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**PLUMBING**

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**SECTION 22 00 00**

**PLUMBING**

**PART 1 - GENERAL**

1.1 GENERAL PROVISIONS

- A. The General Requirements, Division 01, and Bidding And Contract Requirements, Division 00, are hereby made a part of this Specification Section.
- B. Examine all drawings and all sections of the specifications and requirements and provisions affecting the work of this section.
- C. Refer to work in the following Specification Sections
  - 1. 22 00 00 PLUMBING

1.2 SCOPE OF WORK

- A. This project includes the partial renovation/new construction of 644 SF of Worcester Institute Toilet space. Selective demolition of existing systems shall be required. This work includes the removal of all existing plumbing fixtures within the project area and replacement with new plumbing fixtures.
- B. The building is to be commissioned. Provide all labor required to fully test and demonstrate that all systems operate as designed.
- C. The work under this section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems. In addition, see scope of work included in related sections 22 60 00 and 22 66 00. In general, the following items are specified under this section:
- D. Water Systems:
  - 1. Domestic (Potable) water piping system.
- E. Wastewater Systems:
  - 1. Sanitary Drainage System
- F. Plumbing fixtures and trim.
- G. General:
  - 1. Testing and Cleaning of all piping systems
  - 2. Hose bibs.
  - 3. Insulation.
  - 4. Valves.
  - 5. Fittings unions, flanges and couplings.
  - 6. Cleaning, testing and disinfection of piping systems.

7. All supplementary steel for piping and equipment support.
8. Drilling for installation of inserts.
9. Vibration isolation and flexible connections.
10. Fire seal off all penetrations in floors and walls to the rating of the barrier.
11. Core drilling.
12. Operating and Maintenance Manuals
13. Coordination Drawings
14. Shop Drawings
15. Record (As-Built) Drawings

H. Work of this section is generally shown on the Plumbing Drawings.

### 1.3 RELATED WORK

- A. Principal classes of Work related to the Work of this section are listed in the specification Table of Contents, and are specified to be performed under the indicated sections of the specifications. Refer to the indicated sections for description of the extent and nature of the indicated Work, and for coordination with related trades. This listing may not include all related Work items. Coordinate and schedule the Work of this section with that of all other trades.
- B. The following work is not included in this section and will be provided under other sections:
1. Concrete work.
  2. Painting, except as specified herein.
  3. Electrical power wiring for all equipment.
  4. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division 01, General Conditions.

### 1.4 PRODUCTS FURNISHED, BUT NOT INSTALLED UNDER THIS SECTION

- A. Furnish pipe sleeves for placement into formwork by the General Contractor.
- B. Furnish access panels and doors for installation by the General Contractor.
1. Furnish access panels for installation in walls, ceiling and floors at locations to permit access for adjustment, removal, replacement and servicing of all concealed equipment, valves and materials installed under this section of the specifications.
  2. Access panels will be installed under the section of the related trades of the finished surfaces in which they are located.
  3. Access panels shall be located in closets, storage rooms and/or other non-public areas if possible, positioned so that the equipment can be easily reached, and the size shall be sufficient for this purpose (min. 16" x 16"). When access panels are required in corridors, lobby or other habitable areas, they will be located as directed by the Owner's Representative.
  4. Access panels shall be prime painted, keyed alike and provided with cylinder lock and two (2) keys for each panel. Units shall be manufactured by Milcor, Inland Steel, Miami Carey or approved equal. Required fire resistance of walls and ceilings shall be maintained.

## 1.5 DEFINITIONS

- A. As used in this section, the following items are understood to have the following meaning:
1. *“Contractor or Subcontractor”*, unless otherwise qualified, shall mean the installer of the work specified under this section.
  2. *“Furnish”* shall mean purchase and deliver to the project site, complete with every necessary appurtenance.
  3. *“Install”* shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting and proper operation at the proper location in the project.
  4. *“Provide”* shall mean "Furnish" and "Install".
  5. *“Work”* shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
  6. *“Concealed”* shall mean hidden from sight in chases, furred-in spaces, shafts, hung ceilings, embedded in construction or in a crawl space. Areas to be concealed as part of tenant alterations to the building shall also be considered in this definition.
  7. *“Exposed”* shall mean not installed underground or concealed as defined above.
  8. *“Furnished by others”* shall mean materials or equipment purchased under other sections of the general contract and installed by this section of the specifications by this trade Contractor.
  9. *“Owners Representative”* shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.
  10. *“Date of Substantial Completion”* shall indicate the date where the work has been formally accepted as evidenced by completed final punchlist or where the work has reached the stage that the Owner obtains beneficial use and commences utilization of the installed systems for business or occupancy purposes. The General Requirements, Division 01, shall supercede this definition where specifically defined.
  11. *“Piping”* shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

## 1.6 CODES, REFERENCES AND PERMITS

- A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with Massachusetts Department of Public Safety Codes, Massachusetts Department of Environmental Protection, Massachusetts State Building Code 780 CMR and any other Codes and Regulations having jurisdiction including but not limited to:
1. Massachusetts State Plumbing Code (248 CMR 10.00)
- B. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:
1. American National Standards Institute (ANSI)
  2. American Society of Mechanical Engineers (ASME)
  3. American Society of Testing and Materials (ASTM)
  4. American Water Works Association (AWWA)
  5. Factory Mutual System (FM)
  6. Institute of Electrical and Electronic Engineers (IEEE)

7. Cast Iron Soil Pipe Institute (CISPI)
    - a. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
    - b. Standard, Stainless-Steel Shielded, Couplings: Standard Couplings shall conform to CISPI 310 and ASTM C 1277. Shield Assemblies shall consist of a stainless steel bi-directional corrugated shield; stainless-steel bands and tightening devices; and an ASTM C 564, rubber sleeve. Couplings shall bear the NSF Trademark, and be manufactured in the USA.
  8. Plumbing and Drainage Institute (PDI)
  9. National Association of Plumbing-Heating Cooling Contractors (NAPHCC)
  10. National Electrical Manufacturer's Association (NEMA)
  11. National Fire Protection Association (NFPA)
  12. National Sanitation Foundation (NSF)
- C. All pressure vessels shall conform to ASME and Massachusetts Codes and Regulations.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- F. ASME Compliance:
  1. Where ASME-code construction is indicated, fabricate and label commercial, water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- G. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."
- H. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- I. All pipe and fittings shall be manufactured in the United States.
- J. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.
- K. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the Owner. If work is covered before inspection and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

## 1.7 GENERAL REQUIREMENTS

### A. Nameplates

1. Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.

### B. Equipment Guards

1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

## 1.8 OBTAINING INFORMATION

- A. Obtain from the manufacturer the proper method of installation and connection of all equipment that is to be furnished and installed. Obtain all information that is necessary to facilitate the work and to complete the project.
- B. Prior to performing any new work, uncover, locate and determine the routing, size, material and direction of slope of all existing piping system to which connection is to be made. The invert elevation of the existing drains and sewers must be established prior to any slab cutting for new piping systems.

