

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Advertisement for Bid, 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 their Sub-Contractor's work.

1.2 DESIGN CRITERIA

- A. All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals for any part of the work, services, materials, or equipment to be used on or applied to this project are hereby directed to familiarize themselves with the Contract Documents. In case of conflict between these General Provisions and the General and/or Special Conditions, the Contractor shall contact the Engineer for clarification and final determination prior to the Bid.
- B. 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 Plumbing Systems indicated or specified in the Contract Documents.
- C. Any materials, labor, equipment, or services not mentioned specifically herein which may be necessary to complete any part of the Plumbing Systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the Plans and/or Specifications, shall be included in the Bid as part of this Contract.
- D. It is not the intent of this Section of the Specifications to make any Contractor, other than the General Contractor, Prime Contractor, or Construction Manager responsible to the Owner. 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.
- E. The Architect and Engineer do not define the scope of individual trades, subcontractors, material suppliers and vendors. Any sheet numbering system or specification numbering system used which identifies disciplines is solely for the Architect and Engineer's convenience and is not intended to define a subcontractor's scope of work. Information regarding individual trades, subcontractors, material suppliers and vendors may be detailed, described, and indicated at different locations throughout the Contract Documents. No consideration will be given to requests for change orders for failure to obtain and review the complete set of Contract Documents when preparing Bids, prices, and quotations. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.

- F. It is the intent of the Contract Documents to deliver to the Owner a new, complete, and operational project once the 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.
- G. In general, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owner at least seven (7) days prior to the interruption of any services (gas, domestic water, heating, etc.). The Owner 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 for the Contractors involved until a complete schedule of interruptions can be developed.
- H. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of Bidder/Proposer's own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation from the Owner.
- I. Each Bidder/Proposer shall also be governed by any unit prices and Addenda insofar as they may affect part of their work or services.
- J. DEFINITIONS AND ABBREVIATIONS:
1. Contractor - Any Contractor whether bidding, proposing, or working independently or under the supervision of a General Contractor, Prime Contractor, Construction Manager and who installs any type of Mechanical Work as specified in the Contract Documents or, the General Contractor.
 2. Engineer - The Consulting Mechanical-Electrical Engineer either consulting to the Owner, Architect, or Other, etc. In this case: CMTA, Inc., Consulting Engineers.
 3. Architect - The Architect of Record for the project.
 4. 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 Owner, etc.
 5. Bidder/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.
 6. The Project - All the work required under this Contract.
 7. Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.
 8. Provide - Furnish and install complete, tested, and ready for operation.
 9. Install - Receive and place in satisfactory operation.
 10. Indicated - Listed in the Specifications, shown on the Plans or Addenda thereto.
 11. Typical or Typ.- Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
 12. ADA - Americans with Disabilities Act.
 13. AGA - American Gas Association.
 14. ANSI - American National Standards Institute.
 15. ASME - American Society of Mechanical Engineers.
 16. IBC - International Building Code.

17. NEC - National Electrical Code.
18. NEMA - National Electrical Manufacturers Association.
19. NFPA - National Fire Protection Association.
20. OSHA - Office of Safety and Health Administration.
21. UL - Underwriters Laboratories.

1.3 INTENT AND INTERPRETATION:

- A. It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc as necessary for trouble free operation, tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.
- B. All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- C. 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.
- D. The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer / Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
- E. The Contractor shall give written notice 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 a minimum of ten (10) days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

1.4 INDENTIFICATION:

- A. 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.

1.5 PLANS AND SPECIFICATIONS:

- A. The Plans 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 Plans are not intended to show every item which may be necessary to complete the systems. All Bidder/Proposers shall anticipate that additional items may be required and submit their Bid accordingly.
- B. The Plans and Specifications are intended to supplement each other. No Bidder/Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Bidder/Proposer shall request a clarification not less than ten (10) 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.
- C. The Plans and Specifications shall be cooperative and anything appearing in the Specifications which may not be indicated on the Plans or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. Contractor shall make all their 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.
- E. The Engineer shall reserve the right to adjust in location of piping, equipment, etc. where such adjustments are in the interest of improving the project.
- F. Should conflict, overlap or 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 their branch until instructions in writing are received from the Engineer.
- G. Unless dimensioned, the Plans only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the Plans 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.
- H. Each Bidder/Proposer shall review all Plans in the Contract Documents to ensure that the work they intend to provide does not create a conflict with or affect the work of others in any way. Where such affect does occur, it shall be the Bidder/Proposer's responsibility to satisfactorily eliminate any such conflict or effect prior to the submission of their proposal. Each Bidder/Proposer shall ensure that there is adequate space to install their equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the Bidder/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.
- I. Where on the Plans 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.

- J. 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.
- K. Where within the Contract Documents the word “typical” or “typ.” 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.
- L. Each Contractor shall evaluate ceiling heights specified on Architectural Plans. Where the location of equipment or systems may interfere with ceiling heights or maintenance and access of equipment or systems, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Do not install equipment or systems in the affected area until the conflict is resolved. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work or cost incurred on the part of the Contractor or unduly delay the work.
- M. The Contractor shall provide a layout confirmation of equipment rooms to verify that all of the equipment submitted and approved will in fact fit into the proposed space and have adequate clearance for service. See COORDINATION DRAWINGS SECTION.

1.6 EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS:

- A. When any Contractor requests approval of materials and/or equipment of different physical size, weight, capacity, function, color, access, that the design allows for 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 compensate them for all necessary changes in their work. Any Plans, 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 Engineer does not in any way absolve the Contractor of this responsibility.
- B. 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 this Part are met. Requested substitutions shall be submitted to the Engineer a minimum of ten (10) days prior to Bid. If this procedure is not followed, the substitution will be rejected. If prevailing laws of cities, towns, states, or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- C. Wherever any equipment and material are specified exclusively, only such items shall be used unless substitution is accepted in writing by the Engineer.
- D. Each Bidder/Proposer shall furnish along with their 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 ensure that the Engineer

will approve shop drawings unless the equipment, materials, etc., submitted in shop drawings are satisfactorily comparable to the items specified and/or indicated.

- E. Coordinate kitchen equipment selection by the Construction Manager and General Contractor prior to Bid. Any deviations and/or conflicts for any kitchen equipment shall be the Contractor's responsibility.

1.7 QUALIFICATIONS OF CONTRACTOR/WORKERS:

- A. All Contractors and their subcontractors bidding this project must have been a licensed company for a minimum of three (3) years to qualify to Bid this project. Individual employee experience does not supersede this requirement.
- B. All plumbing subcontractors bidding the plumbing scope of work must have completed one project of 70% this subcontract cost size and two projects of 50% this subcontract cost size.
- C. All plumbing work shall be accomplished by qualified workers competent in the area of work for which they are responsible. Untrained and incompetent workers, 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 workers and unqualified or incompetent workers shall refrain from work in areas not deemed satisfactory. Requests for relief of workers shall be made through the normal channels of Architect, Contractor, etc.
- D. The Contractor shall hold all required licenses in the State which the work is to be performed.
- E. All plumbing work shall be accomplished by Journeymen Plumbers under the direct supervision of a Master Plumber as defined under State Plumbing Law Regulations and Code. Proof and Certification may be requested by the Engineer.
- F. All insulation and pipe fitting work shall be installed by workers normally engaged in this type of work.
- G. All automatic control systems shall be installed by workers normally engaged or employed in this type of 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 worker is the employee of this Contractor, the worker may be utilized subject to review of their qualifications by the Engineer and after written approval from same.
- H. All special systems shall be installed only by workers normally engaged in such services. Exception to this specification may only be made in writing by the Engineer.
- I. All electrical work shall be accomplished by Licensed Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.

1.8 HAZARDOUS MATERIALS:

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building or site.

- B. 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, ensure that their 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.
- C. 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.
- D. 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.
- E. 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.
- F. No asbestos or mercury containing materials shall be installed in this project.

1.9 COORDINATION DRAWINGS:

- A. Detailed electronic coordination drawings shall be required for this project. A specific line-item shall be included on the schedule of values by each Trade for "preparation of coordination drawings". This line-item value shall be approved by the Engineer. The Engineer and the Engineer's Field Inspector shall closely monitor progress and quality of the preparation of the electronic coordination drawings and may withhold pay requests as deemed appropriate.
- B. Coordination Drawings shall be provided on this project. Drawings shall be prepared in electronic format. The Architect and Engineer will supply electronic drawings files of the Contract Documents upon the Contractor's request and release.
- C. The basis for the Coordination Drawings shall be the sheet metal ductwork fabrication shop drawings, all electrical feeder conduits, and other conduits 2" and larger, and piping and components in ceiling spaces. The Coordination Drawings shall be prepared by the Mechanical Contractor. The Coordination Drawings shall indicate (1) systems above ceilings in finished areas, (2) systems supported from the structure in finished areas without ceilings, (3) systems in the mechanical rooms, and (4) all wall, roof, floor penetrations. These drawings shall indicate all ductwork as double lined with bottom elevations noted.
- D. Pre-Coordination Meetings with all necessary trades shall occur. During these meetings, the Contractors shall discuss locations/elevations where piping, conduits, cable path, etc will be installed with respect to the sheetmetal fabrication drawings and other trades. The sheetmetal ductwork and gravity piping systems shall be given the first priority. Each Trade shall provide the Mechanical Contractor electronic drawings of all of their systems (with elevation noted),

coordinated with the ductwork and other trades for them to incorporate into the Coordination Drawings. Coordination Meetings shall then occur so that all conflicts can be resolved between Trades. All conflicts shall be resolved between all Trades at these Coordination Meetings and the Mechanical Contractor shall then amend the Drawings to include the Final Coordinated Work.

- E. After completion of the Final Coordination Drawings, a Final Review with all Trades shall occur to provide any final comments and approval by all Trades. Other interim coordination meetings will be required to insure successful coordination drawings. Any additional coordination items will be updated by the Mechanical Contractor. The Final Approved Coordination Drawings shall be distributed to each Trade by the Mechanical Contractor. The Mechanical Contractor shall also furnish a complete 30x42 paper set of drawings to the jobsite main office and shall utilize them for updates of field conditions/deviations that occur during construction. Final Approved Coordination Drawings shall also be distributed to the Prime Contractor, Owner, Architect and Engineer for their Records. This process shall be completed prior to starting any work.
- F. Each Contractor shall insure that any deviations from the Coordination Drawings are recorded as they occur, in red erasable pencil on Coordination Drawings kept at the jobsite. Upon completion of a particular phase, the Mechanical Contractor shall incorporate all field deviations into the Coordination Drawings to be utilized as Record Drawings. The Engineer shall review the Record Documents from time to time to ensure 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. The Record Drawings shall be distributed electronically (on CD) to the Prime Contractor, Owner, Architect and Engineer for their Records.
- G. The plumbing contractor is responsible to the general contractor for the shop drawing layout of the following rooms and details:
 - 1. Concrete pads and foundations
 - 2. Equipment room layouts with actual equipment
 - 3. Roof layouts
 - 4. Trench locations and sizes
 - 5. Dimensioned floor drain locations
 - 6. Congested areas above ceilings adjacent to mechanical and electrical room

PART 2 - PRODUCTS (NOT USED):

PART 3 - EXECUTION:

3.1 EXAMINATION OF SITE AND CONDITIONS:

- A. Each Bidder/Proposer shall inform themselves 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.
- B. Each Bidder/Proposer shall also fully acquaint themselves 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. A 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.

3.2 CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.:

- A. 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 their work. They 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. They shall also obtain all required certificates of inspection for their work and deliver same to the Engineer before request for acceptance and final payment for the work.
- B. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. The Contractor shall include in their work, without extra cost, any labor, materials, services, apparatus and Plans in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.
- D. 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.
- E. 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.
- F. 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 Authority Having Jurisdiction. Plumbing work shall not commence until such Plans are in the possession of the Plumbing Contractor.
- G. 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.
- H. Where minimum code requirements are exceeded in the Design, the Design shall govern.
- I. The Contractor shall insure that their work is accomplished in accord with the OSHA Standards and that they conduct their work and the work of their personnel in accord with same.
- J. All work relating to the handicapped shall be in accord with regulations currently enforced by the Authority Having Jurisdiction and the American Disabilities Act.
- K. The installation of all fuel storage tanks and associated piping, whether interior or exterior, shall be inspected by the State Fire Marshal, Hazardous Materials Section, before backfill. Submit certificate of this inspection to the Engineer.

