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SECTION 200100 - GENERAL PROVISIONS - MECHANICAL

PART 1 – GENERAL:

1.1 The Advertisement for Bids, Instructions to Bidders, Bidding Requirements, General, Special and Supplementary Conditions, and all other contract documents shall apply to the Contractor's work as well as to each of his Sub-Contractor's work. All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals to any part if for work, services, materials or equipment to be used on or applied to this project are hereby directed to familiarize themselves with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.

1.2 Each Proposer shall also be governed by any unit prices and Addenda insofar as they may affect part of their work or services.

1.3 The work included in this division consists of the furnishing of all labor, equipment, transportation, excavation, backfill, supplies, material, appurtenances and services necessary for the satisfactory installation of the complete and operating Mechanical System(s) indicated or specified in the Contract Documents.

1.4 Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the Mechanical Systems in a substantial manner, in compliance with the requirements stated, implied or intended in the drawings and/or specifications, shall be included as part of this Contract.

1.5 It is not the intent of this section of the specifications to make any Contractor, other than the General Contractor, responsible to the Owner, Architect and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Architect, then to the Engineer. Also, this section of the specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.

1.6 It is the intent of this Contract to deliver to the Owner a new project once work is complete. Although plans and specifications are complete to the extent possible, it shall be the responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials required for the complete installation without additional cost to the Owner.

1.7 In general, and to the extent possible, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owner at least forty-eight (48) hours prior to the interruption of any services (gas, domestic water, heating, etc.). The Owners shall be advised of the exact time that interruption will occur and the length of time the interruption will last. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.

1.8 Definitions and Abbreviations:

1.8.1 Contractor - Any Contractor whether proposing or working independently or under the supervision of a Construction Manager and who installs any type of mechanical work (Controls, Plumbing, HVAC, Sprinkler, Gas Systems, etc.).

1.8.2 Engineer - The Consulting Mechanical-Electrical Engineers either consulting to the Owners, Architect, other Engineers, etc. In this case: CMTA, Inc., Consulting Engineers.

1.8.3 Architect - The Architect of Record for the project.

1.8.4 Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.

1.8.5 Provide - Furnish and install complete, tested and ready for operation.

1.8.6 Install - Receive and place in satisfactory operation.

1.8.7 Indicated - Listed in the Specifications, shown on the Drawings or Addenda thereto.

1.8.8 Typical - Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.

1.8.9 Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owners, etc.

1.8.10 Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.

1.8.11 OSHA - Office of Safety and Health Administration.

1.8.12 KBC - Kentucky Building Code.

1.8.13 The Project - All of the work required under this Contract.

1.8.14 NEC - National Electrical Code.

1.8.15 NFPA - National Fire Protection Association.

1.8.16 ASME - American Society of Mechanical Engineers.

1.8.17 SMACNA - Sheet Metal and Air Conditioning Contractors National Association.

1.8.18 ANSI - American National Standards Institute.

1.8.19 ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.

1.8.20 NEMA - National Electrical Manufacturers Association.

1.8.21 UL - Underwriters Laboratories.

1.8.22 ADA - Americans with Disabilities Act.

1.9 Required Notices: Ten days prior to the submission of a proposal, each proposer shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, Proposers signify that they have included the cost of all required items in the proposal and that the Proposer will be responsible for the safe and satisfactory operation of the entire system.

PART 2 – INTENT:

2.1 It is the intention of the Contract Documents to call for finished work, tested and ready for operation.

2.2 Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.

PART 3 – DRAWINGS AND SPECIFICATIONS:

3.1 The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The drawings are not intended to show every item which may be necessary to complete the systems. All proposers shall anticipate that additional items may be required and submit their bid accordingly.

3.2 The drawings and specifications are intended to supplement each other. No Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Proposer shall request a clarification not less than twelve days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.

3.3 The drawings and specifications shall be considered to be cooperative and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.

3.4 Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. The work shall be coordinated with all other branches of work in such a manner as to cause a minimum of conflict or delay.

3.5 The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.

3.6 Should conflict or overlap (duplication) of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.

3.7 Unless dimensioned, the mechanical drawings only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to insure no conflict with other work.

3.8 Each Proposer shall review all drawings including Architectural, Mechanical, Electrical, Fire Protection, Landscaping, Structural, Surveys, etc., to insure that the work he intends to provide does not encroach a conflict with or affect the work of others in any way. Where such effect does occur it shall be the Proposer's responsibility to satisfactorily eliminate any such encroachment conflict or effect prior to the submission of his proposal. Each Proposer shall in particular insure that there is adequate space to install his equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the proposer and shall be accomplished fully without expense to others and that they are reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to insure adequate spaces.

3.9 Where on the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation

or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.

3.10 Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.

3.11 Where on the Drawings or Addenda the word typical is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.

3.12 Special Note: Always check ceiling heights indicated on Architectural Drawings and Schedules and insure that they may be maintained after all mechanical and electrical equipment is installed. Do not install equipment in the affected area until the conflict is resolved.

PART 4 - EXAMINATION OF SITE AND CONDITIONS:

4.1 Each Proposer shall inform their self of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, above and below grade, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. Each Proposer shall also fully acquaint their self with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of utilities, etc. His proposal shall cover all expenses or disbursements in connection with such matters and conditions. No allowance will be made for lack of knowledge concerning such conditions after bids are accepted.

PART 5 - EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS:

5.1 When any Contractor requests approval of materials and/or equipment of different physical size, weight, capacity, function, color, access, it shall be understood that such substitution, if approved, will be made without additional cost to anyone other than the Contractor requesting the change regardless of changes in connections, space requirements, electrical characteristics, etc. from that indicated, electrical service, etc. In all cases where substitutions affect other trades, the Contractor requesting such substitutions shall advise all such Contractors of the change and shall renumerate them for all necessary changes in their work. Any drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineers does not in any way absolve the Contractor of this responsibility.

5.2 Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; any devices, products, materials, fixtures, forms, or types of construction which, in the judgment of the Engineer, are equivalent to those specified are acceptable, provided the provisions of Paragraph (5.1) immediately preceding are met. Requested substitutions shall be submitted to the Engineer a minimum of ten days prior to bids.

5.3 Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the Engineers.

5.4 Each Proposer shall furnish along with his proposal a list of specified equipment and materials which is to be provided. Where several makes are mentioned in the specifications and the Contractor fails to state which they propose to furnish, the Engineer shall choose any of the makes mentioned without change in price. Inclusion in this list shall not insure that the Engineers will approve shop drawings unless the equipment, materials, etc., submitted in shop drawings are satisfactorily comparable to the items specified and/or indicated.

5.5 Required Notices: Ten days prior to the submission of a proposal, each proposer shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws,

ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, Proposers signify that they have included the cost of all required items in the proposal and that the Proposer will be responsible for the safe and satisfactory operation of the entire system.

PART 6 - SUPERVISION OF WORK:

6.1 The Contractor shall personally supervise the work for which they are responsible or have a competent superintendent, approved by the Engineers, on the work at all times during progress with full authority to act on behalf of the Contractor.

PART 7 - CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.:

7.1 The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, inspections and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, etc. in connection with his work. He shall also file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. He shall also obtain all required certificates of inspection for his work and deliver same to the Engineers before request for acceptance and final payment for the work. Ignorance of Codes, Rules, Regulations, Laws, etc. shall not render the Contractor irresponsible for compliance. The Contractor shall also be versed in all Codes, Rules and Regulations pertinent to his part of the work prior to submission of a proposal.

7.2 The Contractor shall include in their work, without extra cost, any labor, materials, services, apparatus and drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.

7.3 All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.

7.4 All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of, or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable.

7.5 All plumbing work is to be constructed and installed in accordance with applicable codes, plans and specifications which have been approved in their entirety and/or reflect any changes requested by the State Department of Health. Plumbing work shall not commence until such plans are in the possession of the Plumbing Contractor.

7.6 All Heating, Ventilation and Air Conditioning work shall be accomplished in accordance with the Kentucky Building Code (KBC) and amendments thereto, the latest standards recognized by the American Society of Heating, Refrigerating and Air Conditioning and the National Fire Protection Association.

7.7 The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.

7.8 Where minimum code requirements are exceeded in the Design, the Design shall govern.

7.9 The Contractor shall insure that his work is accomplished in accord with the OSHA Standards and that he conducts his work and the work of his personnel in accord with same.

7.10 All work relating to the handicapped shall be in accord with regulations currently enforced by the Department of Housing, Buildings and Construction, State of Kentucky and the American Disabilities Act.

7.11 All work in relation to domestic water systems shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the requirements of the local water utility company.

7.12 All work in relation to the installation of sanitary or storm sewers shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the local agency governing such installations.

7.13 Discharge of any toxic, odorous or otherwise noxious materials into the atmosphere or any system shall be subject to regulations of the Environmental Protection Agency (EPA) and/or the air pollution control commission. If in doubt, contact the State Division.

PART 8 - EQUIPMENT SUPPORT:

8.1 Each piece of equipment, apparatus, piping, or conduit suspended from the ceiling or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform or carrier in accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded by such equipment. Provide any required additional bracing, cross members, angles, support, etc.

PART 9 - DUCT AND PIPE MOUNTING HEIGHTS:

9.1 All exposed or concealed ductwork, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping and ductwork shall, insofar as possible, run perpendicular or parallel to the building structure.

PART 10 - COST BREAKDOWNS (SCHEDULE OF VALUES):

10.1 Within thirty days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.

PART 11 – GUARANTEES AND WARRANTIES:

11.1 The Contractor shall guarantee all equipment, apparatus, materials, and workmanship entering into their Contract to the best of its respective kind and shall replace all parts at his own expense, which are proven defective within the time frame outlined in the General Conditions of the Contract. The effective date of completion of the work shall be the date of the Engineer's Statement of Substantial Completion. Items of equipment which have longer guarantees, as called for in these specifications, shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Engineer shall then submit these warranties, etc. to the Owner. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall not invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period, due to negligence of his operator or other employees. Refer to other sections for any special or extra warranty requirements.

11.2 Provide all warranty certificates to Owner.

PART 12 - CHANGES IN MECHANICAL WORK:

12.1 REFER TO GENERAL AND SPECIAL CONDITIONS.

PART 13 - CLAIMS FOR EXTRA COST:

13.1 REFER TO GENERAL AND SPECIAL CONDITIONS.

PART 14 - SURVEY, MEASUREMENTS AND GRADE:

14.1 The Contractor shall lay out their work and be responsible for all necessary lines, levels, elevations and measurements. The Contractor must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from failure to do so.

14.2 The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

14.3 Should the Contractor discover any discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the contract documents, the Contractor shall promptly notify the Engineer and shall not proceed with this work until the Contractor has received instructions from the Engineer on the disposition of the work.

PART 15 - TEMPORARY USE OF EQUIPMENT:

15.1 The permanent heating and plumbing equipment, when installed, may be used for temporary services, with the consent of the Engineers. Should the permanent systems be used for this purpose the Contractors shall make all temporary connections required at their expense. They shall also make any replacement required due to damage wear and tear, etc., leaving the same in "as new" condition.

15.2 Permission to use the permanent equipment does not relieve the Contractors from the responsibility for any damages to the building construction and/or equipment which might result because of its use.

PART 16 - TEMPORARY SERVICES:

16.1 The Contractor shall arrange any temporary water, electrical and other services which he may require to accomplish his work. Refer also to General and Special Conditions.

PART 17 - RECORD DRAWINGS:

17.1 The Contractor shall insure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to insure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose and deliver to the Engineers upon completion of the work.

17.2 All underground utilities/piping installed as part of this project shall be surveyed by a land surveyor licensed in the State of Kentucky. The survey shall be furnished on a compact disc in AutoCad ".dwg" format and ".pdf" format. Also furnish one mylar copy.

PART 18 - MATERIALS AND WORKMANSHIP:

18.1 All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Proposer shall determine that the materials and/or equipment he proposes to furnish can be brought into the building(s) and installed within the space available. In certain cases, it may be

necessary to remove and replace walls, floors and/or ceilings and this work shall be the responsibility of the Contractor. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of filters, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s). Insure, through coordination that no other Contractor seals off access to space required for equipment materials, etc.

18.2 Materials and equipment, where applicable, shall bear Underwriters' Laboratories label where such a standard has been established.

18.3 Use extreme care in the selection of equipment and its installation to insure that noise and vibration are kept at a minimum. The Engineer's determination shall be final and corrections to such discrepancies shall be made at the cost of the Contractor.

18.4 Each length of pipe, fitting, trap, fixture and device used in the plumbing or drainage systems shall be stamped or indelibly marked with the weight or quality thereof and with the manufacturer's mark or name.

18.5 All equipment shall bear the manufacturer's name and address. All electrically operated equipment shall bear a data plate indicating required horsepower, voltage, phase and ampacity. Pumps shall have a data plate indicating horsepower, static pressure head and flow rate.

PART 19 - COOPERATION AND COORDINATION WITH OTHER TRADES:

19.1 The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.

19.2 Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than ¼" = 1'-0", clearly indicating how his work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. He shall make the necessary changes in his work to correct the condition without extra charge.

19.3 The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

PART 20 - QUALIFICATIONS OF CONTRACTOR/WORKMEN:

20.1 All mechanical contractors bidding this project must have been a licensed company for a minimum of two years to qualify to bid this project. Individual employee experience does not supersede this requirement.

20.2 All mechanical subcontractors bidding the mechanical work must have completed one project of 70% this subcontract cost size and two projects of 50% this subcontract cost size.

20.3 All mechanical work shall be accomplished by qualified workmen competent in the area of work for which they are responsible. Untrained and incompetent workmen, as evidenced by their workmanship, shall be summarily relieved of their responsibilities in areas of incompetency. The Engineer shall reserve the right to determine the quality of workmanship of any workman and unqualified or incompetent workman shall refrain from work in areas not deemed satisfactory. Requests for relief of a workman shall be made through the normal channels of Architect, Contractor, etc.

20.4 All plumbing work shall be accomplished by Journeymen Plumbers under the direct supervision of a Master Plumber as defined and clarified under Kentucky State Plumbing Law Regulations and Code. Proof and Certification may be requested by the Engineer.

20.5 The installation of all Heating, Ventilating and Air-Conditioning Systems (HVAC) by any Contractor, whether in existing or new building construction shall be performed by a Licensed Kentucky Master HVAC Contractor. This includes any Contractor installing HVAC systems, piping and ductwork.

20.6 All sheet metal, insulation and pipe fitting work shall be installed by workmen normally engaged or employed in these respective trades, except where only small amounts of such work are required and are within the competency of workmen directly employed by the Contractor involved.

20.7 All automatic control systems shall be installed by workmen normally engaged or employed in this type work, except in the case of minor control requirements (residential type furnaces, packaged HVAC equipment with integral controls, etc.) in which case, if a competent workman is the employee of this Contractor, he may be utilized subject to review of his qualifications by the Engineer and after written approval from same.

20.8 All special systems (Automatic Sprinkler Equipment, etc.) shall be installed only by workmen normally engaged in such services. Exception to this specification may only be made in writing by the Engineer.

20.9 All electrical work shall be installed pursuant to current State law. (ie. All electrical work shall be installed by licensed electricians).

PART 21 - CONDUCT OF WORKMEN:

21.1 The Contractor shall be responsible for the conduct of all workmen under his supervision. Misconduct on the part of any workman to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens or dehabilitating drugs on the job site is strictly forbidden.

PART 22 - PROTECTION OF EQUIPMENT:

22.1 The Contractor shall be entirely responsible for all material and equipment they furnish in connection with their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All piping, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged stolen or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at their expense.

PART 23 - SCAFFOLDING, RIGGING AND HOISTING:

23.1 The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

PART 24 - BROKEN LINES AND PROTECTION AGAINST FREEZING:

24.1 No conduits, piping, troughs, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. If in doubt, contact the Engineer. Do not install piping across or near openings to the outside whether they are carrying static or moving fluids or not. Special Note: Insulation on piping does not necessarily insure that freezing will not occur.

PART 25 – CLEANING:

25.1 The Contractor shall, at all times, keep the area of their work presentable to the public and clean of rubbish and debris caused by his operations; and at the completion of the work, shall remove all rubbish, debris, all of his tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of his rubbish or debris.

25.2 After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.

25.3 Ductwork and piping shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4” above the floor and shall be completely covered in plastic. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not “dried-in”. If this is required, the entire lengths of duct shall be covered in plastic to protect. The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.

PART 26 - CONCRETE WORK:

26.1 The Contractor shall be finally responsible for the provisions of all concrete work required for the installation of any of his systems or equipment. The Contractor may, at his option, arrange with the others to provide the work. This option, however, will not relieve the Contractor of his responsibilities relative to dimensions, quality of workmanship, locations, etc. In the absence of other concrete specifications, all concrete related to Mechanical work shall be 3500 psi minimum compression strength at 28 days curing and shall conform to the standards of the American Concrete Institute Publication AC1-318. Heavy equipment shall not be set on pads for at least seven (7) days after pour. Insert 6-inch steel dowel rods into floors to anchor pads.

26.2 All concrete pads shall be complete with all pipe sleeves, anchor bolts, reinforcing steel, concrete, etc. as required. Pads larger than 18" in width shall be reinforced with ½" round bars on 6" centers both ways. Bars shall be approximately 3" above the bottom of the pad. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms, all surfaces shall be rubbed to a smooth surface. Chamfer all square edges one-half inch.

26.3 In general, concrete pads for equipment shall extend four (4) inches beyond the equipment's base dimensions. Where necessary, extend pads 30 inches beyond base or overall dimensions to allow walking and servicing space.

26.4 Exterior concrete pads shall be four (4) inches minimum above grade and four (4) inches below grade on a tamped four (4) inch dense grade rock base unless otherwise indicated or specified. Surfaces of all foundations and bases shall have a smooth finish with one-half (½) inch chamfer on exposed edges. Turn down edges 18” below grade.

PART 27 - NOISE, VIBRATION OR OSCILLATION:

27.1 All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound

or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at their expense.

27.2 All equipment subject to vibration and/or oscillation shall be mounted on vibration supports whether indicated or not suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc. by means of flexible connectors, vibration absorbers, or other approved means. Unitary equipment, such as small room heating units, small exhaust fans, etc., shall be rigidly braced and mounted to wall, floor or ceiling as required and tightly gasketed and sealed to mounting surface to prevent air leakage and to obtain quiet operation. Flush and surface mounted equipment such as diffusers, grilles, etc., shall be gasketed and affixed tightly to their mounting surface.

27.3 The Contractor shall provide supports for all equipment they furnish. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineers.

PART 28 – ACCESSIBILITY:

28.1 The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and hung ceilings for the proper installation of his work. He shall cooperate with all others whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.

28.2 The Contractor shall locate and install all equipment so that it may be serviced, and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, etc.

28.3 The Contractor shall provide in the bid access panels for each concealed shut-off valve, motorized control damper, manual air damper or other device requiring service as shown on engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work.

PART 29 - RESTORATION OF NEW OR EXISTING SHRUBS, PAVING, SURFACES, ETC.:

29.1 The Contractor shall at their expense restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item and shall be to the satisfaction of the Owner and/or Engineer.

PART 30 - MAINTENANCE OF EXISTING UTILITIES AND LINES:

30.1 The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that comes within the contract construction site, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily.

30.2 Utilities and lines, where known, are indicated on the drawings. Locations and sizes are approximate. Prior to any excavation being performed, the Contractor shall ascertain that no utilities or lines are endangered by new excavation. Exercise extreme caution in all excavation work.

30.3 If utilities or lines occur in the earth within the construction site, the Contractor shall probe and locate the lines prior to machine excavation or blasting in the respective area.

30.4 Cutting into existing utilities and services where required shall be done in coordination with and only at times designated by the Owner of the utility.

30.5 The Contractor shall repair to the satisfaction of the Owner and Engineer, any surfaces or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.

30.6 Machine excavation shall not be permitted with ten feet of electrical lines or lines carrying combustible and/or explosive materials. Hand excavate only.

30.7 Protect all new or existing lines from damage by traffic, etc. during construction. Repairs or replacement of such damage shall be at the sole expense of the party responsible.

PART 31 – WEATHERPROOFING:

31.1 Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.

PART 32 - FINAL CONNECTIONS TO EQUIPMENT:

32.1 The Contractor shall finally connect to mechanical services (water, gas, air), any terminal equipment, appliances, etc., provided under this and other divisions of the work. Such connections shall be made in strict accord with current codes, safety regulations and the equipment manufacturer's recommendations. If in doubt, contact the Engineers prior to installation.

PART 33 - REQUIRED CLEARANCE FOR ELECTRICAL EQUIPMENT:

33.1 The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, ductwork, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost.