## 1.9 MATERIAL AND EQUIPMENT STANDARDS

- A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.
- B. Substitutions may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. The request for each substitution must be accompanied by complete specifications together with drawings or samples to properly appraise the materials, equipment or process. Highlight and list all applicable specification requirements, which the substituted material deviates from.
- C. If a substitution of materials or equipment in whole or in part is made, bear the cost of any changes necessitated by any other trade as a result of said substitution.
- D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.
- E. All material, equipment and accessories provided under this section must be listed on the Massachusetts Board of Registration of Plumbers and Gas Fitters accepted Plumbing Products System.

## 1.10 SUBMITTALS

- A. Conform to the requirements of Division 01, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing Contractors and shall note the name(s), license number(s) and license expiration dates(s) of the Contractor(s) installing the Plumbing work.
- B. Definitions:
1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
  2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications, certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:
    - a. Meet all performance criteria listed in the schedules and outlined in the specifications.
    - b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space – this determination is solely the responsibility of the Contractor.
    - c. Products must adhere to all architectural considerations including, but not limited to; being of the same color as the product scheduled or specified and fitting within the architectural enclosures and details.
- C. Submittal Procedures, Format and Requirements
1. Review submittal packages for compliance with Contract Documents and then submit to Owner's Representative for review. Submit enough sets of shop drawings such that, after review, two (2) sets will be kept by the reviewer, with only the remaining sets returned with reviewer's marks and comments.
  2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
    - a. Title
    - b. Equipment number
    - c. Name and location of project
    - d. Names of Owner, Engineer and Seller
    - e. Names of manufacturers, suppliers, vendors, etc.
    - f. Date of submittal
    - g. Whether original submittal or resubmitted
  3. Shop Drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum  $\frac{1}{4}$  inch = 1 foot scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary.
  4. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or

wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

5. Provide Shop Drawings showing details of piping connections to all equipment. If connection details are not submitted and connections are found to be installed incorrectly, this Contractor shall reinstall them within the original contract price.
6. Provide complete data for all auxiliary services and utilities required by submitted equipment.
7. Provide a complete description of all controls and instrumentation required including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.
8. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
9. The Owner's Representative shall approve all materials before commitment for materials is made.

D. Specifications and Schedule Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with each specification criteria listed in each paragraph for those submittals listed in Paragraph E: Product Data that are noted with an asterisk (\*).
2. The statement of compliance shall consist of a list of all paragraphs (line by line) identified in Part 2 and applicable Part 3 of the specification for which the submitted product in the opinion of the manufacturer complies, deviates, or does not meet.
3. Where the proposed submittal complies fully, the word "comply" shall be placed opposite the paragraph number.
4. Where the proposed submittal does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
5. Verify each field of the associated schedule where associated technical data is presented on the drawings. Where the submitted material does not "comply" provide the value the submitted equipment will achieve based upon the specified conditions.
6. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question and the product will be rejected.
7. Submissions which do not include a point by point statement of compliance as specified shall be disapproved.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping – General. A submittal is required for each pipe class listed in these specifications.
2. Unions and Flanges
3. Pipe Joint Materials
4. Hangers, Inserts and Supports
5. Valves
6. Hose Bibbs
7. Plumbing Fixtures and Trim
8. Traps
9. Cleanouts
10. Insulation

11. Watertight Sleeves
  12. Access Panels
  13. Identification, labels and tags.
  14. Submit All Related Valves, Fittings, Unions, Flanges And Couplings
  15. For welded systems, submit weld coupons
  16. Fire rated penetration assemblies indicating ASTM E814 (UL 1479) classification for the application involved. Submittals of individual components or products (i.e., mortars or sealants) without detailed installation drawings shall be rejected as incomplete submittals.
  17. Sleeve packing
  18. Traps
- F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.
1. Do not submit multiple product information in a single bound manual.
  2. Three-ring binders shall not be accepted.
- G. Deviations
1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Owner's Representative.
  2. Without letters flagging the deviation to the Owner's Representative, it is possible that the Engineer may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Engineers, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Engineer has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
  3. Approval of proposed deviations, if any, will be made at discretion of Engineer.
- H. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. This Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule. Allow at least ten (10) working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that twenty (20) working days, exclusive of transmittal time are required when more than five (5) shop drawings of a single trade are received in one (1) calendar week.
- I. Responsibility
1. Intent of Submittal review is to check for capacity, rating, and certain construction features. Ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the

- Plumbing Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.
2. Inform Contractors, manufacturers, suppliers, etc. of scope and limited nature of review process and enforce compliance with contract documents.
- J. In the event that the Shop Drawings for any of the products specified herein are not provided:
1. Furnish and install all materials and equipment herein specified in complete accordance with these specifications.
  2. If materials and/or equipment are installed that are not in complete accordance with these specifications, remove this material and/or equipment. Replace material and/or equipment with material and/or equipment that are in complete accordance with these specifications, at the direction of the Owner's Representative.
  3. Removal and replacement of materials and/or equipment that is not in complete compliance with these specifications shall be done at no extra cost to the Owner.
  4. Removal and replacement of materials and/or equipment that is not in complete compliance with these specifications shall not be allowed as a basis for a claim of delay of completion of the Work.
- K. Mark dimensions and values in units to match those specified.
- L. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

#### 1.11 OPERATION AND MAINTENANCE DATA

- A. Commence preparation of the Operating and Maintenance (O&M) Manuals immediately upon receipt of "Approved" or "Approved as Noted" shop drawings and submit each section within one (1) month. The final submission shall be no later than two (2) months prior to the projected date of Substantial Completion of the Project.
- B. Each O&M document shall include the manufacturer's web address for equipment specific O&M information for Internet access by the Owner.
- C. The manual shall consist of three (3) sets of manuals and include three (3) sets of CDs, which shall contain the scanned content of the entire manual. The manual shall highlight the actual equipment used and not be a master catalog of all similar products of the manufacturer. The manual shall be submitted for review prior to creation of the CDs.
- D. The Manual shall contain the following:
1. Operations Manual
    - a. Systems description including all relevant information needed for day-to-day operations and management including start-up and shut-down instructions.
    - b. Systems description including all relevant information needed for day-to-day operations and management.
    - c. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.
  2. Maintenance Manual
    - a. Maintenance and Lubricating Chart: furnish three (3) sets of charts indicating equipment tag number, location of equipment, equipment

- service, greasing and lubricating requirements, lubricants and intervals of lubrication. One (1) chart shall be framed under glass and mounted where directed by the Owner's Representative.
- b. Valve and System Chart: correspond to valve tags, refer to paragraph identification systems.
  - c. Recommend List of Spare Parts: furnish two (2) typed sets of instructions for ordering spare parts with sectional views of the fittings or equipment showing parts numbered or labeled to facilitate ordering replacements. Each set shall include a list with itemized prices of those parts recommended to be kept on hand as spares, as well as the name and address of where they may be obtained.
  - d. Provide copy of all warranty information with associated date of substantial completion (Commencement of Warranty) and end date of coverage all components / subsystems specifically included and excluded.
3. Provide O&M manuals for each of the following:
- a. Fixtures

#### 1.12 WARRANTIES

- A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the Contractor may have by law or by provisions of the Contract Documents.
- B. All materials, equipment and work furnished under this section shall be guaranteed against all defects in materials and workmanship for a minimum period of one-year (1) commencing with the Date of Substantial Completion. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.
- C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the drawings.
- D. Upon receipt of notice from the Owner of the failure of any part of the systems during the warranty period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

#### 1.13 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

- A. It is the intention of the specifications and drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the drawings, but mentioned in the specifications or vice-versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided without additional expense to the Owner.
- B. The drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the project and shall have the approval of the Owner's Representative

before being installed. Follow drawings, including his shop drawings, in laying out work and shall check the drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Owner's Representative before proceeding with the installation. Without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

- C. Any requests for information (RFI) for resolving an apparent conflict or unclarity, or a request for additional detail, shall include a sketch or equivalent description of proposed solution.
- D. Size of pipes and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge. All work shall be
- E. installed in an approved workmanlike manner.

