

SECTION 23 50 00

SUPPLEMENTARY CONDITIONS FOR MECHANICAL AND ELECTRICAL WORK

PART 1 - GENERAL

1.1 GENERAL

- A. Requirements set forth herein are in addition and shall be considered as complementary to the General and Additional ALL PRIME CONTRACTORS and SUB-CONTRACTORS shall familiarize themselves with said provisions.
- B. It is intent of Drawings and Specifications to call for finished work, tested and ready for operation. All materials, equipment and apparatus shall be new, of highest grade and quality and free from imperfections.
- C. Any apparatus, appliance, material or work not shown on Drawings, but mentioned in Specifications, or vice versa, or any incidental accessories or minor details now shown but necessary to make work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be provided by Contractor without additional cost to Owner.
- D. With submission of Bid, Contractor shall give written notice to Architect of any materials, apparatus or omissions believed to be in violation of laws, ordinances, rules or regulations or authorities having jurisdiction. In absence of such written notice, it is mutually agreed that Contractor shall include cost of providing all systems in accordance with applicable regulations without additional cost to Owner.

1.2 EXAMINATION

- A. Contractor, before submitting Bid, shall examine site, building and existing facilities, Drawings and Specifications, become informed as to State and local codes and laws having jurisdiction, allow for licenses and fees to be paid as directed under the Contract and/or as required by law.
- B. Claims made for extra payment for the following reasons will not be allowed: Unfamiliarity with work to be performed by other trades, existing conditions at job site, local or State laws and codes and minor alterations due to field conditions.

1.3 CONTRACT DOCUMENTS

- A. Drawings and Specifications Drawings accompanying these Specifications are intended to show general arrangement and extent of work to be done. Work in all its details is subject to approval of Architect, whose decision on all points of difference shall be final and binding on Contractor. Any work or materials which are rejected must be immediately replaced by Contractor.
- B. Drawings and Specifications together mutually explain each other and indicate work to be done, and anything appearing in one and not in other shall be as if appearing in both. In case of disagreement between Drawings and Specifications or within either document itself as to better quality, greater quantity or more costly work shall be included in contract price and matter referred to Engineer's attention for decision or adjustment.

1.4 EQUIPMENT LOCATIONS

- A. Location of equipment, outlets, etc., as indicated on Drawings shall be considered as reasonably correct, but it shall be understood that they are subject to modifications as may be found

necessary or desirable at time of installation in order to meet any unforeseen or design conditions. Such changes shall be made by Contractor without additional cost to Owner.

- B. Locations of pipes, ducts, electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route location of each pipe, duct and electrical raceway prior to fabrication.
- C. Offsets, transitions and changes in direction in pipes, ducts and electrical raceways shall be made as required to maintain proper headroom and pitch of sloping lines, whether or not indicated on the Drawings. The Contractor shall provide for all trades, air vents, pull boxes, etc. as required to effect these offsets, transitions and changes in direction.
- D. Architect reserves right to relocate any outlet or equipment to a distance of five feet in any direction from that indicated or described; said changes, if any, will be requested prior to installation and shall be made without additional cost to Owner.

1.5 COOPERATION

- A. The Contractor shall compare the mechanical and electrical Drawings and Specifications with those for other trades and shall report any discrepancies between them to the Engineer and shall obtain from him written instructions for changes necessary in the mechanical and electrical work. The mechanical and electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provision to avoid interference in a manner approved by the Architect. All changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.
- B. Every effort shall be made not to damage, soil or scratch the work of other Contractors.
- C. In case of damage to work or materials of other Contractors, he shall be required to pay for such damage as may be incurred. Architect shall be sole arbitrator in this matter.

1.6 SPACE CONDITIONS

- A. Work shall be confined to space allowed for it. If space is not sufficient, Architect shall be notified. More space shall not be used unless authorized by Architect.

1.7 ACCESSIBILITY

- A. Contractor shall install all work so that all parts required are readily accessible for inspection, operation, maintenance and repair. Minor deviations from Drawings may be made to accomplish this, but changes of magnitude shall not be made without prior written approval from Architect.
- B. The Contractor shall install all mechanical and electrical work to permit removal (without damage to other parts) of coils, heat exchanger bundles, fan shafts and wheel, draw-out circuit breakers, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts, raceways, traps, starters, motors, control components to clear the openings of swinging doors and of access panels.

1.8 ACCESS DOORS

- A. Location: Access doors in building construction through which a man must pass to repair or operate valves and other apparatus will be provided by others. All other required access doors, panels, cabinets, etc. shall be furnished by Contractor requiring same, for access to equipment provided under his Contract. Access doors shall be provided for valves, cleanouts, air vents,

dampers, and for adjustments of apparatus where necessary and required. Access doors shall be installed by General Contractor. Doors must be made at job site so as not to cause delay to other trades.

- B. Type: Access doors shall have angle frame, cold rolled steel, shaped to provide a rabbet on all sides to house door and confine wall. Frames shall be 16 gauge steel, doors 14 gauge to 29" dimension vertical or horizontal and 12 gauge for larger sizes. Hinges shall be concealed type permitting a door swing of 175°. Panels shall have prime coat of gray rust inhibitive paint. Access panels shall be similar to "Milcor" as manufactured by Inland Steel Products Company, Style "K" for plastered surfaces and Style "M" for masonry and tile surfaces. Panels must be available at job site, not to cause delay to other trades.

1.9 DAMAGE

- A. Each Contractor shall protect and leave in perfect condition materials, apparatus, fittings, fixtures and trim in scope of his Contract. Should any items be damaged or broken or workmanship molested, no matter by whom such damage is caused, work must be corrected and damaged items replaced with new units by Contractor at no additional cost to Owner. Work which needs redoing because of damage shall be done by skilled trade which originally performed such work.
- B. Any adjustments between Contractors relative to damage to work or materials shall not be responsibility of Owner, Architect or their representatives.

1.10 LAW ORDINANCES, PERMITS AND FEES

- A. The Contractor shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work, file for necessary approvals with the Town or Village and all other State governmental departments having jurisdiction, obtain all required certificates of inspection for his work and deliver same to the Architect before request for acceptance and final payment for the work.

1.11 CODES AND STANDARDS

- A. Contractor shall include in his Bid any labor, materials, services, apparatus, Drawings (in addition to Contract Documents), necessary to comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In case of difference between building codes, specifications, State laws, local ordinances, industry standards and utility company regulations and Contract Documents, most stringent shall govern. Contractor shall promptly notify Engineer in writing of any such difference.
- C. Noncompliance: Should Contractor perform any work that does not comply with requirements of applicable building codes, State local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting deficiencies.
- D. Applicable codes and standards for material furnished and work installed shall include all State laws, local ordinances, utility company regulations, special requirements of Owner's insurance underwriters, requirements of governmental agencies having jurisdiction, and applicable requirements of following nationally accepted codes and standards:
- E. Codes:
 - International Building Code of New York State
 - International Plumbing Code
 - National Electrical Code
 - International Mechanical Code

- International Fuel Gas Code
 - International Energy Conservation Code
- F. Industry Standards, Codes and Specifications:
- AIEE American Institute of Electrical Engineers
 - ANSI American National Standards Institute
 - ASHRAE American Society of Heating, Refrigeration & Air Conditioning Engineers
 - ASME American Society of Mechanical Engineers
 - ASTM American Society of Testing Materials
 - AWWA American Water Works Association
 - IPCEA Insulated Power Cable Engineers Association
 - NBS National Bureau of Standards
 - NEMA National Electrical Manufacturers Association
 - NFPA National Fire Protection Association
 - NEC National Electrical Code
 - SMACNA Sheet Metal and Air Conditioning National Association
 - UL Underwriters' Laboratories
 - AGA American Gas Association

1.12 DEFINITIONS

- A. The term "Contractor" or "this Contractor" shall be interpreted to mean individual, partnership, or corporation to whom Contract has been awarded.
- B. Whenever the terms "provide" or "provided" are used in the specifications, they shall mean "furnish & install" or "furnished & Installed," "connect" or "connected", "apply" or "applied", "erect" or "erected," "construct" or "constructed," or similar terms, unless otherwise indicated in the specifications.
- C. Words in the singular shall also mean and include the plural wherever the context so indicates, and words in the plural mean the singular wherever the context so indicates.
- D. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated," "scheduled," "detailed," or any other diagrammatic or written reference made on the drawings.
- E. Wherever the terms "material" or "materials" are used in the specifications, they shall mean any "product," "equipment," "device," "assembly" or "item" required under the contract, as indicated by trade or brand name, manufacturer's name, 10 standard specification reference or other description. The terms "approved" or "approval" shall mean the written approval of the Engineer.
- F. The terms "specification" or "specifications" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- G. The terms "directed," "required," "permitted," "ordered," "designated," "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Engineer; the terms "approved," "acceptable," "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Engineer; the terms "necessary," "reasonable," "proper," "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Engineer.

- H. "Piping" includes, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
- I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceiling, embedded in construction or in crawl spaces.
- J. "Exposed" means not installed underground or "concealed" as defined above.
- K. "Invert Elevations" means the inside bottom of pipe.
- L. "Wiring" includes, in addition to wire, all conductors, raceways, boxes, devices, supports, hangers and other accessories relative to such wiring.