PART 34 – INDEMNIFICATION:

34.1 The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

PART 35 - HAZARDOUS MATERIALS:

35.1 Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, insure that his workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.

35.2 CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.

35.3 If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise them immediately.

35.4 The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

35.5 No asbestos or mercury containing materials shall be installed in this project.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 200200 - SCOPE OF THE MECHANICAL WORK

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS – MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 The Mechanical work for this Contract shall include all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to the Owner the complete mechanical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not necessarily limited to the following:

1.3 Complete domestic water service to 5’-0” beyond building footprint. Refer to Civil Drawings/Specifications for additional requirements.

1.4 Complete sanitary sewer service to 5’-0” beyond building footprint. Refer to Civil Drawings/Specifications for additional requirements.

1.5 Interior domestic hot, cold and recirculating hot water system.

1.6 Interior soil, waste and vent systems.

1.7 All plumbing equipment, fixtures and fittings.

1.8 All mechanical exhaust systems.

1.9 All insulation associated with mechanical systems.

1.10 Complete heating and ventilation systems.

1.11 All required pressure testing, flushing, purging, pressure and flow testing requirements.

1.12 Final coordination and connection of all mechanical equipment furnished by others (e.g., kitchen equipment).

1.13 All required controls, including self checkout and commissioning.

1.14 All applicable services and work specified in GENERAL PROVISIONS - MECHANICAL.

1.15 Provide all required motor starters, etc. not provided under the electrical sections.

1.16 Thorough instruction of the owner’s maintenance personnel in the operation and maintenance of all mechanical equipment.

1.17 Thorough coordination of the installation of all piping, equipment and any other material with other trades to insure that no conflict in installation.

1.18 Approved supervision of the mechanical work.

1.19 Procurement of all required inspections, including fees for all inspection services and submission of final certificates of inspection to the Engineers (Plumbing, etc.).

1.20 Excavation, backfilling, cutting, patching, sleeving, concrete work, etc., required to construct the mechanical systems.

1.21 Equipment and controls start-up, verification and documentation as specified.

1.22 Record drawings, final inspection certificates, test results, O & M documentation, warranty certification, spare parts and other specified closeout documentation.

1.23 Required schedule of values breakdown.

1.24 Pipe, duct and equipment identifications.

1.25 Pre-installation meetings and equipment mockups.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 200300 - REQUIRED SHOP DRAWINGS, DESCRIPTIVE LITERATURE, MAINTENANCE MANUALS, PARTS LISTS, SPECIAL KEYS & TOOLS

PART 1 – GENERAL:

1.1 The Contractor's attention is directed also to Section 013305-Submital Procedures for submittal process and requirements.

1.2 Each shop drawing and/or manufacturers descriptive literature shall have the proper notation indicated on it and shall be clearly referenced to the specifications, schedules, fixture numbers, etc., so that the Engineer may readily determine what the Contractor proposes to furnish. All data and information schedules indicated or specified shall be noted on each copy of each submittal.

1.3 Submittal data shall include specification data including metal gauges, finishes, accessories, etc. Also, the submittal data shall include certified performance data, wiring diagrams, dimensional data, and a spare parts list. Submittal data shall be reviewed by the Engineer before any equipment or materials is ordered or any work is begun in the area requiring the equipment.

1.4 All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the General Contractor and the Architect to show that the drawings have been reviewed by the Contractor. Any drawings submitted without these stamps of approval may not be considered and will be returned for proper resubmission.

1.5 It shall be noted that review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.

1.6 The Engineers review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for: adaptability of the item to the project; compliance with applicable codes, rules, regulations and information that pertains to fabrication and installation; dimensions and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project.

1.7 Equipment shall not be ordered and no final rough-in connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractor. It shall be the Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. The Contractor shall coordinate with all the other trades having any connections, roughing-in, etc. to the equipment.

1.8 If the Contractor fails to comply with the requirements set forth above, the Engineer shall have the option of selecting any or all items listed in the Specifications or on the drawings; and the Contractor shall be required to furnish all materials in accordance with this list.

1.9 Colors for equipment in other than mechanical spaces shall be selected from the Manufacturer's standard and factory optional colors. Color samples shall be furnished with the shop drawing submission for such equipment.

1.10 Shop Drawing Submittals

1.10.1 All submittals for HVAC equipment shall include all information specified. This shall include air and water pressure drops, RPM, noise data, face velocities, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.

1.10.2 All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule.

1.10.3 All items submitted shall be designated with the same identifying tag as specified on each sheet.

1.10.4 Any submittals received in an unorganized manner without options listed and with incomplete data will be returned for resubmittal.

PART 2 - SHOP DRAWINGS:

2.1 Shop Drawings, descriptive literature, technical data and required schedules shall be submitted on the following:

	Plumbing Fixtures, Fittings and Trim
(2.2.1)	Plumbing Equipment
	Floor Drains
(2.2.1)	Electric Heaters
(2.2.2&2.2.1)	Controls
	Louvers
	Ductwork Accessories (Dampers, Sealant, etc.)
	Insulation
(2.2.1)	Exhaust Fans

2.2 Special Notes:

2.2.1 Upon substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item marked (1) above. These documents shall include at least:

2.2.1.1 Detailed operating instructions
2.2.1.2 Detailed maintenance instructions including preventive maintenance schedules.
2.2.1.3 Addresses and phone numbers indicating where parts may be purchased.
2.2.1.4 Expanded parts drawings, parts lists, service manuals, schematics, wiring diagrams.

2.2.2 Shop drawings for the Control Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system.

PART 3 - SPECIAL WRENCHES, TOOLS, ETC.:

3.1 The Contractor shall furnish, along with equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed under the Contract. Wrenches shall include necessary keys, handles and operators for valves, cocks, hydrants, etc. A reasonable number of each shall be furnished. Provide the following minimally:

3.1.1 Two (2) wall hydrant keys per hose bibb (HB or freezefproof wall hydrant (FPWH).

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 201100 - SLEEVING, CUTTING, PATCHING, FIRESTOPPING AND REPAIRING

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 The Contractor shall be responsible for all openings, sleeves, trenches, etc., that he may require in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the Construction Manager and all other trades. Coordinate with the General Contractor, any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the Contractor.

1.3 The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, ductwork, conduit, etc., to go through; however, when this is not done, the Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Engineer. Any damage caused to the buildings by the workmen of the responsible Contractor must be corrected or rectified by him at is own expense.

1.4 The Contractor shall notify other trades in due time where he will require openings or chases in new concrete or masonry. He shall set all concrete inserts and sleeves for his work. Failing to do this, he shall cut openings for his work and patch same as required at his own expense.

1.5 The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly made good to the satisfaction of the Engineer.

1.6 All work improperly done or not done at all as required by the Mechanical Trades in this section, will be performed by the Construction Manager at the direction of the Contractor whose work is affected. The cost of this work shall be paid for by the Contractor responsible.

PART 2 – SLEEVES:

2.1 Cast iron or Schedule 40 (minimum) steel sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking between pipe and sleeve for water proofing.

2.2 In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation.

2.3 Horizontal sleeves passing through exterior walls or where there is a possibility of water leakage and damage shall be caulked watertight. Vertical sleeves in roofs shall be flashed and counterflashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed.

2.4 Where sleeves pass through roof construction, sleeves shall extend minimum of 8" above the roof. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated.

2.5 Openings thru structural slabs shall be accomplished by means of sleeves. (No drilling will be allowed in structural slabs). In waffle, pre-cast or pan joist construction, openings may be made by means of diamond

(core) drilling or as otherwise approved by the Engineers.

PART 3 – CUTTING:

3.1 All rectangular or special shaped openings in plaster, stucco or similar materials, including gypsum board, shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirement is to provide smooth even termination of wall, floor and ceiling finishes as well as to provide a fastening means for grilles, diffusers, lighting fixtures, etc.

3.2 The Mechanical Contractor shall coordinate all openings in masonry walls with the Construction Manager; and, unless otherwise indicated on the Architectural drawings, shall provide lintels for all openings required for the mechanical work (Louvers, wall boxes, exhaust fans, etc.). Lintels shall be sized as follows:

3.2.1 New Openings under 48" in width: Provide one 3½"x3½"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on either side.

3.2.2 New Openings over 48" in width: Consult the Project Structural Engineer.

3.3 No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.

3.4 Pipe openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.

PART 4 - PATCHING AND REPAIRING:

4.1 Patching and repairing made necessary by work performed under this division shall be included as a part of the work and shall be done by skilled mechanics of the trade or trades for work cut or damaged, in strict accordance with the provisions herein before specified for work of like type to match adjacent surfaces and in a manner acceptable to the Engineer.

4.2 Where portions of existing lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced to the satisfaction of the Engineer.

4.3 Where the installation of conduit, ducts, piping, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, duct, pipe, etc., shall be tightly filled with an approved non-combustible fire insulating material satisfactory to maintain the rating integrity of the wall, floor or ceilings affected.

4.4 Where the installation of ductwork requires the penetration of non-rated floors, the space around the duct or pipe shall be tightly filled with an approved non-combustible material.

4.5 Where ducts penetrate fire rated assemblies, fire dampers shall be provided with an appropriate access door.

4.6 Piping passing through floors, ceilings and walls in finished areas, unless otherwise specified, shall be fitted with chrome plated brass escutcheons of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the pipe around which it is installed.

4.7 Stainless steel collars shall be provided around all ducts, flues, breechings, large pipes, etc. at all wall penetrations; both sides.

PART 5 - FIRESTOPPING MATERIALS:

5.1 All mechanical pipes and ducts penetrating fire rated floors and walls must be firestopped. Firestopping

assembly must be UL listed.

5.2 Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type. (i.e., one hour fire rated gypsum wall board with insulated metal pipe penetration.)

5.3 3M fire protection products are listed below. Approved manufacturers: 3M, Meta Caulk Hilti, STI. Equivalent products may be submitted if they are UL listed.

5.4 The manufacturer of the firestopping materials must provide on site training for the Contractor. The training session shall demonstrate to the contractors the proper installation techniques for all the firestopping materials. The training session shall be four hours minimum. Contact the Engineer prior to conducting this training session.

5.5 Firestopping materials to include but not limited to the following:

5.5.1 3M fire barrier FS-195 wrap/strip.

5.5.2 3M fire barrier CP 25 caulk.

5.5.3 3M fire barrier MP moldable putty.

5.5.4 3M fire barrier RC-1 restricting collar with steel hose clamp.

5.5.5 3M fire barrier damming materials.

5.5.6 3M fire barrier CS-195 composite sheet.

5.5.7 3M fire barrier fire dam 150 caulk.

5.5.8 Steel sleeves.

PART 6 - INSTALLATION REQUIREMENTS OF FIRESTOPPING MATERIALS:

6.1 The following indicates the 3M penetration detail for uninsulated pipe penetration of various wall and floor construction types:

6.1.1 One, two or three hour fire rated solid or block concrete wall - 3M #5300-MPC16 or 3M #5300-MPC26.

6.1.2 One hour fire rated gypsum wallboard - 3M #5300-MPC7.

6.1.3 Two hour fire rated gypsum wallboard - 3M #5300-MPC7.

6.2 The following indicates the 3M penetration detail for -insulated pipe penetrations of various wall and floor construction types:

6.2.1 One, two and three hour concrete block wall - 3M #5300-IMP2.

6.2.2 One hour fire rated gypsum wallboard - 3M #5300-IMP4.

6.2.3 HVAC ducts penetrating a one or two hour fire rated wall or floor shall be firestopped per 3M #5300-HVD1.

6.2.4 Multiple pipes penetrating fire rated floors and walls may be firestopped as a group. Submit 3M details for specific applications if this method of firestopping is chosen.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 201200 - EXCAVATION, TRENCHING, BACKFILLING AND GRADING

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 The Contractor shall include all excavating, filling, grading, and related items required to complete their work as shown on the drawings and specified herein or as required to complete, connect and place all mechanical systems in satisfactory operation.

1.3 Unless otherwise shown or required, provide separate trenches for sewers, water lines and other underground raceways, with a minimum of 10 feet measured from outside diameter between pipes. In locations, such as close to buildings where separate trenches for sewers and water lines are impractical, lay the water pipe on a solid shelf at least 2'-0" above the top of the sewer and 2'-0" to the side. All exterior lines shall have a minimum earth cover of thirty six (36) inches to top of pipe, unless otherwise indicated.

1.4 Water lines crossing under sewer lines, or crossing less than 2 feet above sewer lines, must be encased for a distance not less than 5 feet on either side of the point of crossover.

PART 2 - EARTH AND ROCK CLASSIFICATION:

2.1 Materials to be excavated shall be unclassified, and shall include earth, rock, concrete or any other obstructions encountered in trenching to install underground utility pipes. Include all costs for rock removal, including mass rock and trench rock in the bids. No adjustment in the Contract sum will be made on account of the presence or absence of rock, shale, or other materials encountered in the excavating.

2.2 Refer to Division 312000 - Earthwork and the Civil Drawings for additional information.

2.3 The contractor shall be responsible for the removal of all materials encountered as required for the installation of the work.

2.4 Without regard to the materials encountered, all excavation and materials excavated shall be unclassified. It shall be distinctly understood that references to rock, earth, topsoil or any other excavated or non-excavated material or other material on the construction plans, cross section, contract documents, technical specification or provisions, whether in numbers, words, letters, lines or graphically shown, is solely for information for the Engineer and Owner. This information shall not be taken as an indication of the classification of the material to be excavated, bored or removed by any method, including drilling and blasting, or materials not removed. This information shall not be taken as to the quantity of either rock, earth, topsoil, or any other material involved, or the quality of the material such as hardness, wetness, workability or suitability of the material either during excavation and construction or as a material to be reused during construction.

2.5 The contractor shall draw his own conclusions as to the surface and sub-surface conditions to be encountered during construction of this project. The Engineer and Owner does not give any guarantee or warranty as to the accuracy of the data shown and no claim will be considered for additional compensation when the materials encountered are not in accord with the information shown.

PART 3 - BENCH MARKS AND MONUMENTS:

3.1 Maintain carefully all bench marks, monuments and other reference points. If disturbed or destroyed, replace as directed.

PART 4 – EXCAVATION:

4.1 Excavate trenches of sufficient width for proper installation of the work. When the depth of backfill over sewer pipe exceeds 10 feet, keep the trench at the level of the top of the pipe as narrow as practical. Trench excavation for piping eight inches and smaller shall not exceed thirty inch width for exterior lines and twenty-four inch width for interior lines. Excavate to 6" below the bottom of new pipes for installation of compacted grillage.

4.2 Sheet and brace trenches as necessary to protect workers and adjacent structures. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc., and current OSHA Standards. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving. Where removal of sheeting and/or bracing is hazardous, leave in place. Cut off such sheeting not to be removed at least 3 feet below finished grade.

4.3 Rules and regulations governing the respective utilities shall be observed in executing all work under this heading. Active utilities discovered in the course of excavation shall be protected or relocated in accordance with written instructions from the Engineer. Inactive and abandoned utilities encountered in trenching operations shall be removed and abandoned with ends plugged or capped in accord with current codes and safe practice. If in doubt, contact Engineers. Machine excavation shall not be allowed within ten (10) feet of existing electric lines or lines carrying combustible materials. Use only hand tools.

4.4 The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted unless authorized in writing by the Engineer. Any damage to existing structures, exterior services, or rock intended for bearing, shall be corrected at the responsible Contractor's expense.

4.5 Perform final grading of trench bottoms by hand tools; carry machine excavation only to such depth that soil bearing for pipes and raceways will not be disturbed. Grade the bottom of trenches evenly to insure uniform bearing for all piping and raceways. Cut bell holes as necessary for joints and jointmaking. Except as hereinafter specified, bottom of trenches for bell and spigot pipe, flanged pipe, etc. shall be shaped to the lower quadrant of pipe with additional excavation for bell or flange. Piping installed where it rests on bell or flange and/or is supported with blocks or wedges will not be accepted.

4.6 Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper jointing of pipe. Any dewatering from this Contractor's trenches which is required during construction, shall be included in this Contract.

4.7 In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, utility lines, large trees to remain, etc. The Contractors shall take the necessary steps to prevent flow of eroded earth by water or landslide onto the property of others, or against the structures. The repair of all such damage or any other damage incurred in the course of excavation shall be borne by the responsible Contractor.

4.8 Use surveyor's level to establish elevations and grades.

4.9 Machine excavation shall be held a sufficient distance from foundations and footings to insure no damage to same. Contractors shall accept full responsibility and pay for repairs and/or replacement of structural members, footings, etc.

4.10 The Contractor shall accept the site as it is and remove all trash, rubbish and material from the site prior to starting excavation work.

4.11 The Contractor shall provide and maintain barricades and temporary bridges around excavations as required for safety. Temporary bridges shall be provided where excavations cross paved areas and walks. The Contractor shall maintain these bridges in a safe and passable condition for all traffic until removal. Refer to OSHA Standards for such installations and comply with same in all details.

4.12 Pay particular attention to existing utilities and lines to avoid damage. The locations of existing lines which are indicated on the plans were taken unconfirmed from drawings prepared for previous construction and locations are approximate only. Also, certain water, gas, electric, storm and sanitary sewer lines and other underground appurtenances, active or abandoned, may not appear on the drawings. It shall be each Mechanical Contractor's responsibility to ascertain the location of all lines and excavate with caution in their area.

4.13 Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor’s expense.

PART 5 – BACKFILL, COMPACTION AND SURFACE REPAIR:

5.1 Backfilling for mechanical work shall include all trenches, manhole pits, storage tank pits, and/or any other earth and/or rock openings which are excavated under this Contract. Backfilling shall be carefully performed and the surface restored to its original level to receive new finish. Wherever trenches and earth openings have not been properly filled and/or settlement occurs, they shall be re-excavated, re-filled and properly compacted, smoothed off and finally made to conform to the level of the original ground surface.

5.2 All trenches shall be backfilled with 6" of manufactured sand or #8 crushed stone after finished excavation. Install the new pipe on the compacted fill material. Install tracer wire on pipe. Apply any special coatings to the pipe at this point. Also perform all required pressure tests and check the grade of the pipe to ensure that it is correct and free of swags, bows or bends. Once testing is complete, backfill the pipe bed to 12" above the top of the pipe with specified compacted fill material. Backfill the remainder of the trench with earth (debris and rock free) tamped at 6" intervals. Water settling of backfill is permitted only as an aid to mechanical compacting.

5.3 Backfill and compact beneath areas to be seeded or sodded within six (6) inches of finished grade. The remaining six (6) inches shall be backfilled with clean top soil.

5.4 Backfill and compact beneath paved areas, walks, etc. shall be brought to proper grade to receive the sub-base and paving. No paving shall be placed on uncompacted fill or unstable soil.

5.5 Wherever, in the opinion of the Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting piping, special support shall be provided as directed by the Engineer.

5.6 Backfill and compaction for natural gas lines shall be in strict accordance with the local utility company or local municipality’s requirements. If in doubt, contact the utility company or local municipality.

5.7 Unsuitable material and surplus excavated material not required for backfill shall be removed from the site. The location of dump and length of haul shall be the affected Contractor's responsibility.

5.8 Provide and place any additional fill material from off the site as may be required for backfill. Fill obtained from off site shall be of kind and quality as specified for backfill and the source approved by the Engineer and shall be brought to the site by the Contractor requiring the fill.

5.9 In the absence (if not specified or indicated elsewhere in the drawings or specifications to be done by others) of such work by others, the Contractor shall lay new sod over his excavation work for existing disturbed grassy areas. Level, compress and water in accord with sound sodding practice.

5.10 Compaction: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

5.10.1 At a minimum, fill in grass areas shall be compacted to 95% Standard Proctor Density, ASTM D-698, at moisture content between 2 percent below to a 3 percent above the optimum moisture content or as specified in Division 312000 – Earthwork; whichever is most stringent.

5.10.2 At a minimum, fill in concrete or asphalt area shall compacted to 98% Standard Proctor Density, ASTM D-698, at moisture content between 2 percent below to a 3 percent above the optimum moisture content or as specified in Division 312000 – Earthwork; whichever is most stringent.

5.11 Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

5.12 Grading:

5.12.1 Grading Outside Building Lines:

5.12.1.1 All materials used for backfill around structures shall be of a quality acceptable to the Engineer and shall be free from large or frozen lumps, large rocks, wood, and other extraneous material. All spaces excavated and not occupied by footings, foundations, walls or other permanent work shall be refilled with earth up to the surface of the surrounding ground, unless otherwise specified, with sufficient allowance for settlement. In making the fills and terraces around the structures, the fill shall be placed in layers not exceeding 8 inches in depth and shall be kept smooth as the work progresses. Each layer of the fill shall be compacted. Sections of the fill immediately adjacent to buildings or structures shall be thoroughly compacted by means of mechanical tamping or hand tamping as may be required by the conditions encountered. All fills shall be placed so as to load structure symmetrically.