#### 1.14 INSPECTION OF SITE CONDITIONS

- A. Prior to submission of bid, visit the site and review the related construction documents to determine the conditions under which the Work has to be performed. Report, in writing to the Owner's Representative, any conditions which might adversely affect his work.

#### 1.15 SURVEY AND MEASUREMENTS

- A. Base all required measurements, horizontal and vertical, from referenced points established WITH the Owner's Representative and be responsible for correctly laying out the Work required under this section of the specification.
- B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

#### 1.16 DELIVERY, STORAGE AND HANDLING

- A. No materials shall be delivered or stored on site until corresponding Shop Drawings have been approved.
- B. All manufactured materials shall be delivered to the site in original packages or containers bearing the manufacturers labels and product identification.
- C. Protect materials against dampness. Store off floors, under cover and adequately protected from damage.
- D. Inspect all plumbing equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

#### 1.17 PROTECTION OF WORK AND PROPERTY

- A. Be responsible for the care and protection of all work included under this section until the completion and final acceptance of this Contract.
- B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.
- C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.
- D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

#### 1.18 SUPERVISION

- A. Supply the service of a competent Supervisor with a minimum of five (5) years' experience in Plumbing Construction Supervision who shall be in charge of the Plumbing work at the site.

#### 1.19 SAFETY PRECAUTIONS

- A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the Owner and OSHA throughout the entire construction period of the project.
- B. Furnish, place and maintain proper guards and any other necessary construction required to secure safety of life and/or property.

#### 1.20 SCHEDULE

- A. Construct work in sequence under provisions of Division 01 and as coordinated with the Owner's Representative.

#### 1.21 HOISTING, SCAFFOLDING AND PLANKING

- A. The work to be done under this section of the specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

#### 1.22 CUTTING AND PATCHING

- A. Include all coring, cutting, patching, and fireproofing necessary for the execution of the work of this section. Structural elements shall not be cut without written approval of the Architect. This Contractor shall be responsible for taking all precautions required to identify hidden piping, conduits, etc. before any core drilling and/or cutting of slabs commences, including X-raying the affected slabs. Provide fire stopping to maintain the fire rating of the fire resistance-rated assembly. All penetrations and associated fire

stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details and be listed by UL or FM.

- B. When core drilling and/or cutting of the slab, this Contractor shall be responsible for taking all precautions for identifying hidden piping, conduits, etc. before core drilling proceeds, include x-raying the slabs
- C. All work shall be fully coordinated with all phases of construction, in order to minimize the requirements for cutting and patching.
- D. Form all chases or openings for the installation of the work of this section of the specifications, or cut the same in existing work and see that all sleeves or forms are in the work and properly set in ample time to prevent delays. Be responsible that all such chases, openings, and sleeves are located accurately and are of the proper size and shape and consult with the Owner's Representative and all other trades concerned in reference to this work. Confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the approval of the Owner's Representative.
- E. Fit around, close up, repair, patch, and point around the work specified herein to match the existing adjacent surfaces and to the satisfaction of the Owner's Representative.
- F. Fill and patch all openings or holes left in the existing structures by the removal of existing equipment which is part of this section of the specifications.
- G. All of this work shall be carefully done by workmen qualified to do such work and with the proper and smallest tools applicable.
- H. Assume any cost caused by defective or ill-timed work required by this section of the specifications.
- I. When, in order to accommodate the work required under this section of the specifications, finished materials of other trades must be cut or fitted, furnish the necessary drawings and information to the trades whose materials must be cut or fitted.

#### 1.23 SLEEVES, INSERTS AND ANCHOR BOLTS

- A. Coordinate with other trades the location of and maintaining in proper positions, sleeves, inserts and anchor bolts to be supplied and/or set in place under this section of the specifications. In the event of incorrectly located preset sleeves, inserts and anchor bolts, etc., all required cutting and patching of finished work shall be done under this section of the specifications.
- B. All pipes passing through floors, walls, ceilings or partitions shall be provided with fire stopping to maintain the fire rating of the structure. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details. Provide sleeves for all penetrations where required by the listed detail, for the penetration of all mechanical room floors and where specifically required on the drawings.
- C. Field drilling (core drilling), when required, shall be performed under this section of the specifications, after receipt of approval by the Owner's Representative.

1. When coring cannot be avoided, provide ¼ inch pilot hole prior to coring. When coring through floor or slab, verify location of core on floor below and protect and piping, ductwork, wiring, furniture, personnel, etc., below the location of the core.

#### 1.24 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Provide all supplementary steel, factory fabricated channels and supports required for the proper installation, mounting and support of all Plumbing equipment, piping, etc., required by the specifications.
- B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the Owner's Representative as shown on the drawings or herein specified.
- C. The type and size of the supporting channels and supplementary steel shall be determined by the Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.
- D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.
- E. All supplementary steel including factory fabricated channels, supports and fittings shall be approved, shall be galvanized steel, aluminum or stainless steel where exposed or subject to rust producing atmosphere and shall be manufactured by Unistrut, H-strut, Powerstrut or approved equal.

#### 1.25 ACCESSIBILITY

- A. All work provided under this section of the specification shall be installed so that parts requiring periodic inspection, maintenance and repair are accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

#### 1.26 WELDING QUALIFICATIONS

- A. Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC IX and AWS B2.1/B2.1M. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1 Welding shall be performed in accordance with AWS D10.12M/D10.12 The Owner's Representative shall be notified twenty-four (24) hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING STRUCTURAL.

- B. A fire watchman with an approved fire extinguisher shall be posted at the site of the welding work, during that work, and for a minimum of thirty (30) minutes after the work is completed, to see that sparks or drops of hot metal do not start fires.