- L. Work in elevators, elevator shafts and elevator equipment rooms shall comply with the Elevator Code enforced by the Authority Having Jurisdiction.
- M. All work in conjunction with a natural gas installation shall, in addition to all other Codes, Rules, Regulations, Standards, etc., comply with the requirements of the local gas supplier and/or standards and recommendations of the American Gas Association.
- N. 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.
- O. 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.
- P. 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 Department for Environmental Protection.
- Q. Where conflict arises between any code and the Plans and/or Specifications, the code shall apply except in the instance where the Plans and Specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten (10) days prior to bid date, otherwise the Contractor shall make the required changes at their own expense.
- R. All work shall conform to the US Dept of Energy (DOE) regulations 10 CFR parts 429 & 431, effective Jan. 27, 2020.

3.3 SUPERVISION OF WORK:

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

3.4 CONDUCT OF WORKERS:

- A. The Contractor shall be responsible for the conduct of all workers under their supervision. Misconduct on the part of any worker to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt removal of that worker. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens or debilitating drugs on the job site is strictly forbidden.

3.5 COOPERATION AND COORDINATION WITH OTHER TRADES:

- A. 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.
- B. 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 $\frac{1}{4}" = 1'-0"$, clearly indicating how their 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. Make the necessary changes in the work to correct the condition without extra charge.

- C. 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.

3.6 GUARANTEES AND WARRANTIES:

- A. 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 their 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 Project's Statement of Final acceptance. 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 their operator or other employees. Refer to other sections for any special or extra warranty requirements.
- B. Provide all warranty certificates to Owner. All warranties begin starting at the final acceptance date, submit warranty certificates accordingly.

3.7 COST BREAKDOWNS (SCHEDULE OF VALUES):

- A. Within thirty (30) 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.
- B. The breakdown shall be minimally as follows. Material and labor shall be listed separately. Pay special attention to required withholding percentages for startup, testing, documentation, acceptance, owner training, etc.:
 - 1. Shop Drawings
 - 2. Motor Load Coordination with other subcontractors
 - 3. Record Drawings & Acceptance
 - 4. O&M Manuals & Acceptance
 - 5. Owner Training & Acceptance
 - 6. Spare Parts
 - 7. Coordination Drawings
 - 8. Identification Materials & Labor
 - 9. Piping Materials & Labor
 - 10. Piping Testing, Cleaning, Documentation, Acceptance, etc.
 - 11. Piping Purging, Flushing, Cleaning
 - 12. Insulation (Piping) Materials & Labor

13. Plumbing Fixtures and Equipment
14. Plumbing Materials, Piping & Labor
15. Plumbing Shop Fabrication
16. Domestic Water Heater Equipment & Labor
17. Domestic Water Heater Startup, Testing, Documentation, Training, Acceptance, etc.
18. Test and Balance Materials & Labor
19. Test and Balance Initial Report, Final Report and Acceptance

3.8 CHANGES IN MECHANICAL WORK:

- A. REFER TO GENERAL AND SPECIAL CONDITIONS.

3.9 CLAIMS FOR EXTRA COST:

- A. REFER TO GENERAL AND SPECIAL CONDITIONS.

3.10 MATERIALS AND WORKMANSHIP:

- A. All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Bidder/Proposer shall determine that the materials and/or equipment they propose 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/or disassemble/reassemble the materials and equipment and this work shall be the responsibility of the Contractor, whether specifically initiated or not.
- B. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of fans, motors, coils, 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.
- C. Materials and equipment shall bear Underwriters' Laboratories label where such a standard has been established, where applicable.
- D. 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.
- E. All equipment shall bear the manufacturer's name and address. All electrically operated equipment shall bear a name plate indicating required horsepower, voltage, phase, and ampacity. Pumps shall have a data plate indicating horsepower, pressure, and flow rate.

3.11 TEMPORARY SERVICES:

- A. The Contractor shall arrange any temporary water, electrical and other services which may be required to accomplish the work. Refer also to General and Special Conditions.
- B. All temporary services shall be removed by Contractor prior to completion of work.

3.12 MEASUREMENTS AND GRADE:

- A. The Contractor shall lay out their work and be responsible for all necessary lines, levels, inverts, elevations, and measurements. The Contractor must verify the figures shown on the Plans before laying out the work and will be held responsible for any error resulting from failure to do so.
- B. The Contractor shall base all measurements, both horizontal and vertical from established benchmarks. 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.
- C. 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.

3.13 PROTECTION OF EQUIPMENT:

- A. 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.

3.14 REQUIRED CLEARANCES FOR ELECTRICAL EQUIPMENT:

- A. The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, equipment, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost. Coordinate with the Electrical Contractor prior to any work.

3.15 EQUIPMENT SUPPORT:

- A. 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. Do not support items from roof/floor deck or bridging.

3.16 PIPE MOUNTING HEIGHTS:

- A. All exposed or concealed equipment, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping shall, insofar as possible, run perpendicular or parallel to the building structure. Refer to Plans for minimum heights of ducts and piping. Minimum height above ceilings shall be 6" clear including insulation, unless otherwise noted.

3.17 BROKEN LINES AND PROTECTION AGAINST FREEZING:

- A. No conduits, piping, 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. Do not install piping across or near openings to the outside whether or not they are carrying static or moving fluids. Insulation on piping does not necessarily ensure that freezing will not occur. If in doubt, contact the Engineer.

3.18 WEATHERPROOFING:

- A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as specified and approved by the Architect and Engineer before work is performed. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.
- B. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

3.19 FINAL CONNECTIONS TO EQUIPMENT:

- A. The Contractor shall finally connect plumbing services (water, sanitary, gas, air, etc.), to any terminal equipment, appliances, kitchen equipment, etc., provided under this and/or other divisions of the work. Various equipment connections indicated are based upon "basis of design" equipment selections. Should alternate equipment be purchased by the General Contractor, then this Contractor shall make the necessary provisions in the Bid for any and all differences. Change Orders shall not be considered for any differences due to alternate equipment purchase. Such connections shall be made in strict accord with current codes, safety regulations and the equipment manufacturer's recommendations. If in doubt, contact the Engineer prior to installation.

3.20 ACCESSIBILITY:

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and ceilings for the proper installation of their work. They 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.
- B. 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, motors, controls, etc.
- C. Whether shown on the Plans or not, the Contractor shall provide in the Bid access panels for each concealed shut-off valve 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. Change orders for access panels will not be accepted.

3.21 SCAFFOLDING, RIGGING AND HOISTING:

- A. 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.

3.22 CONCRETE WORK:

- A. The Contractor shall be responsible for the provisions of all concrete work required for the installation of any of their systems or equipment. The Contractor may, at their option, arrange with the others to provide the work. This option, however, will not relieve the Contractor of their responsibilities relative to dimensions, quality of workmanship, locations, etc.
- B. In the absence of other concrete Specifications, all concrete related to Mechanical work shall be 3500 psi minimum compression strength at 28 days curing, slump: $4'' \pm 1''$, air entrainment 4.5% water to cement ratio 0.5 and shall conform to the standards of the American Concrete Institute Publication AC1-318. Heavy equipment shall not be installed on pads for at least seven (7) days after pour. Insert 6-inch steel dowel rods into new and existing floors to anchor pads.
- C. 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 $\frac{1}{2}''$ deformed round bars on 6" centers both ways. Bars shall be approximately 2" 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 vertical edges $\frac{3}{4}''$ and tool horizontal edges with $\frac{3}{4}''$ radius.
- D. In general, unless otherwise noted, concrete pads for equipment and piping penetrations shall be a minimum of 4" thick, extend six (6) inches beyond the equipment's base dimensions.

3.23 MAINTENANCE OF EXISTING UTILITIES AND LINES:

- A. The locations of all piping, conduits, cables, and utilities, or otherwise, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily. Provide a seven (7) day written notice to Engineer, Architect and Owner prior to interrupting any utility service or line.
- B. Known utilities and lines as available to the Engineer are shown on the Plans. However, it is additionally required that, prior to any construction being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Hand dig if required to locate. Contractor shall bear costs of repairing damaged utilities.
- C. Cutting into existing utilities and services shall be performed in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.

3.24 CLEANING:

- A. The Contractor shall, at all times, keep the area of their work presentable to the public and clear from rubbish and debris caused by their operations; and at the completion of the work, they shall remove all rubbish, debris, all of their 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 their rubbish or debris.

- B. 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.
- C. Piping shall be kept clean at all times. Piping stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic. Do not install the piping or insulation 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 may periodically inspect that these procedures are followed.

3.25 NOISE, VIBRATION OR OSCILLATION:

- A. 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.
- B. 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, by means of flexible connectors, vibration absorbers, or other approved means.
- C. 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 Engineer.

3.26 EQUIPMENT/CONTROLS STARTUP & VERIFICATION:

- A. The Contractor and their Subcontractors shall include in the bid to provide equipment and startup and verification for ALL Systems specified for this project.
- B. A pre-start-up conference shall be held with the Architect, Engineer, Owner, General Contractor, Mechanical Contractor, Electrical Contractor, Controls Contractor, Test and Balance Contractor, and the Manufacturer's providing startup services. The purpose of this meeting will be to discuss the goals, procedures, etc. for start-up.
- C. Specific line-items shall be included on the schedule of values by each Trade for "equipment and controls startup". These line-item values shall be approved by the Engineer. The Construction Manager, General Contractor, Owner, and the Engineer's Field Inspector(s) shall closely monitor progress and quality of the equipment and controls startup and may withhold pay requests as deemed appropriate until satisfactorily completed.
- D. The Contractor shall be responsible for completion of System Verification Checklists/Manufacturer's Checklists. Factory authorized startup is required for all equipment.

Unless noted otherwise, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include the following:

1. Water Heating System
2. Water Flow Meters

- E. The manufacturer's recommended startup procedures and checklists will be acceptable for use in the project. All startup/verification process shall be thoroughly documented by the Contractor and shall include the time and date when performed.
- F. The Contractor shall "zip-tie" a start-up report to each piece of equipment in a clear plastic cover. Once start-up completion is verified by the Engineer the Contractor shall remove all reports and consolidate them into close-out documentation. The Contractor shall be responsible for completion of System Verification Checklist (SVC) / Manufacturer's Checklists.

3.27 INSPECTION, APPROVALS AND TESTS:

- A. Before requesting a final review of the installation from the Architect and/or Engineer, each Contractor shall thoroughly inspect their installations to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineer for unnecessary and undue work on their part.
- B. The Contractor shall provide as a part of this Contract any required Agency inspection, licensed and qualified to provide such services. All costs incidental to the provisions of inspections shall be borne by the Contractor.
- C. The Contractor shall advise each Inspecting Agency in writing, with an informational copy of the correspondence to the Architect and/or Engineer, when they anticipate commencing the work. Inspections shall be scheduled for rough-in as well as finished work. The rough-in inspections shall be divided into as many inspections as may be necessary to cover all rough-in without fail. Failure of the Inspecting Agency to inspect the work in a timely manner and submit the related reports may result in the Contractor having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- D. Approval by an Agency Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these Plans and Specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- E. Before final acceptance, the Contractor shall furnish the original and three (3) copies of the certificates of final approval by the Agency Inspector to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

3.28 ABOVE-CEILING AND FINAL PUNCH LISTS:

- A. The Contractor shall review each area and prepare and complete their own punch list for each of the subcontractors as required for the Project Schedule.

- B. Seven (7) days notice shall be given to the Engineer for review of above ceiling work that will be concealed by tile or other materials. Seven (7) days notice shall be given to the Engineer for review of below ceiling work and final inspection.
- C. When all work from the Contractor's punch list is complete at each of the major Project Stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven (7) days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review. The Contractor's representative may be requested at the inspections.
- D. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$125.00 per hour plus travel expense for extra trips required to complete either of the above ceiling, below ceiling or final punch lists.

3.29 OPERATING INSTRUCTIONS:

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment for a period of two (2) days of eight (8) hours each, or as otherwise specified. Refer to Section PLUMBING EQUIPMENT for additional requirements. During this period, instruct the Owner or their representatives fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least seven (7) days written notice to the Owner, Architect and Engineer in advance of this training period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representatives that were present.
- B. Each Contractor shall furnish three complete bound sets for approval to the Engineer instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft form, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions. Refer to Specification Section SHOP DRAWINGS for additional detail.
- C. Each Contractor, in the above-mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.

3.30 RECORD DRAWINGS:

- A. 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 ensure 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 Engineer upon completion of the work.

- B. All underground utilities/piping installed as part of this project shall be surveyed by a land surveyor licensed in the State in which the project is being constructed. The survey shall include actual pipe depths to top of pipe every 100 feet in length. The survey shall also include benchmarks dimensions relative to above grade, fixed structures. The survey shall be furnished on a compact disc in AutoCad “.dwg” format and “.pdf” format. The survey information shall be included in the closeout documentation.