5.12.1.2 As set out hereinbefore, rough grading shall be held below finished grade and then the topsoil which has been stockpiled shall be evenly spread over the surface. The grading shall be brought to the levels shown on the Drawings. Final dressing shall be accomplished by hand work or machine work, or a combination of these methods as may be necessary to produce a uniform and smooth finish to all parts of the regrade. The surface shall be free from clods greater than one inch in diameter. Excavated rock (1" and smaller) may be placed in the fills, but is shall be thoroughly covered. Rock placed in fills shall not be closer than 24 inches from finished grade.

5.13 Maintenance:

5.13.1 Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

5.14 Disposal of Excess Non-organic Soil and Rock:

5.14.1 Unless otherwise directed, excess topsoil and subsoil suitable for fill shall remain the property of the Owner and be stockpiled by the Contractor on-site where directed.

5.14.2 General: Any excess excavated waste material shall become the property of the Contractor and shall be disposed of by the Contractor at no additional cost to the Owner.

PART 6 - MINIMUM DEPTHS OF BURY (TO TOP OF PIPE):

6.1 In the absence of other indication, the following shall be the minimum depth of bury to top of pipe of exterior utility lines. (Check drawings for variations).

6.1.1	Domestic Water Lines	36 inches below final grade.
6.1.2	Sanitary Lines (Exterior)	36 inches below final grade.
6.1.3	All Other Lines Not Listed	36 inches below final grade.

6.2 The minimum bury depth based on initial grade shall be 30 inches.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 201300 - PIPE, PIPE FITTINGS AND PIPE SUPPORT

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 The piping indicated shall be installed complete and shall be of the size indicated. When a pipe size is not indicated, the Contractor shall request the pipe size from the Engineers. All piping shall be installed straight and true, parallel or perpendicular to the building construction. Piping shall be installed so as to allow for expansion without damage to the building finishes, structure, pipe, equipment, etc., use offsets, U-bends or expansion joints as required. Where a section of piping is not indicated but is obviously required for completion of the system, the Contractor shall provide same at no additional cost to the project. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers and other building openings.

1.3 All pipes shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted. Spacing of pipe supports shall not exceed eight feet for pipes up to 3 inches and ten feet on all other piping. Small vertical pipes (1 inch and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants. Insulated piping shall be supported on a rigid insulation block at each hanger so as to prevent crushing of insulation by hangers. Hangers shall pass completely around the insulation jacket and a steel protective saddle shall be applied to prevent compression of the insulation. (Refer to Specifications Section entitled INSULATION-MECHANICAL.

1.4 Where piping rests directly on a hanger, clip, bracket or other means of support, the support element shall be of the same material as the pipe, (e.g., copper to copper, ferrous to ferrous, etc.) or shall be electrically isolated one from the other so as to prevent pipe damage by electrolysis. Pay particular attention and do not allow copper pipe to rest on ferrous structural members, equipment, etc. without electrolytic isolation.

1.5 Where plastic piping penetrates a fire rated assembly, it shall be replaced with a threaded metal adapter and metal pipe or whatever means necessary to maintain the separation rating in accordance with local plumbing and fire codes.

1.6 Plastic piping or any material with a flame and smoke spread rating not approved for plenum use shall not be permitted in supply, return, relief or exhaust plenums.

1.7 Dielectric couplings or nipples shall be provided at all connections of dissimilar materials.

1.8 In general, piping shall be installed concealed except in Mechanical, Janitor Rooms, etc. unless otherwise indicated, and shall be installed underground or beneath concrete slabs only where indicated. All lines at ceilings shall be held as high as possible and shall run so as to avoid conflicts with other trades, and to facilitate the Owner's use and maintenance. Location of pipe in interior partitions shall be carefully coordinated with whoever will construct the partitions after the piping is in place. Where exposed risers occur they shall be kept as close to walls as possible.

1.9 Unless otherwise indicated, all materials shall be new and of the best grade and quality for the type specified.

1.10 Installation of pipe shall be in such a manner as to provide complete drainage of the system toward the source. Drain valves shall be provided at all drainage points on pipes. Drain valves shall be ½" size gate type with 3/4" hose thread end and vacuum breaker. Label each drain valve.

1.11 Pipe shall be cut accurately to measurements established at the building by the Contractor and worked into place without springing or forcing. All pipes shall be reamed to full pipe diameter before joining and before assembling. All lengths of pipe shall be set vertically and tapped with a hammer to remove scale and dust and inspected to insure that no foreign matter is lodged therein.

1.12 All hot and cold water piping shall be kept a sufficient distance apart so as to prevent heat transfer between them. Cold water piping shall also be kept apart from refrigerant hot gas lines.

1.13 Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing; if in doubt, consult Engineer.

1.14 Piping for all drainage systems shall be installed to permit flow, trapping, and venting in accord with current codes and sound practice.

1.15 All increases in vent size at roof shall be by means of service weight cast iron increasers.

1.16 Non-metallic piping shall be installed in strict accordance with the manufacturer's instructions. If no such instructions are available, consult Engineers.

1.17 Nipples shall be of the same material, composition and weight classification as pipe with which installed.

1.18 Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineers prior to submission of a bid proposal.

1.19 Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If necessary, contact Engineers.

1.20 Piping materials in each system shall, to the extent practicable, be of the same material. Frequent changes of material (for example, from copper to steel) shall be avoided and in no case shall be accomplished without use of insulating unions and permission of the Engineers.

1.21 Apply approved pipe dope (for service intended) to <u>all</u> male threaded joints. The dope shall be listed for such use.

1.22 Eccentric reducers shall be used where required to permit proper drainage and venting of pipe lines; bushings shall not be permitted.

1.23 All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.

1.24 The entire domestic hot, cold and recirculating hot water piping system shall be sterilized in strict accord with requirements of the Department of Health Codes, Rules and Regulations for the State in which the work is being accomplished.

1.25 The entire sanitary waste and vent piping system within the building shall be air-tight. If any sewer gases are present within the building, it is the contractor’s responsibility to locate and correct this problem completely, and re-tested. Any odor problems within a one year after substantial completion is the responsibility of the contractor to correct.

1.26 Site water piping utilized for domestic service shall be filled, cleaned and disinfected. Disinfection shall utilize chlorine per the local water company standards. Hyper-chlorinated water shall be discharged (and diluted if required) at the end of the pipeline into the sanitary sewers per local utility regulations.

PART 2 - UNIONS AND FLANGES AND WELDED TEES:

2.1 Screwed unions, soldered unions or bolted flanges shall be provided as required to permit removal of equipment, valves and piping accessories from the piping system. Keep adequate clearances for coil removal, rodding, tube replacement, motor lubrication, filter replacement, etc. Flanged joints shall be assembled with appropriate flanges, gaskets and bolting. The clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system.

2.2 Dielectric insulating nipples or couplings shall be used wherever the adjoining materials being connected are of dissimilar metals such as connections between copper and steel pipe.

2.3 Tee connections for welded pipe shall be made up with welding fittings. Where the size of the side outlet is such that a different connection technique than on the run is required, a weldolet, sockolet, or threadolet type fitting may be used for the branch in place of reducing tees only where the branch is 2/3 the run size or smaller.

PART 3 - SPECIFICATIONS STANDARDS:

3.1 All piping and material shall be new, made in the United States and shall conform to the following minimum applicable standards:

3.1.1 Steel pipe; ASTM A-53.

3.1.2 Copper tube; Type K, L, M; ASTM B88-62; Type DWV ASTM B306-62.

3.1.3 Cast iron soil pipe; ASA A-40.l and CS 188-59.

3.1.4 Cast iron drainage fittings; ASA B16.12.

3.1.5 Cast iron screwed fittings; ASA B16.4.

3.1.6 Welding fittings; ASA B16.9.

3.1.7 Cast brass and wrought copper fittings; ASA B16.18.

3.1.8 Cast brass drainage fittings; ASA B16.23.

3.1.9 Solder; Handy and Harmon, United Wire and Supply; Air Reduction Co. or equivalent.

PART 4 - PITCH OF PIPING:

4.1 All piping systems shall be installed so as to drain to a low point. Certain minimum pitches shall be required for this drainage. For proper flow and/or for proper operation, the following pitches shall be required:

4.2 Interior Soil, Waste and Vent Piping: ¼ inch per foot in direction of flow where possible but in no case less than 1/8" per foot.

4.3 Exterior Sanitary Lines: Not less than one (1) percent fall in direction of flow and no greater than indicated.

4.4 Condensate Drain Lines From Cooling Equipment: Not less than ¼ inch per foot in direction of flow.

4.5 Exterior Storm Lines: Not less than 1 percent grade in direction of flow.

4.6 All Other Lines: Provide ample pitch to a low point to allow 100 percent drainage of the system.

PART 5 – APPLICATIONS:

5.1 Sanitary Sewer – Exterior:

5.1.1 Refer to Civil Plans and Specifications.

5.2 Storm Sewer – Exterior

5.2.1 Refer to Civil Plans and Specifications.

5.3 Domestic Water Piping - Exterior

5.3.1 Refer to Civil Plans and Specifications.

5.4 Soil, Waste and Vent Piping (Below Slab)

5.4.1 Schedule 40 PVC pipe with drainage pattern fittings and solvent cement joints made in accordance with the Plumbing Code. PVC pipe will not be allowed in boiler rooms unless otherwise stated on the construction documents.

5.5 Soil, Waste and Vent Piping (Above Slab)

5.5.1 Type DWV copper drainage piping with cast bronze drainage pattern fittings with solder joints.

5.5.2 Schedule 40 PVC pipe with drainage pattern fittings and solvent cement joints made in accordance with the Plumbing code.

5.6 Domestic Cold, Hot and Recirculating Hot Water Piping (Above Slab)

5.6.1 Type "L" hard copper tubing with wrought copper fittings with lead free solder equivalent in performance to 95/5. (Maximum lead content of solder and flux is 2%).

5.7 Domestic Cold, Hot and Recirculating Hot Water Piping (Below Slab)

5.7.1 Type "K" hard or soft copper tubing with wrought copper fittings and brazed joints. There shall be no joints beneath slabs.

5.8 Water Heater Relief Line

5.8.1 Type "M" copper tubing with sweat fittings and 95/5 solder.

5.9 Site Sanitary Sewer - Force Main:

5.9.1 Ductile cast iron pipe shall conform to ANSI A21.51 and AWWA C151. All ductile cast iron pipe thickness shall be designed according to ANSI A21.50 and AWWA C150 requirements.

5.9.2 Ductile cast iron pipe and fittings shall receive the standard cement mortar lining with bituminous seal coat on the inside in accordance with ANSI A 21.4 requirements. Thickness of the lining shall be as set out in

aforesaid specification. Pipe and fittings shall have standard coal tar or asphalt based bituminous outside coating a minimum of 1 mil thick.

5.9.3 Fittings for ductile cast iron pipe shall be mechanical joint Class 250 gray iron conforming to ANSI A21.10 and AWWA C110 for short body cast iron fittings. Fittings shall be bituminous coated outside and shall receive the standard cement mortar lining with bituminous seal coat on the inside as specified hereinbefore.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202100 - VALVES AND COCKS

PART 1 – GENERAL:

1.1 Each Mechanical Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

1.2 Each Mechanical Contractor (and/or Sub-Contractors) shall provide all valves required to control, maintain and direct flow of all fluid systems indicated or specified. This shall include, but may not be limited to all valves of all types including balancing cocks, air cocks, lubricated plug cocks, packed plug cocks, special valves for special systems, etc., for all Mechanical Systems.

1.3 All valves shall be designed and rated for the service to which they are applied.

1.4 The following type valves shall not be acceptable: Zinc, plastic, fiber or non-metallic.

1.5 Each type of valve shall be of one manufacturer, i.e., gate valves, one manufacturer, globe valves, one manufacturer, silent check valves, one manufacturer, etc.. The following valve manufacturers shall be acceptable: Lunkenheimer, Powell, Nibco, Crane, Jenkins, T & S Brass, Walworth, Milwaukee, DeZurik, Consolidated Valve Industries, Inc., Bell & Gossett, Apollo.

1.6 All valves shall comply with current Federal, State and Local Codes.

1.7 All valves shall be new and of first quality.

1.8 Contractor shall provide colored tape on ceiling tile where valves are located above ceiling. Provide access panels where valves are located above hard ceiling.

PART 2 - TYPES AND APPLICATION - DOMESTIC WATER:

2.1 Globe Valves (2" and under): Globe Valves shall have bronze body, bonnet and disc holder. Globe valve shall have union bonnet, integral seat, teflon or stainless steel renewable disc and be rated for 150 psi working pressure. Globe valve shall be Nibco T-235 for threaded ends or Nibco S-235 for solder ends.

2.2 Check Valve (2" and under): Check valve shall have bronze body, disc and hinge. check valve shall be Y-pattern type, horizontal swing, renewable disc and rated for 150 psi working pressure. Check valve shall be Nibco T-413 for threaded ends or Nibco S-413 for solder ends.

2.3 Ball Valve (2" and under): Ball valve shall have bronze body, ball and reinforced, water tight seat. Valve shall be "full-port" type. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 180 degrees F water temperature and 150 psi working pressure. Ball valve shall be Nibco T-585 for threaded ends and Nibco S-585 for solder ends.

2.4 Strainers (2" and under): Watts 77S Series "Y" type strainer with cast iron body and threaded ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with cleanout plug and be rated for 200 psi working pressure.

2.5 Pressure Reducing Valves: Watts #U5B water pressure reading valve with bronze body, bolted bonnet, integral stainless steel strainer and outlet water pressure gauge. Internal disc, diaphragm and stainless steel seat shall all be removable. Valve shall be rated for inlet water pressures up to 300 psi. Water pressure

reducing valves shall be provided for all equipment where water pressure exceeds the equipment manufacturer's ratings.

2.6 Vacuum Breakers: Watts #288A atmospheric type vacuum breaker with brass body. Vacuum breaker shall be rated for 210 degrees F and 125 psi working pressure and shall meet ASSE Standard 1001.

2.7 Double Check Valve: Double check valve shall have bronze body construction and be provided with inlet strainer, (2) gate valves for isolation and (3) test ports. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. Assembly must meet requirements of AWWA Standard C506. Provide Watts #900 with threaded ends for sizes 2" and less. For sizes over 2" provide Watts #709 with flange ends.

2.8 Reduced Pressure Backflow Preventers: Watts #909 reduced pressure backflow preventers shall be provided with inlet strainer, (2) gate valves for isolation, (3) test ports and air gap fitting. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. RPBP shall be UL listed and meet AWWA C511 standards. All valves 3" and less in size shall bronze body construction, over 3" in size shall have epoxy coated cast iron bodies. Assemblies 2" and under in size shall have threaded ends, over 2" in size shall have flange ends.

2.9 Balancing Valve: Bell & Gossett "Circuit Setter" Model CB or equal balancing valve. All valves to be of bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT inserts and check valves. Valve bodies to have 1/4" NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplates to assure specific valve settings. Valves shall be designed for positive shut-off.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202200 - INSULATION - MECHANICAL

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

1.2 Work under this section shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for all mechanical systems specified herein and/or as indicated.

1.3 Application of insulation materials shall be done in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use. Insulation shall be applied by a company regularly engaged in the application of insulation and any work deemed unacceptable by the Engineers shall be removed and properly installed at the expense of the Contractor.

PART 2 – MANUFACTURERS:

2.1 Insulation shall be as manufactured by Manville, Keene Corp., Knauf, Owens-Corning, Armstrong, World Industries or other approved equivalent. Insulation sundries and adhesives shall be as made by Benjamin Foster, Childers, Vimasco or approved equivalent.

PART 3 - FIRE RATINGS AND STANDARDS:

3.1 Insulations, jackets and facings shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255 and UL 723 procedures not exceeding Flame Spread 25, Smoke Developed 50 and Fuel Contributed 50.

3.2 Adhesives, mastics, tapes and fitting materials shall have component ratings as listed above.

3.3 All products and their packaging shall bear a label indicating above requirements are not exceeded.

PART 4 - GENERAL APPLICATION REQUIREMENTS:

4.1 Insulation shall be applied on clean, dry surfaces in a neat and workmanlike manner reflecting the best current practices in the trade. Insulation shall not be applied to piping, ductwork or equipment until tested, inspected and released for insulation.

4.2 Where more than one thickness of insulation is required, joints (both longitudinal and transverse) shall be staggered.

4.3 All insulation shall be continuous through walls, ceiling openings and sleeves. However, insulation shall be broken through fire walls. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. If necessary, extra fittings and pipe are to be used. No noticeable deformation of insulation or discontinuity of vapor seal, where required, will be accepted. Coordinate work with plumbers, pipe fitters, etc. to assure hanger locations agree with location of insulation inserts.

4.4 “Concealed", where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. "Exposed" shall mean that piping or equipment is not "concealed"

as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered as "exposed".

4.5 Existing and/or new insulation removed and/or damaged during course of construction shall be repaired or replaced as directed by the Engineer.

4.6 Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Do not use staples thru the jacket. NO EXCEPTIONS!

4.7 All insulation shall be installed with joints butted firmly together.

4.8 The Contractor shall insure that all insulation (piping, ductwork, equipment, etc.) is completely continuous along all conduits, equipment, connection routes, etc. carrying cold fluids (air, water, other) and that condensation can, in no way, collect in or on the insulation, equipment, conduits, etc. Any such occurrence of condensation collection and/or damage therefrom shall be repaired solely at the expense of the Contractor.

PART 5 - PIPING SYSTEMS:

5.1 GENERAL

5.1.1 Bevel insulation and jacket at all points where insulation terminates at unions, flanges, valves and equipment. Note: Applies to hot water lines only; cold water lines require continuous insulation.

5.1.2 Pipe insulation shall extend around valve bodies to above drain pans in hydronic equipment over pumps, etc. to insure no condensation drip or collection.

5.1.3 Valves, flanges and unions shall only be insulated when installed on piping whose surface temperature will be at or below the dew point temperature of the ambient air.

5.1.4 Insulation shall not extend through fire and smoke walls. Pack sleeve at fire and smoke wall with approved fire retardant packing similar to mineral wool.

5.2 INSULATION SHIELDS AND INSERTS

5.2.1 Metal insulation shields are required at all pipe hangers where the piping is insulated. Metal shields shall be constructed of galvanized steel, formed to a 180 ° arc. Insulation shields shall be the following size:

PIPE SIZE	SHIELD GAUGE	SHIELD LENGTH
2" AND LESS	20	12"
2 1/2" TO 4"	18	12"
5" TO 10"	16	18"
12" AND GREATER	14	24"

5.2.2 Insulated pipes 2” in diameter and larger shall be additionally supported with wood inserts of sufficient compressive strength to carry the weight of the pipe and fluid. Inserts shall extend beyond extend beyond the hanger and shall be at least 6” in length.

5.3 PREMOLDED INSULATION FITTING COVERS

5.3.1 Provide PVC insulated fitting covers on all pipe fittings, flanges, valves and pipe terminations. Fittings shall be insulated by applying the proper factory precut insulation insert to the pipe fitting. The ends of the insulation insert shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe insulation tufted and tucked in, fully insulating the pipe fitting. The proper thickness of insulation must be applied to keep the jacket temperature less than 150°F. An approved vapor retarder mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover shall then be applied and secured with pressure sensitive tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side. On fittings where the operating temperature is below 50°F, two or more layers of the insulation inserts shall be applied with the first layer being secured with a few wrappings of fiber glass yarn to eliminate voids. One addition insert shall be used for each additional 1" of pipe insulation above 1-1/2".

5.4 INSULATION MATERIAL (FOR THE FOLLOWING SYSTEMS)

Insulation shall be Owens-Corning Model 25ASJ/SSL or approved equivalent fiberglass pipe insulation with an all service jacket. The insulation shall be a heavy density, pipe insulation with a K factor not exceeding 0.27 Btu per inch/h.ft² °F at 75°F mean temperature. The insulation shall be wrapped with a vapor barrier jacket. The jacket shall have an inside foil surface with self sealing lap and a water vapor permeability of .02 perm/inch. All circumferential joints shall be vapor sealed with butt strips. All insulation shall be installed in strict accordance with the manufacturer's recommendations. The following pipes shall be insulated with the thickness of insulation as noted.