## 1.27 PROJECT CLOSEOUT

### A. Construction Observations By The Engineer

1. The engineer shall make progress site visits during construction, and one substantial completion (punchlist) site visit for determining substantial completion.
2. The Trade Contractors and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.
3. Progress Site Visits
  - a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.
  - b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

### B. Substantial Completion

1. When the Work under this section is substantially complete, submit written notice with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.
2. The following items shall be completed prior to the written request for substantial completion site visit:
  - a. Certification of successful operation of all systems.
  - b. Training of the Owner's personnel in the operation of the systems.
  - c. Record Drawings in accordance with the contract specifications.
  - d. Operation and Maintenance manuals.
  - e. Testing reports.
  - f. Balancing reports.
  - g. Manufacturers certificates of approvals.
  - h. Emergency contact list for reporting of malfunctioning equipment during the warranty period.
  - i. Contractors Project Completion certificate in accordance with the building code requirements.
3. Should the Engineer, during the substantial completion visit, observe that the Work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punchlist. The Punchlist will provide for a place for the Contractor and General Contractor to sign off and date each item individually indicating that the observed deficiency item has been corrected.
4. Should the Engineer, during the substantial completion site visit, observe that the Work is not substantially complete, s/he will provide, a written list of the major deficiencies and a reason for the work not being considered substantially complete.

5. If the work is found not to be substantially complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any further observations by the engineer.
  6. Remedy all deficiencies listed in the punchlist within the time frame required by the contract.
- C. Engineer's Construction Completion Certification
1. Where required by the applicable code, the Engineer's Construction Completion Certification will be issued by NV5 when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:
    - a. Water Distribution and Supply Pressure Test
    - b. Drainage and Vent System Pressure Test
  2. There shall be NO outstanding items identified on the punchlist for scope within any of these categories.
- D. Final Completion
1. The following items shall be submitted prior to the written request for Final completion:
    - a. Revised Substantial Completion items to be resubmitted in accordance with the review process comments.
    - b. Warranties commencing the date of Substantial completion
    - c. Individual Signed and dated Punchlist acknowledging completion of all punchlist items
  2. When all of the punchlist work items are complete and resolved and the work is ready for final observation site visit. The signature lines for completion of each punchlist item shall be signed by the Contractor indicating the work is complete and signed by the General Contractor indicating s/he has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punchlist items are complete the Engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punchlist work to be incomplete during final inspection a written listing of the observed deficiencies will be prepared by the Engineer.
  3. If the work is not fully complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any reobservations by the Engineer.
- E. Re-observation Fees
1. The re-observation fee shall be \$1200.00 per visit.
- F. Contractor's Project Completion Certificate
1. Upon completion of work and prior to request for Certificate of Occupancy, each Trade Contractor and the General Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. NV5 can furnish a blank Contractor's certificate form upon request. The certificate shall certify:
    - a. Execution of all work has been installed in accordance with the approved construction documents.

- b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.
2. The certificate shall include the following information:
- a. Project.
  - b. Permit Number.
  - c. Location.
  - d. Construction Documents.
  - e. Date on Plans and specifications submitted for approval and issuance of the Building Permit.
  - f. Addendum(a) and Revision Dates.
3. The certificate shall be signed by the Contractor and include the following:
- a. Signature.
  - b. Date.
  - c. Company.
  - d. License Number.
  - e. License Expiration Date.

**PART 2 - PRODUCTS**

2.1 RESERVED

2.2 PIPE, FITTINGS AND JOINTS - GENERAL

A. PIPE MATERIALS SPEC INDEX

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS	PIPE MATERIAL
		(PSIG)	TEMPERATURE (°F)		
Domestic Cold Water	CW	100	250	A10	Copper
Sanitary Waste & Vent	S, W or V	Gravity	120	D10	Cast Iron

*General Pipe Spec Notes:*

1. Each valve type shall be the product of a single manufacturer. Each system shall be provided with valves as required by code and shown on the drawings and shall be installed to facilitate operation, replacement and repair.
2. Provide shut-off valves on supply piping to individual pieces of equipment.
3. Provide pipe dope, Teflon tape, wax rings, neoprene gaskets and other jointing compounds as required by best standard practice and only on service as recommended by manufacturer.
4. Apply putties and jointing compounds for plumbing fixtures and trim as recommended by manufacturers.
5. Valves on insulated piping systems shall be equipped with extended handles to accommodate insulation thickness.
6. Piping Routed through Metal Stud or Wood Stud Partitions: Provide centering such that piping does not come in contact with metal studs and also protection of piping systems routed horizontally through metal stud or wood stud partitions where the piping crosses a stud. Sleeve type protection shall be used to prevent damage to the lateral piping by the use of screws/nails/fasteners. Provide pre-manufactured products equal to Puncture Solution, or on site sleeves.

PIPE CLASS A10		Various Systems Water Piping	
Item	½ INCH TO 2 INCHES	2½ INCHES AND LARGER	
All pipe, fittings, and valves used in this distribution system and installed after January 4, 2014 must comply with the new Federal Mandate known as the "Reduction of Lead in Drinking Water Act-2014". Therefore, after the enactment date of 1/4/14, all products installed must comply. Any product pipe, fittings or valve installed after the enactment date that does not comply, shall be removed and changed by this contractor at his/her own expense to comply with the Federal Law			
Pipe	Seamless copper water tube, drawn temper, Type L. ASTM B-88.  See Note 1.	Seamless copper water tube, drawn temper, Type L. ASTM B-88.  See Notes 2 & 5.	
Fittings	Wrought copper, solder-joint. ASME B16.22, NSF 61, NSF 61-G, and NSF 372 compliant.	ASTM B-75 or ASTM B-152 copper alloy fittings or ASTM B-584 grooved end cast bronze fittings per UNS C89836 or C92200 and C89833.	
Joints	ASTM solder filler material shall be lead free to comply with the federal mandate of 2014  ASTM B-813 liquid or paste flux. Soldering procedures shall comply with ASTM B-828.	Rolled groove prepared and assembled in accordance with manufacturer instructions.  Ductile iron coupling with copper alkyd enamel paint coating, ASTM A-536. Grade "P" Flouroelastomer, "EHT", or "EHP" EPDM elastomer gasket rated -30F to 250F, ASTM D-2000. Equal to Grinnell Style 640 or 672 or Victaulic Style 607 with "P" Flouroelastomer gasket coupling.	
Mechanical joints	Cast copper alloy unions, hexagonal stock with ball-and-socket joint, solder joint ends. ASME B16.18.	ANSI Class 150 flange adapter equal to Grinnell Model 61 or Victaulic Style 641 for connections to flanged equipment. ANSI B16.1 dimensions.	
Branch Connections		Grinnell Style 619 or 621 or Victaulic Mechanical T Style 622	
Valves	Valves in the interior domestic water piping systems (cold water, hot water, and hot water return) shall be as manufactured by Apollo, Watts, Milwaukee, Nibco, Conbraco, or Grinnell.		
Ball	All bronze, lead free, 2 piece, full port, stainless steel ball and stem, PTFE seats, solder end connections. 600 PSIG WOG. Watts LF-B6080G2, Apollo 77CLF-240 or approved equal.	Class 125, cast iron body, FDA epoxy coated. Full port, flanged ends, stainless steel ball and stem. ANSI B16.1 flange dimensions. Watts G-4000-FDA series, Apollo IBV.	