1.13 CUTTING AND PATCHING

- A. Contractor must lay out his work in advance to minimize unnecessary cutting and patching.
- B. Cutting and patching of holes in walls, partitions, ceilings and floors and building in of chases, recesses or other openings that may be required shall be done by Contractor requiring same. All such patching and chases shall be finished to match existing adjacent finishes. Provide all new acoustic tile ceilings in areas where such ceilings are disturbed.
- C. Drilling and patching for expansion bolts, hangers, and other supports shall be done by Contractor requiring same, subject to review by Architect.
- D. Openings in masonry walls and floors shall be core drilled or saw cut. No chopping will be permitted. Drilling and cutting shall not affect the structural integrity of the wall or floor.
- E. Pavements, sidewalks, roads and curbs, planted areas, fences and all other site structures shall be cut, patched, repaired and/or replaced as required to permit installation of work of various trades and such cutting, patching, repairing and replacing shall be responsibility of, and paid for by, Contractor under Section of Specifications for trade requiring work. Work shall be done by Contractor normally employed for such work at expense of Contractor requiring same.
- F. Each Contractor shall bear expense of all cutting, patching, repairing or replacing of work of other trades required because of his negligence or tardiness or because of any damage caused by him.

1.14 REMOVALS AND RELOCATIONS

- A. Remove and/or relocate all existing equipment, fixtures, wiring, piping and ductwork not being incorporated into the new design or as required to accommodate Architectural changes. Removals shall be carefully phased so that existing portions of the building continue to be served while the first phase of the new construction takes place. All existing equipment, fixtures, piping, ductwork, wiring not being reused in the new design shall be removed. Protect existing equipment, fixtures piping, ductwork, and wiring which is to remain. Existing equipment which is reused shall be checked for proper operation and cleaned.
- B. Extreme care shall be taken during removal of Mechanical/Electrical facilities so as not to damage architectural facilities.
- C. Where light fixtures are removed, lighting controls and switches not being reused shall also be removed.

- D. Coordinate removals work with that of other trades. Any existing equipment fixtures, piping, ductwork, etc., which is to be reused, shall be so identified to the other Contractors. Should it be damaged or removed, it shall be repaired or replaced. Responsibility for protecting, identifying, storing, repairing and replacing shall be by the Contractor who would normally provide the item.
- E. Removals shall be complete and include all trim, supports and accessories.
- F. Where raceways, piping or ductwork cannot be removed, cap and make safe behind finished construction.
- G. No disruption of existing services will be permitted without prior approval of the Owner.
- H. Wiring and piping for equipment which is to be relocated shall be disconnected, relocated and reconnected.
- I. During the course of removing existing and installation of all new service, equipment, fixtures, piping, ductwork and wiring, no interruption of existing facilities will be permitted without the consent of the Owner. All new wiring, piping, ductwork and equipment shall be installed, connected and made ready for final connections to existing systems before disrupting services. These final connections shall be made with such force as may be required to minimize time of shutdown or discontinuance of existing services. Prior to making final connections to existing services, schedule with Owner exact time and duration of discontinuance of service. A minimum of one (1) week notice shall be given to the Owner and other Contractors of any shutdown of services.
- J. Provide all piping, ductwork, wiring, raceways, equipment, appliances and labor required for temporary connections and bypasses necessary to permit continuous operating with minimum interruption of service.
- K. Disposition of equipment and fixtures being removed shall be reviewed with Owner. Equipment or fixtures which the Owner wishes to retain shall be carefully removed and set aside at a location designated by Owner. All other equipment, fixtures and trim shall be removed from site and properly disposed of.

1.15 USE OF PREMISES

- A. Each Contractor shall perform all work necessary to deliver, store, and protect his material and equipment and shall provide a locker for safe and orderly storing of materials and tools. Location of such locker shall be with approval of Architect. Contractor shall change location thereof when so directed by Architect.
- B. The Contractor shall confine his apparatus, storage of materials and construction operations to the limits indicated by ordinances or permits or as may be directed by the Architect. He/she shall not unreasonably encumber the premises with materials.
- C. In the utilization of ground area, the protection of pavement, curbs, walks, structures, and other permanent improvements shall be installed and maintained.
- D. In storing materials within any structure, or when using structure as a shop, the Contractor shall consult with the Architect and Owner and shall restrict storage to spaces designated for such purposes. The Contractor will be held responsible for repairs, patching or cleaning arising from such use.
- E. Ground storage shall be similarly restricted.
- F. The Contractor shall not trespass or enter upon areas that are noted as being restricted.

- G. Plumbing fixtures shall not be used for emptying water from buckets, pails or other containers. Notwithstanding any approvals or instructions which must be obtained by the Contractor from the Owner in connection with use of premises, the responsibility for the safe working conditions at the site shall be the Contractor's and the or Owner shall not be deemed to have any responsibility or liability in connection therewith.

1.16 CLEANING

- A. Each Contractor shall, while engaged in work, maintain everything used in conjunction therewith in an orderly and clean condition and shall periodically during progress of work, or when directed by Architect, clean up and remove from building rubbish accumulated from his work.
- B. Work areas shall be cleaned on a daily basis. Areas occupied by Owner shall be kept clean at all times.
- C. Before reporting for final inspection, preceding acceptance by Architect, Contractor shall thoroughly clean fixtures, and apparatus of dust, stains, grease, oil, etc., and touch up with enamel or paint any scratched or marred surfaces. Finish of all trim and equipment shall be in perfect condition.

1.17 MANUFACTURER'S REPRESENTATIVE

- A. Each Trade Contractor shall provide, at appropriate time or as directed by Architect, the services of a competent factory-trained Architect of particular manufacturer of equipment or item involved so as to inspect, adjust, and place in proper operating condition any and all items of manufacturer. No additional compensation will be allowed to Contractor for such services.

1.18 SUPERVISION AND LAYOUT

- A. Contractor shall have a competent English speaking, foreperson in charge of his respective work for duration of Contract. Dealings at site will be made with this person only.
- B. Contractor shall not employ on job unfit persons or anyone not skilled in work assigned, nor anyone considered detrimental to best interests of job.
- C. Contractor to supervise the work, lay out the work and do necessary measuring.
- D. All work shall be executed at and from as many different points, at such times and with such force as to meet completion schedules and/or as may be deemed necessary by Architect.

1.19 MATERIALS AND WORKMANSHIP - GENERAL REQUIREMENTS

- A. Guarantees of Performance: Contractor shall be held to have carefully examined and checked Drawings and Specifications before acceptance of Contract, starting any work, or purchasing any materials. Contractor shall inform Engineer of any changes or additions necessary to make possible fulfillment of any guarantees called for by this Specification, failing which, he shall be deemed to have accepted such guarantees and be bound thereby.
- B. Wherever hereinafter guarantees of durability, operating capacity, proper functioning or like are called for, or whenever it is specified that manufacturer shall furnish detail drawings, test certificates or performance curves, supervise installation of his apparatus, test or adjust it after installation, keep it in repair for a stated period, or render other similar services, Contractor will be held responsible for thorough performance or specific services under actual conditions of installation.

- C. Same shall apply in cases where special adjustment or other services are necessary to insure proper and efficient functioning of apparatus, even though not specifically called for. It is intended that entire plant be ready for satisfactory operation, and Contractor is hereby made responsible for this result.
- D. In every case where Contractor's own employees cannot adequately perform above described services, such performance shall be included in the Contract with subcontractors, manufacturers, etc., or else subsequently pay them any additional fees required therefore so that a satisfactory and ready plant will be secured without additional cost to Owner.

1.20 ABBREVIATIONS

- A. The following abbreviations shall apply:

HC - Heating Contractor = Contractor

EC - Electrical Contractor = Sub Contractor

GC - General Contractor = Sub Contractor

1.21 JURISDICTIONAL DISPUTES

- A. Contractor shall assume responsibility for resolving jurisdictional disputes and resolving all claims arising from factory vs. field installation, etc.
- B. Wherever factory mounting, piping or wiring of controls and accessories, etc., are called for, Contractor shall ascertain at time of Bid that all work is in accord with local jurisdiction and shall allow for all costs to comply with. Extras arising out of jurisdictional disputes will not be permitted.

1.22 FOUNDATIONS AND SUPPORTS

- A. All piers, supports, shelving, foundations, anchor bolts, hangers, auxiliary steel, etc., unless specified under other Sections, required by Mechanical or Electrical Contractors for support or hanging of their equipment shall be provided by Contractor requiring same. All such work shall be done by Contractor requiring same. All such work shall be done in a manner approved by Architect.
- B. The anchoring of all equipment to the structure shall comply with all applicable requirements of the local governing codes.
- C. Support and fastening of all mechanical and electrical equipment shall be by the Trade Contractors. All equipment hung from overhead construction shall have weight of equipment distributed by use of structural iron supports, as necessary and approved, substantially fastened to structural support system. any wall-mounted equipment, which cannot be supported from architectural or structural materials shall have its own independent support system furnished by the Contractor. Proposed installation method shall be reviewed by the Architect.

1.23 ESCUTCHEONS

- A. Contractor shall provide escutcheons on pipes wherever they pass through floors, ceilings, walls or partitions.
- B. Escutcheons for pipes passing through outside walls shall be Ritter Pattern and Casting Company No. 1 solid, cast brass, flat type, secured to pipe with a set screw.
- C. Escutcheons for pipes passing through floors shall be Ritter Pattern and Casting Company No. 3A split-hinged, cast brass chromium plated type.

- D. Piping passing through exterior walls, floors below grade, etc., shall be made watertight with caulking compound and pipe sleeves with wall collar located at the center of the wall extending 8" all around the pipe. Collar to be 1/8" thick steel welded to sleeve.