5.4.1 Domestic Water Systems:

5.4.1.1	Domestic Cold Water -	1" thick insulation
5.4.1.2	Hydronic System Fill Lines From Domestic Cold Water -	1" thick insulation
5.4.1.3	Domestic 110°F Hot Water and 110°F Recirculating Hot Water -	1" thick insulation

5.5 JACKETS

5.5.1 Exposed (Mechanical Rooms, Interior Finished Rooms and Storage Rooms):

5.5.1.1 All insulated piping installed within 8' of the finished floor, in the above areas shall have a 6 oz. canvas jacket with fire retardant lagging apply to the insulation specified for the piping.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202300 - THERMOMETERS, PRESSURE GAUGES AND OTHER MONITORING INSTRUMENTS

PART 1 – GENERAL:

1.1 The Mechanical Contractor(s) shall include all thermometers, pressure gauges and/or compound gauges at the locations indicated.

1.2 All thermometers, pressure gauges and/or compound gauges shall be provided with “PET Cocks” to allow the gauge to be removed and replaced without shutting down system.

PART 2 - THERMOMETERS AND PRESSURE GAUGES:

2.1 All thermometers and pressure gauges shall be readable from a standing position on the floor.

2.2 Water thermometers shall be Bimetal type with 3" dial, stainless steel case, stainless steel stem and socket with length as required by piping system. Accuracy to be plus or minus 1%. Lens to be plastic. Hot water thermometer shall have a 30°F to 240°F range and chilled water thermometer shall have a 25°F to 125°F range. (Marsh Master Therm or equal.)

2.3 Pressure gauges shall be Bourdon Type, circular, 2-1/2" face, black letters on white face graduated in 2 PSI or less and shall be manufactured for service intended. Provide with pig tail connectors and gauge cocks. Accuracy to be plus or minus 2%. Water pressure and low pressure steam gauges shall have 0 to 100 PSI range and medium/high pressure steam gauges shall have 0 to 200 PSI range. (Marsh Acculite II or equal.)

2.4 Provide direct mount Bimetal dial thermometers in HVAC ductwork. Thermometer shall be 3" diameter, with acrylic plastic lens and stainless steel case. Air temperature range shall be 25°F to 125°F. (Marsh Master Therm or equal.)

2.5 Pressure gauges and thermometers subject to vibration shall be mounted remotely away from vibrating pipe surface, etc. with flexible tubing.

2.6 Mount thermometers in approved wells. Do not make direct contact of base with fluid in pipe.

2.7 Gauges and thermometers shall be Marsh, Marshalltown, Trerice, Weksler or equivalent.

PART 3 - PRESSURE/TEMPERATURE TEST STATION (PETES PLUG):

3.1 Provide 1/4" NPT fitting to receive either a temperature or pressure probe, 1/8" OD. Fitting shall be solid brass with two valve cores. (Valve core material to be Neoprene for temperatures up to 200ºF and Nordel for temperatures between 200ºF and 275ºF.). Petes Plugs to have 3" length when installed on insulated pipes and 1-1/2" length for uninsulated pipes. Petes Plug to be fitted with a color coded cap strap with gasket, and shall be rated at 1000 PSIG at 140ºF. In addition, the installing contractor shall supply the owner (4) pressure gauges with 1/8" OD probe and (4), five-inch stem pocket testing thermometers rated for 25-125ºF chilled water and 4, 0-200ºF hot water thermometers.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202400 - IDENTIFICATIONS, TAGS, CHARTS, ETC.

PART 1 – GENERAL:

1.1 Each Mechanical Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

PART 2 - PIPING IDENTIFICATION:

2.1 All piping installed shall be identified according to the chart hereinafter specified. Provide stenciled markers and arrows indicating direction of flow on all piping installed under this contract. Markers and arrows shall be painted on the piping using machine cut stencils. All letters shall be sprayed using fast drying lacquer paint. All markers and arrows shall be properly oriented so that descriptive name may be easily read from the floor. Piping shall be identified on 6 foot centers. All piping shall be minimally identified once above all room ceilings and where it passes thru walls or floors. At the Contractor's option, Setmark or equivalent manufactured marking system may be substituted for field marking. The following table describes the size of the color field and size of the identification letters which shall be used for pipes of different outside pipe diameters.

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS
INCHES	INCHES	INCHES
3/4 TO 1 1/4	8	½
1 ½ TO 2	8	3/4
2 ½ TO 6	12	1 1/4
8 TO 10	24	2 ½
OVER 10	32	3 ½

2.1.1 DCW Domestic Cold Water
2.1.2 DHW Domestic Hot Water (120 ºF)
2.1.3 RHW Recirculating Hot Water (120 ºF)

PART3 - EQUIPMENT IDENTIFICATION:

3.1 Unless otherwise specified, all equipment shall be identified with the title of the equipment as taken from the plans in a position that is clearly visible from the floor. The equipment shall be identified neatly and conspicuously with engraved black lamacoid plates (or equivalent) with 2” high white letters on the front of each piece of equipment. **All mechanical equipment shall have the electrical panel number and circuit number identified on the lamacoid plate.** Coordinate with the electrical contractor.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202500 - HANGERS, CLAMPS, ATTACHMENTS, ETC.

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Provisions - Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 Each Contractor's attention is also directed to Section 201300, Pipe, Pipe Fittings and Pipe Support.

1.3 This section includes, but is not limited to, furnishing and installing dampers, supports, anchors, and accessories for piping, ductwork, equipment, etc. Furnishing and installing shall be by each trade for the completion of their work.

1.4 Power driven anchors and expansion anchors shall be permitted only when permission is granted in writing by the Architect and Engineer.

PART 2 - MATERIALS AND EQUIPMENT:

2.1 Hangers, Clamps, Attachments, Etc.:

	SIZE	SPECIFICATION
1. Pipe Rings	2" pipe and smaller	Adjustable swivel split ring or split pipe ring, Grinnell Figures 104 and 108, Elcen, Fee & Mason, or approved equivalent.
2. Pipe Clevis	2-1/2" pipe and larger	Adjustable wrought Clevis type, Grinnell Figure 260, Elcen, Fee & Mason, or approved equivalent.
3. Pipe Clevis	All	Steel Clevis for insulated pipe, Elcen Figure 12A, Grinnell, Fee & Mason or approved equivalent.
4. Rise Clamps	All	Extension pipe or riser clamp, Grinnell Figure 261, Elcen, Fee & Mason or approved equivalent.
5. Beam Clamps and Attachments	All	Grinnell Figure numbers listed or, Elcen, Fee & Mason, or approved equivalent. Malleable beam clamp with extension piece figure 229; I-beam clamp figure 131; C-clamp figures 83, 84, 85, 86, 87, and 88.
6. Brackets	All	Welded steel brackets medium weight, Grinnell Figure 195, Elcen, Fee & Mason or approved equivalent.

7. Concrete Inserts	All	Grinnell Figure numbers listed or, Elcen, Fee & Mason or approved equivalent. Wrought steel insert Figure 280 and wedge type insert Figure 281.
8. Concrete Fasteners	All	Self-drilling concrete inserts, Phillips, Grinnell, Elcen or approved equivalent.
9. Trapeze Hangers	All	Approved by Engineer
10. Rod Attachments	All	Grinnel Figure numbers listed or Elcen, Fee & Mason, or approved equivalent. Extension piece Figure 157, rod coupling Figure 136, and forged steel turnbuckle Figure 230.
11. U-Bolts	All	Standard, U-bolt, Grinnell Figure 137, Elcen, Fee & Mason, or approved equivalent.
12. Welded Pipe Saddles	All	Pipe covering protection saddle sized for thickness of insulation, Grinnell Figure 186, Elcen, Fee & Mason or approved equivalent.
13. Pipe Roll	All	Adjustable swivel pipe roll, Grinnell Figure 174, Elcen, Fee & Mason, or approved equivalent.
14. Protection Saddle	All	Sheet metal pipe protection saddle (See Specification Section 202200, Elcen Figure 219, Fee & Mason, Power Strut, or approved equivalent.
15. Hanger Rods	All	Steel, diameter of the hanger threading, ASTM A-107.
16. Miscellaneous Steel	All	Steel angles, rods, bars, channels, etc., used in framing for supports and fabricated brackets, anchors, etc., shall conform to ASTM-A-7.
17. Concrete Channel Inserts	All	Heavy duty or Light Duty Series as required.
18. Adjustable Spot Insert	All	Adjustable spot insert. Design load 1000 lbs.

PART 3 – INSTALLATION:

3.1 Unless otherwise specifically indicated or hereinafter specified in the specifications, all supporting, hanging and anchoring of piping, ductwork, equipment, etc., shall be done by each trade as is necessary for completion of the work and shall be as directed in the following paragraphs:

3.2 Supporting and hanging shall be done so that excessive load will not be placed on any one hanger so as to allow for proper pitch and expansion of piping. Hangers and supports shall be placed as near as possible to joints, turns and branches.

3.3 For concrete construction, utilize adjustable concrete inserts for fasteners. Expansion anchors and power driven devices may be used when approved in writing by the Architect/Engineer. Utilize beam clamps for fastening to steel joists and beams and expansion anchors in masonry construction. When piping is run in joists, piping shall be top mounted on trapeze type hangers with each pipe individually clamped to trapeze hanger.

3.4 Trapeze hangers are not allowed, unless specifically approved by the engineer.

3.5 Install all miscellaneous steel other than designed building structural members as required to provide means of securing hangers, supports, etc., where piping does not pass directly below or cross steel joists.

3.6 Piping shall not be supported by the equipment to which it is connected. Support all piping so as to remove any load or stress from the equipment.

3.7 Where piping, etc., is run vertically, approved riser clamps, brackets or other means shall be utilized at approximately 10'-0" center to center minimum and an approved adjustable base stand or fitting on concrete support base shall be utilized at the base of the vertical run.

3.8 Where piping is run along walls, knee braced angle frames or pipe brackets with saddles, clamps, and rollers (where required) mounted on structural brackets fastened to walls or columns shall be used.

3.9 Support all ceiling hung equipment, with approved vibration isolators.

3.10 Where copper tubing is specified, hangers shall be of copper clad type when piping is uninsulated.

3.11 Uninsulated piping hung from above shall be supported with ring and clevis type pipe hangers. Uninsulated piping mounted on trapeze and wall bracket type support shall be held in place with U-bolts. U-bolts shall allow for axial movement in the piping.

3.12 All insulated piping shall be supported with clevis type and pipe roll hangers. Hangers shall be sized to allow the pipe insulation to pass through the hangers. Install insulation protection saddles at all hanger locations. Welded pipe saddles shall be installed at all hangers on piping 5" and larger. The pipe saddles shall be sized for the thickness of insulation used. Hangers shall fit snugly around outside of insulation saddles.

3.13 Under no conditions will perforated band iron or steel wire driven hangers be permitted.

3.14 In general, support piping at the following spacing:

3.14.1 Steel and copper piping - 8 foot intervals for piping 3" and smaller; 10 foot intervals for larger piping.

3.14.2 Schedule 40 plastic pipe: Shall be supported at intervals not to exceed four (4) feet and at the end of the branches and at the change of direction and shall be installed as to permit freedom of movement. Vertical piping shall be supported at their bases and all upward movement shall not be restricted. Hangers shall be at least one (1) inch wide and shall not compress, distort, cut or abrade the piping to allow free movement at all times.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 203100 - TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS

PART 1 – GENERAL:

1.1 The General Conditions, Instructions to Bidders, General Provisions - Mechanical, and other Contract Documents are a part of this specification and shall be binding on all Mechanical Contractors and sub-contractors. It shall be each Contractor's responsibility to apprize himself of all information pertinent to his work prior to submitting his proposal. No adjustments will be made in this Contract which is a result of failure to comply with this requirement.

1.2 The Engineer, or his authorized representative, shall be notified by the Contractor twenty-four (24) hours in advance of any tests called for in these specifications or required by others. Any leaks or imperfections found shall be corrected and a new tests run to the satisfaction of the Engineer or his authorized representative. Upon completion of a test, a written approval of that part of the work will be given to the Contractor. Only after written approval, signed by the Engineer, shall the Contractor apply insulation or paint or allow his work to be furred-in. This written approval, however, does not relieve the Contractor of the responsibilities for any failure during the guarantee period. The expense of all tests shall be borne by the Contractor, along with all temporary equipment, materials, gauges, etc. required for tests.

1.3 RELATED DOCUMENTS

1.3.1 All Division 20 specification sections, drawings, and general provisions of the contract apply to work of this section, as do other documents referred to in this section.

1.4 SCOPE OF WORK

1.4.1 The owner will directly contract with a certified testing, adjusting, and balancing (TAB Agency) to test, adjust, and balance the HVAC systems. The plumbing and fire protection requirements noted hereinafter shall be provided by the responsible contractor.

1.4.2 This specification section is included herein to assist and inform the Contractor of the standards, requirements and scope of the work to be performed by the Owner’s TAB Contractor.

PART 2 – PLUMBING:

2.1 Piping shall be tested before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory.

2.2 Water piping systems shall be subjected to a hydrostatic test of one hundred fifty pounds. The system shall be proven tight after a twenty-four (24) hour test.

2.3 The house drain line, interior storm sewers, interior rain water conductors, and all soil, waste and vent piping shall be subjected to a hydrostatic test of not less than a 10-foot head or an air test of not less than 5 lbs. per sq. inch using a mercury column gauge and shall hold for 15 minutes.

2.4 Exterior sewer lines to the termination point outside the building shall be subject to a ten-foot hydrostatic test or an approved smoke test. These lines shall be subjected to a second test after 2 feet of backfill has been properly installed.

2.5 After fixtures have been installed, the entire plumbing system, exclusive of the house sewer, shall be subjected to an air pressure test equivalent to one inch water column and proven tight. The Contractor responsible shall furnish and install all of the test tees required, including those for isolating any portion of the system for tests.

2.6 Thermometers and gauges shall be checked for accuracy. If instruments prove defective, they shall be replaced.

2.7 The Contractor shall perform all additional tests that may be required by the Department of Health or other governing agency.

2.8 Set temperature control on water heaters and adjust tempering valves as required.

2.9 Balance the water flow rate of each domestic hot water recirculating pump. Set the flow rate for each balancing valve in the recirculating hot water system. If flow rates are not indicated, contact the engineer for each balance valve GPM.

2.10 Any leaks or imperfections found shall be corrected and a new test run until satisfactory results are obtained. The cost of repair or restoration of surfaces damaged by leaks in any system shall be borne by the Contractor.

PART 3 - PREPARATION AND COORDINATION REQUIREMENTS – GENERAL

3.1 System installation and equipment startup shall be complete prior to the TAB Agency's being notified to begin.

3.2 The building control system shall be complete and operational. The Building Control system contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

3.3 All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

3.4 Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

PART 4 - PREPARATION AND COORDINATION REQUIREMENTS – HVAC CONTROLS

4.1 Written notice shall be submitted through the Construction Manager to the Architect stating that the Control System is operating and controlling the HVAC System.

4.2 The control subcontractor shall have entered all data needed for the TAB Agency to begin work.

4.3 The Control subcontractor shall be available to correct any problems that the TAB Agency might have with the systems.

4.4 All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for HVAC controls.

PART 5 - PREPARATION AND COORDINATION REQUIREMENTS – MECHANICAL

5.1 Written notice shall be submitted through the Construction Manager stating that the HVAC system is operational and ready for the TAB Agency.

5.2 The Mechanical Contractor shall test all piping before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory. Water piping systems shall be subjected to a hydrostatic test of not less than one hundred pounds and shall be proven tight after a twenty-four (24) hour test.

5.3 The Mechanical subcontractor shall have proved all units operational and all air outlets in the full open position.

5.4 The Mechanical Contractor shall be available to correct any problems that the TAB Agency might have with any equipment or systems.

5.5 The control subcontractor shall have entered all data needed for the TAB Agency to begin work.

5.6 The Control subcontractor shall be available to correct any problems that the TAB Agency might have with the systems.

5.7 All motors, bearings, etc. shall be checked and lubricated as required during start-up procedures. All automatic, pressure regulating and control valves shall be adjusted. Excessive noise or vibration shall be eliminated. Provide all start-up documents to Designer prior to any test and balance services.

5.8 The Mechanical Contractor shall furnish and install any replacement sheaves, pulleys and drive belts required for flow adjustments, as determined by the TAB Agency. Adjustable sheaves shall be selected so that the final adjustment position is in the middle third of the total adjustment range.

5.9 All costs for additional work by the TAB Agency due to the Contractor's failure to comply with the above shall be paid by the Contractor and any subcontractor(s) for mechanical work.

PART 6 - WORK BY TAB AGENCY

6.1 The following is the scope of work for the Test and Balance Contractor. Reference only:

6.1.1 Balance all exhaust air grilles to within 10% of design air flow rate.

6.1.2 Balance all exhaust air fans and record inlet static pressure.

6.1.3 Balance domestic hot water return system including all balance valves and record settings and flows.

PART 7 - DEFINITIONS, REFERENCES AND STANDARDS

7.1 All work shall be in accordance with the latest edition of the National Standards, as published by the National Organization affiliated with the TAB Agency.

END OF SECTION.

DIVISION 22 - PLUMBING

SECTION 220100 - PLUMBING SPECIALTIES

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work specified in this section.

1.2 The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the State Plumbing Code.

1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of his rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.

1.4 All equipment and specialties shall be new unless other wise indicated or specified. They shall also be of equivalent quality, dimensions, material, etc. as those specified.

1.5 All equipment and specialties shall be installed as recommended by the manufacturer.

1.6 Prior to final inspection, test by operation at least twice, all equipment.

1.7 Prior to final inspection, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.

1.8 All equipment and specialties shall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost.

PART 2 - DRAINAGE SPECIALTIES:

2.1 General: Provide all drainage specialties indicated, specified and/or required to provide complete and acceptable removal of all storm, sanitary, waste, laboratory waste, etc. from the building and into approved receptors. Drainage specialties shall be on non-electrolytic conduction to the material to which they are connected. Drainage specialties shall be installed in a manner so as to insure no leakage of toxic or odorous gases or liquids and shall have traps and/or backflow preventers where required. Nor shall they allow backflow into other or existing systems.

2.2 Cleanouts – Interior (CO): In addition to cleanouts indicated, provide cleanouts in soil and waste piping and storm drainage at the following minimum locations:

2.2.1 At base of each stack.

2.2.2 At fifty (50) foot maximum intervals in horizontal lines.

2.2.3 At each change of direction of a horizontal line.

2.2.4 As required by current State Plumbing/Building Codes.

2.2.5 As required to permit rodding of entire system. (If in doubt, contact Engineers.)

2.2.6 Water closets, slop sinks and other fixtures with fixed traps shall not be accepted as cleanouts.

2.2.7 Cleanouts and/or test tees concealed in inaccessible pipe spaces, walls and other locations shall have an eight (8) inch by eight (8) inch (minimum) access panel or cover plates shall be set flush with finished floors and walls and shall be key or screw driver operable.

2.2.8 Access panels for cleanouts shall be of the Zurn, 1460 series or equivalent by Josam or Wade. Where they are not to receive paint, they shall be polished bronze unless otherwise indicated where they are to receive paint or other finishes. They may, at the Contractor's option, be Perma-Coated steel, prepared to receive finish.

2.2.9 Cleanouts and access panels shall be sized so as to permit the entry of a full sized rodding head capable of one hundred percent circumferential coverage of the line served.

2.2.10 Provide a non-hardening mixture of graphite and grease on threads of all screwed cleanouts during installation.

2.2.11 Do not install cleanouts against walls, partitions, etc. where rodding will be difficult or impossible. Extend past the obstruction.

2.2.12 In finished walls, floors, etc., insure that cleanouts are installed flush with finished surfaces and, where required, grout or otherwise finish in a neat and workmanlike manner.

2.2.13 Cleanouts shall be as manufactured by Zurn, Josam, Wade, Ancon, Jay R. Smith, similar to the following:

2.2.13.1 Zurn, Z-1440 cleanouts or Z-1445 cleanout tee at base of exposed stack and at change in direction of exposed lines.

2.2.13.2 Zurn, Z-1440 cleanout or Z-1445-1 cleanout tee where stacks are concealed in finished walls.

2.2.13.3 Zurn, ZN-1400-T cleanout with square scoriated top in finished concrete and masonry tile floors.

2.2.13.4 Zurn, ZN-1400-Tx cleanout with square recessed top for tile in vinyl and linoleum finished floors.

2.2.13.5 Zurn, ZN-1400-Z cleanout with round recessed top for terrazzo floors.

2.2.13.6 Zurn, Z-1400-HD cleanout with tractor cover for exterior locations. Provide concrete supporting pad crowned to shed water. Refer to drawings for pad size.

2.2.13.7 Mueller, No. D-731 or D-714, Nibco, Flage or equivalent for cleanouts in copper waste with cover plates and/or access panels listed for other cleanouts.

2.2.13.8 Threaded hex head type cleanouts of same materials as pipe for piping 2" and smaller.

2.2.13.9 Zurn, cleanout with round top with adjustable retainer for carpet area. Install flush with carpet.

2.3 Floor Drains: Provide floor drains at locations indicated and/or as required by State Plumbing/Building Codes. Install in a neat and workmanlike manner. Coordinate locations with appropriate persons or party to insure floor pitch to drain where required.