3.31 COMMISSIONING: CONTRACTOR RESPONSIBILITIES:

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - 3. Attend commissioning team meetings.
 - 4. Integrate and coordinate commissioning process activities with construction schedule.
 - 5. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority.
 - 6. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 - 7. Complete commissioning process test procedures.

3.32 DIVISION OF WORK:

- A. This section delineates the division of work between the Electrical Contractor, Mechanical Contractor, and Plumbing Contractors. For single prime contracts and “Construction Manager at Risk”, the project manager shall determine the final division of work or as directed in contract documents.
- B. Specific work to be done under Division 26 is hereinafter listed or described. All other work necessary for the operation of Divisions 22 and 23 equipment shall be performed under those Divisions.
- C. All individual motor starters and drives for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated otherwise.
- D. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter, VFD or disconnect switch. Under Division 26, line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Divisions 22 and 23.
- E. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Divisions 22 and 23.
- F. Equipment with built-in disconnects or outlets provided under Divisions 22 or 23 shall be wired under Division 26 to the line side of the disconnect switch, or the outlet. A disconnect switch shall be provided under Division 26 if the equipment is not provided with a built-in disconnect switch. In this case wiring from the switch to the equipment shall be under Divisions 22 or 23. See sheet M-603 Electrical Equipment Connection Detail regarding the location and wiring of

disconnects for other equipment. The built-in switch for outdoor equipment shall be in minimum NEMA 3R enclosure.

- G. All electrical work shall be performed by individuals and/or companies who are properly licensed by the state of North Carolina.

END OF SECTION 220500

SECTION 220501 - SCOPE OF THE PLUMBING WORK

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE

- A. The Plumbing 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 paragraphs.
- B. All applicable services and work specified in COMMON WORK RESULTS FOR PLUMBING.
- C. Installation of all equipment per the manufacturer's instruction, whether specifically detailed or not.
- D. Provide all required motor starters, etc. not provided under the electrical sections.
- E. Thorough instruction of the Owner's maintenance personnel in the operation and maintenance of all mechanical equipment.
- F. Thorough coordination of the installation of all piping, insulation, equipment, and any other material with other trades to insure no conflict in installation.
- G. Approved supervision of the plumbing work.
- H. Procurement of all required inspections, including fees for all inspection services and submission of final certificates of inspection to the Engineers.
- I. Excavation, backfilling, cutting, patching, sleeving, concrete work, etc., required to construct the mechanical systems.
- J. Equipment and controls start-up, verification and documentation as specified.
- K. Record drawings, final inspection certificates, test results, O & M documentation, warranty certification, spare parts, and other specified closeout documentation.
- L. Required schedule of values breakdown.
- M. Pipe and equipment identifications.
- N. Preinstallation meetings and equipment mockups.
- O. Complete storm sewer system connected to the local system/utility.

- P. Complete natural gas system connected to the local system/utility.
- Q. Domestic hot, cold, and recirculating hot water system.
- R. Soil, waste, and vent systems.
- S. Roof drainage systems.
- T. All plumbing equipment, fixtures, and fittings.
- U. All insulation associated with plumbing systems.
- V. Condensate drainage systems.
- W. All required pressure testing, flushing, purging, pressure, and flow testing requirements.
- X. Final coordination and connection of all equipment furnished by others (e.g., kitchen equipment, appliances).
- Y. Complete natural gas piping systems.
- Z. All required controls, including self-checkout and commissioning.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 220501

SECTION 220502 - SHOP DRAWINGS, MAINTENANCE MANUALS AND PARTS LISTS

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE

- A. The Contractor shall prepare and submit to the Engineer, through the Prime Contractor and the Architect within thirty (30) days after the date of the Contract, required copies of all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter. Refer to Division 1 requirements for shop drawing submittal requirements.
- B. Prior to ordering any materials or rough-in of any kind, the Contractor shall be responsible for final coordination of all electrical requirements (i.e., voltage, phase, circuit breaker, wire sizing, etc.) with the Electrical Contractor. There will be no change in the Contract Amount for any discrepancies. A final coordination meeting shall be held with the Architect, Owner, Engineer, Prime Contractor, Mechanical Contractor, Electrical Contractor, and their sub-contractors.
- C. 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.
- D. 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.
- E. Colors for equipment in other than mechanical spaces shall be selected from the Manufacturer's standard and factory optional colors unless noted otherwise on the Plans. Color samples shall be furnished with the shop drawing submission for such equipment.
- F. All submittals for equipment shall include all information specified and scheduled. This shall include water pressure drops, RPM, noise data, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.
- G. All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule. All items submitted shall be designated with the same identifying tag as specified on each sheet.
- H. Any submittals received in an unorganized manner without options to be provided specifically noted 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:

Access Doors
Water Heater (2.1A; 2.1C)
Firestopping (2.1D)
Floor Drains (2.1A)
Insulation
Plumbing Fixtures, Fittings and Trim (2.1A)
Plumbing Specialties (2.1A)
Pumps and Hydronic Specialties (2.1A)
Roof Drains
System Verification Check Lists
Controls & Components (2.1B)
Valves (2.1A)
Variable Frequency Drives (2.1A)

(Refer to the corresponding Special Notes.)

- A. SPECIAL NOTES: For all items above, upon final acceptance of the project, the Contractor shall deliver to the Engineer (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item above. Where available, documents shall include at least:
1. Detailed operating instructions
 2. Detailed maintenance instructions including preventive maintenance schedules.
 3. Addresses and phone numbers indicating where parts may be purchased.
 4. Expanded parts drawings, parts lists, service manuals, schematics, wiring diagrams.
 5. Master air filter list including equipment identification, filter size, filter quantity, and supplier contact information.
 6. Start-up reports, service records and test reports.
- B. Shop drawings for the Temperature Control Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system. Refer to Specification Section – CONTROLS for additional requirements.
- C. The Contractor shall submit project specific UL listed firestopping installation drawings to the authority having jurisdiction where required for their approval as required.

PART 3 - EXECUTION

- 3.1 Provide all shops in electronic/PDF format. The Engineer's comments will be returned in electronic format.
- 3.2 Each shop drawing and/or manufacturers descriptive literature shall have the proper notation indicated on it selecting equipment, accessories and features 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.

- 3.3 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.
- 3.4 All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the Prime 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.
- 3.5 The Contractor shall make any corrections or changes required by the Engineer and shall re-submit for final review as outlined above.
- 3.6 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. The Contractor shall also coordinate piping side connections.
- 3.7 The Engineer's 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, weight and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project.

END OF SECTION 220502

SECTION 220515 - SLEEVING, CUTTING, PATCHING, REPAIRING AND FIRESTOPPING FOR PLUMBING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE

- A. The Contractor shall be responsible for all openings, sleeves, trenches, etc., that may be required in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the General Contractor and all other trades. Coordinate with the General Contractor, any openings which they are 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.
- B. The Contractor shall plan their 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 route through; however, when this is not coordinated, the Contractor shall then do all cutting and patching required for the installation of their work, or pay other trades for doing this work when so directed by the Engineer. Any damage caused to the building by this Contractor shall be corrected or rectified at their expense.
- C. The Contractor shall notify other trades in due time where they will require openings or chases in new concrete, masonry, etc. Set all concrete inserts and sleeves for their work. Failing to coordinate, Contractor shall cut openings for the work and patch same as required at their expense with qualified tradesman.
- D. 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 corrected to the satisfaction of the Engineer.
- E. All work improperly performed or not performed as required in this section, shall be corrected by the General Contractor at the responsible Contractor's expense.

PART 2 – PRODUCTS

2.1 SLEEVES:

- A. Cast iron or Schedule 40 steel sleeves shall be installed through all walls of concrete or block construction. 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. Horizontal sleeves passing through exterior walls below grade or where there is a possibility of water leakage or penetration installation shall be watertight. Utilize "Link-Seal" at these locations.

- B. In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated.
- C. Vertical sleeves in roofs shall be flashed and counter-flashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed. Where sleeves pass through roof construction, sleeves shall extend minimum of 12" above the roof.

PART 3 - EXECUTION

3.1 CUTTING:

- A. All openings in plaster, gypsum board or similar materials, shall be framed by means of plaster frames, casing beads, or 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 devices, etc.
- B. The Contractor shall coordinate all openings in concrete and masonry walls with the General Contractor; and, unless otherwise indicated in the Contract Documents, shall provide lintels for all openings required for the mechanical work such as louvers, exhaust fans, etc. Prime paint all lintels. Lintels shall be sized as follows:
 - 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 each end.
- C. No cutting shall be performed at location that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- D. 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.

3.2 PATCHING, REPAIRING AND FINISHING:

- A. 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 workers of the trade. The work shall be performed in strict accordance with the provisions herein before specified to match adjacent surfaces and in a manner acceptable to the Engineer.
- B. Where portions of existing sites, lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced back to original or better condition to the satisfaction of the Engineer.
- C. Piping passing through floors, ceilings and walls in finished areas shall be fitted with chrome plated brass escutcheon trim pieces of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the pipe/duct around which it is installed.
- D. Flanged metal collars shall be provided around all pipes, etc. at all wall penetrations, both sides. Penetrations through any wall will require the installation of flanged collars. Openings shall not be any larger than 2" in any direction than the piping/duct passing through the wall. Openings larger than this requirement shall also be infilled to match adjacent construction. Fill void with

insulation for sound reduction.

3.3 FIRESTOPPING:

- A. Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type of penetration (one hour fire rated gypsum wall board with insulated metal pipe penetration, etc.) Provide copies to the authority having jurisdiction if required.
- B. All penetrating fire rated floors and walls shall be firestopped by this Contractor. All firestopping products and assemblies installed shall be UL listed.
- C. Where the installation of conduit, 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 and properly sealed to maintain the rating integrity of the wall, floor or ceilings affected.
- D. Where the installation of piping requires the penetration of non-rated floors, the space around the duct or pipe shall be tightly filled with an approved non-combustible material.
- E. The manufacturer of the firestopping materials shall provide onsite training for the installing Contractor. The training session shall demonstrate to the Contractor the proper installation techniques for all the firestopping materials.
- F. Firestopping materials include (but are not limited to) wraps, strips, caulks, moldable putties, restricting collars with steel hose clamps, damming materials, composite sheets, fire dam caulks, steel sleeves, etc.
- G. The following indicates the 3M penetration details for uninsulated pipe penetration of various wall and floor construction types (the list is not inclusive):
 - 1. One, two or three hour fire rated concrete floor - 3M #5300-MPC8.
 - 2. One, two or three hour fire rated solid or block concrete wall - 3M #5300-MPC16 or 3M #5300-MPC26.
 - 3. One hour fire rated gypsum wallboard - 3M #5300-MPC7.
 - 4. Two hour fire rated gypsum wallboard - 3M #5300-MPC7.
- H. The following indicates the 3M penetration details for insulated pipe penetrations of various wall and floor construction types (the list is not inclusive):
 - 1. One, two and three hour fire rated concrete floor - 3M #5300-IMP2.
 - 2. One, two and three hour concrete block wall - 3M #5300-IMP2.
 - 3. One hour fire rated gypsum wallboard - 3M #5300-IMP4.
 - 4. Two hour fire rated gypsum wallboard - 3M #IMP7.
- I. Multiple pipes penetrating fire rated floors and walls may be fire-stopped as a group. Submit details for specific applications if this method of firestopping is chosen.

END OF SECTION 220515

SECTION 220523 – VALVES FOR PLUMBING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE

- A. Each Contractor 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 valves, air vents, drain valves, check valves, special valves for special systems, etc., for all Mechanical Systems.
- B. ACCEPTABLE MANUFACTURERS: Lunkenheimer, Powell, Nibco, Crane, Jenkins, T & S Brass, Walworth, Milwaukee, DeZurik, Consolidated Valve Industries, Inc., Bell & Gossett, Apollo.
- C. The following type valves shall not be acceptable: Zinc, plastic, fiber or non-metallic.
- D. Each type of valve shall be of one manufacturer, i.e., ball valves, one manufacturer, butterfly valves, one manufacturer, check valves, one manufacturer, etc.
- E. All valves shall comply with current Federal, State and Local Codes. All valves shall be new and of first quality. All valves shall be designed and rated for the service to which they are applied. Zinc, plastic, fiber, or non-metallic valves shall not be acceptable.
- F. 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 – PRODUCTS

2.1 DOMESTIC WATER APPLICATIONS:

- A. GATE VALVE (2" AND UNDER): Use ball valves as specified.
- B. GATE VALVE (2½" AND LARGER): Gate valve shall have bronze body, bonnet, and solid wedge. Gate valve shall be rising stem with bolted bonnet and solid wedge. Valve shall have rated for 150 psi working pressure. Gate valve shall be Nibco T-134 for threaded ends or Nibco S-134 for solder ends.
- C. 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.
- D. BALL VALVES (2½" & LARGER): Ball valve shall have bronze body, ball, and reinforced,

watertight seat. 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 250 degrees F water temperature and 200 psi working pressure. Ball valve shall be Nibco T-580 for threaded ends and Nibco S-580 for solder ends. Provide extended handles for all ball valves installed in an insulated system.