1.24 PAINTING

- A. Painting and touching up shall be responsibility of Contractor installing equipment and/or materials.
- B. Galvanized and Copper Pipe: Uncovered piping shall be cleaned and left unpainted.
- C. Materials not Accessible: Hangers, metal supports, pipe, conduit and miscellaneous equipment, except copper and galvanized, which is above hung ceilings, in chases or areas not accessible when job is completed shall be given a prime coat of paint to prevent rusting or corroding of material.
- D. Exposed Material: Hangers, metal supports, pipe and conduit air handling units, tanks, electric fixture stems and canopies, and all material with exposed metal surfaces shall be finished as described above with prime and final coats of paint. Equipment which has factory enamel finished surfaces which has been slightly scratched or chipped shall be cleaned and at discretion of Engineer shall be touched up with factory paint. Equipment which is more than slightly rusted, scratched or chipped shall at discretion of Engineer be repainted in its entirety with a factory finish.
- E. All underground ductwork, piping and conduits shall be given two (2) coats of asphaltum.
- F. Finish painting of patched and damaged architectural finishes: provide all required preparation of surfaces, priming and finish painting of all patched or damaged areas to match existing adjacent finishes in color, texture and quality of paint.

1.25 EQUIPMENT START-UP AND TESTING

- A. Each Contractor shall furnish services of qualified men thoroughly familiar with job and installed work to operate and make adjustments so that equipment and work furnished under this Contract operates as required.
- B. Contractor shall consult Engineers in their offices during progress of job or in field during field inspections by Engineers regarding changes necessitated by job conditions, explanations of functions of equipment, controls, balancing, operations, etc.
- C. Contractor shall instruct Owner's operating personnel during start up and separate operating tests of each major item of equipment including pumps, boilers, burner, chillers, compressors, fire alarm, etc. During operating tests, Contractor shall prove operation of each item of equipment to satisfaction of Architect.
- D. At least seven (7) days notice of equipment start-up and operating tests shall be given to Architect. See technical sections of these specifications for additional field tests, factory tests and certifications required.

1.26 INSTRUCTIONS AND LITERATURE

- A. Contractor is to thoroughly instruct building custodian or person/persons designated by Owner in proper care and operation of work furnished and installed by him. Contractor shall prepare for use by Owner a detailed brochure of instructions in non-technical terms describing maintenance

and operation of all apparatus, valves, controls, switches, fixtures, etc., furnished and installed by him. Two (2) preliminary copies must be submitted for checking and approval, after which two (2) bound copies of corrected material shall be delivered to Architect for turning over to Owner. Brochures shall contain copies of all finally corrected shop drawings of all equipment.

- B. At completion of instruction period, when Contractor and Owner are satisfied of Owner's knowledge to operate equipment, Contractor shall obtain in writing Owner's acceptance of instructions.

1.27 COORDINATION OF THE WORK

- A. Each Contractor or Sub-Contractor shall coordinate the work with that of the Contractor for General Construction and with Contractors or Sub-Contractors for the other Mechanical and Electrical trades. Work shall be scheduled in accordance with the project schedule so that all of the work will be installed at the proper time without delaying completion of the project.
- B. Each Contractor or Sub-Contractor shall check the Contract Drawings and Specifications for all of the other trades so as to become familiar with the various items of apparatus and equipment, which will be furnished or set under the different Contractors, that require connections or other coordination.
- C. Each Contractor or Sub-Contractor shall furnish to the Contractor for General Construction, detailed advance information regarding all the requirements related to work under other Divisions and/or Sections. Furnish sizes, accurate data, and location of any and all pads, chases, sleeves, and slots through floor slabs, walls, foundation, ceilings, roof, and other special openings required.
- D. Each Contractor or Sub-Contractor shall carefully check space requirements with other Contractors to ensure that piping, conduits, fixtures, equipments, ducts, etc. can be installed in the spaces allotted for same.
- E. Wherever the work of the various Contractors or Sub-Contractors interconnects each Contractor or Sub-Contractor shall provide all information, as required for equipment, to the connecting Contractor or Sub-Contractor so that the connecting Contractor or Sub-Contractor will be able to properly provide all water and drain connections, electrical connections or general construction provisions.
- F. Each Contractor or Sub-Contractor shall check the Architectural Drawings for all ceiling height requirements.
- G. HC shall provide electronic copy of the ductwork shop drawings for trade coordination. Prior to circulating copies of these drawings, HC shall check and update with the latest structural drawings, architectural layouts, ceiling plans and ceiling heights. Each Contractor or Sub-Contractor shall mark up their equipment, piping, fixture, panel and conduit locations on the drawings and return them to the HC, who shall incorporate all information onto final coordination drawings. Coordination meetings shall be held at locations and at frequencies required to accomplish this. After HC has incorporated the data from all trades, a final coordination meeting shall be held where each Contractor or Sub-Contractor shall "sign-off" the coordination drawings. The "sign-off" shall be complete prior to the start of any work.

1.28 CONTRACTORS USE OF ENGINEERS CAD FILE

- A. General: At Contractors written request, copies if engineers CAD files will be provided to Contractor for Contractors use in connection with project, subject to the following conditions:

CADD Indemnification Agreement

At your request, we are furnishing architectural drawings in AutoCAD format for you use. No representation is made by Rogers McCagg Architects as to the accuracy of the data provided in electronic format, or the accuracy of any plots made from these files. Only drawings issued by Rogers McCagg Architects as hard copy shall constitute Construction Document drawings. Use of these files is at the sole risk and liability of the user. Such files are for information and reference only, and are being provided on the condition that _____ indemnifies Tietjen Venegas Consulting Engineers against any claim, liability or expenses, including attorney fees, arising from the use of the CAD file we are furnishing for the project by _____ or any person or entity using these CADD files with _____ knowledge or permission. The user shall verify the contents of the CAD file with the existing conditions.

Accepted by: Signature _____ Date _____

Printed Name & Title

B. The above shall be executed

1.29 RECORD DRAWINGS

- A. Contractor shall prepare and maintain a set of drawings on which a current record of any changes made so that at completion of work a complete record will be shown thereon of actual installation. At completion of work the changes recorded shall be entered on to the electronic file for the drawings by the Contractor and shall be turned over to Owner and shall be certified and notarized to be complete and accurate. Owner shall be provided one USB flash drive and two (2) sets of prints. All electronic drawing files shall be prepared using the latest AutoCad release.

1.30 SHOP DRAWINGS

- A. See individual Sections for items requiring submission of shop drawings or other descriptive materials.
- B. The name of the manufacturer, model, accessories, size, etc. shall be clearly noted.
- C. Contractor shall review shop drawings and materials prior to submission and all shop drawings shall be stamped by the Contractor indicating satisfactory review of same. Any deviations or changes to Contract Documents shall be clearly noted.
- D. Submission shall clearly indicate material and equipment being proposed for the project.
- E. Review of shop drawings by the Architect/Engineer shall not relieve the Contractor of the responsibility of furnishing materials in accordance with the Contract Documents.
- F. Contractor shall be responsible for quantities, physical sizes, electrical characteristics, etc. Any additional costs incurred due to the substitution of equipment (e.g. electrical, structural, etc.) shall be borne by the Contractor making the substitution.

1.31 GUARANTEE AND SERVICE

- A. Guarantee and service the entire installation for a period of one year from the date of substantial completion.
- B. The final acceptance will be made after Contractor has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirement of the drawings and specifications, and has furnished all required certificates of inspection, drawings, instructions and approvals.
- C. Contractor shall, during the period of the guarantee, replace or repair at not cost to the Owner any piece of equipment and/or materials which is found to be defective. The replacement or repair shall be performed the same day of notification in an emergency fashion when notified by the Owner or authorized representative. Contractor shall also repair damage to surrounding work caused by the failure, repair or replacement of defective equipment.
- D. During guarantee period, Contractor shall provide at no additional cost to the Owner, full service and maintenance for all equipment and systems, including all necessary inspections, servicing, lubrication, adjustments, replacements and cleaning necessary to maintain equipment and systems in top working efficiency. Included shall be a minimum of four (4) scheduled service visits for routine and preventive maintenance. Terms of service contract shall be submitted for review.
- E. Response time for emergency service shall be four (4) hours during business hours and six (6) hours on nights, weekends or holidays, and two (2) days for routine servicing.
- F. Refrigeration compressors shall have a factory guarantee including parts and labor for five (5) years total. Certificates shall be turned over to the Owner.
- G. Refer to technical paragraphs for additional guarantee and servicing requirements for specific equipment and systems.

END OF SECTION

SECTION 23 70 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 GENERAL

- A. All work of this Section shall be governed by the requirements of the Conditions of the Contract and the entire Division 1, General Requirements.
- B. Due to the nature of the work and the rigid time schedule required, the utmost cooperation between Contractors must be attained.
- C. Refer to Section 235000 for Supplementary Conditions for Mechanical and Electrical Work, the requirements of which are part of this work.
- D. HC shall visit site to ascertain existing conditions, access available and to take measurements for items related to work.
- E. HC shall provide concrete pads for all plumbing equipment.
- F. HC shall be a firm regularly engaged in the installation of Plumbing systems for a period of at least five (5) years and shall have the licenses and certificates required by local regulations. License/certificate holder shall be an Owner or Officer in the firm and have a minimum of five (5) years employment.
- G. All electrical components shall bear U.L. labels.
- H. HC shall obtain all permits and pay all fees related to his work.
- I. All work shall be in accord with International Mechanical and International Fuel Gas Codes, International Energy Conservation Code, local codes and regulations.
- J. HC shall provide Owner with invoices and other data required for utility rebate.
- K. HC shall become familiar with drawings of other trades and its impact/effect on the HVAC work.
- L. HC shall fire-stop openings around pipes and ducts passing through floors and walls. M.
Refer to Section 235000 for coordination drawing requirements.
- N. The following abbreviations shall apply:
 - HC - Heating Contractor = Contractor
 - EC - Electrical Contractor = Sub Contractor
 - GC - General Contractor = Sub Contractor

1.2 QUALITY ASSURANCE

- A. Requirements given herein may be affected by other related requirements of the project specifications. Correlation of contract requirements is the responsibility of the Contractor.