2.3.1 Install floor drains in strict accordance with manufacturer's recommendations and the State Plumbing and Building Codes unless otherwise indicated.

2.3.2 Each floor drain located on floors above the lowest floor shall be provided complete with a three (3) foot by three (3) foot, four (4) pound sheet lead flashing and clamping collar or chlorinated polyethylene shower pan liner of 30 mil. Lead pans shall be given a heavy coat of asphaltum on bottom and sides before

installation and a heavy coat on exposed surfaces (if any). After installation, provide one ply of fifteen (15) pound roofing felt beneath each pan.

2.3.3 Insure by coordination with the appropriate persons or party that spaces served by a floor drain(s) has a water seal extending at least three (3) inches from the floor of the space served on all floors above the lowest level.

2.3.4 The floor drains shall be Zurn, Josam, Wade, Watts Drainage, Ancon or equivalent, similar to the following:

2.3.5 FD-1 - Zurn, ZN-415 floor drain with 6"dia. nickel bronze strainer, Type "B", dura-coated cast iron body with bottom 3" outlet. Provide with trap primer connection. Provide with 4" Sure Seal Model SS preassembled Inline Floor Drain Trap Sealer. Commercial grade ABS plastic housing and neoprene rubber diaphragm with 1 soft rubber sealing gaskets. Floor rating ASSE – 1072 AF-GW

2.4 Cleanouts (Exterior) (CO): Provide exterior cleanouts at each location indicated and in the manner indicated. Permanently locate all exterior cleanouts with four (4) by four (4) inch solid concrete marker flush with grade labeled "CO". Exterior cleanouts shall be of the type indicated.

2.5 Water Supply Specialties: Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in a neat and workmanlike manner in accordance with the manufacturer's recommendations and the Building Code.

2.5.1 Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.

2.6 Freezeproof Wall Hydrants (FPWH): Provide code approved wall hydrants at each location indicated in a neat and workmanlike manner. Affix tight to walls and insure that the feed piping is on the heated side of the building insulation blanket.

2.6.1 Where hydrants are of handwheel type, remove handwheels and turn over to owners in an envelope labeled "Wall Hydrants" exterior upon completion of the project.

2.6.2 Where hydrants have key operators, turn over at least two (2) keys in an envelope labeled "Wall Hydrants" to owners upon completion of the project.

2.6.3 Where hydrants have lockable boxes, turn over at least two (2) keys in an envelope labeled "Wall Hydrants, Exterior" to owners upon completion of project.

2.6.4 Mount all wall hydrants at least twenty (20) inches above finished exterior grade. Where this is not possible or practical, contact Engineers.

2.6.5 Wall hydrants shall be as follows or equivalent:

2.6.5.1 Zurn 1320 or equivalent, 3/4", with half-turn ceramic cartridge, encased, flush, non-freeze, anti-siphon, automatic draining wall hydrant with key lock and combination backflow preventer/vacuum breaker.

2.7 Hose Bibbs (HB): Provide code approved hose bibbs with vacuum breakers and male threaded spouts at each location indicated, in public toilet rooms and as follows:

2.7.1 Do not install hose bibbs in spaces which do not have existing planned or installed floor drains even if sill cocks are indicated for these areas.

2.7.2 Hose bibbs shall be mounted at eighteen (18) inches above finished floor served.

2.7.3 The hose bibbs shall be Woodford or equivalent similar to the following:

2.7.3.1 HB-Woodford Model BR24 with recessed housing with rough brass finish.

2.8 Boiler Drains (BD): Install 3/4 inch bronze body boiler drains, similar and equivalent to Nibco, No. 72 or 73, as indicated and at the following locations:

2.8.1 At the low point of the plumbing system.

2.8.2 In each hot water heater and/or storage tank.

2.8.3 On each water storage tank.

2.8.4 At each pump suction.

2.8.5 At the low point of each isolatable section of any system carrying water.

NOTE: Install a code approved vacuum breaker where installation on to domestic water system.

2.9 Water Hammer Arrestors (WHA): Provide water hammer arrestors at each location indicated and/or as required to eliminate hydrostatic on the domestic water system. Provide at least one water hammer arrestor at all quick acting valve locations including:

Automatic clothes washers – Type "A"
Mop Basins (downstream of check valve) – Type "A"
Flush valve fixtures – Type "B" (Each toilet room with 1-3 flush valve fixtures shall have its own Type "B" water hammer arrestor)

2.9.1 Multiple Fixtures – Branch Line Less Than 20' Long: The preferred location for a Zurn Shoktrol is at the end of the branch line between the last two fixtures served when the branch lines do not exceed 20' in length, from the start of the horizontal branch line to the last fixture supply on this line.

2.9.2 Multiple Fixtures – Branch Line More Than 20' Long: On branch lines over 20' in length, use two Shoktrols whose capacities total the requirement of the branch. Locate one unit between the last and next to last fixture and the other unit approximately midway between the fixtures.

2.9.3 Water hammer arrestors shall be Zurn, Z-1700, Shoktrol, Smith, Josam, Wade or equivalent. Water hammer arrestors shall be stainless steel, bellows type. Field fabricated capped cylinders shall not be acceptable.

2.9.4 Note: Provide insulating unions where arrestors are of dissimilar material from the piping served (unless piping is non-conducting, such as ABS or PVC).

2.9.5 Schedule:

MARK	MANUFACTURER & MODEL	SIZE (FIXTURE UNITS)	P.D.I. SIZE
TYPE "A"	ZURN, Z-1700 #100	1-11	A
TYPE "B"	ZURN, Z-1700 #200	12-32	B
TYPE "C"	ZURN, Z-1700 #300	33-60	C
TYPE "D"	ZURN, Z-1700 #400	61-113	D

PART 3 - GENERAL SPECIALTIES:

3.1 Vacuum Breakers and Back Flow Preventers: Where required by the Building Code, whether indicated or not, provide approved vacuum breakers or backflow preventers at the following locations.

3.2 Where domestic water system connects to fire protection system.

3.3 At any hose (threaded) tap on the domestic water system.

3.4 At all mop basins, provide check valves to the hot and cold water supply upstream of the faucet.

3.5 Roof Flashings: All plumbing vents or other plumbing passing thru the roof shall be flashed as approved by the State Plumbing and Building Codes and as recommended by the roofing manufacturer and/or Contractor.

END OF SECTION.

DIVISION 22 - PLUMBING

SECTION 220200 - PLUMBING FIXTURES, FITTINGS AND TRIM

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

1.2 The Contractor shall provide all fixtures complete with trim required and connect in a manner conforming to the State Plumbing Code.

1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of his rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.

1.4 Coordinate stainless steel sink with architectural casework shop drawings. Do not order sinks until this has been coordinated.

1.5 Water supplies shall connect through walls with stops and chrome plated escutcheons with set screws. In general, furnish the following with manual loose key stop valves:

1.5.1 Drinking Fountains
1.5.2 Wall-hung Lavatories
1.5.3 Hose Bibbs

For all other fixtures, furnish with manual permanent-key stop valves (ie. sinks in casework, etc.). When in doubt, contact Engineer prior to installation.

1.6 Water supplies shall connect through walls with stops and chrome plated escutcheons with set screws.

1.7 All exposed piping, stops, traps, tailpieces, etc. shall be code approved chrome plated brass unless otherwise indicated or specified. Where acid resistant piping is indicated on the drawing or the specifications, all piping and ancillary components from the sink/lavatory to dilution basin shall be acid resistant acid specified and required by code.

1.8 All fittings, fixtures and trim shall be new unless otherwise indicated or specified. They shall also be of equivalent quality, dimensions, material, etc. as those specified.

1.9 Handicapped fixtures shall be mounted as recommended by the Ohio Building Code and ADA.

1.10 All fixtures shall be mounted as recommended by the manufacturer unless otherwise indicated or specified and so as to be rigid to walls and floors. Pay particular attention to flush valves and bracket concealed portion to building structure during rough-in. Loose, shaky flush valves, lavatories, etc. shall not be acceptable.

1.11 Prior to final inspection open all faucets and allow to run for fifteen (15) minutes, then remove all faucet aerators and thoroughly clean until smooth flow is obtained.

1.12 Prior to final inspection, test by operation at least twice:

1.12.1 (Where applicable) adequate flow of hot and/or cold water at;

1.12.1.1 All Faucets
1.12.1.2 Flush Valves and Tanks
1.12.1.3 Hose Bibbs
1.12.1.4 Sill Cocks
1.12.1.5 All Other Valved Hot and/or Cold Water Openings In the Plumbing System
1.12.1.6 All toilet seats
1.12.1.7 All flush tank overflows

1.13 Prior to final inspection, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from plumbing fixtures and thoroughly clean same.

1.14 All fixtures shall be set level and true and shall be grouted into finished walls, floors, etc. in a neat and workmanlike manner with an approved waterproof non-yellowing grout for such service.

1.15 Special Note for Handicap Grab Rails: Coordinate top of shower valves, flush valves, flush tank, etc., with location of grab rails as shown on the architectural plans. The Contractor shall install all items to allow for installation, removal and service without removal of the grab bar.

1.16 Available Manufacturers: Subject to compliance with requirement's manufacturers offering plumbing fixtures and trim which may be incorporated in the work include the following:

1.16.1 Plumbing Fixtures - Water Closet, Lavatory and Urinal

1.16.1.1 American Standard, U.S. Plumbing Products
1.16.1.2 Briggs
1.16.1.3 Crane Plumbing
1.16.1.4 Eljer Plumbingware Div., Wallace-Murray Corp.
1.16.1.5 Kohler Co.
1.16.1.6 Universal-Rundle
1.16.1.7 Zurn

1.16.2 Plumbing Trim

1.16.2.1 American Standard, U.S. Plumbing Products
1.16.2.2 Chicago Faucet Co.
1.16.2.3 Kohler Co.
1.16.2.4 Delta Co.
1.16.2.5 T&S Brass & Bronze Work Co.
1.16.2.6 Just Co.
1.16.2.7 Speakman Co.
1.16.2.8 Zurn Aqua-Spec

1.16.3 Flush Valves

1.16.3.1 Sloan Valve Co.
1.16.3.2 Zurn Co.
1.16.3.3 Delaney

1.16.4 Fixture Seats

1.16.4.1 Bemis Mfg. Co.
1.16.4.2 Church Seat Co.
1.16.4.3 Olsonite Corp., Olsonite Seats

1.16.5 Fixture Carriers

1.16.5.1 Josam Mfg. Co.
1.16.5.2 Kohler Co.
1.16.5.3 Tyler Pipe
1.16.5.4 Zurn Industries
1.16.5.5 Wade

1.16.6 Ice Machine Connection Box

1.16.6.1 Guy Gray Co.
1.16.6.2 Oatley, Inc.
1.16.6.3 Wolverine Brass, Inc.

PART 2 – SELECTION

P-1 Water Closet – Flush Valve, Wall Mounted – ADA Height

Zurn model Z5615-BWL vitreous china, elongated rim, siphon action water closet. Provide 1½" top spud, solid plastic elongated seat with open front, extended back, and check hinge. Provide with concealed carrier. Mount seat at 18" AFF. Install flush valve on "open" side of water closet. Water closet flush valve shall be as follows:

- Manual ADA flush valve shall be Zurn model Z6000-WS1. Top of flush valve handle shall be a maximum of 31-1/4" A.F.F.

P-2 Lavatory – Wall-hung, Backsplash – ADA Compliant

Zurn model Z5344, 20"x18" vitreous china lavatory with backsplash, rectangular basin, splash lip, front overflow, and 4" center faucet holes. Provide with concealed arm support and wall carrier. Provide lavatory drain with integral perforated strainer, 3/8" angle rigid supplies with stops and P-trap. Install insulation on the supply lines and P-trap similar to Brocar "Trap Wrap" vinyl plastic covering per ADA Standards. Mounting height to be per ADA. Lavatory trim shall be as follows:

- Self-metering faucet shall be Zurn model Z86100-CP4-3M with polished chrome-plated cast brass body, single inlet, 3-3/4" centerline spout, and vandal resistant push-button handle. Furnish with vandal resistant 0.5 GPM aerator and 4" cover plate. Furnish and install Wilkins model ZW3870 tempering mixing valve.

P-3 Ice Maker Connection Box

IPS Corporation Water-Tite mini round ice maker outlet box with integral water hammer arrestor and preloaded nails. Connect cold water supply line to water supply at adjacent sink. Field paint exposed portions of box to match adjacent wall surfaces.

P-4 Drinking Fountain – ADA - Exterior

Elkay model LK4430BF1U barrier free, bi-level, pedestal mounted drinking fountain with bottle filler. Fountain shall have powder coated steel finish, stainless steel bowls, heavy duty galvanized welded steel pedestal, front mounted self-closing activation buttons, polished chrome non-squirt bubblers, and vandal resistant access door.

P-5 Drinking Fountain – ADA – Exterior, Wall Hung

Elkay model LK4405 barrier free, single level, wall mounted drinking fountain. Fountain shall have powder coated steel finish, stainless steel bowl, heavy duty galvanized welded steel wall bracket, front mounted self-closing activation buttons, polished chrome non-squirt bubblers, and vandal resistant access door.

END OF SECTION.

DIVISION 23 - HVAC

SECTION 230200 - HVAC EQUIPMENT

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

1.2 The Contractor shall provide in complete working order the following heating, ventilation and air conditioning equipment located as indicated and installed, connected and placed in operation in strict accordance with the manufacturer's recommendations. All equipment shall be factory painted and, where applicable, factory insulated and shall, where such standards exist, bear the label of the Underwriters Laboratory.

1.3 All HVAC equipment shall comply with the latest provisions of ASHRAE Standard 90 and all provisions of the International Energy Conservation Code.

1.4 Note to Suppliers and Manufacturers Representative furnishing proposals for equipment for the project:

1.4.1 Review the Controls Section of these Specifications (if applicable) to determine controls to be furnished by the equipment manufacturer, if any.

1.4.2 All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.

1.4.3 Review the section of these specifications entitle: REQUIRED SHOP DRAWINGS, DESCRIPTIVE LITERATURE, MAINTENANCE MANUALS, PARTS LISTS, SPECIAL KEYS, TOOLS, ETC., and provide all documents called for therein.

1.4.4 Ensure that the equipment which you propose to furnish may be installed, connected, placed in operation and easily maintained at the location and in the space allocated for it.

1.4.5 Review all documents as indicated in Paragraph "1.1" preceding.

1.4.6 Determine from the Bid Documents the date of completion of this project and insure that equipment delivery schedules can be met so as to allow this completion date to be met.

1.4.7 Electric motors shall be furnished with the equipment and shall be of the size and type scheduled or otherwise specified. All motors shall be UL labeled and shall comply with applicable NEMA standard. Motors shall be high efficiency type. Refer to Section 250100.

1.4.8 Review the Section on Motor Starters and Electrical Requirements for Mechanical Equipment.

1.4.9 Where manufacturer’s temperature controls are specified, they shall be in full compliance with NFPA 90-A including automatic smoke shut down provisions.

1.4.10 For all belt driven equipment, provide final fan and motor sheaves as determined by the air balance contractor during project balancing phase. The mechanical contractor shall install any new sheaves and belts as required for balancing and smooth startup without any noticeable squealing.

PART 2 – EQUIPMENT:

2.1 Refer to drawings and schedules for requirements.

END OF SECTION.

DIVISION 23 - HVAC

SECTION 231100 - REGISTERS, GRILLES, DIFFUSERS & LOUVERS

PART 1 - REGISTERS, GRILLES AND DIFFUSERS:

1.1 GENERAL

1.1.1 Alternate R, G & D selections, other than manufacturers and models listed below, will be accepted, provided quality, function and characteristics are equivalent. Acceptable alternates are Metalaire, Anemostat, Price, Titus, Carnes, Nailor Industries and Tuttle & Bailey. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes shall be selected by the Architect. If Architect elects not to select color, all colors shall be white. Factory color samples shall be submitted with shop drawings.

1.1.2 Include with the shop drawings a room-by-room schedule indicating devices installed. Also note ceiling types and installations.

PART 2 – SELECTION:

2.1 Refer to drawings for schedule.

PART 3 – LOUVERS:

3.1 GENERAL

3.1.1 RELATED DOCUMENTS

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

3.1.2 SUMMARY

3.1.2.1 Section Includes:

3.1.2.2 Fixed, extruded-aluminum exterior wall louvers.

3.1.3 DEFINITIONS

3.1.3.1 Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

3.1.3.2 Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

3.1.3.3 Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

3.1.4 PERFORMANCE REQUIREMENTS

3.1.4.1 Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

3.1.4.1.1 Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft., acting inward or outward.

3.1.4.2 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

3.1.4.2.1 Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

3.1.4.2.2 Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

3.1.5 SUBMITTALS

3.1.5.1 Provide separate and distinct submittals with separate transmittal forms for each of the buildings covered by these specifications. Combined submittals will be returned without review.

3.1.5.2 Product Data: For each type of product indicated.

3.1.5.2.1 For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

3.1.5.3 Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

3.1.5.4 Samples for Initial Selection: For units with factory-applied color finishes.

3.1.5.5 Samples for Verification: For each type of metal finish required.

3.1.5.6 Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

3.1.6 QUALITY ASSURANCE

3.1.6.1 Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

3.1.6.2 Welding: Qualify procedures and personnel according to the following:

3.1.6.2.1 AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

3.1.6.3 SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

3.1.7 PROJECT CONDITIONS

3.1.7.1 Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

3.2 PRODUCTS

3.2.1 MATERIALS

3.2.1.1 Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

3.2.1.2 Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise

recommended by metal producer for required finish.

3.2.1.3 Fasteners: Use types and sizes to suit unit installation conditions.

3.2.1.3.1 For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

3.2.1.3.2 For color-finished louvers, use fasteners with heads that match color of louvers.

3.2.1.4 Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

3.2.1.5 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

3.2.2 FABRICATION, GENERAL

3.2.2.1 Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

3.2.2.2 Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

3.2.2.3 Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.

3.2.2.4 Maintain equal louver blade spacing to produce uniform appearance.

3.2.2.5 Fabricate frames, including custom sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

3.2.2.5.1 Frame Type: Channel.

3.2.2.6 Include supports, anchorages, and accessories required for complete assembly.

3.2.2.7 Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

3.2.2.7.1 Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.

3.2.2.8 Provide custom brake-formed loose sills, made of aluminum, 1/8-inch thick, as indicated on the Drawings for drainage to exterior and to prevent water penetrating to interior. Provide sills with same finish as louvers.

3.2.2.9 Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

3.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

3.3.1 Horizontal, Drainable-Blade Louver:

3.3.1.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- Airolite Company, LLC (The).
- American Warming and Ventilating, Inc.; a Mestek company.
- Arrow United Industries.
- Construction Specialties, Inc.
- Greenheck Fan Corporation.
- Industrial Louvers, Inc.
- Nystrom Building Products/Airline Louvers.
- Reliable Products, Inc.
- Ruskin Company; Tomkins PLC.

3.3.1.2 Louver Depth: 6 inches.

3.3.1.3 Frame and Blade Nominal Thickness: Not less than 0.080 inch

3.3.1.4 Blade Angle: 45 degrees.

3.3.1.5 Louver Performance Ratings:

3.3.1.5.1 Free Area: Not less than 7.0 sq. ft. for 48-inch- wide by 48-inch- high louver.

3.3.1.5.2 Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area intake velocity.

3.3.1.5.3 Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 700 fpm.

3.3.1.6 AMCA Seal: Mark units with AMCA Certified Ratings Seal.

3.3.2 LOUVER SCREENS

3.3.2.1 General: Provide screen at each exterior louver.

3.3.2.1.1 Screen Location for Fixed Louvers: Interior face.

3.3.2.1.2 Screening Type: Bird screening.

3.3.2.2 Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

3.3.2.3 Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

3.3.2.3.1 Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.

3.3.2.3.2 Finish: Mill finish.

3.3.2.3.3 Type: Rewirable frames with a driven spline or insert.

3.3.2.4 Louver Screening for Aluminum Louvers:

3.3.2.4.1 Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

3.3.3 FINISHES, GENERAL

3.3.3.1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

3.3.4 ALUMINUM FINISHES

3.3.4.1 Finish louvers after assembly.

3.3.4.2 High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3.3.4.2.1 Color and Gloss: The Architect will select a PPG Duranar (Basis of Design) regular coating, custom color. Color will not be an exotic, XL or XL Exotic coating. Each building may have up to two colors for louvers,

3.4 EXECUTION

3.4.1 EXAMINATION

3.4.1.1 Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

3.4.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.4.2 PREPARATION

3.4.2.1 Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.4.3 INSTALLATION

3.4.3.1 Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

3.4.3.2 Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

3.4.3.3 Form closely fitted joints with exposed connections accurately located and secured.

3.4.3.4 Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

3.4.3.5 Protect aluminum surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.4.4 ADJUSTING AND CLEANING

3.4.4.1 Clean exposed surfaces of louvers that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

3.4.4.2 Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

3.4.4.3 Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

3.4.4.4 Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.4.5 SELECTION

3.4.5.1 Refer to drawings for schedule

END OF SECTION.