- E. THREE PIECE BALL VALVE (2" AND UNDER): Ball valve shall have bronze body, ball, and reinforced, watertight seat. Valve shall be three-piece, swing-out, construction to facilitate inspection and repair. 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-595 for threaded ends and Nibco S-595 for solder ends.
- F. 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.
- G. STRAINERS (2½" AND LARGER): Watts 77F Series "Y" type strainer with semi-steel body and flanged ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with bolted cleanout and be rated for 200 psi working pressure.
- H. 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.
- I. 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.
- J. DOUBLE CHECK VALVE: Double check valve shall have bronze body construction and be provided with inlet strainer, two (2) gate valves for isolation and three (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. For sizes 2" and less, provide Watts #900 (or equal) with threaded ends. For sizes 2½" and larger, provide Watts #709 (or equal) with flange ends.
- K. REDUCED PRESSURE BACKFLOW PREVENTERS: Reduced pressure backflow preventers shall be provided with inlet strainer, two (2) gate valves for isolation, three (3) test ports and air gap fitting. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. RBPB shall be UL listed and meet AWWA C511 standards. Watts #909 or equal by Wilkins or Conbraco. 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. Perform backflow preventer test and provide results with closeout documentation.

- L. BALANCING VALVE: Bell & Gossett “Temp Setter” 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.

2.2 NATURAL GAS APPLICATIONS:

- A. GAS BALL VALVE (2" AND LESS): Nibco TFP600N gas ball valve. Valve shall be forged two-piece brass, CSA/CGA CR 91-002 certified, 5 psig rating, lever handle, full port ball valve, lubricated shaft, PTFE seats, blowout proof stem and threaded ends.
- B. GAS LUBRICATED PLUG VALVE, (2½" AND GREATER): Homestead lubricated industrial plug valve, Model 611/612, 100% round port, leak-proof, spring-loaded ball and lubricant sealed check valve. Provide with threaded ends and lever handle.

PART 3 - EXECUTION (NOT USED):

END OF SECTION 220523

SECTION 220529 - HANGERS, CLAMPS, ATTACHMENTS, ETC. FOR PLUMBING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE OF WORK

- A. Each Contractor's attention is also directed to Specification Section PIPE, PIPE FITTINGS AND SUPPORT.
- B. This section includes, but is not limited to, furnishing, and installing supports, anchors, and accessories for piping, ductwork, equipment, etc. Furnishing and installing shall be by each trade for the completion of their work as directed in this Section.

PART 2 – PRODUCTS:

2.1 MATERIALS AND EQUIPMENT:

- A. HANGERS, CLAMPS, ATTACHMENTS SCHEDULE:
 - 1. ACCEPTABLE MANUFACTURERS: Grinnell, Elcen, Fee & Mason.
 - 2. All hangers, clamps and attachments shall be manufactured products.
 - 3. Pipe Rings (2" pipe and smaller) – adjustable swivel split ring or split pipe ring.
 - 4. Pipe Clevis (2.5" pipe and larger) – adjustable wrought clevis type.
 - 5. Pipe Clevis (All pipe sizes) – steel clevis for insulated pipe.
 - 6. Riser Clamps (All pipe sizes) – extension pipe or riser clamp.
 - 7. Beam Clamps (All pipe sizes) – malleable beam clamp with extension piece.
 - 8. Brackets (All pipe sizes) – medium weight steel brackets.
 - 9. Concrete Inserts (All pipe sizes) – wrought or wedge type inserts.
 - 10. Concrete Fasteners (All pipe sizes) – self-drilling concrete inserts.
 - 11. Rod Attachments (All pipe sizes) – extension piece, rod coupling, forged steel turnbuckle
 - 12. U-bolts (All pipe sizes) – standard u-bolt.
 - 13. Welded Pipe Saddles (All pipe sizes) – pipe covering protection saddle sized for thickness of insulation.
 - 14. Pipe Roll (All pipe sizes) – adjustable swivel pipe roll.
 - 15. Protection Saddle (All pipe sizes) – 180 degree coverage, sheet metal pipe protection saddle.
 - 16. Hanger Rods (All pipe sizes) – Steel, diameter of hanger threading.
 - 17. Concrete Channel Inserts (All pipe sizes) – continuous heavy duty slot inserts unistrut.
 - 18. Adjustable Spot Inserts (All pipe sizes) – continuous heavy duty spot insert unistrut.
 - 19. Miscellaneous steel such as steel angles, rods, bars, channels, etc used in framing for supports, fabricated brackets, anchors, etc. shall confirm to ASTM-A-7.

PART 3 – EXECUTION:

3.1 INSTALLATION:

- A. 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.
- B. Hangers and supports shall be placed as near as possible to joints, turns, and branches.
- C. 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.
- D. Utilize beam clamps for fastening to steel joists and beams. Expansion anchors in masonry construction. Do not support piping or ductwork from bridging or metal decking.
- E. When piping is routed in joists, piping shall be top mounted on trapeze type hangers with each pipe individually clamped to trapeze hanger. Do not support piping or ductwork from bridging angles.
- F. Trapeze hangers shall be submitted and reviewed.
- G. 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 structural elements.
- H. 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.
- I. Where piping, etc., is routed vertically, approved riser clamps, brackets or other means shall be utilized at approximately 10'-0" center to center minimum. An approved adjustable base stand or fitting on concrete support base shall be utilized at the base of the vertical run.
- J. Where piping is routed along walls, knee braced angle frames, etc. pipe brackets with saddles, clamps, and rollers mounted on structural brackets fastened to walls or columns shall be used.
- K. Where copper tubing is specified, hangers shall be of copper clad type when piping is uninsulated.
- L. Uninsulated piping hung from above shall be supported with ring and clevis type pipe hangers. Uninsulated piping mounted on trapeze (when allowed) and wall bracket type support shall be held in place with U-bolts. U-bolts shall allow for axial movement in the piping.
- M. 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.
- N. Under no conditions will perforated band iron or steel wire driven hangers be permitted.

- O. Support steel and copper piping at a minimum of eight (8) foot intervals for piping 3" and smaller and ten (10) foot intervals for larger piping. Provide additional support at end of the branches and change of direction.
- P. Support plastic pipe 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.
- Q. Where fireproofing is dislodged/damaged from the building structure due to Contractor's installation of hangers, clamps, etc., it shall be the Contractor's responsibility to repair all dislodged/damaged fireproofing to original fireproofing rating. This shall also include all work performed by their Contractor's sub-contractors.
- R. Ensure that all bolts and nuts are tightened.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATIONS, TAGS, CHARTS, FOR PLUMBING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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.

PART 2 – PRODUCTS:

2.1 TAGS AND CHARTS:

- A. Provide and install on each valve 1" in size or greater for all mechanical systems a 1.5" diameter circular bronze or baked phenolic tag fitted to each valve so that it cannot be removed. Each tag shall be embossed consecutively with sequential number identifiers. Number identifiers shall be determined by the Contractor sequentially.
- B. Provide typewritten valve charts indicating each valve identifier, the valves service, normal position and its location. Also furnish one electronic copy on CD in "*.xls" format. One (1) copy of this chart shall be mounted in suitable frame(s) with clear plastic covers in a conspicuous location in each of the major mechanical rooms. Repeat only main valves which are to be operated in conjunction with operations of more than single mechanical room.
- C. All emergency shutoff valves shall be identified with a permanent engraved tag hung from the valve with 1-inch high lettering. Emergency shutoff valves shall be identified as any valve whose closure could create an emergency condition in the facility (i.e. natural gas, water, domestic hot water, etc.).
- D. Label all control panels and disconnect switches with service and equipment served.

2.2 PIPING IDENTIFICATION:

- A. All piping installed shall be identified according to the charts 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 twelve (12) 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.
- B. 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	Label Length	Letter Size
3/4" – 1 1/4"	8"	1/2"
1 1/2" – 2"	8"	3/4"
2 1/2" – 6"	12"	1 1/4"

8" – 10" 24" 2 ½"

- C. The following chart describes the pipe service and label identification which shall be used for various pipes.

PIPE	ABBREVIATION
Domestic Cold Water	D.C.W.
Domestic Hot Water	D.H.W.
Recirculated Hot Water	D.H.W.R.
Natural Gas	NAT.GAS.
Sanitary Sewer Piping	SAN
Sanitary Vent Piping	VENT
Storm Sewer Piping	STORM

PART 3 – EXECUTION:

3.1 PAINTING OF PIPING:

- A. All insulated and uninsulated piping in the mechanical rooms, shall be completely painted by this contractor.
- B. All piping shall be painted in accordance with the following color-coding chart. Verify colors with the Owner prior to painting. Paint all pipes evenly in a workmanlike manner. Apply a minimum of two coats of paint for sufficient coverage.

PIPE	PIPE COLOR CODE	ABBREVIATION
Domestic Cold Water	Light Blue w/Black Letters	D.C.W.
Domestic Hot Water	Dark Blue w/White Letters	D.H.W.
Recirculated Hot Water	Dark Blue w/White Letters	D.H.W.R.
Natural Gas	Yellow w/Black Letters	NAT.GAS.
Sanitary Sewer Piping	Grey With No Letters	
Sanitary Vent Piping	Grey With No Letters	
Storm Sewer Piping	Grey With No Letters	

- C. Water heaters, storage tanks, heat exchangers, etc. shall be painted light gray.
- D. Where a pipe is not specifically identified in this table, painting and marking shall be in accordance with the most recent ANSI Standards. Verify with Engineer.

3.2 NATURAL GAS PIPING IDENTIFICATION:

- A. All-natural gas piping within mechanical rooms shall be painted safety orange. Natural gas valves shall be painted red. Piping shall be prepped as required and piping shall be painted with at least two coats of paint or more if required to properly cover the piping. Piping in the kitchen shall be painted black. Exterior gas piping shall be painted to match the building with color as directed by the Architect/Owner.
- B. In addition, natural gas piping and meter loop shall be painted color as selected by Architect.

3.3 EQUIPMENT IDENTIFICATION:

- A. Unless otherwise specified, all equipment shall be identified. The titles shall be short and concise, and abbreviations may be used as long as the meaning is clear. In finished rooms and mechanical rooms, equipment shall be identified neatly and conspicuously with engraved black lamacoid plates (or equivalent) with 1" high white letters on the front of each piece of equipment.
- B. All mechanical equipment and associated starters/disconnects shall have the electrical panel number and circuit number identified on a lamacoid plate. Coordinate with the Electrical Contractor.

3.4 ACCESS THROUGH LAY-IN CEILINGS:

- A. Mark each lay-in ceiling panel which is nearest access to equipment, valves, dampers, filters, duct heaters, etc., with colored tape labels located on the ceiling grid.

END OF SECTION 220553

SECTION 220570 - EXCAVATION, TRENCHING, BACKFILLING AND GRADING FOR PLUMBING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE OF WORK

- A. 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.

PART 2 – PRODUCTS (NOT USED):

PART 3 - EXECUTION:

3.1 EARTHWORK CLASSIFICATION:

- A. Without regard to the materials encountered, all excavation and materials excavated shall be unclassified. Materials to be excavated shall include earth, rock, concrete, or any other obstructions encountered in excavation and/or trenching to install underground utility pipes, tanks, vaults, or other equipment.
- B. 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, debris, obstructions, or other materials encountered in the excavating. The Contractor shall be responsible for the removal of all materials encountered as required for the installation of the work.
- C. 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.
- D. The Contractor shall draw their own conclusions as to the surface and sub-surface conditions to be encountered during construction of this project. The Engineer and Owner do 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.

- E. Refer to Specification Division EARTHWORK located in the Site Work portions of the Specifications and Civil Drawings for additional information. Also refer to the GEOTECHNICAL report (provide for informational purposes only) included in the Front End of the Specifications.