- B. All Heating, Ventilating and Air Conditioning Work on this project shall be governed by this specification.

1.3 SCOPE OF WORK

- A. HC shall provide all labor, material and appliances required for a complete heating, ventilating and air conditioning installation as shown on Drawings and hereinafter specified, including but not limited to the following principal items:

1. Piping, Fittings, Valves
2. Sheet Metal Work
3. Insulation and Covering
4. Foundations, Supports, Sleeves and Plates
5. Rooftop Units
6. Ducted Split AC System
7. Oil Fired Boilers
8. Wall Heater
9. Circulators
10. Electric Motors, Motor Controllers and Wiring
11. Vibration Isolators
12. Registers, Diffusers, and Grilles
13. Spray Foam Insulation
14. Automatic Temperature Controls
15. Shop Drawings
16. Start-up, Tests and Adjustments
17. Maintenance and Guarantee

1.4 REMOVALS AND RELOCATIONS

- A. Refer to Section 235000.

1.5 WORK IN CONNECTION WITH OTHER TRADES

- A. The following principal items of work will be done under other Sections of these Specifications:

1. Electric Wiring: HC shall furnish motor starters, controls and other electrical equipment as specified and deliver same to EC at job site for installation. EC shall provide all disconnect switches, fuses and wiring.
2. All equipment, trim and controls furnished by others required to be mounted by HC shall be furnished to him for mounting.
3. Responsibility: HC shall be held responsible for correct installation and operating of all material furnished by him under this contract whether or not equipment is installed by him.

1.6 PIPING, FITTINGS, VALVES A.

- A. Piping:

1. Circulating Hot Water, Cold Water Make-Up Piping: Copper tubing, Type "L" hard temper for 2 1/2" and smaller, soldered joints; Schedule 40, ASTM A-53, seamless, black steel; for 3" and larger, welded fittings.

2. As an alternating Uponor straight length PEX-A joint with Uponor Pro Pex expansion fitting may be used for mains and listed Uponor Pex-A tubing joined with Pro Pex expansion fitting may be used for branches. Piping connection to equipment to be Type A Copper.
 3. Piping run underslabs shall be PEX tubing installed with Armaflex insulation. Runs shall be continuous without joints or fittings below the slab.
 4. All solder shall be Silverbrite, lead – free.
 5. Condensate Drain Piping: Copper tubing, Type “M”, hard temper with soldered joints using DWV fittings.
 6. Refrigerant Piping: Type ACR copper tubing with brazed joints.
- B. Fittings:
1. All fittings for black pipe 3” and over shall be weld fittings, Tube Turn, or equal. Flange connections shall be used as indicated on the Drawings and where else required to facilitate removal of equipment, piping, valves or connecting accessories. Flanges shall be 125 lb. C.I. screwed for pipes ½” to 2” and 150 lbs. F.S. welded for pipes 2 ½” and larger. On pipe 1 ½” and smaller, unions may be used in lieu of flanges.
 2. Victaulic fittings with rolled grooves and EDPM seals may be used in lieu of welded fittings.
 3. All fittings for copper tube shall be wrought copper joined using Silverbrite lead-free solder. Unions of brass pattern shall be used as required to facilitate the removal of equipment or accessories in connection with copper tube. Flanges shall be used on connections greater than 2”.
- C. Valves:
1. Provide shut-off valve to isolate each item of equipment for maintenance service and replacement, provide balancing valve or cock to adjust flow.
 2. Valves for pipe sizes of 2 ½” or less shall be Apollo 70-200 or Milwaukee Series 150, for sizes 3” and larger Milwaukee Series C, lug type butterfly valves shall be provided.
 3. Balancing valves shall be of the square head cock type. Provide custodian with at least two operators use with balancing valves. Balancing valves shall be the same size as the adjacent piping.
 4. Check valves shall be of the horizontal swing check type with brass or bronze working parts and removable disc except where lift check valves shall be used on the discharge side of circulating pumps.
 5. Where combination shut off and balancing valves noted on plans, provide a shut-off valve and a Bell & Gossett circuit setter.
 6. Valves for chilled piping to have extended stems to permit installation of full thickness insulation.
- D. Dielectric Fittings:

1. Piping connections between dissimilar metals shall be made with dielectric fittings or insulating fittings to prevent electrolytic corrosion. Dielectric fittings shall be of the screwed union type as manufactured by EPCO.

E. General Piping:

1. Run, arrangement, position, connections, etc., of equipment and materials shown on the Drawings shall be taken as a close approximation to a true position and, while they shall be followed as closely as possible, right is reserved to change locations, etc., to accommodate any condition which might arise during progress of the work without additional compensation to Contractor for such changes.
2. Runs shall be straight and direct, forming right angles or parallel lines with building walls and other pipes, and be neatly and evenly spaced. Offsets will be permitted only where necessary to allow pipes to follow walls.
3. Responsibility for accurately laying out work rests with Contractor. Should interference occur, the Engineer's decision shall be final. Where so shown or required, piping shall be concealed in building walls or above ceilings.
4. Horizontal runs, except where concealed in partitions shall be kept as high as possible and close to walls. Cooperate with other trades that grouped lines will not interfere with each other.
5. Contractor shall take special care in supporting pipe to provide for expansion and venting. Pockets and traps shall be avoided but where required, shall be provided with drains. Provide air vents at all high points.

1.7 IDENTIFICATION OF EQUIPMENT, PIPING AND CONTROLS

- A. All equipment shall be stenciled or labeled with Lamacoid plates screwed thereon which shall indicate system service.
- B. Motor starters shall be provided with Lamacoid plates which indicate system served.
- C. All valves shall be tagged with 2" brass plated tags and chain and a valve chart schedule framed and wall mounted shall be provided where directed.
- D. Piping Identification, Coding and Painting
- E. All piping in Boiler, Fan, Storage and Equipment Rooms and all piping above accessible ceiling shall be coded and identified as herein specified.
- F. Apply color-coded polyvinyl chloride pipe bands identifying pipe contents and direction of flow.
- G. Apply bands on 15' centers on piping in Equipment Rooms and 25' elsewhere on straight runs; at valve locations at point where piping enters and leaves a partitions, wall, floor or ceiling.
- H. Apply bands at exit and entrance points to each vessel, tank or piece of equipment.
- I. Bands widths shall be 8" for pipes up to 10" diameter and 16" wide for larger diameter piping. Letter heights stating service shall be preprinted on band, 3/4" high for 16" bands.
- J. For insulated pipes, apply bands after insulation and painting work has been completed.

- K. Provide ten (10) additional bands of each type for future use by Owner's personnel.
- L. Follow manufacturer's instructions for application procedures using non-combustible materials and contact adhesives.
- M. All piping shall be color coded in full accordance with ANSI 13.1, 1981 Standards. Pipe markers shall be as manufactured by Seton Name Plate Corp., or equivalent.
- N. All piping which is not insulated, tanks and equipment shall be painted. Equipment provided with a factory finished coating shall be cleaned and touched up as necessary. Equipment provided with a factory primer shall be given two (2) coats of enamel paint after installation. Pipe, hangers, support and equipment shall be primed and given two (2) coats of enamel paint. Color for piping and tanks shall be in accordance with ANSI 13.1, 1975 Standard, color of equipment and supports shall be as directed by Architect.

1.8 SHEET METAL WORK

- A. Provide all sheet metal work for all systems shown on Drawings, including all required register boxes, diffuser collars, balancing dampers, fire dampers, and auxiliary work necessary to make the various system complete and ready for satisfactory operations.
- B. Except as noted, all sheet metal for systems shall be fabricated of galvanized steel. Galvanized sheet metal shall be of the best grade. Ducts shall be constructed, braced and reinforced and of a gauge thickness in accordance with SMACNA Duct Manual, latest Edition.
- C. Any duct connections made with holes or open corners shall be opened and redone or soldered tight at the discretion of the Architect. No caulking compound shall be used to cover imperfect workmanship. Panels shall be cross creased for stiffness and supported with braces, ties and angles to prevent buckling.
- D. Double radius turning vanes shall be provided in all square elbows.

1.9 INSULATION AND COVERING

- A. General:
 - 1. Insulate all circulating hot water, piping, ductwork and equipment as herein noted.
 - 2. All insulation work shall be performed under this Section.
 - 3. All joints shall be butted firmly together. All insulation shall be installed in accordance with best practice of the trade and in accordance with manufacturer's recommendations. All workmanship shall be done so as to leave a smooth finish with no raveled edges.
 - 4. Fittings shall be insulated with preformed sections and covered with Zeston fittings.
 - 5. Insulation shall be continuous at hangers and supports.
 - 6. Provide high density insulation inserts under pipe supports and hangers. Shields to be T-2000 Calsil with ASJ jacket by Thermal Pipe Shields.
 - 7. For all piping, end joint strips and overlap seams shall be adhered with a vapor barrier mastic and stapled with outward clinch staples on 4" centers.

8. All insulation materials, adhesives, mastics and jackets assemblies shall be UL rated and classified. Ratings shall not exceed:

Flame	25
Fuel Contributed	50
Smoke Developed	50

- B. Insulate circulating, hot water and cold water make-up piping with 4 lb. per cubic feet density glass fiber with maximum "K" factor of 0.24 at 75°F. mean temperature, with factory applied ASJ vapor barrier jacket.

Thickness: 1" for sizes 1 ½" and smaller
2" for sizes 2" and larger

- C. Refrigerant Piping:

1. Insulate refrigerant lines with 1" thick armaflex. Coat exterior piping with approved UV resistant paint.

- D. Ductwork:

1. Air conditioning, supply and return, make-up air, kitchen hood exhaust and dishwasher exhaust ductwork shall be insulated as herein noted. External insulation may be omitted where air conditioning, supply and return ducts are acoustically lined.