Strainers	Bronze body, threaded or solder ends to suit, stainless steel screen, 400 pound WOG. Apollo 59LF series
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. Contact between dissimilar metals shall be made with di-electric couplings or di-electric flanges. Contact between ferrous and stud bolts and bronze flanges shall be electrically insulated with non-metallic washers.</li> <li>2. Provide mechanical joint connections to all equipment such as water heaters, pumps, compressors, etc.</li> <li>3. Above grade water piping eight (8) inches and larger shall be Schedule 40 galvanized steel piping with galvanized fittings and grooved joints.</li> <li>4. Valves used for throttling of flow shall be butterfly type with memory stop. Ball valves shall not be acceptable for balancing on hot water return piping.</li> <li>5. Valves shall be provided with Buna-N, TFE or EPDM seats suitable for the service intended.</li> <li>6. The pressure classifications for valves specified herein are working steam or water, oil, gas (WOG) pressure ratings.</li> <li>7. Lever handles on all valves shall be color coded in conformance with ANSI Standard A-13.1.</li> <li>8. Shut-off valves on the incoming water service and on the discharge of the water meter shall be a gate valve or other full-way valve.</li> <li>9. Ball valves used to isolate emergency equipment shall be equipped with a "latch lock lever" # (-27) and be pad locked in the open position.</li> <li>10. Grooved joint couplings shall incorporate an angled-pattern bolt pad design to provide confirmation of joint integrity upon visual metal-to-metal bolt pad contact with slight offset and no torque requirement. Tongue and recess designs may only be used if a torque wrench is utilized (IAW published installation instructions) and each coupling is either tagged or marked with indelible ink to indicate the actual torque value attained.</li> <li>11. A Grinnell Victaulic factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. Contractor shall remove and replace any improperly installed products. Gaskets used on potable water systems shall be UL classified in accordance with ANSI/NSF-61 for both hot (180F) and cold (86F). Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.</li> </ol>	

PIPE CLASS D10	Cast Iron Piping	
ITEM	ABOVE GRADE	BELOW GRADE
Pipe	<p>Three (3) inches And Larger: Hubless Cast Iron Soil Pipe, Service Weight. ASTM-A-888, CISPI 301.</p> <p>2½ inches And Smaller: Hubless Cast Iron Soil Pipe, Service Weight. ASTM A-888, CISPI 301 Or Type L Copper Tubing. ASTM B8872. See Note 1.</p>	<p>Two (2) inches And Larger: Hub And Spigot Cast Iron Soil Pipe, Extra Heavy. ASTM A-74 Or Service Weight If Code Approved. Piping Shall Be Asphalt Or Coal Tar Pitch Coated.</p>
Fittings	<p>Three (3) inches And Larger: Hubless Cast Iron Fittings, Service Weight. ASTM-A-888, CISPI 301.</p> <p>2½ inches And Smaller: Hubless Cast Iron Fittings, Service Weight. ASTM A-888, CISPI 301 Or Wrought Copper DWV Fittings. See Note 1.</p>	<p>Two (2) inches And Larger: Hub And Spigot Cast Iron Fittings, Extra Heavy. ASTM A-74. Asphalt Or Coal Tar Pitch Coated. DWV Pattern.</p>
Joints	<p>Hubless Cast Iron: Heavy Duty Stainless Steel Band Coupling With Neoprene Gasket. Bank Torque Of eighty (80) Inch-Pounds. 15 PSig Pressure Rating. Husky SD 4000 Or Clamp-All Hi-Torq 80. See Note 2.</p> <p>Copper: 95/5 Solder.</p>	<p>Neoprene Compression Gaskets Conforming To ASTM C-564.</p>
Backwater Valve – Pit Style		<p>Pit Style Backwater Valve:</p> <p>Duco Cast Iron Gravity with Bronze Backwater Valve and CI Secured Gate. Provide flashing clamp. Polished Bronze Face. J.R. Smith Co. 7000,, Zurn, Josam, Watts</p>
Backwater Valve – In Line		<p>Cast Iron Gravity Flow Type, Bronze Mounted, Hub End. Exterior Shall Be Mastic Coated, Bolted Or Extended Cover In Accordance With Installation Parameters. J.R. Smith Co. 7012 - 7022, Josam 67500, Zurn Industries Z-1095, Watts, BV-200</p>
Backwater – Manual Shutoff Gate		<p>Duco Cast Iron Gravity Flow Type, Bronze Mounted with removable wheel handle. J.R. Smith Co. 7150, Josam, Zurn Industries, Watts</p>
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. CISPI 310 No-Hub Couplings Will Not Be Accepted As Equal To Manufacturers Listed.</li> <li>2. Copper Tube And Fittings Shall Not Be Used On Urinal Wastes.</li> <li>3. Piping through electric rooms: sanitary, storm, and vent piping through electric rooms shall be sleeved through a sufficiently sized schedule 10 galvanized sleeve piping with Grooved style fittings and couplings. Extend dual wall piping to a distance of one (1) foot beyond the exterior on each side of the electric room. Terminate with a closure method comprised of a caulked joint at each end with a closed ¼ inch ball valve available to monitor the containment area of the piping system.</li> </ol>		

### 2.3 PIPING AND MATERIAL SUNDRIES

- A. Materials and equipment shall be of the best quality manufactured, new, unused and free from all defects. Piping and fittings shall conform to the latest ANSI, ASTM, and NFPA and AWWA Standards including latest amendments and shall be in conformance with state and local plumbing codes, material standards.
- B. Each length of pipe, each pipe fitting, trap, materials and/or device used in the respective system shall have cast, stamped or indelibly marked on it, the maker's name or mark, weight and quality of the product when such marking is required by the approved standard that applies.
- C. Unions and Flanges
  - 1. Unless otherwise specified herein, unions for copper and brass piping two (2) inches and smaller shall be 125 pounds (steam working pressure) brass ground joint type. Larger than two (2) inches in diameter shall be 150 pounds flat faced brass flanges conforming to ANSI Standard B16.24. Flanges shall have copper clad steel bolts and nuts and 1/16-inch minimum thickness red rubber full faced gaskets.
  - 2. Where brass flanges and ferrous flanges are to be joined, ferrous flanges shall be full faced.
  - 3. Mating of ferrous and non-ferrous flanges shall be separated with rubber gaskets (1/16-inch minimum thickness) and Teflon liners installed in the boltholes. Boltholes shall be drilled to receive the Teflon liners. Physical contact between the ferrous and non-ferrous flanges including the bolts, nuts, and washers will not be permitted.
- D. Nipples
  - 1. Close and shoulder nipples shall be of corresponding materials as specified for the respective piping system and shall be extra heavy.