3.2 EXCAVATION:

- A. 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.
- B. Water lines crossing under sewer lines, or crossing less than 2 feet above sewer lines, must be concrete encased for a distance not less than 5 feet on either side of the point of crossover.
- C. Excavate trenches of sufficient width for proper installation of the work. Excavate to 6" below the bottom of new pipes for installation of compacted fill.
- D. Sheet and brace trenches as necessary to protect workers and adjacent structures. Comply with local regulations or, in the absence thereof, with the latest version of "Manual of Accident Prevention in Construction" by the Associated General Contractors of America and current OSHA Standards. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and/or equipment 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.
- E. Rules and regulations governing the respective utilities shall be observed in executing all work under this Division. 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 Engineer.
- F. Machine excavation shall not be allowed within ten (10) feet of electric lines, natural gas lines or other lines carrying combustible materials. Use only hand tool excavation methods.
- G. The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted. Any damage to existing structures, piping services, or rock intended for bearing, shall be corrected at the responsible Contractor's expense.
- H. 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 joint making. 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.
- I. Keep trenches free from water while construction is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper joining of pipe.

Any dewatering from this Contractor's trenches which is required during construction, shall be included in this Contract.

- J. In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, utility lines, landscaping to remain, etc. The Contractor 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 at the responsible Contractor's expense.
- K. Use surveyor's level to establish elevations and grades.
- L. Machine excavation shall be held a sufficient distance from foundations and footings to insure no damage to same. Contractor shall accept full responsibility and pay for repairs and/or replacement of structural members, footings, etc.
- M. The Contractor shall accept the site as it is. Remove all trash, rubbish, and unsuitable material from the site at the completion of excavation work.
- N. The Contractor shall provide and maintain barricades, trench plates and temporary bridges around excavations as required for safety. Temporary plates or bridges shall be provided where excavations cross paved areas and walks. The Contractor shall maintain these plates and 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.
- O. 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 Contractor's responsibility to ascertain the location of all lines and excavate with caution in their area.
- P. 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.
- Q. Maintain carefully all benchmarks, monuments, and other reference points. If disturbed or destroyed, replace as directed.

3.3 BACKFILL, COMPACTION AND SURFACE REPAIR:

- A. Backfilling for Plumbing Work shall include all trenches, manhole pits, tanks 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.
- B. All trenches shall be backfilled with a bedding of 6" of manufactured sand or #8 crushed stone after finished excavation. Install the new pipe on the compacted fill material. Install tracer wire on all pipe. Apply any special coatings to the pipe. 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

coatings and testing are 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 (rock and debris free) tamped at 6" intervals. Water settling of backfill is permitted only as an aid to mechanical compacting.

- C. 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 topsoil.
- D. Backfill and compact beneath concrete slabs, paved areas, walks, etc. shall be brought to proper grade to receive the sub-base and paving. No concrete or paving shall be placed on uncompacted fill or unstable soil.
- E. 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.
- F. 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.
- G. 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.
- H. Provide and place any additional fill material from off the site as may be required for backfill. Fill obtained from offsite 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.
- I. If not specified or indicated elsewhere in the Contract Documents to be performed by Others, the Contractor shall lay new sod over their excavation work for existing disturbed grassy areas. Level, with adjacent surface, compact and water in accord with sound sodding practice.
- J. Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated in the following two paragraphs.
- K. At a minimum, fill in grass areas shall be compacted to 90% 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 Specification Division EARTHWORK; whichever is most stringent.
- L. At a minimum, fill in concrete or asphalt area shall be 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 Specification Division EARTHWORK; whichever is most stringent.
- M. 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.
- N. 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.

- O. 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.
- P. 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 as specified. 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. Refer to Specification Division EARTHWORK.
- Q. Maintenance Settling: Where settling is measurable or observable at excavated areas during Project Warranty Period, remove surface (pavement, concrete or any other surface or 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.
- R. Disposal of Excess Non-organic Soil and Rock: Any excess excavated waste material shall become the property of the Contractor and shall be disposed of by the Contractor off site at no additional cost to the Owner.
- S. Unless otherwise directed by the Owner during construction, excess topsoil and subsoil suitable for fill shall be disposed of by the Contractor off site at no additional cost to the Owner.

3.4 MINIMUM DEPTHS OF BURY TO TOP OF PIPE:

- A. 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.

1. Domestic Water Lines	36 inches below final grade.
2. Storm Lines	24 inches below final grade.
3. Sanitary Lines	36 inches below final grade.
4. Natural Gas Lines	36 inches below final grade.
5. All Other Lines Not Listed	36 inches below final grade.

END OF SECTION 220570

SECTION 220700 – PLUMBING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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.
- B. The Contractor's attention is also directed to Specification Section, SHOP DRAWINGS, MAINTENANCE MANUALS AND PARTS LISTS FOR PLUMBING.

1.2 SCOPE OF WORK

- A. 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.
- B. Application of insulation materials shall be performed in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use.
- C. Insulation thicknesses shall comply with the latest version of ASHRAE 90.1 and IECC at a minimum.
- D. All insulation materials shall be installed per the latest edition of the National Commercial and Industrial Insulation Standards.
- E. Insulation shall be installed by a company regularly engaged in the application of insulation and any work deemed unacceptable by the Engineer shall be removed and properly installed at the expense of the Contractor.
- F. Unless otherwise specified or allowed, closed cell type insulation shall not be acceptable.

PART 2 – PRODUCTS

2.1 Acceptable Manufacturers - Johns Manville, Knauf, Owens-Corning.

2.2 Fire Ratings and Standards:

- A. Insulations, jackets, facings, adhesives, mastics, tapes, fitting materials, etc. 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.
- B. All products and their packaging shall bear a label indicating above requirements are not exceeded.
- C. Fiber glass duct wrap shall meet the requirements of Scientific Certification Systems Certification or Greenguard Validation of Formaldehyde Free.

- D. Fiber glass mechanical board shall meet the requirement of the Greenguard Standards for Low-Emitting Products.
 - E. Fiber glass pipe insulation shall meet the requirement of the Greenguard Gold level standard.
- 2.3 PIPE INSULATION MATERIAL: Insulation shall be Knauf "Earthwool 1000° Pipe Insulation ASJ+/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 0.02 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 minimum thickness of insulation as noted.
- A. Domestic Cold Water: 1" thick insulation
 - B. HVAC Fill Lines: 1" thick insulation
 - C. Roof Drain Piping: 1" thick insulation (Horizontal piping for primary & overflow systems)
 - D. Domestic Hot Water & Return Lines:
 - 1. Piping 1-1/4" and less: 1" thick insulation
 - 2. Piping 1-1/2" and greater: 1-1/2" thick insulation
 - E. Floor Drain Sanitary Pipes: All floor drains that have condensate spilled to the drain, and the sanitary pipe is not below slab, shall have its respective sanitary pipe insulated with 1" thickness. Insulate the pipe until it connects to a 4" main, but a minimum of 20 feet in the direction of flow.

PART 3 – EXECUTION

- 3.1 The Contractor shall photograph any installations prior to concealment. This includes duct risers in chases and at rooftop equipment.
- 3.2 General Application Requirements:
 - A. "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 "exposed".
 - B. 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.
 - C. Where more than one thickness of insulation is required, joints (both longitudinal and transverse) shall be staggered.
 - D. 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.

- E. Existing and/or new insulation removed and/or damaged during course of construction shall be repaired or replaced by the Contractor at their expense.
- F. Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Do not use staples through the jacket. NO EXCEPTIONS!
- G. All insulation shall be installed with joints butted firmly together.
- H. The Contractor shall insure that all insulation (piping, 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.

3.3 Piping Systems:

- A. Seal insulation and jacket at all points where insulation terminates at unions, flanges, valves, and equipment. This applies to hot water lines only as cold-water lines require continuous insulation and vapor barrier.
- B. Valves, flanges, and unions shall only be insulated when installed on cold fluid piping whose surface temperature will be at or below the dew point temperature of the ambient air.
- C. 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 and seal with approved sealant.
- D. Metal insulation shields and inserts are required at all pipe hangers where the piping is insulated. Metal shields shall be constructed of galvanized steel, formed to a 180-degree arc. Insulation shields shall be the following size:

Pipe Size	Shield Gauge	Shield Length
2" and less	20	12"
2 ½" - 4"	18	12"
5" - 10"	16	18"
Over 10"	14	24"

- E. 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.
- F. Provide pre-molded 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 additional insert shall be used for each additional 1" of pipe insulation above 1-1/2". All joints shall be fully sealed.

END OF SECTION 220700

SECTION 220810 - TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 RELATED DOCUMENTS

- A. The Engineer, or 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.
- B. Only after written approval, signed by the Engineer, shall the Contractor apply insulation or paint or allow the 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.

PART 2 - PRODUCTS (NOT USED):

PART 3 - EXECUTION:

3.1 BALANCING:

- A. The test and balance of this system shall be by a Contractor who employs only the services of a certified AABC or independent NEBB firm whose sole business is to perform test and balance services.
- B. The test and balance contractor shall bid directly to the Mechanical or Plumbing Contractor.
- C. The Contractor shall provide all start-up documents to Test and Balance Contractor prior to any test and balance services.
- D. The 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 as specified and shall be proven tight after a twenty-four (24) hour test.
- E. 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.
- F. System balancing, where required, shall be performed only by persons skilled in this work. The system shall be balanced as often as necessary to obtain desired system operation and results.
- G. Testing shall occur after completion of the ceiling systems installation.

- H. All deficiencies observed by the Test and Balance Contractor shall be reported immediately to the Engineer and Mechanical Contractor.
- I. Refer to Specification Section – COMMON WORK RESULTS FOR PLUMBING for startup requirements.
- J. Balance domestic hot water return system including all balance valves and record settings and flows.
- K. 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.
- L. Instruments used for testing and balancing of the hydronic systems shall have been calibrated within a period of six months prior to balancing. All final test analysis reports shall include a letter of certification listing instrumentation used and last date of calibration.
- M. Three (3) copies of the complete test reports shall be submitted to the Consulting Engineer prior to final acceptance of the project. Preliminary test reports shall be submitted when requested.
- N. The Contractor shall provide and coordinate work to provide sufficient time before final completion date so that tests and balancing can be accomplished and provide immediate labor and tools to make corrections when required without undue delay.
- O. The Test and Balance Contractor shall be present during the Engineer's final inspection of the building, or a separate project review date. The Engineer may request confirmation of the air balance report by asking for new measurements to be taken at that time. Any information in the test and balance report may be asked to be reconfirmed.

END OF SECTION 220810

SECTION 221116 – DOMESTIC WATER PIPING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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.
- B. Each Contractor's attention is also directed to Specification Section HANGERS, CLAMPS, ATTACHMENTS, ETC.

1.2 SCOPE

- A. Unless otherwise indicated, all materials shall be new and of the best grade and quality for the type specified. Materials shall comply with the “Buy American Act”.
- B. Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineer prior to submission of the bid.
- C. 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 Engineer. 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.
- D. Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If in doubt, consult Engineer.

1.3 SPECIFICATIONS STANDARDS:

- A. All piping and material shall be new, comply with the “Buy American Act” and shall conform to the following minimum applicable standards:
 - 1. Steel pipe; Schedule 40; ASTM A-53.
 - 2. Copper tube; Type K, L, M; ASTM B88-62; Type DWV ASTM B306-62.
 - 3. Welding fittings; ASA B16.9.
 - 4. Cast brass and wrought copper fittings; ASA B16.18.
 - 5. Cast brass drainage fittings; ASA B16.23.

PART 2 – PRODUCTS:

2.1 UNIONS, FLANGES AND WELDED TEES:

- A. 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.

- B. Dielectric insulating couplings or though ways shall be used wherever the adjoining materials being connected are of dissimilar metals such as connections between copper and steel pipe.
- C. Tee connections for welded pipe shall be assembled 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 $\frac{2}{3}$ the run size or smaller. Weld-o-let and thread-o-let branch connections are acceptable.

2.2 PLUMBING PIPING APPLICATIONS:

- A. DOMESTIC COLD, HOT AND RECIRCULATING HOT WATER PIPING (ABOVE SLAB):
 - 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%).
- B. DOMESTIC COLD, HOT AND RECIRCULATING HOT WATER PIPING (BELOW SLAB):
 - 1. Type "K" soft copper tubing. No fittings below slab.