2. External Insulation:

- For concealed ductwork provide fiberglass blanket with FRJ aluminum jacket.
- Blanket shall be wired on, with all joints overlapped, pasted and sealed.
- For ductwork exposed in fan rooms, mechanical rooms, accessible attics and outdoors, provide 3# density rigid fiberglass board with ASJ cover. Install with stick clips and corner beads. Tape all joints, seams and clips.

3. Thickness: Unless otherwise noted, all heating and ventilating and air conditioning ducts and make-up air and dishwasher exhaust duct, shall be insulated to thickness specified. Unless otherwise noted, thickness as follows:

Supply & Return	2" thick
Boiler Breeching	2" thick

- E. Pipe Jacketing

- All heating hot water in Boiler Room to be wrapped with Speed Line PVC, 20 mill color jacketing.
- Hot water supply to be wrapped with red color jacketing.
- Hot water return to be wrapped with purple color jacketing.
- Cold water to be wrapped with blue color jacketing.

1.10 FOUNDATIONS, SUPPORTS, SLEEVES AND PLATES

- A. Unless otherwise noted, HC shall provide all foundations, hangers, and supports for his equipment including piping, air conditioning units, fans, fin pipe radiation and covers, ductwork, etc.

- B. All ductwork, piping, wiring, and equipment shall be hung or supported from structural members only.
- C. Ductwork shall be supported in accord with SMACNA Standards.
- D. Piping:
 - 1. All pipe shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire or perforated metal to support pipes will not be permitted.
 - 2. Spacing of pipe supports shall not exceed 8' for pipes up to 1-1/2" and 10' on all other piping.
 - 3. Finned pipe shall be supported on wall brackets. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.
 - 4. All horizontal pipe, where run overhead or on walls, shall be supported as follows, unless otherwise indicated:
 - a. On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4".
 - 5. All supports shall be fastened to structural members or additional steel supports provided by HC. Where connecting to bar joists, connections shall be made at panel points.
 - 6. Where pipes pass through masonry, concrete walls, foundations, or floors, HC shall set such sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit 1" of insulation to be provided around pipe passing through. HC shall be responsible for exact location of these sleeves.
 - 7. Sleeves shall not be used in any portion of building where use of same would impair strength or construction features of the building. Insert for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeve insert locations shall be thoroughly checked with Architect so as not to conflict with other trades.
 - 8. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.
 - 9. All piping passing from floor or walls to finned pipe enclosure or panel radiators shall be provided with sleeves of same material and finish as adjacent enclosure.
- E. Unless otherwise noted, auxiliary steel supports for support of all mechanical equipment as required for particular applications or as directed and indicated on Drawings shall be by HC. All equipment hung from overhead construction shall have weight or equipment distributed by use of angle or channel iron beams as necessary and approved or substantially fastened to beams used for building structural support.
- F. All operating equipment shall be supported so as to produce the minimum amount of noise transmission.
- G. Provide vibration isolation devices for support of all equipment having moving parts.

- H. Provide curb rails, Pate or equivalent for mounting of roof mounted equipment, condensing units, etc.

1.11 SHOP DRAWINGS

- A. All manufactured and fabricated items shall be submitted for review before installation of same. Submission shall be in form of manufacturer's standard printed sheets, pamphlets or bulletins and shall be clearly indicated thereon as to size, type, etc.
- B. Before fabricating any work, HC shall prepare and submit drawings of all ductwork and complicated piping including coordination of lighting, ceiling grid, structural steel and connections to related equipment showing all dimensions and details of construction and installation. No work is to be fabricated until shop drawings are reviewed. Shop drawings for fan rooms, boiler and equipment rooms shall be 3/8" equal to 1'-0" minimum scale. Shop drawings for ductwork shall be 1/4" equals on foot minimum. Piping, ductwork and equipment shop drawings shall be prepared using AutoCad and electronically submitted.
- C. Review of submission shall mean review of equipment and/or fabrications as to design and performance only. Contractor shall be responsible for scheduling quantities, physical size to suit allowable space, electrical characteristics, etc.
- D. Any additional costs incurred due to substitution of equipment (e.g., electrical, structural, etc.) shall be borne by HC.
- E. The following items require a submission of shop drawings:
 - 1. Piping Materials
 - 2. Ductwork
 - 3. Insulation
 - 4. Hangers and Supports
 - 5. Rooftop Units
 - 6. Circulating Pumps
 - 7. Split System Ducted AC System
 - 8. Boilers
 - 9. Water Heater
 - 10. Diffuser, Registers and Grilles
 - 11. Motor Controls
 - 12. Spray Foam Insulation Materials
 - 13. Automatic Temperature Controls
- F. Refer to Supplementary Conditions for Mechanical and Electrical work, section 235000 for additional requirements and if requesting use of contract drawings for use in preparing shop drawings.

1.12 START-UP, TESTS, ADJUSTMENTS AND INSTRUCTIONS

- A. Unless otherwise specified, all new and altered piping systems shall be hydrostatically tested to 100 psig. Test shall be four (4) hour duration, during which time piping shall show no leaks and during time no sealing of leaks will be permitted.
- B. Refrigerant piping and system shall be pressure tested, purged and after charging, leak tested with an electronic leak detector.
- C. Balancing shall be done by a certified NEBB or AABC balancing firm.

- D. HC shall balance out all systems and submit test reports showing operational data to include the following:
1. Motor power consumption for fans and pumps
 2. Air quantities at each outlet and each inlet
 3. Fan RPM and total air quantities at each unit
 4. Discharge and inlet static pressures at each unit
 5. Pump inlet and discharge pressures
 6. Pump water flow
 7. Water flow for each unit
 8. Motor size and amperage draw for each fan and pump
- E. An allowance of six (6) additional four (4) hour periods shall be provided to rebalance air and/or water flows if found necessary.
- F. HC shall furnish services of a qualified person, thoroughly familiar with job, to operate and make all adjustments so that system and control equipment shall operate as intended. This person shall make adjustments including balancing of water and air systems in cooperation with qualified representative of mechanical equipment manufacturers and temperature control manufacturer. Architect is to be notified when this balancing is to be performed.
- G. When all work is in an acceptable operating condition, Owner shall be furnished with trade literature, parts lists, and operating instructions for all equipment furnished.
- H. As part of the operating and maintenance manual HC shall provide a detailed listing for each item of equipment installed.
- I. As a minimum the listing shall include:
1. Unit type
 2. Unit designation
 3. Unit location
 4. Area or areas served by unit
 5. Starter location
 6. Unit manufacturer
 7. Model number
 8. Scheduled capacity
 9. Electrical, volts, phase, amps
 10. Motor HP
 11. Filter type, quantity and sizes
 12. Belt quantity and model
- J. Roof-mount equipment shall have weatherproof Lamicoid labels listing:
1. Unit number and type
 2. Area served
 3. Filter type, quantity and sizes
 4. Belt quantity and model
- K. Contractor shall furnish a framed set and two sets unframed charts with the number of all critical valves corresponding to 2" brass numbered valve discs chained to these valves to Architect.
- L. Final inspection and review shall be made only after proper completion of all of the above requirements.

1.13 CIRCULATING PUMPS-IN-LINE

- A. Pumps shall be of size and capacity schedule on drawing be Bell & Gossett Series 60 or equivalent.
- B. Pumps shall be In-Line type, close-coupled, single stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections.

1.14 OIL FIRED BOILERS

- A. The boilers shall be a Crown Tobago as scheduled on drawing or equivalent.
 - 1. Boiler to be rugged wet base, cast iron heat exchanger.
 - 2. Energy star with efficiency of 88.2%.
 - 3. Extended 10 year warranty.
 - 4. Multiple boiler controller.
 - 5. New Boiler breeching.

1.15 ROOFTOP UNITS

- A. Schedules for Decentralized HVAC Equipment
 - 1. Decentralized Unitary HVAC Equipment Schedule
 - a. Rooftop unit schedule – refer to drawings.
- B. General
 - 1. Description
 - a. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor for cooling duty and gas combustion for heating duty.
 - b. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
 - c. Unit shall use environmentally sound, Puron refrigerant.
 - d. Unit shall be installed in accordance with the manufacturer's instructions.
 - e. Unit must be selected and installed in compliance with local, state, and federal codes.
 - 2. Quality Assurance
 - a. Unit meets ASHRAE 90.1 minimum efficiency requirements.
 - b. 3-phase units are Energy Star certified.
 - c. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
 - d. Unit shall be designed to conform to ASHRAE 15, 2001.
 - e. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL or ETL-listed and certified under Canadian standards as a total package for safety requirements.
 - f. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - g. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
 - h. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.