### 2.4 HANGERS AND SUPPORTS

- A. Hangers shall be installed, as required, to meet code compliance as to location/spacing and Manufacturer's Standardization Society (MSS) Standard Practice Bulletins SP-58 & 69.
- B. Hanger material shall be compatible with piping materials with which it comes into contact.
- C. Hangers shall be installed, in addition to the above, at all changes of direction (horizontal and vertical), valves and equipment connections. Hangers shall be located so that their removal is not required to service, assemble or remove equipment.
- D. Horizontal runs may use band hangers up to four (4) inch size. Piping larger than four (4) inches shall be provided with Clevis type.
- E. Vertical support shall be by means of riser clamps (anchors with split ring type allowable up to two (2) inch size only) and adjustable pipe support with flange anchored to floor.
- F. Where three (3) or more pipes are running parallel to each other, factory fabricated gang pipe hangers with pipe saddle clips or rollers may be used in lieu of the hereinbefore

specified hangers. These hangers shall be sized to provide for insulation protectors as hereinafter specified. Pipe saddle clips shall be not less than 16 gauge metal and shall be copper when installed with uninsulated copper piping. Where pipe rollers are provided for insulated copper piping, insulation protectors shall be provided at each set of rollers and filled with a section of heavy density fiberglass pipe covering.

- G. Insulation protectors (shields) for horizontal piping shall be constructed of galvanized steel formed to a 180 degree arc and twelve (12) inches long, 18 gauge for hangers five (5) inches in size and smaller, 16 gauge for hangers larger than five (5) inches in size.
- H. Exposed rods, clamps, hangers, and shields shall be electrogalvanized coated.
- I. Upper Attachments to Building Structure:
  - 1. Existing Reinforced Concrete Construction: Upper attachment welded or clamped to steel clip angles that are expansion-bolted to the concrete. Expansion bolting shall be located so that piping loads place bolts in shear. Submit details for approval.
  - 2. Structural Steel Framing: Upper attachments welded or clamped to structural steel members. Additional steel members may be necessary in some support locations where piping locations differ from that known on contract drawings. Submit details for approval.
  - 3. Structural Wood Framing: Submit details for approval.
  - 4. Expansion Fasteners and Power Set Fasteners: In existing concrete slab construction, expansion fasteners may be used for hanger loads up to one-third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to one-fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.
- J. All inserts in new concrete construction shall be capable of developing the full strength of the rod or bolt used in them and shall be either continuous insert type or malleable iron concrete inserts for rod sizes 3/8 inch to 7/8 inch. Continuous inserts shall have anchors every four (4) inches and shall extend 1-1/2 inches above the back of the insert and shall hook to provide anchor. All inserts shall be tied into the reinforcing steel rods with wire and properly sized reinforcing rods shall be inserted through the special holes, hooks, or brackets provided in or on the inserts to securely anchor insert to the structure.
- K. Valve and piping supports, from the floor, shall be adjustable pipe support and complete with pipe standard and flange, anchored to floor.
  - 1. Supports shall be installed at each control valve, riser tee or elbow and where any unsupported section exceeds 4 feet-0 inches in length measured along piping centerline and within 4 feet-0 inches off floor.

## 2.5 SLEEVES AND ESCUTCHEONS

- A. All pipes passing through rated floors, walls, or partitions shall be provided with sleeves having an internal diameter with a minimum of one (1) inch larger than the outside diameter of the pipe or insulation on covered lines.
- B. Sleeves through outside walls shall be Schedule 40 galvanized steel pipe with a 150 pound galvanized steel slip on welding flanges, welded at the center of the sleeve and shall be painted with one (1) coat of bitumastic paint, inside and outside.

- C. Sleeves through masonry floors and interior masonry walls shall be Schedule 40, black, steel pipe. Sleeves through interior nonmasonry walls or partitions shall be 22 gauge galvanized sheet steel.
- D. The sleeves through outside walls and slab on grade shall be provided with pipe to wall penetration closures. Seals shall be mechanical type of interlocking rubber links shaped to fill space between pipe and sleeve. Links shall be assembled with bolts to form a belt around the pipe with pressure plate under each bolt head and nut. After seal assembly is positioned, tightening of bolts will provide watertight seal. Determine the required inside diameter of each individual sleeve before ordering, fabricating or installing. The inside diameter of each sleeve shall be sized as recommended by the manufacturer to fit the pipe and to assure a watertight joint.
- E. Sleeves through walls shall terminate flush with face of wall. Sleeves through floor walls shall terminate one (1) inch above finished floor.
- F. Required fire resistance of floors and walls shall be maintained where penetrations occur. Fire stopping at sleeves shall be installed per manufacturer recommendations. Fire stopping material shall be UL listed for the service and fire rating. Provide asbestos-free fire stopping material capable of maintaining an effective barrier against flame, gases, and temperature. Provide noncombustible fire stopping that is nontoxic to human beings during installation or during fire conditions. Devices and equipment for fire stopping service shall be UL FRD listed or FM P7825 approved for use with applicable construction, and penetrating items.
  - 1. Fire Hazard Classification:
    - a. Material shall have a flame spread of 25 or less, a smoke developed rating of 50 or less when tested in accordance with UL 723 or UL listed and accepted.
  - 2. Fire Stopping Rating:
    - a. Fire stopping materials shall be UL FRD listed or FM P7825 approved for "F" and "T" ratings at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected, except that "F" and "T" ratings may be three (3) hours for fire stopping in through-penetrations of 4-hour fire rated wall or floor.
- G. Escutcheons shall be provided with a set screw to properly hold escutcheon in place and provided at all exposed floor and wall penetrations. Escutcheons on C.P. piping shall be chrome plated.

## 2.6 INSULATION

- A. General: The pipe covering specified herein for piping systems shall be provided in strict accordance with the manufacturer's printed instructions, the best practice of the trade and to the full intent of this specification.
  - 1. The sealers, tapes, adhesives and mastics used in conjunction with the installation of the pipe covering specified herein shall possess the maximum possible fire safe qualities available and shall be of a type approved by Factory Mutual, Factory Insurance Association or National Fire Protection Association.
  - 2. Valves, fittings, flanges and accessories shall have the same thickness of pipe covering applied as the adjacent pipe. Pipe covering for these items shall be factory PVC molded type.

3. Longitudinal seams and butt joint shall be sealed with a fire retardant, vapor barrier adhesive.
4. Insulation at hangers shall be protected with sheet metal saddles.

B. Interior Cold Water, Hot Water, and Hot Water System Piping

1. All interior cold water, tempered water, tempered water return, hot water and hot water return piping shall be insulated with a preformed fiberglass insulation which meets the property requirements of ASTM C547, "Standard Specification for Mineral Fiber Pipe Insulation". Pipe insulation shall have a white, factory applied, fire retardant, reinforced vapor barrier jacket.
2. Insulation shall be continuous through sleeves.
3. Minimum insulation thickness shall be in accordance with the State Energy Code, 2021 IECC table C403.12.3, all local amendments, or at least 1-inch, whichever is greater. Insulation thickness shall be based on conductivity "K" factor range of 0.22 - 0.28 BTU-in/hr-ft<sup>2</sup>-°F for fluid temperatures up to 140°F. Insulation thickness shall be based on conductivity "K" factor range of 0.25 - 0.29 BTU-in/hr-ft<sup>2</sup>-°F for fluid temperatures between 141°F and 200 °F. For minimum thickness of alternative insulation types outside the stated conductivity range, see test method for steady state heat transfer properties of horizontal pipe insulations, ASTM C335-95 and the State Energy Code.
4. Ends of insulation at termination points shall be sealed to the pipe with a pre-molded PVC type fitting. Pipe fittings and valves shall be provided with pre-molded PVC covers with fiberglass inserts.
5. Pipe insulation within 6 feet-0 inches of finished floor, in exposed installations, as well as all heat traced piping, shall be provided with 20 mil. PVC continuous covers in addition to the vapor barrier jacket. Fittings and seams shall be solvent welded.
6. Insulation shall be manufactured by Owens-Corning Fiberglas Corp., Knauf Fiberglass, Certainteed or equal.