DIVISION 23 - HVAC

SECTION 231200 - SHEET METAL AND FLEXIBLE DUCT

PART 1 – GENERAL:

1.1 The Contractor's attention is directed to the General and Special Conditions, General Requirements-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

1.2 This branch of the work includes all materials, labor and accessories for the fabrication and installation of all sheet metal work as shown on the drawings and/or as specified herein. Where construction methods for various items are not indicated on the drawings or specified herein, all such work shall be fabricated and installed in accordance with the recommended methods outlined in the latest edition of SMACNA's Duct Manual and Sheet Metal Construction for Low Velocity Ventilating and Air Conditioning Systems. These references and plate numbers shall be used by the Engineer for required sheet metal thicknesses and final acceptance of methods of fabrication, hanging, accessories, etc. All equipment furnished by manufacturers shall be installed in strict accord with their recommended methods.

1.3 All ductwork stored on site shall be maintained dry and clean. All stored ductwork shall be covered and ends shall be capped. After duct is installed open ends shall be capped with plastic. It is the responsibility of the Contractor to maintain a clean duct system. If system is soiled this Contractor shall be responsible for having ductwork cleaned by a NADCA Certified Contractor.

1.4 Ductwork and piping shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4” above the floor and shall be completely covered in plastic. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not “dried-in”. If this is required, the entire lengths of duct shall be covered in plastic to protect. The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.

1.5 Prior to purchase and fabrication of ductwork (shop fabricated or manufactured), the Contractor shall coordinate installations with new and existing conditions. Notify the Engineer if there are any discrepancies for resolution.

PART 2 - LOW VELOCITY DUCTWORK:

2.1 GENERAL (LOW VELOCITY)

2.1.1 Double turning vanes shall be installed in square turns and/or where indicated.

2.1.2 Provide a “high efficiency” type take-off with round damper (Flexmaster STOD-B03 or approved equal) for all round duct branches from a rectangular main to a GRD. Refer to the detail on the drawings for all installation requirements. Approved Manufacturers: Flexmaster, Dampers Express, and the Ductor Shop.

2.1.3 Cross-break all ducts where either cross sectional dimension is 18" or larger.

2.1.4 Air volume dampers shall be installed in each duct branch takeoffs and/or where indicated, whichever is more stringent. All such dampers shall be accessible without damage to finishes or insulation and shall be provided where required for proper system balance.

2.1.5 Unless otherwise dimensioned on the drawings, all diffusers, registers and grilles shall be located aesthetically and symmetrically with respect to lighting, ceiling patterns, doors, masonry bond, etc.

2.1.6 The interior surface of the ductwork connecting to return/exhaust air grilles shall be painted flat black. The ductwork shall be painted a minimum of 24" starting from the grille.

2.1.7 Ducts shall be hung by angles, rods, 18 ga. minimum straps, trapezes, etc., in accordance with SMACNA's recommended practices. There shall be no less than one set of hangers for each section of ductwork. Where ductwork contains filter sections, coils, fans or other equipment or items, such equipment or items shall be hung independently of ductwork with rods or angles. Do not suspend ducts from perlins or other weak structural members where no additional weight may be applied. If in doubt, consult the structural engineer.

2.1.8 Provide approved flexible connectors at inlet and outlet of each item of heating and cooling equipment whether indicated or not. Install so as to facilitate removal of equipment as well as for vibration and noise control.

2.1.9 All ductwork connections, fittings, joints, etc., shall be sealed. Seal with hardcast "Irongrip 601". Apply per manufacturer's recommendations. Acceptable manufacturers': Hardcast, Duro-Dyne and Galvagrip.

2.1.10 Duct dimensions indicated are required inside clear dimensions. Plan duct layouts for adequate insulation and fitting clearance.

2.1.11 All angular turns shall be made with the radius of the center line of the duct equivalent to 1.5 times the width of the duct.

2.1.12 Miscellaneous accessories such as test openings with covers, latches, hardware, locking devices, etc., shall be installed as recommended by SMACNA and/or as indicated. Test openings shall be placed at the inlet and discharge of all centrifugal fans, VAV boxes, fan sections of air handling units, at the end and middle of all main trunk ducts and where indicated. All such openings shall be readily accessible without damage to finishes.

2.1.13 Whether indicated or not, provide code approved, full sized fire dampers at all locations where ductwork penetrates fire rated walls. Fire stop rating shall meet or exceed the rating of the wall. Provide an approved access panel at each fire damper located and sized so as to allow hand reset of each fire dampers. All such fire dampers and access panels shall be readily accessible without damage to finishes. Refer to Architectural Plans for locations of fire rated walls. All access doors shall be 16"x16" or as high as ductwork permits and 16" in length.

2.1.14 The Contractor who installs the sheet metal shall furnish to the Air Balancing Contractor, a qualified person to assist in testing and balancing the system.

2.1.15 Locate all supply, return and exhaust diffusers and grilles in the locations shown on the architectural reflected ceiling plan.

2.1.16 All fans and other vibrating equipment shall be suspended by independent vibration isolators.

2.2 MATERIALS (LOW VELOCITY)

2.2.1 Ductwork, plenums and other appurtenances shall be constructed of one of the following: (Except MRI Scan Rooms – only use aluminum in the MRI Scan Rooms)

2.2.1.1 Steel sheets, zinc coated, Federal Specification 00-S-775, Type I, Class E & ASTM A93-59T with G-90 zinc coating.

2.2.1.2 Aluminum alloy sheets 3003, Federal Specification AA-A-359, Temper H-14.

2.2.2 Ductwork, plenums and other appurtenances shall be constructed of the materials of the minimum weights or gauges as required by the latest SMACNA 2" W.G. Standard or below table. When gauge thickness differs, the heavier gauge shall be selected. The below table shall serve as a minimum.

Round Diameter	Duct Gauge	Rectangular Width	Duct Gauge
3-12 Inches	26 Ga.	3-12 inches	26 Ga,
12-18 Inches	24 Ga.	13-30 inches	24 Ga.
19-28 Inches	22 Ga.	31-54 inches	22 Ga.
29-36 Inches	20 Ga.	55-84 inches	20 Ga.
37-52 Inches	18 Ga.	85 inches and up	18 Ga.

2.2.3 Insulated Flexible Air Duct (Use Only Where Indicated)

2.2.3.1 Thermaflex G-KM or equal. Flexible air duct shall be one (1) inch thick fiberglass insulation with CPE liner permanently bonded to a coated spring steel wire helix supporting a fiberglass scrim and fiberglass insulating blanket. Flexible air duct shall be listed under UL Standard 181 as a Class I flexible air duct complying with NFPA 90A and 90B. Maximum flame spread = 25 and maximum smoke developed = 50. Minimum insulating value is R-4.2. Flexible duct shall be used only for GRD runouts and no section shall be more than five feet in length. Acceptable manufacturers: Thermaflex, Atco, Flex Master.

2.3 MISCELLANEOUS (LOW VELOCITY)

2.3.1 Flexible Connectors: Duro-Dyne, Ventfabrics, Inc., U.S. Rubber or equivalent; conforming to NFPA No. 90A; neoprene coated glass fabric; 20 oz. for low velocity ducts secured with snap lock.

2.3.2 Turning Vanes: Fabricated as recommended by SMACNA: noiseless when in place without mounting projections in ducts. All turning vanes shall be double blade type.

2.3.3 Access Doors in Ductwork: Flexmaster TBSM, Air Balance, Vent Products or equal. Access doors for rectangular ducts shall be 16"x16" where possible. Otherwise install as large an access door as height permits by 16" in length. Door shall be 2" thick double-wall insulated with continuous hinge and cam lock. Provide in ducts where indicated or where required for servicing equipment whether indicated or not. Provide a hinged access door in duct adjacent to all fire, smoke and control dampers for the purpose of determining position. Access doors shall also be provided on each side of duct coils and downstream side of VAV boxes and CAV boxes.

2.3.4 Access Doors in Ceilings or Walls: Provide Kees D Panel, Cesco, Milcor or equal. 24"x24", 16 gauge galvannealed steel door and frame with primer finish to accept specified finish, 3 screwdriver operated cam latches and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors. For fire rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.

2.3.5 Volume Dampers (Rectangular): Leader MO3 or Empco, Air Balance, Louvers and Dampers, Cesco, Ruskin, Pottorff, Greenheck, rectangular volume dampers. Frames shall be 18 gauge galvanized steel. Blades shall be opposed blade 18 gauge galvanized steel with triple crimped blades on 6" centers. Linkage shall be concealed in jamb. Bearings shall be ½" nylon. Maximum single section size shall be 48" wide and 72" high. Provide with Ventfabrics 1" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.

2.3.6 Volume Dampers (Round): Leader BR-4 or Empco, Air Balance, Louvers and Dampers, Cesco, Ruskin, Pottorff, Greenheck round volume dampers. Dampers shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 22 gauge steel and 5" long. Damper blades shall be 20 gauge crimped galvanized steel. Axle shall be 3/8"x5" square plated steel. Bearing shall be 3/8" nylon. Provide with

Ventfabrics 1" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.

END OF SECTION.

DIVISION 25 – BUILDING AUTOMATION SYSTEM

SECTION 250100 - ELECTRIC MOTORS, MOTOR STARTERS AND OTHER ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 – GENERAL:

1.1 Prior to ordering any materials or rough-in of any kind, the Mechanical Contractor shall be responsible for final coordination of all electrical requirements (i.e. voltage, phase, circuit breaker, wire sizing, etc.) with the Electrical Contractor .

1.2 There will be no change in the Contract Amount for discrepancies.

1.3 A final coordination meeting shall be held with the Architect, Owner, Engineer, Construction Manager, Mechanical Contractor, Electrical Contractor and their sub-contractors.

PART 2 - MOTORS:

2.1 The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

2.2 Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

2.3 Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

2.4 Temperature Rating: Rated for 40 deg. B environment with maximum 50 deg. C temperature rise for continuous duty at full load (Class B Insulation).

2.5 Starting capability: frequency of starts as indicated by automatic control system and not less than 5 evenly time spaced starts per hour for manually controlled motors.

2.6 Service Factory: 1.15 for poly-phase motors and 1.35 for single phase motors.

2.7 Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

2.8 Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.

2.9 Provide inverter rated motors where variable frequency drives are utilized. Motor shall be premium efficiency type with Class F insulation.

2.10 Bearings:

2.10.1 Ball or roller bearings with inner and outer shaft seals;

2.10.2 Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance;

2.10.3 Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

2.11 Enclosure Type:

2.11.1 Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;

2.11.2 Guarded drip-proof motors where exposed to contact by employees or building occupants;

2.11.3 Weather protected Type I for outdoor use, Type II where not housed;

2.12 Overload protection: Provide built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

2.13 Efficiency: Provide "Energy Efficient" motors with a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a minimum efficiency as listed below:

1 HP	85.5% Eff'y	10 HP	91.7%
1-1/2 to 2 HP	86.5%	15 HP	93%
3 HP	89.5%	20 HP	93%
5 HP	89.5%	25 HP and up	94%
7-1/2 HP	91.0%		

2.14 Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

PART 3 - MOTOR STARTERS-GENERAL:

3.1 Provide motor starters where indicated on the mechanical equipment schedules or elsewhere in the contract documents.

3.2 Motor starters shall be NEMA style. Their sizing and installation shall be coordinated with the equipment manufacturer's requirements and in accordance with the National Electrical Code.

3.3 All starters shall be size 0 minimum. They shall be constructed and tested in accord with latest edition of NEMA standards. All starters shall be across-the-line magnetic type, unless indicated otherwise. On motors of 20 H.P. or greater rating, the supplier should provide starters capable of limiting inrush currents. These shall be of the wye-delta, 2 speed-2 winding, or reduced voltage open-transition type, as required. Do not utilize closed transition starters unless specifically indicated.

3.4 Magnetic starters shall be furnished with the following characteristics and accessories as a minimum. See other sections of these specifications and mechanical schedules for further requirements.

3.4.1 Contacts shall be silver-alloy, double-break type except NEMA size 8 and 9 shall be single-break type. Contacts shall be replaceable without removal of wiring or removal of starter from enclosure. Number of contacts shall be as required for service indicated. Contacts shall be gravity dropout type, positive operation.

3.4.2 Coil voltage shall be 120 volts, A.C., 60 HZ or less, as required to suit control systems available voltages. Coils shall be of molded construction, except for size 8 and 9 which shall be hand wound. Provide coil clearing contact as required.

3.4.3 Provide control transformer of adequate K.V.A. as required on all starters with line-to-line voltages higher than 120 volts A.C. Provide fuse block and slow-blow fuse to protect control transformer per NEMA, N.E.C. and U.L.

3.4.4 Provide hand-off-auto selector switch in face of starter, wired into hand and off switch positions. Auto position (if needed) to be field wired as indicated on plans or schedules for automatic control.

3.4.5 Provide NEMA Class 20 resetable overload relays, accurately sized to the motor nameplate rating of the motor served and the temperature differential between motor and controller. Overloads shall be easily

replaceable, and resetable without opening enclosure, via a push button or similar means. Class 10 or Class 30 overloads may be used depending on type of motor duty encountered.

3.4.6 Provide at least one N.O. auxiliary contact (field-convertible to N.C. operation) with each starter. Refer to mechanical details or schedules for additional requirements, if any. All starters shall have space for two additional single-pole contacts.

3.4.7 All starters shall be thru-wiring type.

3.4.8 Provide phase failure sensing relay to open starter coil circuit (on loss of one or more phases) on all three-phase starters controlling motors of 7½ H.P. or larger.

PART 4 - ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT:

4.1 All mechanical equipment shall be provided for single point electrical connection unless specifically noted to the contrary.

4.2 The equipment manufacturer shall provide internally mounted fuses with his equipment, as required, to comply with the U.L. listing on the equipment name plate. (i.e., hermetically sealed compressors or equipment with name plate data that recommends or requires fuse protection.) See also, National Electrical Code, Article 440, Part C, and other applicable sections of the N.E.C.

4.3 It shall be the Contractor's responsibility to assure that all mechanical equipment requiring electrical connections be provided with all required proper wiring, electrical protective devices, disconnecting means and electro-mechanical starting units to properly match the mechanical equipment requirement. Each separate contractor engaged for the project shall coordinate with all other trades to ensure all necessary equipment and labor is included for fully functioning mechanical systems, installed per code requirements.

4.4 Refrigeration condensing units with internal compressors shall be furnished with integral starter.

4.5 All interlock or other control wiring, unless specifically noted otherwise, is the responsibility of this Contractor.

4.6 All equipment shall be suitably enclosed. All enclosures for equipment shall be rated and approved for the environment in which it operates. (i.e., NEMA 1, NEMA 3R, NEMA 7, NEMA 12, etc.) Verify the requirement with the installation condition if not indicated on the plans.

4.7 Observe the following standards for manufacture of equipment and in selection of components:

4.7.1 Starters, control devices and assemblies: NEMA - (I.E.C. style not acceptable)

4.7.2 Enclosures for electrical equipment: NEMA

4.7.3 Enclosed switches: NEMA

4.7.4 All electrical work, generally: NFPA 70

4.7.5 All electrical work in industrial occupancies: J.I.C. standards

4.7.6 All electrical components and materials: U.L. listing required.

4.8 Where scheduled on the drawings, provide disconnect switches and contactors. Disconnect switches to be fusible type or circuit breaker type.

PART 5 - REQUIREMENTS FOR MECHANICAL EQUIPMENT 3/4 H.P. OR LESS:

5.1 This section describes requirements for small mechanical equipment such as (but not limited to) package terminal heating/cooling units, water source heat pumps, VAV boxes, unit heaters, vertical and horizontal unit ventilators, exhaust fans, in-line fans, fan coil units, cabinet heaters, DDC temperature control panels, etc.

5.2 Small equipment with motor(s) of 3/4 H.P., single phase or less are generally not required to be furnished with starter(s), unless otherwise noted.

5.3 For such equipment, provide integral contactor or horsepower-rated relay where controlled by thermostat or other type of switch. Contactors or relays shall be as recommended by the manufacturer of the equipment.

5.4 Provide transformer within unit as required to provide low voltage A.C. for thermostat control.

5.5 Provide internal fusing for unit motor and other loads in fuse block or in-line fuseholder. See also Article 2.2, this Section.

5.6 Where externally-mounted disconnecting means is required and would be impractical, unsightly or inappropriate in the judgment of the Engineer, disconnects shall be located within the unit. These disconnects may be fusible H.P.-rated snap switches or manual starters with overload elements, as required. Locate this and other electrical equipment within enclosure where easily accessible behind access panel or door on unit, and as acceptable to the electrical inspector or local authority having jurisdiction. Refer to mechanical equipment schedules for further information.

END OF SECTION.

DIVISION 25 – BUILDING AUTOMATION SYSTEM

SECTION 250400 – TEMPERATURE CONTROLS

PART 1 – GENERAL

1.1 The bid for Temperature Controls for this project shall include an allowance. Refer to bid documents for allowance. Schneider Electric shall furnish and install building controls and to fully integrate the new temperature controls system for this project into the existing TAC-VISTA server/front-end system in the Physical Plant. It is the responsibility of the contractor to coordinate with the temperature control contractor schedules and scope of work. The TCC shall be a subcontractor to the mechanical contractor.

1.2 The temperature controls for this project shall fully integrate to the existing the TAC-VISTA front end system in the Physical Plant. NKU has an on-going service contract with Schneider Electric. The building control system specified herein shall communicate with the TAC-VISTA system via LON protocol. See Section 6 for LON Protocol and LAN communication requirements. Interface and graphics generation on the university's DDC system server is included in this project and shall be consistent with the existing.

1.3 The direct digital control system specified for this project shall seamlessly interface to the existing TAC-VISTA Building Energy Management System Operator Workstations.

1.4 All application specific controllers on all network controllers shall be configurable, commissionable and downloadable through the Server or Supervisor Network Automation Engine IP connection.

1.5 All unitary and field controllers shall be commissioned, uploadable and downloadable from the university host network automation engine. LON object descriptions that are a jumble of letter/numbers are not acceptable.

1.6 The temperature control system shall be a web based system.

1.7 A pre-programming meeting shall be held with the TCC, Engineer, Owner and TAC-VISTA to discuss program variable names, room name scheme LON SNVT's and system structure.

1.8 All controllers, control interface hardware, services, installation, warranty, training, etc., shall be included as hereinafter specified.

1.9 The Temperature Control Contractor (TCC) shall provide all items, articles, materials, devices, operations or methods listed, mentioned or scheduled on the drawings including all labor, materials, equipment and incidentals necessary and required for their completion to provide a complete and operating temperature control system. This will include connecting to any mechanical equipment furnished with a control interface device and contacting the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished.

1.10 The system shall be a complete electronic DDC (Direct Digital Control) temperature control system utilizing "unitary" type controllers. Including such minor details not specifically mentioned or shown, as may be necessary for the complete operation of the system.

1.11 These apparatus' shall consist of, but not limited to, all necessary thermostats, sensing devices, valves, automatic dampers, damper motors, actuators, (except automatic dampers, valves, and damper motors furnished with HVAC equipment), and with the necessary accessories for the complete control of all equipment hereinafter specified.

1.12 Control sequences are specified at the end of this section. Provide all control equipment required to perform sequences described.

1.13 Provide all power wiring necessary for the operation of panels, etc., is to be included as work of this section. Refer to electrical specifications.

1.14 Acceptable Manufacturer's: TAC-VISTA by Schneider Electric Cincinnati Branch Contact: Ron Epp (513) 770-5716 or ron.epp@schneider-electric.com,

1.15 It will be the responsibility of TAC-VISTA to implement this project onto the university's server at the Physical Plant office. Any computer connected to the WAN, utilizing a web browser and having the proper password shall be able to communicate with the university's DDC system.

PART 2 – SUBMITTALS:

2.1 Shop drawing submittals shall include submittal data on every item of the temperature control system that is to be used. This is to include model and part numbers of all devices of the entire control system.

2.2 Submittals must include a complete points list of all necessary points and point types that will be provided by LON objects implemented into the universities TAC-VISTA system. (This will include any pseudo type points as well as all hard wired points). LON object descriptions are to include the equipment and type of point.

2.3 Submittals shall include a written operating sequence, unitary control wiring, building floor plans showing communicating cabling and labels, as well as logic flow diagrams.

