition:

1. Firestopping is defined as the material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies.

C. Application:

1. Tested firestop systems shall be used for all penetrations for the passage of ductwork and piping through floors, fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

D. Quality Assurance:

1. A manufacturer's direct representative (not distributor or agent) shall be on site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

2. Firestop system installations must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated. In addition, proposed firestop materials and

methods shall conform to applicable governing codes having jurisdiction.

3. For those firestop applications that occur for which no UL tested system is available through any manufacturer, a drawing representing the manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted to local authorities having jurisdiction for review and approval prior to installation. Engineer judgment drawings must follow current requirements set forth by the International Firestop Council.

E. Submittals:

1. Manufacturer's submittals shall include specifications and technical data for each type of material including its composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300. The submittal shall also include material safety data sheets as well as any engineering judgement drawings previously approved by local authorities.

F. Installer Qualifications:

1. The firestop system installer must be certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements as previously stated in Quality Assurance.

G. Requirements:

1. All holes, voids, miscellaneous openings, etc., made by penetrations in floor slabs (above grade) for systems provided under this section shall be completely sealed to insure water tight integrity. Installation of firestopping shall be scheduled after completion of penetrating item installation but prior to covering or concealing of openings.

2. Provide firestopping utilizing components that are compatible with adjacent surfaces, the substrates forming openings, and the items penetrating the firestopping under conditions of service and application as demonstrated by the firestopping manufacturer, based on testing and field experience. Note that materials containing flammable solvents shall not be used.

H. Materials:

1. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each specific application.

2. For penetrations by combustible items (penetrants consumed by high heat and flame) including insulated metal pipe that is PVC jacketed, flexible cable

or cable bundles and plastic pipe (closed piping systems), an Intumescent material is required to maintain fire rating of the assembly penetrated.

3. A firestop system with an "F" rating as determined by UL 1479, ASTM E814 or UL 2079, which is equal to the time rating of the construction being penetrated, must be utilized.

I. Preparation:

1. Surfaces to which firestop materials will be applied shall be examined for detrimental conditions. They shall be free of any substances that may effect proper adhesion.

J. Observe and comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.Installation:

1. Firestop materials shall be installed in accordance with published recommendations listed under the heading "Through-Penetration Firestop Systems" in the UL Fire Resistance Directory. In addition, the manufacturer's instructions for installation of through-penetration materials shall be strictly followed.

2. Consult with the engineer prior to installation of any UL firestop systems that might hamper the performance of fire dampers as they pertains to duct work.

K. Miscellaneous:

1. Sealed penetration areas shall be checked thoroughly to ensure proper installation before concealing or enclosing said areas.

38. WIRING DEVICES AND PLATES

A. All wiring devices shall be furnished in strict accordance with the catalog numbers listed on the drawings and here-in specified.

B. Switches:

1. Light switches shall be flush wall mounted, side and back wired design with ivory toggle. They shall be rated 20 amp - 120/277 volt AC, specification grade. Toggles shall be of high impact thermoplastic such as nylon. The following table lists acceptable manufacturers along with their appropriate catalog numbers for the various switch types.

	Hubbell	P & S	A-H / Cooper	Bryant
1-pole	1221	20AC1 1991	4901	
3-way	1223	20AC3 1993	4903	4901PL
Pilot Lt.	1221PL	20AC1-RPL	2999R	

Illum.	1221ILC	20AC1-ISL	1891IL	4901ILC

C. Receptacles, General:

1. All receptacles shall be flush wall mounted unless otherwise approved. The mounting heights are from centerline of device above finished floor. Standard mounting heights are listed on the legend and non-standard are shown on the plan.

D. Convenience Receptacle, General Purpose:

1. Receptacle shall be a duplex 20 amp, 120 volt, 3 wire grounding type. The face shall be of high impact thermoplastic such as nylon. The strap shall wraparound the device. Ground contacts shall be mounted to the strap. An auto-ground clip shall be provided. The device shall be a Hubbell 5352-I, P & S 5362-I, A-H/Cooper 5735-1, Sierra 1462, or Bryant 5352-I.

E. GFCI Receptacle:

1. This device shall be provided where indicated on the drawings and shall be a Hubbell GF5352-I, P & S 1591-FI, A-H/Cooper GF5342-I, or Bryant GF5262R.