C. Handicapped Accessible Lavatories and Sinks

1. Insulation of waste, trap, hot and cold and tempered water supplies at all handicapped accessible lavatories and sinks shall be fully molded, paintable and flexible vinyl insulation system.

2.7 PLUMBING FIXTURES

A. Plumbing fixtures, including water closets, urinals and lavatories shall be of the highest quality vitreous china, white in color and shall be manufactured by American Standard, Kohler or Toto.

B. All Flush Valves and their fixtures shall be operable at 25 PSI at the valve.

1. All Plumbing Fixtures shall be approved for use by the State Plumbing Board
2. Vitreous china fixtures shall be white in color and shall be American Standard, Kohler, Toto or approved equal.
3. Flushometers shall be Sloan, Toto, Zurn or approved equal.
4. Faucets shall be Symmons, Chicago, Zurn, or approved equal.
5. Trim and P-traps shall be McGuire, Zurn, American Standard or approved equal.
6. Water closet seats shall be Toto, Olsonite, Church, Beneke or approved equal.
7. Mop basins shall be Williams, Fiat, Florestone or approved equal. Drinking fountains shall be Sunroc, Halsey Taylor, Hawes or approved equal.

- 8. Insulation kits for handicapped lavatories shall be Truebro, McGuire, Trap-Wrap or approved equal.
  - 9. Stainless steel sinks shall be Just, Elkay, Kindred or approved equal.
- C. See the Plumbing Drawing Schedule Sheet for fixture specifications and tag numbers.

## 2.8 CLEANOUTS

- A. Bodies of cleanout ferrules in hub and spigot or no hub piping shall be standard pipe size conforming in thickness to that required for pipe and fittings, and shall extend not less than 3/4 inch high. Cleanouts in copper waste piping shall be soldered brass cleanout fittings with extra heavy brass screw plugs of the same size as the pipe line. Cleanouts in threaded waste piping shall be cast iron drainage "T" pattern 90 degree branch fittings with extra heavy brass screw plugs of the same size as the pipe.
- B. Floor cleanouts shall be J.R. Smith, Zurn, or Wade, equal to J.R. Smith 4020-PB series in sizes up to four (4) inch, piping larger than four (4) inch size and up to a maximum of eight (8) inch size, shall be provided with JR Smith 4100-PB series in all areas but those with carpet. Areas with carpet shall be provided with recessed covers and markers.
- C. Exterior cleanouts to grade shall be same as for interior floor cleanouts and shall be encased in concrete at a minimum of six (6) inches beyond the greatest outside dimension and a minimum of six (6) inch depth. Top of cleanout shall be set 1/2 inch above finished grade and concrete collar shall be shaped to finished grade.

## 2.9 HOSE BIBBS

- A. Hose bibbs shall be manufactured by Watts, Woodford, J.R. Smith, Zurn or Chicago manufacturer's model numbers used herein are intended as a guide to quality and type of valve to be provided.
- B. Hose bibbs in toilet rooms shall be installed on the cold water supply a minimum of twelve (12) inches above the finished floor and beneath the lavatories.  
  
Hose bibbs shall be an inside sill faucet, with integral vacuum breaker 3/4 inch hose thread outlet with removable handle and polished chrome finish.  
Chicago model 952, Acorn Model 8121-CP, T&S Brass Model B-0720-POL or equal.
- C. Hose bibbs in Mechanical Rooms shall be an inside sill faucet with integral vacuum breaker, 3/4. Inch hose thread outlet, suitable for wall mounting or attaching to column. Woodford model 26PC-3/4.

## PART 3 - EXECUTION

### 3.1 DEMOLITION

- A. Refer to the drawings for demolition scope applicable to the project.

### 3.2 IDENTIFICATION

- A. General

1. All piping, equipment, control panels, and valves furnished and/or installed under this section of the specifications and shall be marked for ease of identification.
2. Marking shall be done using self-adhering (screw or rivets for equipment) labels applied to clean, smooth surfaces. All lettering shall have sharply contrasting background for ease of identification. Colors shall be in accordance with ANSI A13.1 Standards. Samples of stickers together with color schedules shall be submitted for approval.

**B. Pipe Identification**

Provide color-coded pipe identification markers on all piping in the building installed under this section.

1. All pipe markers shall be as manufactured by W.H. Brady, Westline Products, Seton Nameplate Company or approved equal. Stenciling of the piping will not be permitted. Pipe markers, bands and flow arrows shall be pressure adhesive, snap-on, acrylic or vinyl type.
2. Furnish and affix approved adhesive bands identifying the service and direction of flow of each piping system installed under this section of the specifications.
3. Name of the service, taken from drawing legend, shall be printed in black letters, not less than 1 ¼ inches high for piping, including covering, three (3) inches and larger and ¾ inch in height for piping 2-1/2 inches and smaller.
4. Arrows and color band background shall conform to State Plumbing Code for all domestic and protected water systems. Legends, arrows and colors shall conform to ANSI Standard A13.1 covering "Identification of Piping Systems" for all other systems.
5. Identification shall be provided on all piping that is exposed as well as all in concealed locations such as shafts, and above removable ceilings in which piping may be viewed.
6. Each set shall consist of one (1) band on which the name of the service is printed and one (1) band on which is printed a black directional arrow.
7. Bands shall be applied where they can be easily read from the finished floor below, with their long dimension parallel to the axis of the pipe.
8. Bands shall be applied only after any finish painting is completed.
9. In general, the piping of each system shall be identified in the following locations and the piping designation shall be taken from the legend as indicated on the drawings.
  - a. Pipe mains and branches – every twenty-five (25) feet in all accessible open areas and ten (10) feet apart in congested areas.
  - b. At each side of valves and pipe tees.
  - c. Each wall penetration (both sides).
  - d. At each piece of equipment.
  - e. At each floor, above and below ceilings, on exposed risers and drops.
10. The following color coding shall be used with names in black letters on backgrounds indicated:

<b>SCHEDULE OF PIPING IDENTIFICATION</b>		
<b>Service</b>	<b>Legend</b>	<b>Background Color</b>
Cold Water	Domestic Cold Water	Green
Hot Water	Domestic Hot Water	Yellow
Soil or Waste	Sanitary Drain	Green
Vent	Vent	Green

C. Valve Tags

1. All valves on pipes of every description shall have numbering tags. The valve numbers shall correspond with numbers indicated for valves and controls on two-printed Valve Lists prepared using electronic database by the HVAC subcontractor. These printed lists shall state the numbers and locations of each valve and the fixture or group of fixtures which it controls, and other necessary information, such as requiring the opening or closing of another valve when one valve is to be opened or closed.
2. Provide flow diagrams showing all valves. Use the Valve List for callouts of all valves on the flow diagrams, prepared in a form to meet the approval of the Architect. Include this info in the operating and maintenance (O&M) manuals, and, for all mechanical rooms, provide the information laminated, mounted and framed under glass at the direction of the Owner. All valve interior diameters shall be shown in the O&M manuals and on the final Record Drawings.
3. Valve tags shall have neat circular black and white laminated fibre-engraved white showing through tags of at least 1 ½ inches in diameter, attached with a brass hook to each valve stem. Stamp on these valves tags in letters, as large as practical, the number of the valve and the service such as indicated on the "Valve List". The numbers on each service shall be consecutive. All valves on tanks and pumps shall be numbered by three (3) inch black and white laminated fibre-engraved white showing through discs with white numbers two (2) inches secured to stem of valves by means of brass hooks or small solid link brass chain.