PART 3 – EXECUTION:

- 3.1 All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.
- 3.2 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. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers, and other building openings.
- 3.3 All pipes shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. Spacing of pipe supports shall not exceed eight (8) foot intervals for pipes 3" and smaller and ten (10) foot intervals on all other piping. Small vertical pipes (1" and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants.
- 3.4 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 Specification Section INSULATION - PLUMBING.
- 3.5 The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted.
- 3.6 Support piping with standard pipe hangers with C-clamp connection to main structural members (not perlins), use angle steel cross pieces between main structural members where required to provide rigid support.
- 3.7 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. This includes temporary support required during Construction.
- 3.8 In general, piping shall be installed concealed except in mechanical 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.
- 3.9 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 ensure that no foreign matter is lodged therein.
- 3.10 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.
- 3.11 Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing. If in doubt, consult Engineer.
- 3.12 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.
- 3.13 Dielectric couplings or through ways shall be provided at all connections of dissimilar materials.
- 3.14 Nipples shall be of the same material, composition, and weight classification as pipe with which installed.
- 3.15 Apply approved pipe dope for service intended to all male threaded joints. The dope shall be listed for intended use.
- 3.16 Installation of pipe shall be in such a manner as to provide complete drainage of the system, whether detailed or not on plans. Drain valves shall be provided at all drainage points on pipes. Drain valves shall be ½" size ball valves with ¾" hose thread end and vacuum breaker. Label each drain valve.
- 3.17 When running any type of pipe below a footing, parallel to the footing, the area underneath the zone of influence shall be backfilled with 4" of crushed stone, sand bedding or concrete under the pipe. Each pipe section shall be anchored into unexcavated earth on both ends with deadman anchor system. The remainder of the trench in the zone of influence shall be backfilled with cementitious flowable fill. The zone of influence is the area within a 45 degree angle projecting down from the top edge of the footing on all sides of the footing.
- 3.18 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.

3.19 PIPE TESTING:

- A. 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.
- B. Water piping systems shall be subjected to a hydrostatic test of 150 psi. The system shall be proven tight after a twenty-four (24) hour test.
- C. The house drain line, interior storm sewers, interior rainwater 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 psi and shall hold for 15 minutes.
- D. 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.
- E. 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.
- F. The Contractor shall perform all additional tests that may be required by the Department of Health or other governing agency.
- G. 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.

END OF SECTION 221116

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. 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 SCOPE

- A. The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the State Plumbing Code.
- B. All equipment and specialties shall be new. All equipment and specialties shall be installed as recommended by the manufacturer.
- C. Prior to final inspection, test by operation at least twice, all equipment. Also, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.

PART 2 - PRODUCTS

2.1 FREEZEPROOF WALL HYDRANTS:

- A. FREEZEPROOF WALL HYDRANTS: Provide code approved wall hydrants at each location indicated in a neat and workmanlike manner. Affix tight to walls and ensure that the feed piping is on the heated side of the building insulation blanket. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- B. Wall hydrants shall be 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.
- C. Mount all wall hydrants at least twenty (20) inches above finished exterior grade. Where this is not possible or practical, contact Engineer for direction.
- D. Turn over for each hydrant, an operator key in an envelope labeled "Exterior Wall Hydrants" to Owner upon completion of the project. Where hydrants have lockable boxes, turn over an operator key for each in an envelope labeled "Exterior Wall Hydrant Locks" to Owner upon completion of project.

2.2 INTERIOR HOSE BIBBS AND DRAIN VALVES:

- A. HOSE BIBBS AND DRAIN VALVES: Provide code approved hose bibbs and drain valves at each location indicated in a neat and workmanlike manner. Affix hose bibbs tight to walls. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- B. HOSE BIBBS (HB): Provide code approved hose bibbs with vacuum breakers and male threaded spouts at each location indicated (toilet rooms, mechanical rooms, etc.). The hose bibbs shall be Woodford Model B24 (or equal) with loose key handle polished chrome finish, brass construction, and enclosed in a flush mounted wall box. Hose bibbs shall be mounted at eighteen (18) inches above finished floor. Do not install hose bibbs in spaces which do not have floor drains.

2.3 DRAIN VALVES: Install 3/4 inch bronze body drains, similar and equivalent to Nibco, No. 72 or 73, as indicated and at the following locations:

- 1. At the low point and isolatable section of the plumbing system.
- 2. At each low point and isolatable section of the hydronic system.
- 3. At each isolatable pipe section.
- 4. At each water heater.
- 5. At each storage tank.
- 6. At each heat pump.
- 7. At each water-to-water unit.
- 8. At each pump suction.
- 9. Install a code approved vacuum breaker where installation on to domestic water system.

2.4 WATER HAMMER ARRESTORS (WHA):

- A. WATER HAMMER ARRESTORS (WHA): Provide water hammer arrestors at each location indicated and/or as required to eliminate hydrostatic on the domestic water system. Install in an accessible location and in a neat and workmanlike manner. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- B. 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. Provide insulating unions where arrestors are of dissimilar material from the piping served (unless piping is non-conducting, such as ABS or PVC).
- C. 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.
- D. 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.

- E. Provide at least one water hammer arrestor at all quick acting valve locations including:
1. Clothes Washers – Type “A”
 2. Commercial Dishwashers – Type “B”
 3. Mop Basins, downstream of check valves – Type “A”
 4. Flush valve fixtures – Type “B”, each toilet room with 1-3 flush valve fixtures shall have its own Type “B” water hammer arrestor.

F. ARRESTOR SCHEDULE:

Mark	Zurn Model	Fixture Units	P.D.I. Size
Type “A”	#100	1-11	A
Type “B”	#200	12-32	B
Type “C”	#300	33-60	C
Type “D”	#400	61-113	D

2.5 OTHER SPECIALTIES:

- A. 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.
1. Where domestic water system connects to a limited area fire protection system.
 2. Where domestic water system connects to hydronic system.
 3. At any threaded hose tap on the domestic water system.
 4. At all mop basins, provide check valves to the hot and cold-water supply upstream of the faucet.

PART 3 – EXECUTION:

- 3.1 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 3.2 Prior to final inspection, test by operation at least twice, all equipment. Also, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.
- 3.3 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.
- 3.4 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 ensure 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.

END OF SECTION 221119

SECTION 221316 – SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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.
- B. Each Contractor's attention is also directed to Specification Section HANGERS, CLAMPS, ATTACHMENTS, ETC.

1.2 SCOPE

- A. Unless otherwise indicated, all materials shall be new and of the best grade and quality for the type specified. Materials shall comply with the “Buy American Act”.
- B. Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineer prior to submission of the bid.
- C. 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 Engineer. 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.
- D. Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If in doubt, consult Engineer.

PART 2 – PRODUCTS

2.1 SPECIFICATIONS STANDARDS:

- A. All piping and material shall be new, comply with the “Buy American Act” and shall conform to the following minimum applicable standards:
 - 1. Copper tube; Type DWV ASTM B306-62.
 - 2. Cast iron soil pipe; ASA A-40.1 and CS 188-59.
 - 3. Cast iron drainage fittings; ASA B16.12.
 - 4. Cast iron screwed fittings; ASA B16.4.
 - 5. PVC pipe; Schedule 40; ASTM D-1785.

2.2 EXTERIOR APPLICATIONS (SITE WORK):

- A. SITE SANITARY SEWER: Refer to the Civil Plans and Specifications.

2.3 SOIL / WASTE AND VENT PIPING (BELOW SLAB):

- A. SCHEDULE 40 PVC PIPE WITH DRAINAGE PATTERN FITTINGS AND SOLVENT CEMENT JOINTS MADE IN ACCORDANCE WITH THE PLUMBING CODE (ASTM – D2665 & D1784). PVC PIPE SHALL NOT BE INSTALLED WHERE WASTEWATER APPLICATIONS EXCEED 140 DEG F.
- B. HIGH PERFORMANCE COATED HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS (KITCHEN PIPING)
 - A. Pipe and Fittings: ASTM A 74, Service class.
 - B. Gaskets: ASTM C 564, rubber.
 - C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.
 - D. Tensile Strength: 21,000 psig minimum.
 - E. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
 - F. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.
 - G. The inside of each pipe shall be reamed prior to coating to decrease the coefficient of friction.
 - H. Pipe Coating: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating, and finally an electrically deposited, high performance anodic epoxy topcoat. Coating thickness shall be 5 mils or greater on both the OD and ID.
 - I. Fitting Coating: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating, and finally an epoxy acrylic powder topcoat. Coating thickness shall be 5 mils or greater on both the OD and ID.
 - J. Coating Performance: Pipe and Fitting Coatings must pass the following performance specifications per EN 877:
 - 1. 350 hours of salt spray testing
 - 2. Resistance to wastewater for 30 days at 73° F
 - 3. Chemical resistance from pH 2 to pH 12 for 30 days at 73° F
 - 4. Resistance to hot water for 24 hours at 203° F
- C. HIGH PERFORMANCE COATED HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS (KITCHEN PIPING)
 - A. Pipe and Fittings: ASTM A 888 or CISPI 301.

- B. Tensile Strength: 21,000 psig minimum.
- C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
- D. Each length of pipe and each fitting shall be plainly marked with size, country of origin, and name of manufacturer, or manufacturer's registered trademark by which the manufacturer can be readily identified after installation.
- E. The inside of each pipe shall be reamed prior to coating to decrease the coefficient of friction.
- F. Pipe Coating: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating, and finally an electrically deposited, high performance anodic epoxy topcoat. Coating thickness shall be 5 mils or greater on both the OD and ID.
- G. Fitting Coating: Chemically deposited zinc-phosphate pretreatment layer followed by an electrically deposited, high performance cathodic epoxy coating, and finally an epoxy acrylic powder topcoat. Coating thickness shall be 5 mils or greater on both the OD and ID.
- H. Coating Performance: Pipe and Fitting Coatings must pass the following performance specifications per EN 877:
 - 1. 350 hours of salt spray testing
 - 2. Resistance to wastewater for 30 days at 73° F
 - 3. Chemical resistance from pH 2 to pH 12 for 30 days at 73° F
 - 4. Resistance to hot water for 24 hours at 203° F.

2.4 SOIL / WASTE AND VENT PIPING (ABOVE SLAB):

- A. Service weight hubless cast iron pipe with manufacturer's approved bands. No-hub cast-iron and fittings shall be produced and labeled ASTM 888 or CISPI 301. No-hub couplings shall be produced and labeled as ASTM C1277, C1563, or CISPI 310.
- B. Service weight cast iron hub and spigot piping with compression gasket joints. Service-weight cast-iron pipe and fittings shall be produced and labeled as ASTMA74 and C1563.
- C. Type DWV copper drainage piping with cast bronze drainage pattern fittings with solder joints.

PART 3 - EXECUTION:

- 3.1 All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.
- 3.2 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. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers, and other building openings.

- 3.3 All pipes shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. Spacing of pipe supports shall not exceed eight (8) foot intervals for pipes 3" and smaller and ten (10) foot intervals on all other piping. Small vertical pipes (1" and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants.
- 3.4 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 Specification Section INSULATION - PLUMBING.
- 3.5 The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted.
- 3.6 Support piping with standard pipe hangers with C-clamp connection to main structural members (not perkins), use angle steel cross pieces between main structural members where required to provide rigid support.
- 3.7 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. This includes temporary support required during Construction.
- 3.8 In general, piping shall be installed concealed except in mechanical 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.
- 3.9 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 ensure that no foreign matter is lodged therein.
- 3.10 Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing. If in doubt, consult Engineer.
- 3.11 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.
- 3.12 Eccentric reducers shall be used where required to permit proper drainage and venting of pipelines; bushings shall not be permitted.
- 3.13 Installation of pipe shall be in such a manner as to provide complete drainage of the system, whether detailed or not on plans. Drain valves shall be provided at all drainage points on pipes.

Drain valves shall be ½" size ball valves with ¾" hose thread end and vacuum breaker. Label each drain valve.

- 3.14 All increases in vent size at roof shall be by means of service weight cast iron increasers.
- 3.15 When running any type of pipe below a footing, parallel to the footing, the area underneath the zone of influence shall be backfilled with 4" of crushed stone, sand bedding or concrete under the pipe. Each pipe section shall be anchored into unexcavated earth on both ends with deadman anchor system. The remainder of the trench in the zone of influence shall be backfilled with cementitious flowable fill. The zone of influence is the area within a 45 degree angle projecting down from the top edge of the footing on all sides of the footing.
- 3.16 Piping for all drainage systems shall be installed to permit flow, trapping, and venting in accord with current codes and best practice.
- 3.17 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 shall be the Contractor's responsibility to locate and correct any leaks and retest as required. Any sewer odor issues that occur during the Warranty Period shall be corrected by the Contractor.
- 3.18 PITCH OF PIPING:
- A. 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:
 - B. INTERIOR SOIL / GREASE WASTE AND VENT PIPING: ¼" per foot in direction of flow where possible but in no case less than 1/8" per foot.
 - C. SITE SANITARY / GREASE LINES: Not less than one (1) % fall in direction of flow and no greater than indicated.
 - D. ALL OTHER LINES: Provide ample pitch to a low point to allow 100 percent drainage of the system.
- 3.19 PIPE TESTING:
- A. 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.
 - B. Water piping systems shall be subjected to a hydrostatic test of 150 psi. The system shall be proven tight after a twenty-four (24) hour test.
 - C. The house drain line, interior storm sewers, interior rainwater 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 psi and shall hold for 15 minutes.
 - D. 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.