2.4 Submittals shall include the agenda for approval by the engineer and owner of the specified training periods in one hour intervals. (see training section).

2.5 Submittals will include part numbers and manufacturer of all cabling that will be used. (indicate size and intended use).

2.6 Submittals shall include the manufactures recommended grounding procedure for all communication and device cabling.

2.7 The submittal process must be complete before any installation may begin.

2.8 Record Documents:

2.8.1 Provide a complete set of control drawings with as-installed equipment and operating sequences on paper and in electronic format (Visio 2000 or AutoCAD v. 2000 or higher versions). "As-built" (i.e., as-installed and debugged and after system acceptance) documentation shall include the following as minimum:

- All data specified in the shop drawings and submittals in their final "as-built" form.
- Schematic outline of the overall control system for quick reference.
- Adequate record of the work as installed, including exact location of control panels.
- Electronic files shall include sequence of operation.
- System hardware specification data, which provides a functional description of all hardware components.
- System engineering information, which provides all of the information for the system set-up, definition and application.
- System database information that provides the point names and application data programmed into the controllers.
- All of the information, data, procedures and drawings shall be supplied in the form of manuals and electronic copies where applicable.

2.8.2 Provide as-installed (after system acceptance) control logic diagrams showing all points (real and virtual).

2.8.3 DDC systems that use line-based programming must reference line code number with control logic diagrams and/or with sequence of operation text. Control Contractor shall discuss final format with owner.

2.8.4 For application oriented control units, provide sequence of operation text and answers to menu-driven configuration software.

2.8.5 Provide licensed electronic copies of all software provided by allowance. This includes, but is not limited to: project graphic images (editing/modifying/creating), project database, trouble-shooting and debugging programs, project-specific programming code and all other software required to operate and modify the programming code (including software at system level, primary control units, secondary control units, and all communication software). Any hardware devices (cables, protection devices) required to operate the software/hardware shall also be provided.

2.8.6 The Control Contractor shall document deviations from the shop drawing submittals. Documentation should include what equipment was changed and the reason for the change.

2.8.7 Provide copy of final test reports.

2.9 Operating and Maintenance Materials

2.9.1 Provide operation and maintenance data on all equipment requiring service or adjustment.

2.9.2 Operation and Maintenance Manuals: Provide three complete sets of manuals bound in loose-leaf binders. Final copies delivered shall include all modifications made during installation, checkout, and acceptance.

2.9.3 Manuals shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and have nearest service representatives for each item of equipment and each system.

2.9.4 Identify each manual's content on the cover. Place tab sheets at beginning of each chapter or section and at beginning of each appendix. Operation and Maintenance Manuals to include software manual, operations manual, maintenance manual, and acceptance manual.

2.9.4.1 Software Manual: The software manual shall describe all furnished software. The manual shall be oriented to programmers and shall describe calling requirements, data exchange requirements, data file requirements, and other information necessary to enable proper integration, loading, testing, and program execution. Provide one software manual per Host Terminal. Hard copy or CD-ROM acceptable.

2.9.4.2 Operator's Manual: The operator's manual shall provide all procedures and instructions for operation of the system, including, but not limited to:

- General description including an overview of the system, its organization, the concepts of networking and central site/field hardware relationships.
- DDC panels and peripherals.
- System start-up and shutdown procedures.
- Use of system, command, and applications software.
- Alignment and calibration procedures.
- Alarm presentation and reports
- Recovery and restart procedures.
- Report generation
- System schematic graphics
- Establish set-points and schedules
- Download and upload information to or from field hardware
- Generate, collect, and review trends
- Back up system software and data files and

- Interface with third party software (e.g., Excel, Netscape).

2.9.4.3 Maintenance Manual: The maintenance manual shall include: Provide descriptions of maintenance for all equipment including:

- Inspection
- Periodic preventive maintenance
- Fault diagnosis
- Repair or replacement of defective components
- Emergency procedures for failure or fire
- Disassembly and shutdown procedures
- Maintenance instructions for each piece of equipment
- Proper lubricants and lubricating instructions
- Cleaning, replacement and/or adjustment schedule

2.9.4.4 Provide a Bill of Materials with each schematic drawing. List all devices/equipment and match to schematic and actual field labeling. Provide quantity, manufacturer, actual product ordering number, description, size, accuracy, operating ranges (voltage, temperature, pressure, etc.), input/output parameters, etc.

2.9.4.5 Field copies of wiring for Primary and Secondary Control Units. (Laminated and permanently affixed in or above controller).

2.9.4.6 For all equipment not manufactured by the Control Vendor, the Control Vendor shall provide an alphabetical list of system components with the name, address and 24-hour telephone number of the company responsible for servicing each item during the first two years of operation.

PART 3 - MAINTENANCE MANUAL/MAINTENANCE TOOLS:

3.1 Operating instructions, maintenance procedures, parts and repair manuals shall be supplied. Repair manuals shall include detailed instructions in the setup, calibration, repair and maintenance of all equipment furnished. Also supplied with these manuals will be a complete parts listing of all devices supplied which is to include part numbers and model numbers of all parts and component parts along with exploded views of devices. A hard copy of the entire database shall also be furnished.

3.2 Wiring and control diagrams shall be as installed. This means as-built drawings, not design (submittal) drawings.

3.3 All as built drawings (Wiring Diagrams, Flowcharts, and Floor plans) shall be supplied to the owner on AutoCad. (Compact Disc).

3.4 Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving. Software shall be "IBM compatible".

PART 4 – WARRANTY:

4.1 The temperature control system shall be free from defects in workmanship and material for a period of twelve months from substantial completion of project. If during this period from the signed (see below) date of final acceptance, any of the equipment furnished or installed by the TCC is proved to be defective (workmanship or material), it shall be replaced or repaired, free of charge.

4.2 The TCC shall include service required for start-up and calibration of all installed equipment for one season of heating and one season of cooling. A confirmation letter to the Engineer will be required for this work.

PART 5 – PRODUCTS:

5.1 General SI

5.1.1 TAC/Tour Andover Controls shall act as the University's Systems Integrator (SI) to provide several key aspects of the overall LonWorks®-based University Facility Management and Control System (FMCS) systems. These include but are not limited to:

- The TCP/IP level of the system architecture
- All computer servers and operator workstation.
- Data logging and reports of FMCS data
- Alarm presentation
- Time scheduling algorithms
- Graphical representation of data
- Web-based delivery of information
- Adjustment of application parameters (i.e., setpoints)
- Periodic adjustment of calibration offsets

5.1.2 In order to deliver these functions, TAC will provide one or more IP to LON routers and one or more area controllers (AC) depending on the number of devices to be installed by the building controls contractor under Div 25 specifications. The Systems Integrator (TAC) may combine the IP to LON router and area controller into a single physical component.

5.1.3 The area controller (AC) serves several key functions.

- It executes time schedules and broadcasts occupancy commands to the building controllers that it serves.
- It receives data from the building controllers and collects trends of the data.
- It receives data from the building controllers, applies alarm criteria and transmits alarms to the operator workstation alarm handling software provided by TAC.

5.2 Network Physical Interface With the Systems Integrator

5.2.1 For each IP to LON router and area controller provided by TAC, the building controls contractor shall provide a FTT-10 field bus or building LAN to which the building controllers will be connected. The number of building controllers that the building HVAC controls contractor shall be allowed to connect to each field bus is a function of the design of the field bus and the amount of data carried by the field bus. The average bandwidth utilization of any segment of the field bus shall not exceed 20% as measured by the LoyTech Network Analysis Tool over a 1-hour period during occupied mode.

5.2.2 TAC will provide a set of FTT-10 terminals adjacent to each area controller to which the building controls contractor shall attach their FTT-10 LAN.

5.2.3 The building HVAC controls contractor shall be responsible for the FTT-10 LAN terminators. The installation of network terminators shall conform to the guidelines published by Echelon. These guidelines are available on Echelon.com.

5.3 Application Development In Concert With the Systems Integrator (TAC/Tour Andover Controls)

5.3.1 Time Schedules

- Time schedules are the domain of the SI (TAC). Time schedules will be programmed in the area controller(s) (AC) by TAC and occupancy commands shall be bound from the area controller to the building level controllers by TAC where the applications require time based control.
- The SNVT type to be used for the commands shall be SNVT_occupancy.
- The building controls contractor shall inform the SI of all occupancy commands required, the corresponding time schedules, the controllers to which the occupancy commands shall be bound and the name of the receiving variable.

5.3.2 Other Direct or Supervisory Applications

- With the exception of time schedules or optimized start/stop algorithms, all applications shall be programmed within the building controllers. The building controls contractor should not expect the SI to provide any application support within the area controller to execute the required sequence of control.

5.4 Application Configuration Parameters

5.4.1 Programmable Devices

- Within an application program there are numerous parameters that must be adjusted during the commissioning of a system and/or be available for adjustment as requirements change. Some examples are:
- Setpoints
- Timing parameters, i.e., “Fan shall continue to operate until the electric heat has been off for 120 second.”
- PID loop gain
- PID loop integral time constant
- PID loop derivative time constant
- Two position control loop differential
- Calibration offsets for analog inputs

5.4.2 For all applications in programmable building level controllers, configuration parameters shall be input network variables (nvis) to the building level controllers. As a result, these configuration parameters will be accessible to the SI for incorporation into the HMI database and can be adjusted by a systems operator without an application program download.

5.4.3 Application Specific Devices

5.4.3.1 There are two techniques for exposing configuration parameters currently in use by manufacturers of application specific devices.

- Configuration parameters of a specific SNVT type written to EEPROM.

- Configuration parameters that use the Standard Configuration Parameter Type (SCPT) format defined by Echelon.

5.4.4 The configuration parameters of a specific SNVT type have the same characteristics as a dynamic network variable and the Building Controls Contractor’s primary obligation is to submit a list of these configuration parameters to TAC. The submittal shall include the parameter name, purpose and SNVT type.

5.4.5 If the Building Controls Contractor chooses to use an application specific device that uses the SCPT concept, the Building Controls Contractor shall use LonMaker for Windows Integration Software Tool to construct a LonMaker database for the field bus where the application specific device is used. This database shall be provided to TAC.

5.5 DATA COORDINATION WITH TAC/Tour Andover Controls (SI)

5.5.1 Test Mode and Test Values

- This concept only applies to programmable devices.
- The Test Mode / Test Value concept applies to physical or external input points within an application. Using this concept, a system operator can place a physical input point into the test mode and assign a user defined value. When this is done, the electrical signal from the sensor shall be ignored by the application and the test value used in its place.
- The Building Controls Contractor shall provide two network variables for each physical input point associated with a programmable device. The first variable shall be used to place the physical input point into the test mode. The second variable shall be used to assign a test value.
- The Building Controls Contractor shall submit a list of the Test Mode / Test Value network variables to the SI. The list shall define the physical point and the variable names and SNVT types.

5.5.2 Manual Command and Manual Command Value

- This concept only applies to programmable devices.
- The Manual Command / Manual Command Value concept applies to physical or external output points within an application. Using this concept, a system operator can place a physical output point under manual control and assign a manual value or state. When this is done, the external output point ignores the command it routinely receives from the control logic and assumes the value or state of the manual command value.
- The Building Controls Contractor shall provide two network variables for each physical output point associated with a programmable device. The first variable shall be used to place the physical output point into the manual mode. The second variable shall be used to assign a manual command value or state.
- The Building Controls Contractor shall submit a list of the Manual Mode / Manual Command Value network variables to TAC. The list shall define the physical point and the variable names and SNVT types.

5.6 Alarm Data From the Building Controls to the Systems Integrator (TAC)

5.6.1 Alarm data can be either binary or analog. With binary alarm data, the variable has a value of either 0 or 1 and one of these states is defined as the alarm state. With analog alarm data, there is a corresponding threshold that creates an alarm condition (example, mixed air temperature falls below 42 F). A binary alarm can be created by applying the alarm threshold within the building level controllers.

5.6.2 Within an application, alarms can be either self correcting or latching. Self-correcting alarms will return to normal without operator intervention if the conditions within the application return to normal. Latching alarms will remain in the alarm state until an alarm reset parameter is toggled by the system operator.

5.6.3 For binary alarm conditions, the Building Controls Contractor shall expose an output network variable that defines the alarm. If the alarm is a latching alarm, an input network variable shall be established to allow TAC to affect an alarm reset from the HMI. If the binary alarm is created from analog data and an alarm threshold, the Building Controls Contractor shall expose an input network variable that defines the alarm threshold.

5.6.4 For analog non-latching alarms, the Building Controls Contractor shall expose the analog variable as an output network variable and define for TAC the alarm threshold. TAC will apply the alarm threshold within the area controller to create the alarm condition within the HMI.

5.6.5 For analog latching alarms, the Building Controls Contractor shall apply the alarm threshold within the application and create a binary alarm variable and expose it as an output network variable. The Building Controls Contractor shall also create and expose as an input network variable a reset parameter to be toggled by the system operator.

5.6.6 If timing parameters are required by the sequence of control with respect to the creation of alarms ("alarm condition must exist for 60 seconds before an alarm is transmitted"), and the alarm is created in a building level controller, the timing parameter must be exposed as a input network variable.

5.6.7 The Building Controls Contractor shall submit a list of the alarm value network variables to TAC. The list shall define the alarm names and SNVT types.

5.7 Calibration of Analog Inputs

5.7.1 This concept only applies to programmable devices.

5.7.2 As part of each application for each analog sensor input a calibrated value shall be established. The value read from the sensor shall be added to the calibration-offset parameter to create the calibrated value. An output network variable shall be established that transmits the calibrated value to the HMI.

5.7.3 The Building Controls Contractor shall submit a list of the calibration network variables to TAC. The list shall define the point names and SNVT types.

5.8 Dynamic Data Reporting

5.8.1 Data from both application specific and programmable devices shall be exposed as output network variables for access by TAC.

5.8.2 Output network variables from application specific devices are pre-established as part of the embedded application. There is no specific programming work to be done by the Building Controls Contractor. The Building Controls Contractor shall submit to TAC an electronic copy of the application documentation for each application specific node installed.

5.8.3 Output network variable from programmable devices shall be established as part of the applications. As a minimum, the following output network variables are required:

- Status of binary input devices
- The calibrated value for analog input devices
- Status of binary output commands
- The value assigned by the application to analog outputs
- All mode indicators (occupied, unoccupied, summer, winter etc.)
- The output of all PID control objects
- The output of all floating control loop objects or subroutines

PART 6 - SYSTEM ARCHITECTURE:

6.1 The network controller/supervisor links the primary, secondary, and application control units with the host computers for central reporting and system communication via the Wide Area Network (WAN).

6.2 The system shall be configured as a distributed processing network(s) capable of expansion as specified in this section.

6.3 The system architecture shall consist of a multi-level Wide Area Network (WAN), which supports Control Units, networked Operator Workstations, and LAN Interface Devices. The following indicates the functional description of the system structure.

6.3.1 Interbuilding LAN: Used for communication between Primary Controller LANs located in each building, and multiple networked Operator Workstations located in selected buildings. This WAN will consist of using the University's Ethernet backbone with TCP/IP protocol. DDC workstations, network/controller supervisors, and the LAN Interface Device shall employ native TCP/IP protocol with the Ethernet 10BaseT (IEEE802.3)

physical layer standard for connection to Ethernet/ATM routers. DDC workstations or network/controller supervisor shall not require third party routers, gateways or translators for TCP/IP protocol. At a minimum, the Network/controller supervisors shall communicate via LON IP. The network/controller supervisor shall provide LON SNVT's via the university's Ethernet LAN for interface to the university's TAC-VISTA system.

- Control Contractor shall coordinate with university computer personnel on acceptable LAN protocol and interfacing.

6.3.2 Primary Controller LAN: Used to connect Primary Control Units (Primary Control Units-which generally control central plant equipment, terminal equipment, and air handlers) within a building.

6.4 Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Control Units, LAN Interface Devices, and Operator Workstations whether directly connected (via campus backbone) or connected remotely (using the university's WAN).

6.5 The communication speed between the Control Units, LAN interface devices, and MWS computer shall be sufficient to ensure fast system response time under the maximum future loading condition.

6.6 The Operator Workstations shall provide for overall system supervision, operator interface, management report generation, alarm annunciation and remote monitoring.

6.7 The primary and secondary control units shall monitor, control, and provide the field interface for all field points. Each Primary Control Unit or Secondary Control Unit shall be capable of performing DDC functions independent of other Primary Control Units or Secondary Control Units and operator interface devices (Stand-alone).

6.8 Interruptions or fault at any point in the primary LAN shall not interrupt communications between other nodes on the network.

6.9 All line drivers, signal boosters, repeaters, and signal conditioners etc. shall be provided as necessary for proper data communication.

PART 7 - NETWORK CONTROLLER/SUPERVISOR:

7.1 The Network Controller shall be a fully user-programmable supervisory controller. The Network Controller shall monitor and communicate the network of distributed primary, secondary, application-specific control units, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Controllers/Supervisors.

7.2 Controllers shall be microprocessor-based with a maximum program scan rate of one (1) second. They shall be multi-tasking, multi-user, and real-time digital control processors. Controller size and capability shall be sufficient to fully meet the requirements of this Specification.

7.3 Network Controller/Supervisor shall support/communicate with a minimum of 100 primary/secondary control units with no more than 90% of maximum capability used. Memory size shall have at least 20% of availability free for future use.

7.4 Each controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control units. In addition, if memory for historical data trending is not on primary and/or secondary control units, then sufficient memory is required on the network controller to capture and record historical trending data. The network controller / supervisor shall issue all summer/winter commands, clock or other shared commands to all unitary and primary controllers within the building network. If for any reason communications between the unitary(s) and the network controller / supervisor is lost, the unitary(s) shall operate in a stand alone manner (in day operation) until communications is restored. It shall also operate in the "summer" or "winter" mode as last commanded.

7.5 Network Controller/Supervisor shall be capable of interacting host workstations.

7.6 The Network Controller/Supervisor shall have an integrated real-time clock.

7.7 Error detection, correction, and re-transmission to guarantee data integrity.

7.8 Controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The network controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

7.9 In the event of the loss of normal power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Nonvolatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

7.10 During a loss of normal power, the control sequences shall go to the normal system shutdown conditions.

7.11 Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

7.12 Should a primary/secondary controller memory be lost for any reason, the Network Controller/Supervisor shall be able to reload the program with back-ups provided by TCC.

7.13 The network controller / supervisor shall have the capability of being remotely monitored over telephone modem via V90 modem. Additional capabilities shall include automatically dialing out alarms, gathering alarms, reports and logs, programming and downloading database.

7.14 The network controller / supervisor shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:

7.14.1 Assume a predetermined failure mode.

7.14.2 Emit an alarm.

7.14.3 Display card failure identification.

7.15 Install the network controller / supervisor in a surface mounted panel, NEMA type 1 enclosures, with a removable hinged door. Provide a flush mounted key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts.

7.16 The network controller shall support both LonWorks enabled devices using the Free Topology Transceiver FTT10.

7.16.1 All LonWorks controls devices shall be LonMark certified.

PART 8 - SYSTEM SOFTWARE:

8.1 System software will be the latest version available with upgrades provided for full warranty period, and shall be fully licensed to the owner for all Host computer(s) and laptop(s).

8.2 System software shall, at a minimum, provide:

8.3 Monitor and supervise all control points.

8.3.1 Add new points and edit system database.

8.3.2 Change control setpoints, timing parameters and loop tuning of PID coefficients in all control loops in all control units.

8.3.3 Enter programmed start/stop schedules.

8.3.4 View alarm and messages.

8.3.5 Modify existing control logic (or sequence of operation) in all control units.

8.3.6 Upload/Download programs, databases, control parameters, etc.

8.4 Sequence of Operation Programming “Methodology”

8.4.1 The application software shall be user programmable. Application programming shall be provided by the following conventions:

- Line type programming that uses text programming in a language similar to BASIC or FORTRAN.
- Graphical Block Programming: The method of programming shall be by manipulation of graphic icon "blocks." Each block represents a subroutine containing the programming necessary to execute the function of the device that the block represents.

8.5 Unitary Control Unit Database Archiving

8.5.1 The host software shall provide capability to upload sequence of operation, database, and other control parameters from each controller.

8.5.2 Uploaded programs shall be retained on hard disk for system backup.

8.5.3 Programs may be modified using Editor functions, and downloaded to individual controllers as desired. Downloading of databases shall not interrupt other multi-tasked functions that are ongoing.

8.6 Operator Interface Graphic Software

8.6.1 All graphic software shall be in the html web browser format or pinpoint graphics and support multiple simultaneous screens to be opened and resizable in a "Windows" type environment. All functions, except text entry, shall be executable with a mouse.