F. Wall Plates:

1. Provide wall plates for each device application. Standard plates shall be smooth thermoplastic such as nylon, Lexan, or glass-reinforced polyester. Unless otherwise indicated, plate color shall match the device color. All materials shall meet appropriate design and test requirements of NEMA-WD1-1974 as well as UL Plates shall be Hubbell series P, Sierra series RP, or approved equal.

2. Weatherproof covers shall be of cast aluminum or stainless steel construction. Use Hubbell WP8M “In-Use Coverplate” or approved equal.

3. Device plates shall have identification as described in item EQUIPMENT IDENTIFICATION.

4. Plates shall be attached by metal screws finished to match plate color.

5. Plates shall be installed in a vertical position, unless otherwise indicated, with an alignment tolerance of 1/32".

39. MECHANICAL EQUIPMENT WIRING

A. Provide all boxes, conduit and wire required to supply power to the items of mechanical equipment which are to be furnished and installed by the various other contractors.

B. All automatic temperature control conduit and wiring for equipment furnished by the control manufacturer as well as interlocks of that equipment will be the responsibility of the HVAC contractor unless otherwise indicated on the drawings.

C. All power ventilators, utility fans and miscellaneous exhaust fans, which are to be furnished and installed by others shall be provided with a disconnect means at the unit as described on the drawings and/or as required by code.

D. All rough-in and final connections shall be made in accordance with shop drawings and wiring diagrams furnished by the equipment supplier and reviewed by the Engineer.

40. MISCELLANEOUS EQUIPMENT CONNECTIONS

A. Various items of computer equipment will be furnished and set in place by others. This equipment, unless otherwise shown on the drawings, will be furnished with necessary electrical plugs, operating and control switches, terminations in an electrical outlet box, or equivalent electrical connector located on the equipment. This Contractor shall furnish power wiring and outlets to these various items of computer equipment.

B. Disconnect switches shall be installed in an accessible location. Switches within finished areas, shall be located in an inconspicuous place. Under-counter installation of disconnect switches is preferred to locations above counter. However, care shall be taken that such switches will be accessible and that their location does not interfere with the installation of equipment.

C. Roughing-in drawings for equipment shall be obtained from the other Contractors, etc. through the Engineer as the time approaches when such equipment is required. (Allow a reasonable period from the time of notice to secure this information.)

41. TEMPORARY SERVICE FOR CONSTRUCTION

A. Utilize existing facilities for temporary power. Coordinate with Owner’s representative prior to use of any existing facilities.

B. Contractors on the project will provide their own electrical cords and plugs up to a capacity of 20 amperes. However, services for larger items of equipment and for welding machines shall be provided, as requested, under this section of the work. Reimbursement will be made by the contractor requesting such service.

C. Upon completion of the project, the disconnecting of all temporary circuits and the removal of all temporary wiring from the permanent system shall be done under this section of the work. The continuation of the warranty for the system, or any part thereof, shall not be affected by the foregoing.

42. MOTOR STARTERS (INDIVIDUAL)

A. Unless otherwise indicated, provide all required fractional horsepower manual

starters. All other starters, controls, etc., pertaining to equipment provided under other sections of the project will be furnished under that section unless otherwise indicated. These other starters, controls, etc. will be turned over to the electrical contractor to be mounted and wired under this section of the work. Note that certain items of mechanical equipment may have starters that are integrally mounted by the manufacturer on or in the equipment. Such equipment will generally have a power/control panel which shall be fed and connected under this section of the work.

B. Manual Motor Controls:

1. Where indicated on the drawings, provide manual motor control units for fractional horsepower, single phase motors unless otherwise noted. They shall be flush mounted in finished areas. Starters shall be similar to Cutler-Hammer type MS with pilot light and thermal overload protection.

2. Starters shall be manufactured by Square D.

43. DISCONNECT SWITCHES

A. Unless otherwise indicated, provide properly sized safety switches for all items of equipment requiring same on the project, and/or required to meet NEC requirements.

B. All switches shall be enclosed, quick-make, quick-break, externally operated, interlocked, heavy duty switches, fused or unfused as indicated on the drawings or as required by applicable codes (building codes, elevator codes, etc.). Switches shall be as manufactured by Square D.