- E. 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.
- F. The Contractor shall perform all additional tests that may be required by the Department of Health or other governing agency.
- G. 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.
- H. The natural gas service shall be tested in accordance with requirements and/or recommendations of the local gas company.
- I. Natural gas piping downstream of the meter assembly shall be tested per the local gas company requirements or the following (whichever is stricter):
 - 1. Low Pressure (up to 14" wc) – Test to 10 psi for 24 hours, or as required by the gas utility company.
 - 2. Elevated Pressure (up to 2 psi) – Test to 50 psi for 24 hours, or as required by the gas utility company.
 - 3. Medium pressure (up to 60 psi) – Test to 100 psi for 24 hours, or as required by the gas utility company.

END OF SECTION 221316

SECTION 221319 – SANITARY WASTE SPECIALTIES

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. The Contractor's attention is directed to the General and Special Conditions, COMMON WORK RESULTS FOR PLUMBING 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 SCOPE

- A. The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the State Plumbing Code.
- B. All equipment and specialties shall be new. All equipment and specialties shall be installed as recommended by the manufacturer.
- C. Prior to final inspection, test by operation at least twice, all equipment. Also, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.

PART 2 - PRODUCTS

- 2.1 CLEANOUTS: In addition to cleanouts indicated on the drawings, provide cleanouts in soil and waste piping at the following minimum locations:
 - 1. At base of each stack.
 - 2. At fifty (50) foot maximum intervals in horizontal lines.
 - 3. At each change of direction of a horizontal line.
 - 4. For every (4) 45 degree changes in direction
 - 5. As required to permit rodding of entire system.
 - 6. As required by current State Plumbing/Building Codes.
- 2.2 Water closets, mop sinks/basins and other fixtures with fixed traps shall not be accepted as cleanouts.
- 2.3 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 screwdriver operable.
- 2.4 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.
- 2.5 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.
- 2.6 Provide a non-hardening mixture of graphite and grease on threads of all screwed cleanouts during installation.

- 2.7 Do not install cleanouts against walls, partitions, etc. where rodding will be difficult or impossible. Extend past the obstruction.
- 2.8 In finished walls, floors, etc., ensure that cleanouts are installed flush with finished surfaces and, where required, grout or otherwise finish in a neat and workmanlike manner.
- 2.9 EXTERIOR CLEANOUTS (ECO): Provide exterior cleanouts where indicated for all sanitary lines leaving the building within 5'-0" of building perimeter. Permanently locate all exterior cleanouts with 12"x12"x12" solid finished concrete marker slightly above grade in grass areas or flush in concrete or pavement areas. Label "CO". Zurn Z-1400-HD cleanout with tractor cover for exterior locations. Provide concrete supporting pad crowned to shed water.
- 2.10 Cleanouts shall be as manufactured by Zurn, Josam, Wade, Ancon, Jay R. Smith, similar to the following:
1. Zurn Z-1440 or Z-1445 cleanout tee at base of exposed stack and at change in direction of exposed lines.
 2. Zurn Z-1440 cleanout or Z-1445-1 cleanout tee where stacks are concealed in finished walls.
 3. Zurn ZN-1400-T cleanout with scoriated top in finished concrete and masonry tile floors.
 4. Zurn ZN-1400-Tx cleanout with square recessed top for VCT and linoleum finished floors.
 5. Zurn ZN-1400-Z cleanout with round recessed top for poured floors.
 6. Mueller 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.
 7. Threaded hex head type cleanouts of same materials as pipe for piping 2" and smaller.
 8. Zurn cleanout with round top with adjustable retainer for carpet area. Install flush with carpet.
- 2.11 FLOOR DRAINS:
- A. FLOOR DRAINS: Provide floor drains at locations indicated and/or as required by State Plumbing/Building Codes. Install in a neat and workmanlike manner. Install floor drains in strict accordance with manufacturer's recommendations and the State Plumbing and Building Codes. Coordinate locations with General Contractor to ensure floor pitch to drain where required.
 - B. Ensure by coordination with the General Contractor those spaces served with floor drains on all floors above the lowest level have a water seal extending at least three (3) inches from the floor. Also, for these locations, provide a 36"x36", four (4) pound sheet lead flashing sheet and clamping collar or a 30 mil chlorinated polyethylene shower pan liner. Lead pans shall be given a heavy coat of asphaltum on bottom and sides before installation and a heavy coat on any exposed surfaces. After installation, provide one ply of fifteen (15) pound roofing felt beneath each pan.
 - C. The floor drains shall be Zurn, Josam, Smith, Wade, Watts Drainage, Ancon.
- 2.12 OTHER SPECIALTIES:
- A. 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.
 - B. LINT INTERCEPTOR: Provide steel fabricated lint interceptor with acid resistant coating on interior and exterior with non-skid cover and removable lift handle. An aluminum primary and

secondary screen assembly shall be provided with straining baffle with a 3/8" diameter perforated holes. Provide stainless steel tamper resistant securing hardware. Provide an extension collar for invert elevation of the inlet piping to maintain a minimum of 12" below finished floor. Field to verify.

PART 3 - EXECUTION

- 3.1 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 3.2 Prior to final inspection, test by operation at least twice, all equipment. Also, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.
- 3.3 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.
- 3.4 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 ensure 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.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES, FITTINGS AND TRIM

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS

- A. 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 SCOPE

- A. The Contractor shall provide all fixtures complete with trim required and connect in a manner conforming to the State Plumbing Code.
- B. All fixtures and trim shall be new. All fixtures and trim shall be installed as recommended by the manufacturer. 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. All fixtures and trim shall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost. 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.
- C. Fixture seats shall be Church model 2155CTJ, elongated open front less cover w/ JUST-LIFT, STA-TITE check hinge and DuraGuard Antimicrobial Agent, or approved equal.
- D. Coordinate all stainless steel sinks with architectural casework shop drawings for appropriate fit. Do not order sinks until this has been coordinated. Change Orders will be immediately rejected for lack of coordination during construction.

PART 2 - PRODUCTS:

- 2.1 ACCEPTABLE MANUFACTURERS: Subject to compliance with requirement's manufacturers offering plumbing fixtures and trim which may be incorporated in the work include only the following:
 - A. Plumbing Fixtures: American Standard, Kohler, Zurn
 - B. Plumbing Trim: T&S Brass, or Zurn
 - C. Flush Valves: Sloan or Zurn
 - D. Stainless Steel Sinks: Elkay, Just, Moen Commercial, Sterling
 - E. Mop Basins and Laundry Tubs: American Standard, Kohler, Zurn
 - F. Water Coolers: Elkay, Murdock, Oasis, Halsey Taylor or Sunroc
 - G. Showers: Bradley, Symmons, Speakman Company, Willoughby, Aquarius

- H. Appliance Connection Boxes: Guy Gray, Oatley, Wolverine
- I. Fixture Seats: Bemis, Church, Olsonite
- J. Fixture Carriers: Kohler, Zurn, Wade, Watts
- K. Lavatory, Sink, Mop Basin, and Laundry Tub Strainers: American Standard, Elkay, Kohler, Zurn.
- L. P-traps, Tailpieces, and Escutcheons: American Standard, Elkay, Kohler, McGuire, Moen Commercial, Sloan, Zurn.
- M. P-trap Insulation covering for ADA Fixtures: IPS Corp., McGuire, Plumberex.
- N. Water supplies and stops: American Standard, Elkay, Kohler, Moen Commercial, Watts, Zurn,

2.2 PLUMBING FIXTURE SPECIFICATIONS:

P-1 Bi-Level Electric Water Cooler – Bottle Filler - ADA

Elkay model EZSTL8WSLK electric water cooler w/ EZH20 bottle filling station; 8.0 GPH of 50°F water at 90°F room temperature and 80°F entering water; vandal resistant 14 gauge satin finish stainless steel basin and housing, 1/5 HP compressor; 115/1phase/60 HZ and filter. Provide with loose key manual shut-off at wall. Furnish and install with filter as provided by manufacturer as an option. Furnish and install with plastic P-Trap.

P-2 Single Compartment Sink – 19"x19"x5.5" Deep – ADA Compliant

Elkay LRAD1919, single compartment stainless steel sink, 19" x 19" O.D. x 5.5" deep, 18 gauge with 3-hole, 4" center faucet punching. Provide with rear/center drain configuration. Provide with grid strainer, 3/8" chrome supplies stops, offset tailpiece, P-trap, drain and escutcheons. Sink trim shall be as follows:

- Gooseneck faucet with wrist blade handles shall be Zurn model Z812B4-3F with polished chrome-plated cast brass faucet body on 4" centers with quarter turn ceramic disc cartridges and 5-3/8" swing gooseneck spout. Furnish with 0.5 GPM vandal-resistant aerator and 4" color-coded metal wrist blade handles.

PART 3 - EXECUTION:

- 3.1 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 3.2 Handicapped accessible fixtures shall be mounted as recommended by the Building Code and ADA. 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.

- 3.3 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 as specified and required by code.
- 3.4 Water supplies shall connect through walls with stops and chrome plated escutcheons with set screws. In general, furnish drinking fountains, wall-hung lavatories, and hose bibbs with manual loose key stop valves. For all other fixtures, furnish with manual permanent-key stop valves (i.e. sinks in casework, etc.). When in doubt, contact Engineer prior to installation.
- 3.5 Test for appropriate operation at least twice, ALL fixtures and trim including hands-free trim. Open all faucets and allow to run for fifteen (15) minutes, then remove all faucet aerators and thoroughly clean until smooth flow is obtained. Test by operation at least twice, adequate flow of water at flush valves including appropriate adjustment of hands-free devices, faucets including appropriate adjustment of hands-free devices, hose bibbs, fixture drains, shower heads, etc.
- 3.6 Remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from plumbing fixtures and thoroughly clean same.

END OF SECTION 224000

SECTION 228000 – COMMISSIONING - PLUMBING

PART 1 - GENERAL

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, system calibration, testing adjusting and balancing, performance testing and training.

Commissioning during the project will be in conformance with NC GS 143-135.35 - .40 (Article 8C). Our commissioning services conform to ASHRAE Guideline 0-2005; ASHRAE Guideline 1.1-2007 and we follow recommended practices by the University of Wisconsin, Association of Energy Engineers, and NEBB Commissioning Standards.

- A. Review the Owner's Project Requirements (OPR) and design team's Basis of Design (BOD) for clarity and completeness.
- B. Develop commissioning requirements to be included in the construction documents.
- C. Perform a commissioning design review of the design documents and back-check the review comments prior to submission.
- D. Develop and implement the commissioning plan.
- E. Review contractor submittals applicable to systems being commissioned for compliance with the OPR, OBD and design documents.
- F. Verify applicable equipment and systems are installed properly and receive adequate operational checkout by installing contractors.
- G. Verify and document proper performance of plumbing systems.
- H. Assist in review of O&M manuals and warranties.
- I. Develop a Systems Manual to provide future operating staff the information needed to understand and optimally operate the commissioned systems.
- J. Coordinate and verify that the Owner's operating personnel are adequately trained.
- K. Provide a summary of the commissioning activities and submit a commissioning report.
- L. Perform seasonal testing and a review of commissioned systems within the first 10-months after substantial completion.

ABBREVIATIONS

The following are common abbreviations used in the Specifications.

Cx	Commissioning
CxA	Commissioning Authority
PM	Project Manager (Owner)
A/E	Architect and Design Engineers
CM	Construction Manager (CM at Risk)
EC	Electrical Contractor
PC	Plumbing Contractor
MC	Mechanical Contractor
CC	Controls Contractor
Subs	Subcontractors to General
TAB	Test and Balance Contractor
PFC	Prefunctional Checklist
FPT	Function Performance Test
Cx Plan	Commissioning Plan Document

RELATED SECTIONS

- A. Section 01 77 00 – Closeout Procedures
- B. Section 01 79 00 – Demonstration and Training
- C. Section 01 81 00 – General Commissioning Requirements
- D. Section 22 11 23 – Domestic Water Pumps
- E. Section 22 34 00 – Domestic Water Heaters
- F. Section 22 40 00 – Plumbing Fixtures

COMMISSIONING TEAM

- A. The members of the commissioning team consist of the Commissioning authority (CxA), the Owner Project Manager (PM), the Construction Manager (CM), the Mechanical Contractor (MC), the Electrical Contractor (EC), the Plumbing Contractor (PC), the Test and Balance Contractor (TAB), the Controls Contractor (CC), any other installing Subcontractors or suppliers of equipment. Additionally, if desires, the facility plant operator/engineer is also a member of the commissioning team. Representative from the A/E team may also be invited to observe critical procedures.
- B. The Contractor shall, through the CM provide skilled technicians to start-up and debug all systems within the division of work. These same technicians shall be made available to assist the Commissioning Agent in demonstrating prefunctional and functional tests as they relate to each system and their technical specialty.
- C. The Commissioning Agent reserves the right to approve the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include knowledge relative to the specific equipment involved, adequate documentation, tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Agent to get the job done.