- i. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001.
 - j. Roof curb shall be designed to conform to NRCA Standards.
 - k. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
 - l. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
 - m. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
 - n. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
 - o. High Efficient Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007).
3. Delivery, Storage, and Handling
- a. Unit shall be stored and handled per manufacturer's recommendations.
 - b. Lifted by crane requires either shipping top panel or spreader bars.
 - c. Unit shall only be stored or positioned in the upright position.
4. Operating Characteristics
- a. Unit shall be capable of starting and running at 125°F ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at $\pm 10\%$ voltage.
 - b. Compressor with standard controls shall be capable of operation down to 35°F, ambient outdoor temperatures. Accessory low ambient kits shall be available if operation below 35°F, is required. See below for head pressure control package or winter start kit.
 - c. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.
 - d. Unit shall be factory configured for vertical supply & return configurations.
 - e. Unit shall be field convertible from vertical to horizontal airflow on all models. No special kit required on 04-12 models. Supply duct kit required for 14 size model only.
 - f. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.
5. Electrical Requirements
- a. Main power supply voltage, phase, and frequency must match those required by the manufacturer.
6. Unit Cabinet
- a. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.
 - b. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.
 - c. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 or 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the gas heat compartment.
 - d. Base of unit shall have a minimum of four locations for thru-the-base gas and electrical connections (factory installed or field installed), standard.
 - e. Base Rail

1. Unit shall have base rails on a minimum of 3 sides.
 2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
 3. Holes shall be provided in the base rail for moving the rooftop by fork truck.
 4. Base rail shall be a minimum of 16 gauge thickness.
- f. Condensate pan and connections:
1. Shall be an internally sloped condensate drain pan made of a non-corrosive material.
 2. Shall comply with ASHRAE Standard 62.
 3. Shall use a 3/4" -14 NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer's recommendations.
- g. Top panel:
1. Shall be a single piece top panel on 04 thru 12 sizes, two piece on 14 size.
- h. Electrical Connections
1. All unit power wiring shall enter unit cabinet multiple connection, factory-prepared, knockout location.
 2. Thru-the-base capability.
 - a. Standard unit shall have a thru-the-base electrical location using a raised, embossed portion of the unit basepan.
 - b. Factory-approved, water-tight connection method must be used for thru-the-base electrical connections.
 - c. No basepan penetration, other than those authorized by the manufacturer, is permitted.
 - d. Provide factory mounted disconnect switch.
- i. Component access panels
1. Cabinet panels shall be easily removable for servicing.
 2. Unit shall have one factory installed, tool-less, removable, filter access panel.
 3. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have a molded composite handle.
 4. Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.
 5. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
 6. Collars shall be removable and easily replaceable using manufacturer recommended parts.
7. Coils
- a. Standard Aluminum Fin/Copper Tube Coils:
1. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
 2. Evaporator coils shall be leak tested to 150 psig; pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
 3. Condenser coils shall be leak tested to 150 psig; pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

8. Refrigerant Components

- a. Refrigerant circuit shall include the following control, safety, and maintenance features:
 - 1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
 - 2. Refrigerant filter drier - Solid core design.
 - 3. Service gauge connections on suction and discharge lines.
 - 4. Pressure gauge access through a specially designed access port in the top panel of the unit.
- b. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.
 - 1. The plug shall be easy to remove and replace.
 - 2. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
 - 3. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
 - 4. The plug shall be made of a leak proof, UV-resistant, composite material.
- c. Compressors
 - 1. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
 - 2. Models shall be available with single compressor/single stage cooling designs on 04 – 07 sizes models, and 2 compressor/2-stage cooling models on 08 – 14 sizes.
 - 3. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
 - 4. Compressors shall be internally protected from high discharge temperature conditions.
 - 5. Compressors shall be protected from an over-temperature and over-ampereage conditions by an internal, motor overload device.
 - 6. Compressor shall be factory mounted on rubber grommets.
 - 7. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
 - 8. Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

9. Filter Section

- a. Filters access is specified in the unit cabinet section of this specification.
- b. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
- c. Shall consist of factory-installed, low velocity, MERV 13 filters.
- d. Filters shall be standard, commercially available sizes.
- e. Only one size filter per unit is allowed.

10. Evaporator Fan and Motor

- a. Evaporator fan motor:

1. Shall have permanently lubricated bearings.
2. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
3. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.

b. Electric Drive (Direct Drive) X13 – 5 Speed/Torque Evaporator Fan:

1. Multi-speed motor with easy quick adjustment settings.
2. Blower fan shall be double-inlet type with forward-curved blades.
3. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

11. Condenser Fans and Motors

a. Condenser fan motors:

1. Shall be a totally enclosed motor.
2. Shall use permanently lubricated bearings.
3. Shall have inherent thermal overload protection with an automatic reset feature.
4. Shall use a shaft-down design on 04 to 12 models and shaft-up on 14 size with rain shield.

b. Condenser Fans:

1. Shall be a direct-driven propeller type fan.
2. Shall have galvalume blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

12. Special Features and Accessories

a. Staged Air Volume System (SAV) for 2-stage cooling models only:

1. Evaporator fan motor:

- a. Shall have permanently lubricated bearings.
- b. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating.
- c. Shall be Variable Frequency duty and Multi-speed control.
- d. Shall contain motor shaft grounding ring to prevent electrical bearing fluting damage by safely diverting harmful shaft voltages and bearing currents to ground.

b. Variable Frequency Drive (VFD).

1. Shall be installed inside the unit cabinet, mounted, wired and tested.
2. Shall contain Electromagnetic Interference (EMI) frequency protection.
3. Insulated Gate Bi-Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform, allowing for quiet motor operation.
4. Self-diagnostics with fault and power code LED indicator. Field accessory Display Kit available for further diagnostics and special setup applications.
5. RS485 capability standard.
6. Electronic thermal overload protection.
7. 5% swinging chokes for harmonic reduction and improved power factor.
8. All printed circuit boards shall be conformal coated.

- c. Standard Integrated Economizer for single speed units
1. Integrated, gear-driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
 2. Independent modules for vertical or horizontal return configurations shall be available. Vertical return modules shall be available as a factory installed option.
 3. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
 4. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
 5. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
 6. Standard models shall be equipped with low-leakage dampers, not to exceed 2% leakage at 1 in. w.g. pressure differential. Economizer controller on electromechanical units shall be Honeywell W7212 that provides:
 - a. Combined minimum and DCV maximum damper position potentiometers with compressor staging relay.
 - b. Functions with solid state analog enthalpy or dry bulb changeover control sensing.
 - c. Contain LED indicates for:
 - when free cooling is available
 - when module is in DCV mode
 - when exhaust fan contact is closed
 7. Ultra low leak Economizer X system shall be provided with SAV 2-speed Variable Frequency Drive (VFD) systems.
 - a. Maximum damper leakage rate to be equal to or less than 4.0 cfm/sq. ft. at 1.0 in. w.g., meeting or exceeding ASHRAE 90.1 requirements. Economizer controller on electromechanical units shall be Honeywell W7220 that provides:
 - b. 2-line LCD interface screen for setup, configuration and troubleshooting
 - c. On-board fault detection and diagnostics
 - d. Sensor failure loss of communication identification
 - e. Automatic sensor detection
 - f. Capabilities for use with multiple-speed indoor fan systems
 - g. Utilize digital sensors: Dry bulb and Enthalpy
 8. Shall be capable of introducing up to 100% outdoor air.
 9. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air.
 10. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
 11. Dry bulb outdoor air temperature sensor shall be provided as standard. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F. Additional sensor options shall be available as accessories.
 12. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
 13. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy. A remote potentiometer may be used to override the damper setpoint.
 14. Dampers shall be completely closed when the unit is in the unoccupied mode.

15. Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
 16. Compressor lockout sensor shall open at 35°F and close at 50°F.
 17. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
 18. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.
- d. Disconnect switch
1. Provide factory mounted and wired disconnect switch.
- e. Convenience Outlet:
1. Powered convenience outlet
 - a. Outlet shall be powered from main line power to the rooftop unit.
 - b. Outlet shall be powered from line side of disconnect by installing contractor, as required by code.
 - c. Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
 - d. Outlet shall include 15 amp GFI receptacles with independent fuse protection.
 - e. Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer.
 - f. Outlet shall be accessible from outside the unit.
 - g. Outlet shall include a field-installed "Wet in Use" cover.
- f. Propeller Power Exhaust:
1. Power exhaust shall be used in conjunction with an integrated economizer.
 2. Independent modules for vertical or horizontal return configurations shall be available.
 3. Horizontal power exhaust shall be mounted in return ductwork.
 4. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0-100% adjustable setpoint on the economizer control.
- g. Roof Curbs (Vertical):
1. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
 2. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
 3. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
- h. Outdoor Air Enthalpy Sensor:
1. The outdoor air enthalpy sensor shall be used to provide single enthalpy control. When used in conjunction with a return air enthalpy sensor, the unit will provide differential enthalpy control. The sensor allows the unit to determine if outside air is suitable for free cooling.
- i. Return Air Enthalpy Sensor:

1. The return air enthalpy sensor shall be used in conjunction with an outdoor air enthalpy sensor to provide differential enthalpy control.
- j. Indoor Air Quality (CO2) Sensor:
 1. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
 2. The IAQ sensor shall be available in duct mount, wall mount, or wall mount with LED display. The setpoint shall have adjustment capability.
- k. Time Guard
 1. Shall prevent compressor short cycling by providing a 5-minute delay (± 2 minutes) before restarting a compressor after shutdown for any reason.
 2. One device shall be required per compressor.
- l. Hinged Access Panels
 1. Shall provide easy access through integrated quarter turn latches.
 2. Shall be on major panels of – filter, control box, fan motor and compressor
- m. Display Kit for Variable Frequency Drive
 1. Kit allows the ability to access the VFD controller programs to provide special setup capabilities and diagnostics.
 2. Kit contains display module, mounting bracket and communication cable.
 3. Display Kit can be permanently installed in the unit or used on any SAV system VFD controller as needed.
- n. Foil faced insulation
 1. Throughout unit cabinet air stream, non-fibrous and cleanable foil faced insulation is used.
- o. Provide bacnet card for communication with BMS.
- p. Electric Heat
 1. Heater element open coil resistance wire, nickel-chrome alloy, 0.29 inches inside diameter, strung through ceramic insulated mounted or metal frame.
 2. Integral fusing to protection of internal heater circuits. Auto reset thermo limit controls, magnetic heater contactors and terminal block mounted in electric control book.