C. All weatherproof disconnect switches shall be NEMA 3R unless noted or specified otherwise.

44. FUSES

A. All switches and other fusible protective devices furnished and installed under this section shall be supplied with the required fuses. They shall be properly sized to protect the equipment served as well as the smallest branch circuit conductor on the load side of the protective device.

B. Fuses shall be current limiting with 200,000 amperes interrupting rating at minimum 250 volts and of the size and type shown on the drawings. All fuses shall be of the same manufacturer.

C. Fuses shall not be shipped installed in electrical equipment or switchgear and shall not be installed until the equipment is ready to be energized.

D. Fuses thru 600 ampere size shall be UL Class RK-1, similar to Buss LPN-RK1, low peak dual element time-delay. They shall have separate overload and short circuit elements and shall incorporate a spring activated trigger type thermal overload element responsive to fuse temperatures exceeding 284º F.

E. A fuse identification label showing type and size shall be placed inside the door of each switch. The label shall indicate fuse type, ampere rating and interrupting rating.

F. Upon completion of the work under this section, furnish the Owner with 1 complete spare set of fuses for each type and size incorporated on the project.

G. Shop drawings on fuses shall include two copies of the appropriate Time Current Curves. In addition, a separate set of bulletins shall be inserted in the fuse cabinet.

H. Fuses shall be as manufactured by Bussman, Shawmut or Littelfuse Power Gard.

I. Refer to the lighting fixture specification for additional fusing required.

45. LIGHTING FIXTURES

A. The lighting fixtures shown on the plans and indicated on the schedule shall be the basis for bidding.

B. Catalog numbers listed in the fixture schedule do not necessarily have complete prefix and suffix designations for the various applications. Therefore, these numbers shall be verified so that the fixtures will be made for the correct ballast voltage and will be supplied with all hangers, plaster frames, end caps, etc., required for a complete installation.

C. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47, Part 15, and comply with NEMA SSL1 “Electronic Drivers for LED Devices, Arrays or Systems.” LED drivers shall have a sound rating of “A”, have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.

D. Fixture runs shall be straight, level and true. Dented or warped fixtures shall be replaced or repaired to original factory condition.

E. Immediately preceding the final inspection, thoroughly clean fixtures, removing all dust, dirt, finger marks, grease, etc. This shall include all lenses, louvers, etc.

46. PANELBOARDS

A. Furnish and install panelboards as shown on the contract drawings and as specified below.

1. The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL.

B. The following information, in the form of shop drawings, shall be submitted to the Engineer:

1. Breaker layout drawing with dimensions indicated and nameplate designation

2. Component list

3. Conduit entry/exit locations

a. Assembly ratings including:

1. Short circuit rating

2. Voltage

3. Continuous current

4. Cable terminal sizes

C. Manufacturers:

1. Panelboards shall be as manufactured by Square D.

D. Ratings:

1. Panelboards rated 240 Vac or less shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

2. Panelboards shall be labeled with a UL short circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the UL series ratings including:

a. Size and type of upstream device

b. Branch devices that can be used

c. UL series short circuit rating

E. Construction:

1. Interiors shall be completely factory assembled with bolt-on devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

2. Trims for lighting and appliance panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi-flush cylinder lock and catch assembly. The locks shall be master keyed cylinder locks, keyed alike and, where required, to the Owner's keying system.

3. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

4. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

5. Main bus bars shall be solid copper, sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

6. Full-size insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

7. Provide copper ground bus, separate from neutral bus, in all panelboards.

47. CHAIN LINK FENCES AND GATES

DESCRIPTION

A. This work consists of all labor, materials, and equipment necessary for furnishing and installing chain link fence, with pre-inserted high-density polyethylene (HDPE) slats, gates and accessories in conformance with the lines, grades, and details as shown.

B. RELATED WORK

1. Finish Grading: Section 31 20 00, EARTH MOVING, and Section 32 90 PLANTING.

C. MANUFACTURER'S QUALIFICATIONS

1. Fence, gates, and accessories shall be products of manufacturers' regularly engaged in manufacturing items of type specified.

D. SUBMITTALS

1. In accordance with Section 12: SHOP DRAWINGS, furnish the following:

a. Manufacturer's Literature and Data: Chain link fencing, gates and all accessories.

b. Manufacturer's Certificates: Zinc-coating complies with complies with specifications.

c. Certification that fence alignment meets requirements of contract documents.

E. APPLICABLE PUBLICATIONS

1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic

designation only.