MANAGEMENT

- A. The CxA directs and coordinates the commissioning activities and the reports to the Owner. All members work together to fulfill their responsibilities and fulfill the objectives of the Contract Documents.

SCHEDULING

- A. The CxA will work with the CM to project an initial commissioning schedule. The CM will integrate the tentative commissioning schedule into the master schedule. All parties shall address scheduling problems and make necessary notification in a timely manner to avoid delaying the commissioning process. The CM will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. Functional testing will not begin until the CxA receives completed prefunctional checklists, including startup and TAB paperwork; and the subcontractors punch work is complete, and the systems have been tested completely.
- C. The CxA will have 7 business days to review prefunctional documentation for completeness. If it is determined that the prefunctional and TAB report has not been completed and it impacts the original schedule coordinated by the CxA and CM; the schedule will be revised to include the additional days taken for the contractor to properly complete their work and the CxA to review the document.
- D. As construction progresses, scheduled commissioning activities will be reviewed and coordinated between the CxA and CM.
- E. Commissioning is required to be scheduled and completed prior to Substantial Completion.

COMMISSIONING PROCESS DURING CONSTRUCTION

The following narrative provides a brief overview of the commissioning tasks during construction and the general order in which they occur:

- A. Commissioning begins with a Cx kickoff meeting conducted by the CxA where the commissioning processes, including Cx Plan is reviewed with the commissioning team members.
- B. Additional meetings will be required throughout construction, scheduled by the PM, CxA & CM with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
- C. Energy related equipment documentation is submitted to the CxA during the normal submittal process for review, after approval by the A/E, including start-up procedures.
- D. The CxA works with the Subs to detail start-up procedures, including providing the Subs with prefunctional checklists (PFC's) to be completed during the startup process.
- E. The TAB contractor submits their TAB plan, for approval by the CxA prior to starting TAB work.

- F. The CxA will review reports from independent testing agencies and A/E reports from on-site periodic construction observation to maintain cohesiveness with project activities.
- G. The CxA will perform site visits and document the progress of the work. An Issues / Deficiency log will be developed to track installation and coordination issues which would affect commissioning and Owner maintenance.
- H. The Subs, under their own direction, execute and document the prefunctional checklists (PFC's), including start-up and initial checkout. The CxA documents that the checklists and start-ups were completed by the Subs according to the approved plans. This will include the CxA witnessing start-up of selected (major) equipment.
- I. The CxA develops specific equipment and system functional performance test (FPT) procedures. The procedures are developed using approved shop drawings and O&M documentation supplied by the contractors.
- J. Under direction of the CxA, functional performance tests (FPT's) are executed by the appropriate sub-contractors. The results of the FPT's are documented by the CxA.
- K. With support from the TAB and CC contractors, the CxA will verify the values reported in the final TAB report.
- L. During prefunctional checkout and functional performance testing, items of non-compliance in material, installation or setup shall be corrected at the Sub's expense and the system retested.
- M. The CxA reviews the O&M documentation for completeness.
- N. The CxA coordinates and verifies training of Owner staff by vendors and sub-contractors.
- O. Deferred / seasonal / warranty testing is conducted with assistance by the appropriate Sub-contractors.

SUBMITTALS

The CM will provide the CxA a copy of the following items, for the systems to be commissioned:

- A. Construction Schedule (initial and all updates)
- B. Construction Progress Meeting Minutes (all meetings)
- C. Approved shop drawings, materials certifications, and systems data for energy related systems. Approval review comments by the A/E and any resubmittal required by the A/E shall be copied to the CxA.
- D. One set of approved coordination drawings either electronic media or hard copy which includes all commissioned systems e.g., mechanical, electrical, and plumbing.
- E. Piping – Plumbing contractor shall supply one copy of the piping systems pressure test results and one copy of the flushing and clean out report.

- F. Chlorination Report - Plumbing contractor shall supply one copy of the domestic water chlorination report approved by the authority having jurisdiction.
- G. Subs shall submit start-up and initial checkout plan for each piece of equipment / system as recommended by the manufacturer.
- H. Prefunctional checklist (Engineering Point-to-Point Checklist) for controls and energy related equipment as required by this specification.
- I. Operational and maintenance documentation for FPT development.

SYSTEMS TO BE COMMISSIONED

- A. Plumbing Systems
 - 1. Domestic hot water heaters
 - 2. Recirculation pumps
 - 3. Sump pumps

PART 2 - PRODUCTS

TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested.
- B. All testing equipment used by the contractors shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications.

PART 3 - EXECUTION

The following procedures apply to all equipment to be commissioned. This work is to be performed by the contractor or sub-contractor prior to Functional Performance Testing by the Commissioning Team.

GENERAL

- A. Cooperate with the Commissioning Authority in the following manner:
 - 1. Provide and install balancing cocks, access doors, test ports and P&T ports as required by the CxA, A/E and the Owner for functional testing.
 - 2. Allow sufficient time before final completion dates so that functional testing can be accomplished.
 - 3. Provide labor and material to make corrections when required without undue delay.

MEETINGS

- A. Within 60 to 90 days of commencement of construction, the A/E, PM, CxA, and CM shall schedule, plan, and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA.
- B. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular subs.

START-UP AND INITIAL CHECKOUT

- A. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- B. The CxA will develop prefunctional checklists with the Contractor which indicates the required procedures to be executed as part of startup and initial checkout of the systems. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form.
- C. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxA's prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
- D. The full start-up plan shall consist of:
 - 1. The CxA's prefunctional checklists.
 - 2. The manufacturer's standard written start-up procedures copied from the installation manuals with contractor sign-off.

SENSOR AND ACTUATOR CHECKOUT AND CALIBRATION

- A. All field-installed instrumentation sensors and gages shall be calibrated. All test instruments shall have had a certified calibration within the last 12 months.
- B. Calibrate each instrumentation device by making a comparison between the display and the reading at the device, using an instrument traceable to the National Institute of Standards and Technology, which shall be at least twice as accurate as the device to be calibrated, (e.g., if field device is +/- 0.5% accurate, test equipment shall be +/- 0.25% accurate over same range). Record the measured value and displayed value for each device in the prefunctional checklist.

DDC CONTROL SYSTEM

- A. Check each physical output control point by making a comparison between the control command at the DDC system and the status of the controlled device. Check each physical output control point by making a comparison of the actual state of the device and the operator workstation graphical representation of the point condition. Record the results for each device in the Prefunctional checklist.
- B. Verify proper sequences by using the approved checklists to record results and submit the pre-functional checklist. Verify proper sequence and operation of all specified functions.

EXECUTION OF PREFUNCTIONAL CHECKLISTS AND STARTUP

- A. Thirty (30) days prior to startup, the Subs and vendors schedule startup and checkout with the PM, CM and CxA. The execution of prefunctional checklists, startup and checkout is by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
 - 1. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists, plus the final TAB report for all equipment and systems.
 - 2. Only individuals that have direct knowledge and witnessed that a line-item task on the prefunctional checklist was actually performed shall initial or check that item off.

DEFICIENCIES, NON-CONFORMANCE AND APPROVAL IN CHECKLISTS AND STARTUP

- A. The Subs (including the TAB contractor) shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the CxA within 1-week of test completion.
- B. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner and shall notify the CxA as soon as outstanding items have been corrected.
- C. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. If corrective work is not resolved in a timely manner, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

FUNCTIONAL PERFORMANCE TESTING

OBJECTIVES AND SCOPE

- A. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient

performance are identified and corrected, improving the operation, and functioning of the systems.

- B. In general, each system shall be operated through all modes of operation.
- C. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All documentation, including as-built drawings, O&Ms, and submittals shall be at the job site before functional testing commences.
- D. Demonstrate that all functions of the domestic water heating system meet the specified requirements.

DEVELOPMENT OF TEST PROCEDURES

- A. The CxA will develop specific functional checklists test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA will provide a copy of the test procedures in advance to the Sub(s) who shall complete the tests. The Sub(s) shall review and point out to the CxA any specific problems related to the functional checklists because of feasibility, safety, equipment, and warranty protection.

COORDINATION AND SCHEDULING

- A. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. The CxA shall direct, witness and document the functional testing of equipment and systems. The Subs shall execute the tests.
- B. Functional testing is conducted after prefunctional, and startup testing has been satisfactorily completed and non-compliance form items have been closed out. Water balancing must be completed and debugged before the CxA completes a checkout of the water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

DOCUMENTATION

- A. The CxA shall witness and document the results of all functional performance tests using the specific functional checklist forms developed for that purpose. Prior to testing, these forms are provided to the CM & Subs for review.

NON-CONFORMANCE

- A. The CxA will record the results of the functional test and TAB checkout on a standard Test Form. All deficiencies or non-conformance issues will be noted and reported to the PM on a standard Issues Log.

- B. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the Test Form.
- C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the PM.
- D. The CxA documents deficiencies and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CxA submits the Issues Log report to the Sub(s), CM and/or PM. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.
- E. The CxA reschedules the test, and the test is repeated.
- F. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - 1. The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the PM, the CM and to the Sub representative assumed to be responsible.
 - 2. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
 - 3. The CxA documents the resolution process.
 - 4. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA & CM reschedules the test, and the test is repeated until satisfactory performance is achieved.

COST OF RETESTING

- A. The contractor and subs will notify the CxA that the systems are ready for testing. As such, for a given system it assumed that all specified prefunctional tasks are complete by the contractor or Sub. If the CxA discovers that the systems are incomplete at the time of the first functional test, the entire system will be marked as deficient and the retesting procedure for deficient systems will be followed. Any cost associated with retesting will follow the procedures noted herein.
- B. Deficiencies will be noted by the CxA and documented. Deficiencies are associated with completed systems. For deficiencies not related to any prefunctional checklist or start-up fault, retesting of the equipment will be completed once at no "charge" to the CM for their time.
- C. The time and expenses for the CxA and PM to direct, coordinate or perform any retesting beyond the initial retesting noted above will be chargeable to the CM as follows:

1. A specific prefunctional checklist, start-up test item, non-compliance or repeated deficiency exists, and has been reported via commissioning deficiency log.
 2. A system has been determined not ready for testing at the time of the scheduled initial visit.
- D. The Contractor shall respond in writing to the CxA and PM at least as often as non-compliance reports (Issues Logs) are issued. The response shall report the status of each apparent outstanding discrepancy identified during commissioning. Responses shall cover explanations of any disagreements and proposals for their resolution.
- E. The CxA retains the original non-conformance form (Issues Log) until the end of the project.
- F. The CM shall not consider any required retesting by any contractor a justified reason for a claim of delay or for a time extension.

APPROVAL

- A. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA, if necessary. The CxA recommends acceptance of each test to the PM using a standard form. The PM gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

OPERATION AND MAINTENANCE MANUALS (O&M'S)

- A. The contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned sixty (60) days in advance of functional testing.
- B. Operation and Maintenance manuals shall conform to requirements detailed in Specification 01 78 00.

OWNER TRAINING

- A. The CM shall be responsible for coordination of Owner training, scheduling and ultimately for ensuring that training is complete per Specification 01 79 00.
- B. Each Sub and vendor responsible for training shall submit a written training plan to the Owner with copy to the CxA for review and approval prior to training. The plan shall include the following elements:
1. Equipment (included in training)
 2. Intended audience
 3. Location of training
 4. Objectives
 5. Subjects covered (description, duration of discussion, special methods, etc.)
 6. Duration of training on each subject
 7. Instructor for each subject

8. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

WARRANTY AND DEFERRED TESTS

- A. Warranty system testing (10 months after project acceptance) will be conducted and require assistance from the appropriate sub-contractors. Each sub will meet with facility staff to discuss the current building operation and the condition of outstanding issues related to the original commissioning. Problems or concerns they have with operating the building as originally intended will be reviewed, tested and action developed.
- B. If any test cannot be completed prior to occupancy due to the building structure, coordination with other trades or other deficiencies, execution of checklists and functional testing may be delayed upon approval of the PM, A/E, and CxA. These tests will be conducted in the same manner as the seasonal tests as soon as possible.

END OF SECTION 220800