1.16 DUCTED SPLIT AC SYSTEM

A. Condensing Unit

1. System Description
 - a. Out-door mounted, air-cooled, split-system air conditioner. System as scheduled suitable for ground or rooftop installation. Unit consists of a hermetic compressor, an air-cooled coil, propeller-type condenser fan, and a control box. Unit will discharge supply air upward as shown on contract drawings. Unit will be used in a refrigeration circuit to match up to a cased coil.
2. Quality Assurance

- a. Unit will be rated in accordance with the latest edition of AHRI Standard 210.
 - b. Unit will be certified for capacity and efficiency, and listed in the latest AHRI directory.
 - c. Unit construction will comply with latest edition of ANSI/ASHRAE and with NEC.
 - d. Unit will be constructed in accordance with UL standards and will carry the UL label of approval.
 - e. Unit cabinet will be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500-hr salt spray test.
 - f. Air-cooled condenser coils will leak tested at 150 psig and pressure tested at 450 psig.
 - g. Unit constructed in ISO9001 approved facility.
3. Delivery, Storage, and Handling
- a. Unit will be shipped as single package only and is stored and handled per unit manufacturer's recommendations.
4. Equipment
- a. Factory assembled, single piece, air-cooled air conditioner unit. Contained within the unit enclosure is all factory wiring, piping, controls, compressor, refrigerant charge Puron (R-410A), and special features required prior to field start-up.
5. Unit Cabinet
- a. Unit cabinet will be constructed of galvanized steel, bonderized, and coated with a powder coat paint.
6. Fans
- a. Condenser fan will be direct-drive propeller type, discharging air upward.
 - b. Condenser fan motors will be totally enclosed, 1 phase type with class B insulation and permanently lubricated bearings. Shafts will be corrosion resistant.
 - c. Fan blades will statically and dynamically balanced.
 - d. Condenser fan openings will be equipped with coated steel wire safety guards.
7. Compressor
- a. Compressor will be hermetically sealed.
 - b. Compressor will be mounted on rubber vibration isolators.
8. Condenser Coil
- a. Condenser coil will be air cooled.
 - b. Coil will be constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed.
9. Refrigeration Components
- a. Refrigeration circuit components will include liquid-line shutoff valve with sweat connections, vapor-line shutoff valve with sweat connections, system change of Puron (R-410A) refrigerant, and compressor oil.
 - b. Unit will be equipped with high-pressure switch, low pressure switch and filter drier for Puron refrigerant.
10. Operating Characteristics

- a. Will be as scheduled.

11. Electrical Requirements

- a. Nominal unit electrical characteristics will be 208v, single phase, 60 hz. The unit will be capable of satisfactory operation within voltage limits of 187 v to 229 v.
- b. Unit electrical power will be single point connection.
- c. Control circuit will be 24v.

B. Air Handling Units

1. Unit enclosure shall be insulated with a 1 inch foil faced, high density, R4.2 insulation, and be constructed of prepainted galvanized steel. Large front service access panels shall provide easy access to all components. Unit shall be factory equipped with reusable type filters.
2. Fan shall be forward curved with double inlet, mounted on motor shaft, dynamically and statically balanced. Fan -motor assembly shall be removable for service Blower motor shall be ECM type.
3. Cooling coil shall be constructed with brazed copper tubing with aluminum lanced fins. Coil shall have TXV (thermal expansion valve); refrigerant line fittings that braze connections. Condensate pans shall be equipped with primary and auxiliary drain connections with brass inserts, sloping, with minimal standing water retention. Refrigerant to be used will be R-410a.
4. Blower controls shall include control board with time delay relay, a 5 amp replaceable automotive-type circuit protection fuse, and motor speed tap selection terminal (SPT).
5. Provide cased hot water heating coil for each unit.
6. Cooling control system includes 40-VA control circuit (24 v) transformer, with replaceable 5 amp blade-type auto fuse. Low voltage connections shall be point-to-point "screw terminal" connections.
7. Electrical requirements: 208 volts, single phase, frequency 60 hertz.

1.17 DIFFUSERS, REGISTERS AND GRILLES

- A. Provide where shown on Plans, diffusers, registers and grilles of sizes and types indicated on Drawings. Unless otherwise noted on Plans, units shall be by Price or equivalent.
- B. Catalog numbers and performance data are based on Models scheduled on Drawings. Noise levels of all air terminals shall not exceed those of units specified.
- C. Velocity of air in the breathing zone shall not exceed 50' per minute.
- D. A complete schedule of diffusers, registers and grilles shall be prepared and submitted for review.
- E. Supply-Air Registers shall be extruded aluminum construction of the double deflection type, with opposed blade volume dampers. Volume damper blades shall overlap when closed eliminating any possibility of air leakage. Dampers shall be operated by means of removable key. Provide deflectrols for all supply air registers, wherever registers are shown connected at right angles to branch duct servicing same.

- F. Return-air and Exhaust-Air Registers shall be extruded aluminum construction of the single deflection type, with opposed blade volume dampers and horizontal face bars. Dampers shall be operated by means of removable key.
- G. Supply-Air Diffusers: Shall be extruded aluminum construction of the adjustable pattern throw-type for ceiling or duct installations as required. Diffusers shall have multi-blade volume dampers and air distributing grids, supplied by same manufacturer as the diffuser proper. Volume damper shall be operated from below. Blank off quadrants of diffusers as noted to attain one, two or three-way blow. Furnish with grid for uniform air flow.
- H. Slot Diffusers, provide as schedule and specified on the drawings.
- I. Except where otherwise noted, finish shall be in baked enamel of color selected by the Architect.
- J. All air terminals shall be furnished by the manufacturer with sponge rubber gaskets around the frame periphery to provide an air tight seal against the wall or ceiling into which the air terminal is set. Gaskets shall be no less than 1/4" thick, and shall be securely glued to the inside surface of the frame.

1.18 ELECTRIC MOTORS

- A. High efficiency motors shall be provided with all of the equipment furnished under this section.
- B. Minimum efficiencies for 1800 motors shall be in accord in NEMA MG-1, as follows:

Motor Size	Minimum Rated Efficiency
1 HP	85.5%
1 1/2	86.5
2	86.5
3	89.5
5	89.5
7-1/2	91.0
10	91.7
15	93.0
20	93.0
25	93.6
30	94.1
40	94.1
50	94.5

- C. Fractional horsepower motors shall be high efficiency, permanent split capacitor type.

1.19 ELECTRIC MOTORS, MOTORS CONTROLLERS AND WIRING

- A. HC shall furnish all necessary electrical controls, motor starter, switches, etc., for proper operation of equipment furnished by him under this Contract, and as herein noted.
- B. Separate magnetic starter with phase protection and thermal overload protection shall be used for all motors 1/2 HP and over. For motors 20 HP and above, provide reduced voltage starters.
- C. Starters for three phase equipment to have phase loss protection.
- D. Separate manual starter with thermal overload protection for all motors 1/3 HP and under.
- E. Provide non fused disconnect switches at exhaust fans.

- F. Electric service is 120/208 volt, 3 phase, 4 wire, 60 cycle. All motors 1/2" and under 1/2 HP shall be wired for 120 volt, single phase; motors 1/2 HP and over shall be 208 volt, 3 phase, exceptions as specified.
- G. All starters shall have Hand Off Auto push buttons and pilot lights.
- H. Provide all auxiliary contacts and controls required for interlocks and automatic operation of HVAC equipment as noted under temperature control specifications. Control circuit voltage shall not exceed 120 volts. Provide fused control transformers where required.
- I. HC shall be responsible for the proper electrical connections which will be done by EC and shall supply said EC with all necessary wiring diagrams to complete this installation.

1.20 CLOSED CELL SPRAY FOAM INSULATION

A. General

- 1. Close cell spray form insulation shall be provided for the underside of the roof in the area noted on the drawings.
- 2. Spray foam shall be applied to the full thickness of roof joists and to the wall (6" thick) of the upper ceiling plenum.

B. Product Description

- 1. Icynene ProSeal™ is a low pressure closed cell spray applied polyurethane foam insulation manufactured by Icynene Inc. Icynene ProSeal 200/600™ is a nominal 2.4 lbs/ft³ density, low VOC product allowing for 1 hour job site re-entry and 2 hour job site re-occupancy at applicable ventilation rates.
- 2. Foam material shall be as manufactured by Icynene or equivalent. It is suitable for buildings in accordance with the IRC and the IBC including Type I, II, III, IV and V construction. It delivers high R-value and Class II water vapor permeance required in certain climate zones.

C. Properties of Cured Foam

Characteristic	Test Method	Value
Core Density	ASTM D 1622	2.4 lb/ft³
Color		Cream
Aged Thermal Resistance: at 1" at 2" (Calculated) at 3" (Calculated) at 3 1/2"	ASTM C 518	R-7.1 R-14 R-21 R-25
Air Permeance	ASTM E 2178	0.00151 L/s.m² at 1.4"
Water Vapor Permeance	ASTM E 96	0.97 perm at 1.5"
Water Absorption	ASTM D 2842	0.6%
Dimensional Stability at 7 days (% Volume)	ASTM D 2126	8.9% at 158°F and 97% RH

Compressive Strength	ASTM D 1621	40 lb/in ²
Tensile Strength	ASTM D 1623	41 lb/in ²

D. Burn Characteristics

Surface Burning at 4 inches: Flame Spread Index	ASTM E 84	Class 1
Smoke Development		25 300
Commercial Fire Resistance	NFPA 285	Assembly Passed*
Commercial Fire Resistance	ASTM E 119	1, 2 & 3 Hour Ratings*
DC 315 Thermal Barrier	NFPA 286	> 15 minutes
Wall & Ceiling Application Maximum Thickness	ACC377	Walls - none Ceiling - none
Attic & Crawl Space Walls & Roof Uncoated Thickness	ACC377 Appendix X	Walls - 6" Roof - 8"

*Consult Icynene Proseal Engineering Department for details.