2. American Society for Testing and Materials (ASTM):

A121-07 .....Metallic Coated Carbon Steel Barbed Wire

A392-07 .....Zinc-Coated Steel Chain-Link Fence Fabric

A817-07 .....Metal-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire

C94/C94M–07.....Ready-Mixed Concrete

F567-07 .....Installation of Chain-Link Fence

F626-(R2003).....Fence Fittings

F900-05 .....Industrial and Commercial Swing Gates

F1043-06 .....Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework

F1083-08 .....Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

3. Federal Specifications (Fed. Spec.):

FF-P-110J.....Padlock, Changeable Combination

PART 2 - PRODUCTS

GENERAL

A. Materials shall conform to ASTM F1083 and ASTM A392 ferrous metals, zinc-coated; and detailed specifications forming the various parts thereto; and other requirements specified herein. Zinc-coat metal members (including fabric, gates, posts, rails, hardware and other ferrous metal items) after fabrication shall be reasonably free of excessive roughness, blisters and sal-ammoniac spots.

B. CHAIN-LINK FABRIC

1. The fence fabric shall be 8’ high, ASTM A392, 6 gauge wire woven in a 2 inch mesh. Top and bottom selvage shall have twisted and barbed finish. Zinc-coating weight shall be 1.2 ounces per square foot.

2. Fabric shall provide 80% (approx.) privacy when installed correctly that results in not being able to see through the fence when you look straight on.

a. Slats should not slip or go behind the knuckle thus causing less privacy and very sloppy looking, non-uniform slats.

b. Slats should be free from an excess of smudge, grease or insertion marks.

c. Slats should fit tight and securely in the mesh without use of staple or stitch.

d. Hand inserted slats are not an “equal to!”

3. The privacy slats, which shall be pre-inserted at the time of manufacturing, shall be double wall, self locking, 1.25” (approx.) wide to provide a tight fit in the fence fabric and provide 80% (approx.) privacy. The slats shall be manufactured from virgin, high-density polyethylene (HDPE) and shall be {choose one} beige, redwood, black, white, royal blue, forest green, gray, dark brown and sky blue (color chart available from the manufacturer on request).

C. POST, FOR GATES AND FENCING

1. ASTM F1083, Grade SK-40A, round, zinc-coated steel. Dimensions and weights of posts shall conform to the tables in the ASTM Specification. Provide post braces and truss rods for each gate, corner, pull or end post. Provide truss rods with turnbuckles or other equivalent provisions for adjustment.

D. TOP RAIL AND BOTTOM RAIL

1. ASTM F1083, Grade SK-40A, round, zinc-coated steel. Dimensions and weights of posts shall conform to the tables in the ASTM Specification; fitted with suitable expansion sleeves and means for securing rail to each gate, corner, and end posts.

E. BOTTOM TENSION WIRE

1. ASTM A817 and ASTM F626, zinc-coated, having minimum coating the same as the fence fabric.

F. ACCESSORIES

1. Accessories as necessary caps, rail and brace ends, wire ties or clips, braces and tension bands, tension bars, truss rods, and miscellaneous accessories conforming to ASTM F626.

G. BARBED WIRE SUPPORT ARMS

1. ASTM F626, single arm type, steel or malleable iron.

H. BARBED WIRE

1. ASTM A121, zinc-coated steel wire and barbs; standard size and construction: 0.099 inch diameter line wire with 0.080 inch diameter, 2-point barbs.

I. GATES

1. ASTM F900, type as shown. Gate framing, bracing, latches, and other hardware zinc-coating weight shall be the same as the FABRIC. Gates less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of the latching arrangement. When required, extend each end member of gate frame sufficiently above the top member or provide three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

J. GATE HARDWARE

1. Manufacturer's standard products, installed complete. The type of hinges shall allow gates to swing through 180 degrees, from closed to open position. Hang and secure gates in such a manner that, when locked, they cannot be lifted off hinges.

2. Provide stops and keepers for all double gates. Latches shall have a plunger-bar arranged to engage the center stop. Arrange latches for locking. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger bar. Keepers shall consist of a mechanical device for securing the free end of the gate when in full open position.

3. Equip gate openings with padlock conforming to Fed Spec FF-P-110H, Type EPC, size 2 inch. Padlocks shall have chains that are securely attached to the gate or gate post. Before padlocks are delivered to project, submit sample to Resident Engineer for approval. Approved sample may be incorporated in work. Key padlock as directed by the Resident Engineer.