8.6.2 Graphic software shall provide for multitasking such that third party programs can be used while the Operator Workstation Software is on-line. Provide the ability to alarm graphically even when operator is in another software package.

8.6.3 The software shall allow for Owner to create user defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics.

8.6.4 The contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, heat pumps etc.), mechanical system components (e.g., pumps, cooling towers, boilers, etc.), complete mechanical systems and electrical symbols.

8.6.5 The graphic development package shall use a mouse or similar pointing device to allow the user to perform the following:

- Define symbols

- Position items on graphic screens
- Attach physical or virtual points to a graphic
- Define background screens
- Define connecting lines and curves
- Locate, orient and size descriptive text
- Define and display colors for all elements
- Establish correlation between symbols or text and associated system points or other displays.
- Create hot spots or link triggers to other graphic displays or other functions in the software.

PART 9 - EXECUTION - SYSTEM SETUP:

9.1 This section further defines the responsibilities of the installer and building level and the Metasys programmer.

9.2 The following features shall be incorporated into the final delivered product.

9.3 Schedules

9.3.1 Schedule will be installed using time parameters provided by owner or obtained on drawings.

9.3.2 Stand-by mode shall be installed with Owner's approval.

9.3.3 Scheduling editor shall be provided at each Host computer.

9.3.4 Scheduling editor shall be capable of, at a minimum:

- Easy method for selecting time periods and days for occupied and unoccupied periods for each object (e.g., Unit Heaters).
- Holiday and breaks shall be shown clearly on the calendar.
- Weekly Schedules: The weekly schedules screen shall display a full week with holidays and special days included.
- Provide a method for allowing several related heat pump systems or other equipment to follow a similar schedule.
- It shall be possible to easily and directly copy the schedule for any scheduled event to any other scheduled event without reentering all times.
- Each schedule shall accept a unique descriptor of up to at least 20 characters to identify the schedule on screen.
- Annual Schedules: An annual schedule calendar mechanism shall be provided to schedule Holidays, time changes and Special school days a minimum of one year in advance. A full screen editor in calendar format shall be provided to allow speedy selection and review of holidays and special days.
- Dated schedules shall be self-managing and automatically deleted after execution.
- Schedule Override:
  - It shall be possible to easily override, to the on or off condition, any programmed scheduled event at any operator workstation. There shall be no limit to the number of schedules that can be overridden at any one time. Conditions shall revert to schedule when override period ends.

9.4 Graphic Screens

9.4.1 Color graphic Operator Interface:

- Graphics must coincide with NKU Standards as follows:
  - Start/Stop and Status points must indicate a graphical and color change in state, (green to black) or similar presentation using the same color scheme.

  - All applicable control points must have "Forced by Operator" or "Manual Mode" properties that are clearly displayed on individual graphic pages for each point accessible from the graphic page. This is displayed by a "M" in the data field.
  - All alarms must be displayed in the alarm queue and also on the coinciding graphic page with a red flashing alarm indication in the data field and/or similar graphic presentation.
  - All data fields must indicate a unit of measure; DegF, %, ppm, etc.
  - Each graphic page must be individualized; a "Master" may not be used as a template for similar zones/controllers so that zone or area specific instructions/notes can be added to each graphic.
  - The graphical programming software shall allow for interactive mouse-driven placement of block icons on the graphic screen and connection of block inputs to block outputs by means of drawing lines to form a graphic logic diagram.
  - The user shall not have to manually input text to assign block input/output interconnections. Blocks shall allow entry of adjustable settings and parameters via pop-up windows.
  - The clarity of sequence shall be such that the user has the ability to verify that the system programming meets the specs without having to learn or interpret a manufacturers unique programming language.
  - Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs.
  - Logic diagrams shall be viewable either off-line, or on-line with real-time output values.
  - Provide a means for testing and/or debugging the control programs off-line (not communicating with control units) using operator entered values for physical inputs and time.
  - Provide a means for testing and/or debugging the control programs on-line (communicating with control units), showing actual physical inputs and all block outputs in real time.
- Provide dual or multiple function windowing to allow user to view two or more screen and toggle between simultaneous operations.
- Update all point values a minimum of every 10 seconds.
- Each colorgraphic terminal shall be driven by software allowing the operator to access all system information via a system penetration method.
- System penetration shall allow the operator to begin at an entire site plan colorgraphic display and progressively select portions of the site plan to be chosen for closer inspection or selection of a more detailed colorgraphic display of a desired system without being required to enter any commands via the keyboard. Specifically,
  - Graphics display screens shall include a system level graphic of either a map of facilities or an elevation of the building, a graphic of each building floor plan and graphics for each operating system or unit within each building. Entry to the zone and equipment level interface graphics shall be through area maps and/or floor plans to facilitate user orientation. Using a mouse or other pointer device shall access graphics. The system shall provide a visual indication of which building, floor and zone the user is accessing at any time.
- Graphics shall be provided for all mechanical equipment and devices controlled by the DDC system. These graphics shall include:
  - Flow diagram or graphic diagram showing all devices (e.g., valves, dampers, sensors, fans, pumps, boilers, etc.)
  - Current status of all I/O points being controlled and applicable to each piece of equipment.
  - Operating mode (occupied, unoccupied, overridden, etc.)
  - Time and date
  - Percentage valve/damper open or closed (include "open" or "closed" on the screen.
  - Analog readouts in mA or VDC (for commissioning and can be located on a separate screen if needed to reduce screen clutter)
  - All analog and digital input and output points settable from the screen.
  - Place all values in appropriate engineering units and in appropriate locations on the graphic representation.
  - Electrical Schematics associated with all mechanical equipment and devices controlled by the DDC (These schematics should also be provided with as-builts).
- All color graphic screens shall be standardized for similar mechanical equipment and control devices. The type of points displayed will be the same for similar colorgraphic screens.

9.4.2 Other colorgraphic screens shall include:

- Temperature setpoints for all rooms/zones.
- All adjustable points

9.4.3 Accessible System Information:

- Available for display or modification in any specific colorgraphic display shall include, but not be limited to:
  - Real-time value display of any connected point in the system
  - Alarm status condition of any desired system alarm point (change in color when out of range).
  - Any software parameter such as setpoints for control sequences, minimum position adjustments.

9.4.4 Centralized Scheduling and Modification:

- The colorgraphic terminal shall support operator access to the Scheduling Screens that allow the operator to review and modify any or all schedules as desired. The centralized Scheduling function shall allow modification of equipment schedules, modification of facility holiday schedules, and when desired allow assignment of temporary schedules for designated portions of the facility or specific equipment.

9.5 Labeling and Identification

9.5.1 All devices relating to the work or systems included herein, including controllers, valves, motors, relays, etc., shall be identified with a unique identification number or name on the submitted engineering drawings.

9.5.2 Tagging/labeling shall be computer generated or wire markers, input/output wiring, at both ends. These labels will correspond to the identification numbers or names on the AS BUILTS.

- Cable and wiring not specifically associated with an input or output shall be labeled with a number and a function description such as: 120 VAC, Panel #, ect. (e.g., actuator/unit ventilator ect., power supply).
- Category 5 Ethernet cabling and communication cabling shall be easily identified as a unique color and labeled at each end throughout the building.

9.6 Programming Guidelines

9.6.1 All control loops will be standardized throughout the programming code.

9.6.2 All adjustable set-points shall be developed as software points stored at memory locations so that setpoints can be changed by recommending the data stored at the memory location rather than by entering the program and changing parameters and lines in program code.

9.6.3 Control sequences that use outdoor air conditions to trigger certain specific operating modes shall use data generated by one outdoor air temperature sensor. In other words, the data from one sensor shall be shared by the entire system.

9.7 System Commissioning and Training

9.7.1 During all pre-installation meetings and construction meetings with Mechanical Contractor, Engineers, and/or Owners, the Control Contractor attending the meetings must be the application engineer or programmers that are/will design and program the DDC system.

9.8 Demonstration Commissioning

9.8.1 This portion of commissioning must be performed with a representative of the NKU Physical Plant staff and the Engineer present.

9.8.2 Work and/or systems installed under this section shall be fully functioning prior to Demonstration, Acceptance Period and Contract Close Out. Control Contractor shall start, test, adjust, and calibrate all work and/or systems.

9.8.3 Software shall be fully configured to view project specific database and shall include trend logs, specified graphic screens, and reports.

9.8.4 As problems are found, a log shall be completed showing the date, technicians and Owners initials, and any corrective action taken or needed.

9.8.5 Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Control Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

9.8.6 All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of this document.

PART 10 – CABLING:

10.1 A complete cabling system shall be furnished and installed, which shall adhere to the highest workmanlike standard of quality and appearance. Lines shall be installed square with building lines.

10.2 All cabling shall be concealed in walls and above ceilings where ceilings exists. Cabling may be ran above lay-in ceilings without being in conduit. Support from structure. Where cabling is installed in storage rooms, or above non-lay-in ceilings, all wiring shall be installed in conduit.

10.3 Install conduit in wall from wall thermostats to above ceiling for cabling.

10.4 Acceptable manufacturers are Belden, West Penn or Alpha. Any cable other than the above must have prior approval.

10.5 All unitary to unitary zone communication cabling shall be a minimum of 18 AWG minimum. All other sizing of cabling shall be according to manufacturer’s recommendation.

10.6 Furnish a floor plan of the building indicating communication cable labeling and routing as well as addresses and branch wiring from the unitary devices. All cabling shall be labeled on both ends. The type, size and label of all cabling shall be indicated on submittal floor plan drawings.

10.7 Wall space temperature sensor cabling (from the sensor to the unitary controller) shall have a minimum of four (4) conductors.

10.8 All cabling shall be stranded. "NO" solid conductors will be accepted. All cabling shall be 100% shielded with appropriate drain wire and insulation.

10.9 All cable connections shall be continuous run (including shield) whenever possible. Any junctions must be made in a metal enclosure, connections must be soldered, taped and the metal enclosure must be mechanically

attached to the nearest ground. No wire nuts or crimped connections will be accepted. Note location of junction boxes on the as built floor plans.

10.10 All shields must be terminated as per manufacturer's recommendation. Shield termination requirements by the manufacturer must be provided with submittals.

PART 11 - ELECTRICAL WIRING SYSTEMS:

11.1 Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.

11.2 Any power for controls shall be fed from circuits in electrical panels shall not be taken from receptacles, lighting, or equipment circuits. Unitary control power may be taken from the equipment served. If power is taken from the equipment served, the power may not be interrupted to the electronics if the terminal unit is off for any reason. This contractor is responsible for the power source to the unitary controllers and all other control power requirements.

11.3 All control circuits within the electrical panels shall be marked to indicate equipment served.

11.4 The TCC shall do all temperature control interlock wiring. This is to include zone controls, exhaust fans, dampers, etc.

11.5 The TCC shall be responsible for any power required for the unitary controls or control panels. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.

PART 12 - TEMPERATURE SENSORS AND MISCELLANEOUS DEVICES:

12.1 SENSOR RESOLUTION: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be .24 degrees over a year period. Space sensors must be tested and accurate to within .75 degrees F. Outside air, water and duct sensors must be tested and accurate to within 2.0 degrees F.

12.2 SPACE SENSORS AND THERMOSTATS:

12.2.1 Refer to the drawings for proper type and location.

12.2.2 Programmed set-point shall be locally adjustable limited to 2 degrees above set-point and 2 degrees below set-point for supervised areas.

12.2.3 Unsupervised areas shall have non-adjustable set-point.

12.2.4 Generally, thermostats/sensors shall be installed 5'-0" above the finished floor.

12.2.5 Where thermostats/sensors are to be mounted next to a light switch, install at the same height as the light switch.

12.2.6 If there is a question consult engineer prior to rough-in.

12.2.7 SPACE SENSORS: Thermostats shall be provided with a "warmer/cooler" dial.

12.2.8 DISCHARGE AIR AND DUCT ROOM RETURN AIR SENSORS: Shall be rigid insertion type. In all applications, care must be taken to insure that the sensors are securely mounted as not to allow any vibration and installed in such a manner as to indicate the truest possible temperature.

12.2.9 RELAYS: Relays for starting and stopping fractional horsepower motors shall be rated as follows:

12.2.10 1/4 horsepower motors or less use 15 ampere rated relays,

12.2.11 1/3 horsepower motors use 20 ampere rated relays,

12.2.12 1/2 horsepower motors use 30 ampere rated relays,

12.2.13 Relays used for pilot duty service shall be rated at a minimum of 10 amperes.

12.2.14 Provide auxiliary pilot duty relays on motor starters as required for control function.

12.2.15 Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

12.3 CURRENT SENSING DEVICES: Veris Industries model Hx08 Series and H701 or equal. All current sensors shall be capable of alarming to the BAS for belt losses, pump coupling shear or other mechanical failure on loads.

12.4 POTABLE WATER FLOW METER: Onicon Model F-1330/F-1130 series dual turbine insertion flow meter suitable for potable water applications. 50:1 turn down with 2% accuracy with 0.4 to 20 fps range. Install flow meter with sufficient pipe diameters as recommended by manufacturer. Provide factory authorized start-up verification of operation and calibration. Provide with remote display where indicated.

PART 13 -DAMPERS AND ACTUATORS:

13.1 Dampers for various units requiring field mounting shall be tight closing, "ultra low leakage", opposed blade with side and edge seals. They shall be sized and furnished under this section. Installation of dampers shall be by the sheet metal contractor, coordinated by the TCC. Frames shall be no less than 16 gauge galvanized steel and furnished with mounting holes for duct mounting. Damper blades shall be no less than 14 gauge galvanized steel with maximum blade width of 8 inches. Blades shall be secured to 1/2 inch zinc plated axles and hardware with nylon bearings. Provide thrust bearings at the end of each blade. All dampers shall have end switches to positively prove damper position. No Exceptions!

13.2 All damper and valve actuators shall be fail safe spring return type with sufficient force to operate the dampers or valves under all normal operating conditions. They shall return to the normally open position upon a loss of power.

13.3 "ALL" Actuators shall be of the same manufacturer and have internal feedback circuitry to provide a positive action to insure proper positioning of the damper or valve through the entire sequence. Actuators shall have an adjustable starting point to accurately set the range of travel to the output of the controller. All actuators shall also utilize the same input signal (6-9 VDC, 2-10 VDC, 4-20 MA) in order to maintain some consistency in the control application.

13.4 Actuators may be factory installed. If not factory installed they shall be installed as per instructions by the terminal equipment manufacturer.

13.5 Locations mounted above ceiling shall be marked on ceiling grid. Access panels shall be provide in area wih hard ceilings.

13.6 Install damper motors on the outside of the duct in warm areas where possible, not in air stream or locations exposed to outdoor conditions.

PART 14 – EQUIPMENT:

14.1 UNITARY and PRIMARY CONTROLLERS: Controllers utilized in the network must have full stand alone capability required to meet the sequence of operations. Any re-programming of the electronics shall be performed on location using a portable personal computer with appropriate software or through the Network Controller / Supervisor. The entire unitary database shall have the capability of being backed up and or downloaded locally and via modem if required. All primary controllers shall have built in displays for local access and adjustment of control parameters.

14.2 Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F. All controllers shall have an RJ-11 or similar type connection for monitoring or programming access by room or local equipment level with access to any unitary within the network without modification.

14.3 NETWORK CONTROL ENGINE: The Network Control Engine shall have an integral keypad and display and issue, summer/winter commands, or other shared commands to all unitary controllers within the building network. If for any reason communications between the unitary(s) and the global controller is lost, the unitary(s) shall operate in a stand alone manner (in day operation) until communications is restored. It shall also operate in the "summer" or "winter" mode as last commanded.

14.3.1 The Network Control Engine shall have **UPS power supply** to allow a minimum of three days of operation. The Network Control Engine shall be composed of one or more independent, stand-alone, microprocessor to manage the global strategies described in Application software section. The Network Control Engine shall have ample memory to support its operating system, database and programming requirements. The operating system of the global controller shall manage the input and output communications signals to allow distributed unitary controllers to shale real and virtual point information and allow central monitoring and alarms. The database and custom programming routines of the Network Control Engine shall be editable from a single operator station or laptop computer.

14.3.2 The Network Control Engine shall have the capability of being remotely monitored over IP adddress. Additional capabilities shall include automatically emailing, texting out alarms, gathering alarms, reports and logs, programming and downloading database.

14.3.3 The Network Control Engine shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:

- Assume a predetermined failure mode.
- Emit an alarm.
- Display card failure identification.

14.3.4 Install the Network Control Engine in a surface mounted panel, NEMA type 1 enclosures, with a removable hinged door. Provide a flush mounted key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts.

14.4 PANELS: All panels must be surface mounted type, NEMA type 1 enclosures, with a removable hinged door. Provide a flush mounted key lock. (All temperature control panels are to be keyed the same.) All control panels must be painted the same color and identified. (premiered panels will not be acceptable) The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts.

PART 15 - SEQUENCE OF OPERATION –OFFICE:

15.1 A wall mounted thermostat with warmer-cooler adjust shall control electric unit heater to maintain a minimum heating setpoint of 68 deg F (adj.) when the building is schedule occupied and 40 deg F (adj.) when the building is schedule unoccupied.

15.2 The sidewall motorized dampers and ceiling mounted exhaust fans EF-1 shall be used for cooling. When the space temperature exceeds 80 deg F (adj.) the motorized damper shall open and the associated exhaust fan shall start.

PART 16 - SEQUENCE OF OPERATION – RESTROOM HVAC:

16.1 A cabinet mounted thermostat shall control electric cabinet heater to maintain a minimum heating setpoint of 65 deg F (adj.) when the building is schedule occupied and 40 deg F (adj.) when the building is schedule unoccupied.

16.2 The sidewall motorized dampers and ceiling mounted exhaust fans EF-3 and EF-4 shall be interlocked with the dual contact ceiling mounted occupancy sensor. When motion is detected the motorized damper shall open and the associated exhaust fan shall start.

16.3 The sidewall motorized dampers and ceiling mounted exhaust fans EF-3 and EF-4 shall be used for restroom cooling. When the space temperature exceeds 80 deg F (adj.) when the building is scheduled occupied the motorized damper shall open and the associated exhaust fan shall start.

PART 17 - SEQUENCE OF OPERATION – STORAGE HVAC:

17.1 A wall mounted thermostat shall control electric unit heater to maintain a minimum heating setpoint of 65 deg F (adj.) when the building is schedule occupied and 40 deg F (adj.) when the building is schedule unoccupied.

17.2 The sidewall motorized dampers and ceiling mounted exhaust fans EF-2 shall be used for storage cooling. When the space temperature exceeds 80 deg F (adj.) the motorized damper shall open and the associated exhaust fan shall start.

PART 18 – DOMESTIC WATER MONITORING:

18.1 The DDC System shall monitor domestic water consumption.

18.2 Install flow meter in cold water supply to the building.

PART 19 - THE ELECTRICAL SWITCHGEAR/POWER INTERFACE:

19.1 The electrical switchgear shall be monitored through the DDC system via Mod Bus Connection. Coordinate the interface with the switchgear manufacturer. Control wiring to the power meter to be provided by the TCC. The following points shall be monitored:

19.2 There are a total of 1 power meters to monitor.

	Hardware Points				**Software Points**					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Current Phase A					×			×		×
Current Phase B					×			×		×
Current Phase C					×			×		×
Current Neutral					×			×		×
Voltage A-B					×			×		×
Voltage B-C					×			×		×

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Voltage C-A					×			×		×
Voltage A-N					×			×		×
Voltage B-N					×			×		×
Voltage C-N					×			×		×
Real Power - kW					×			×		×
Apparent Power - kVA					×			×		×
Power Factor					×			×		×
Frequency					×			×		×
Real Energy - kWh					×			×		×

PART 20 – SEWAGE EJECTOR PUMP:

19.3 The DDC shall monitor the high limit for the sewage ejector pump and alarm to the BAS

PART 21 – PLUMBING CHASE TEMPERATURE MONITORING:

19.4 The DDC system shall monitor plumbing chase temperature provide a low temperature alarm. Coordinate temperature setpoint with owner. Provide access to temperature sensor through tamperproof access panel located in the men's restroom under the hand-dryer.

19.5 Review electrical specifications and drawings for locations and quantities.

	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Current Phase A					×			×		×
Current Phase B					×			×		×
Current Phase C					×			×		×
Current Neutral					×			×		×
Voltage A-B					×			×		×
Voltage B-C					×			×		×
Voltage C-A					×			×		×
Voltage A-N					×			×		×
Voltage B-N					×			×		×
Voltage C-N					×			×		×
Real Power - kW					×			×		×
Apparent Power - kVA					×			×		×
Power Factor					×			×		×
Frequency					×			×		×
Real Energy - kWh					×			×		×

	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Totals	0	0	0	0	15	0	0	15	0	15

Total Hardware (0) Total Software (30)

END OF SECTION.