- Icynene ProSeal 200/600™ must be covered with ½" of gypsum board, DC-315 intumescent paint coating @ 24 wet mils or approved thermal barrier.
- Icynene ProSeal 200/600™ is subject to all applicable National/State and County building codes regarding fire prevention. Requirements for Thermal Barrier and Ignition Barrier coverings must be met as per the applicable building code as required by the authority having jurisdiction.
- Icynene ProSeal 200/600™ per ACC377 Appendix X test reporting is approved for use in limited access attics and crawl spaces without an ignition barrier or an intumescent paint coating.

E. Water Vapor Permeance & Absorption

1. Icynene ProSeal 200/600™ is a Class II vapor retarder, at 1 ½" thickness, which reduces the amount of moisture that can diffuse through the insulation.
2. Icynene ProSeal 200/600™ meets FEMA criteria for resisting water absorption.

F. Installation

1. Installation shall be by a Licensed manufacturer trained in its installation.
2. Maximum thickness per pass is 3 inches for first pass only, then 2 inches maximum for additional passes. Wait until first layer cools before applying a second layer/lift over the initial layer/lift.
3. This product is not to be installed within 3" (76 mm) of heat emitting devices or where the temperature is in excess of 180°F (maximum service temperature), as per ASTM C411 or in accordance with applicable codes.
4. Icynene ProSeal 200/600™ has excellent adhesion to a wide variety of substrates include common construction materials.
It can be installed in hot, humid or freezing conditions. Minimum substrate temperature for application is 23°F (-5°C). Surface preparation is generally not necessary.

5. Within seconds, the foaming process is complete.
- G. Handling and Safety
 1. For information on health and Safety, refer to the Spray Polyurethane Foam Alliance Health and Safety guidance documents at [www. spraypolyurethane.com](http://www.spraypolyurethane.com).
- H. Availability
 1. Contact Icynene Inc. at 800-758-7325 or visit our website at www.Icynene.com.
- I. Warranty
 1. WHEN INSTALLED PROPERLY IN ACCORDANCE WITH INSTRUCTIONS, THE COMPANY WARRANTS THAT THE PROPERTIES OF THE PRODUCT MEET PRODUCT SPECIFICATIONS AS OUTLINED IN THIS TECHNICAL DATA SHEET. SAVE AND EXCEPT ANY EXCLUSIONS REFERENCED IN THE WARRANTY.
- 1.21 AUTOMATIC TEMPERATURE CONTROLS
 - A. Provide all labor and material for a complete electric/electronic low voltage system of temperature controls.
 - B. Work shall be complete in all respects, including labor, transformers, materials and necessary services, and shall be installed by competent mechanics regularly employed by the control manufacturer.
 - C. The Sub-Contractor performing this work shall be a prime manufacturer presently engaged in the manufacture of direct digital temperature control systems. Installation shall be by factory-trained personnel regularly employed by the controls manufacturer.
 - D. Control manufacturer shall maintain an adequate stock of spare parts and necessary service personnel locally to maintain and service the systems being installed and/or refurbished.
 - E. Service personnel shall be equipped with the control manufacturer's approved tools, testing and calibrating apparatus necessary to perform the work specified herein.
 - F. Complete control drawings shall be submitted for approval before field installation is started. The drawings shall give a complete description of all control elements complete air and water flow diagrams locating instruments, valves, etc. and show all schematic piping and wiring. In addition, the submittal shall include manufacturer's data sheets on each control component and a sequence of operation.
 - G. All electrical wiring, including but not limited to power, control and miscellaneous conduit, connections, etc., required for the installation and operation of the ATCS, will be furnished and installed by the H.C. All wiring shall be in EMT conduit. Low voltage wiring shall not be run in the same conduit as line voltage wiring. Any wiring exposed in public spaces must be concealed or installed in Wiremold, (finish as per Architect). Provide drawings indicating Wiremold runs for review and approval by Architect/Engineer prior to any installations. All wiring must comply with National, State and Local Codes and comply with the requirements of the ATC manufacturer.
 - H. Installation of Valves and Wells: Automatic temperature control valves, separable wells, and other pipe mounted control devices furnished shall be installed by the H.C.
 - I. Instruction, Service and Adjustment:

1. On completion of job, complete adjust the control system. Instruct Owner's representative on the operation of control system and supply three (3) copies of control operating and instruction and maintenance manuals. Obtain from the Owner's representative a signed receipt that he has received the instruction manuals and complete instruction of the operation of the system.
 2. The control manufacturer shall guarantee the system and provide full service contract (normal and emergency) for a period of one year from the date of substantial completion, at no additional cost to the Owner.
 3. Full service contract shall include emergency service with a response time of four (4) hours during the normal workday and eight (8) hours nights and weekends.
 4. Normal service shall include a minimum of four (4) visits to check systems, calibrate controls, replace any parts and perform preventive maintenance.
 5. A written report of work performed shall be provided to the Owner after each visit.
 6. Service contract shall include all labor, parts and material required to maintain systems in top conditions.
- J. Material Requirements:
1. General: All components shall be of the latest type produced by the control manufacturer.
 2. Thermostats and/or sensors shall be mounted 54" above finished floor, except for corridor and Toilet Room thermostats, which shall be, mounted 84" above finished floor.
 3. All room thermostats shall have covers secured with tamperproof screws and concealed adjustment.
 4. Thermostats to be touch screen WIFI thermostats by Ecobee or approved equal.
- K. Valves:
1. All valves shall be full modulating with spring return, unless otherwise specified. In addition, valves shall be quiet in operation, fail-safe, be equipped with throttling plugs and renewable composition discs, and be capable of operating at varying rates of speed to correspond with the exact dictates of the controller. Valves shall be sized by the Contract Contractor and guaranteed to meet the heating requirements. All valves 2" and smaller shall have flanged connections. Valve body rating shall match service requirements.
 2. Valves shall be suitable for hot water or steam with pressure drop not to exceed 3 psi for water and 1 psi for steam.
 3. Control manufacturer shall review plans and schedules and provide valves with operators of size to permit installation within radiation enclosure.
- L. Dampers: Control dampers shall be substantially built in steel frames fabricated from 2" channel or equivalent. Frames shall be equipped with brass trunnions and bearings

and blade end stops. All damper blades shall be galvanized steel. The maximum blade width shall be 10". Furnish corner braces for all damper frames exceeding a 4 square foot area. Maximum width of any section shall be 48" and the maximum section height shall be 96". Furnish horizontal stiffening for any section exceeding 48" in height. Dampers for outdoor air and exhaust air applications shall be low leakage type and provided with neoprene seals on blade edges and end stops.

M. Damper Motors: Damper motors shall be gear train type with adjustable stroke, spring return and shall be of proper size to meet the power requirements, as determined by control manufacturer.

N. Sequence of Operation

1. General

- a. Occupied/unoccupied setpoints and schedules to be coordinated with owner.
- b. During cooling mode, all compressors to be enabled, heating system including building pumps and valves to be off/closed.
- c. During heating mode (60° or below, adjustable), heating system to be enabled. Condensing units to be off.

2. Rooftop Units

- a. Units shall be controlled by space sensors which shall cycle compressors, modulate economizer and activate heating section to maintain space conditions.
- b. During occupied periods, unit shall run continuously. During unoccupied heating periods, units shall be cycled to maintain reduced space temperature and outdoor air damper shall close. During unoccupied cooling periods units shall be off.
- c. When unit starts on occupied cycle, outside air damper shall open to minimum position. A CO2 sensor in return air duct shall modulate to provide demand controlled ventilation.

3. Split System Air Conditioning Units

- a. Units shall be enabled and indexed occupied/unoccupied by the programmable thermostat.
- b. Outside air damper shall open when space is occupied. Outside air damper to close when space is unoccupied.
- c. Provide CO2 sensors to allow for demand controlled ventilation.
- d. Space sensors to modulate hot water valve and cycle condensing units in steps as required to maintain constant space temperature.
- e. Provide dual enthalpy economizer controls to provide free cooling. Interlock relief louvers dampers with outside air dampers.
- f. Units to be off during unoccupied mode. During unoccupied heating mode, unit to be enabled upon a call from room sensor being served by the unit to maintain reduced space temperatures. Outside air and relief dampers to be closed.

4. Boilers

- a. Boilers to provide outdoor reset control, lead lag operation, automatic back up.
- b. Boilers to be enabled during heating system, 60°F or below (adjustable).

5. Circulators

- a. Boiler pumps to be interlocked with associator boiler.

- b. Building circulators to be enabled during heating mode.
 - c. Provide lead lag and automatic alternation to pumps.
- 6. Perimeter Radiation
 - a. Space sensor to open/close motorized valve to maintain space conditions.
- 7. Freeze and Firestat
 - a. Provide manual reset firestat with remote accessible switches for each air handling unit and rooftop unit.
 - b. Provide manual reset freezestats with remote accessible switches for each air handling unit. Freezestats shall have a minimum length of 20'. Wire to shutdown fan, close outside air damper if temperature is below 40 degrees F (adjustable).
- 8. Fire Alarm shutdown
 - a. Coordinate with EC to shutdown air conditioning units upon activation of the fire alarm system.
- 1.22 ALTERNATES
 - A. Provide a Direct Digital Control (DDC) Building Management System (BMS). System to be by Schneider Electric Eco Struxture or approved equal. System to tie all existing and new equipment schedule on HVAC drawings including rooftop units, boilers, pumps, air handling units, condensing units, exhaust fan, wall and unit heaters, domestic electric water heater including temperature sensor after mixing valve, combustion air dampers. System to include floor plan graphics, scheduling, trending and alarms.
- 1.23 GUARANTEE
 - A. Refer to Section 237000

END OF SECTION