K. CONCRETE

1. ASTM C94/C94M, using 3/4 inch maximum-size aggregate, and having minimum compressive strength of 3000 psig at 28 days. Non-shrinking grout shall consist of one part Portland cement to three parts clean, well-graded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

A. INSTALLATION

1. Install fence by properly trained crew, on previously prepared surfaces, to line and grade as shown. Install fence in accordance with ASTM F567 and with the manufacturer's printed installation instructions, except as modified herein or as shown. Maintain all equipment, tools, and machinery while on the project in sufficient quantities and capacities for proper installation of posts, chain links and accessories.

2. A Registered Professional Land Surveyor shall stake out and certify the fence alignment to meet the requirements as shown.

B. EXCAVATION

1. Excavation for concrete-embedded items shall be of the dimensions shown, except in bedrock. If bedrock is encountered before reaching the required depth, continue the excavation to the depth shown or 450 mm (18 inches) into the bedrock, whichever is less, and provide a minimum of 2 inches larger diameter than the outside diameter of the post. Clear loose material from post holes. Grade area around finished concrete footings as shown and dispose of excess earth as directed by the Resident Engineer.

C. POST SETTING

1. Install posts plumb and in alignment. Set post in concrete footings of dimensions as shown, except in bedrock. Thoroughly compact concrete so as it to be free of voids and finished in a slope or dome to divert water running down the post away from the footing. Straight runs between braced posts shall not exceed 500 feet. Install posts in bedrock with a minimum of one inch of non-shrinking grout around each post. Thoroughly work non-shrinking grout into the hole so as to be free of voids and finished in a slope or dome. Cure concrete and grout a minimum of 72 hours before any further work is done on the posts.

D. POST SETTING IN STRUCTURES

1. Install post in retaining walls, curbs, concrete slabs, or similar construction in proper size galvanized pipe sleeves set into the concrete or built into the masonry as shown. Set sleeves plumb and 1/2 inch above the finished structure. Fill space solidly between sleeve and post with non-shrinking grout, molten lead, or sulphur, and finish to divert water running down the post away from the post base.

E. POST CAPS

1. Fit all exposed ends of post with caps. Provide caps that fit snugly and are weathertight. Where top rail is used, provide caps to accommodate the top rail. Install post caps as recommended by the manufacturer and as shown.

F. SUPPORTING ARMS

1. Design supporting arms, when required, to be weathertight. Where top rail is used, provide arms to accommodate the top rail. Install supporting arms as recommended by the manufacturer and as shown.

G. TOP RAILS

1. Install rails before installing chain link fabric. Provide suitable means for securing rail ends to terminal and intermediate post. Top rails shall pass through intermediate post supporting arms or caps as shown. The rails shall have expansion couplings (rail sleeves) spaced as recommended by the manufacturer. Where fence is located on top of a wall, install expansion couplings over expansion joints in wall.

H. TOP AND BOTTOM TENSION WIRE

1. Install and pull taut tension wire before installing the chain-link fabric.

I. ACCESSORIES

1. Supply accessories (posts braces, tension bands, tension bars, truss rods, and miscellaneous accessories), as required and recommended by the manufacturer, to accommodate the installation of a complete fence, with fabric that is taut and attached properly to posts, rails, and tension wire.

J. FABRIC

1. Pull fabric taut and secured with wire ties or clips to the top rail, bottom rail, and tension wire close to both sides of each post and at intervals of not more than 24 inches on centers.

2. Secure fabric to posts using stretcher bars and ties or clips.

K. BARBED WIRE

1. Install barbed wire, when required, on supporting arms above the fence posts. Extend each end member of gate frames sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten to each supporting arm and extended member.

L. GATES

1. Install gates plumb, level, and secure for full opening without interference. Set keepers, stops and other accessories into concrete as required by the manufacturer and as shown. Adjust hardware for smooth operation and lubricate where necessary.

M. REPAIR OF GALVANIZED SURFACES

1. Use galvanized repair compound, stick form, or other method, where

galvanized surfaces need field or shop repair. Repair surfaces in accordance with the manufacturer's printed directions.

N. FINAL CLEAN-UP

2. Remove all debris, rubbish and excess material from the station.

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