3.3 TESTING

A. General

1. All labor, materials, instruments, devices and power required for testing shall be provided by this Contractor. The tests shall be performed in the presence and to the satisfaction of the Architect and such other parties, as may have legal jurisdiction. No piping in any location shall be closed up, furred in, or covered before testing.
2. Where portions of piping systems are to be covered or concealed before completion of the project, those portions shall be tested separately in the manner specified herein for the respective entire system.
3. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Architect shall be retested in part or in whole as directed.
4. The Architect retains the right to request a recheck or resetting of any pump or instrument by this Contractor during the guarantee period at no additional cost to the Contractor.
5. Repair, or if directed by the Architect, replace any defective work with new work without extra charge to the Contract. Repeat tests as directed, until the work is proven to meet the requirements specified herein.
6. Restore to its finished condition any work, damaged or disturbed, provided by other Contractors and engage the original Contractor to do the work of restoration to the damaged or disturbed work.
7. The fixtures shall be tested for stability of support and satisfactory operation. The piping shall be tested when directed by the Engineer for stability.
8. After the fixtures are set and connected, and the piping systems to same have been tested, this Contractor shall turn water onto the fixtures, and equipment, fill the traps, etc., and the proper operation of all items shall be demonstrated by him

in the presence of and to the satisfaction of the Architect/Engineer or their designated representatives.

9. Caulking of screwed joints or holes in piping will not be acceptable.
10. Notify the Architect and any inspectors having jurisdiction, a minimum of forty-eight (48) hours in advance of making any required tests so that arrangements may be made for their presence to witness the scheduled tests.

B. Specific:

1. Sanitary (Waste and Vent) Piping Systems:

- a. Before the installation of fixtures, and equipment each system including vents shall be tested in its entirety or in sections. If this entire system is to be tested, all openings shall be plugged to permit the system to be filled with water to the level of the vent stack or roof drain of each system above the roof where practical. Each system shall hold this water for a minimum of fifteen (15) minutes prior to an inspection. The system shall be tight at all points.
- b. Where a portion of the system is to be tested, the test shall be conducted in the same manner as specified herein for the entire system, except a vertical stack ten (10) feet above the highest horizontal line to be tested may be installed, and filled with water to maintain sufficient pressure. A pump may be used to supply the required pressure. The pressure shall be maintained for a minimum of fifteen (15) minutes prior to an inspection. The system shall be tight at all points.

2. Cold, and Hot Water Piping Systems:

- a. Upon completion of the roughing in and before setting fixtures and final connection to all equipment, all water piping systems shall be tested to a minimum hydrostatic pressure of 125 PSIG.
- b. Each system's test shall be maintained for eight (8) hours without a drop in pressure.
- c. After testing, provide complete adjustment of all parts of each water system until design distribution or balancing is obtained throughout.

3.4 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Prior to completion of the Contract, provide field operating instructions to the Owner's designated representative with respect to operation functions and maintenance procedures for the equipment and systems installed.
- B. All equipment provided under this section of the specifications shall be placed in operation and shall function continuously in an operation test for a period of one (1) week, without shut down due to mechanical failure.
- C. Prior to scheduling the project final inspection and after completion of the entire installation period, provide all work required to adjust all controls, hot water systems balancing and all maintenance to place the systems in operation to meet the requirements of this section of the specifications and Contract Documents.
- D. Provide to the Owner through the Engineer, six (6) complete sets of operating, service, maintenance instruction manuals containing replacement data for the equipment which will require operating, maintenance or replacement and one (1) copy of this literature shall be available during the instruction of the operating personnel while the others are checked for completeness by the Architect.

- E. Sufficient advance notice shall be given to the Owner's designated operating personnel for the specific instruction period. Upon completion of instruction, obtain from the representative(s) written verification that the above mentioned instruction has been performed. Such verification shall be forwarded to the Owner through the Architect.
- F. Each copy of the approved operating and maintenance manual shall contain copies of approved shop drawings, equipment literature, cuts, bulletins performance charts, pump curves, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed and bound in a hard-back three ring binder. Flysheets shall be placed before instructions covering each section. The instruction sheets shall be in 8-1/2 inches by eleven (11) inches with large sheets of drawings folded in neatly. Each manual shall have the following minimum contents:
  - 1. Table of Contents
  - 2. Maintenance
    - a. Maintenance and lubricating instructions
    - b. Replacement charts
    - c. Preventive maintenance recommendations
    - d. Trouble shooting charts for equipment components
    - e. Testing instructions for each typical components
    - f. System draining and filling instructions
    - g. Two typed sets of charts indicating equipment tag number, location of equipment, specific equipment service, greasing and lubricating requirements as recommended lubricant type and intervals of lubrication.
    - h. Two type sets of instructions for ordering spare parts. Each set shall include name, telephone number and address of where they may be obtained.
  - 3. Manufacturer's Literature
    - a. The equipment for which shop drawings have been submitted and approved.
    - b. Wiring diagrams
    - c. Installation drawings
    - d. Manufacturer's representative and contract information
    - e. Guarantees

### 3.5 DISINFECTION, CLEANING AND ADJUSTING

- A. Disinfection
  - 1. Each potable water system (cold, and hot, and hot water return) shall be cleaned and disinfected by this Contractor. Cleaning and disinfection shall be performed after all pipes, valves, fixtures and other components of the system are installed, tested and ready for operation.
  - 2. All domestic water piping shall be thoroughly flushed with clean potable water, prior to disinfection, to remove dirt and other contaminants. Screens of faucets shall be removed before flushing and re-installed after completion of disinfection.
  - 3. Disinfection shall be done using sodium hypochlorite in the following manner:
    - a. A service cock shall be provided and located at the water service entrance. The disinfecting agent shall be injected into and through the system from this cock only.
    - b. The disinfecting agent shall be injected by a proportioning pump or device through the service cock slowly and continuously at an even rate.

- During disinfection, flow of disinfecting agent into main water supply shall not be permitted.
- c. All sectional valves shall be opened during disinfection. All outlets shall be fully opened at least twice during injection and the residual checked with orthotolidine solution.
  - d. When the chlorine residual concentration, calculated on the volume of water the piping will contain, indicates not less than 50 PPM (parts per million) at all outlets, then all valves shall be closed and secured.
  - e. The residual chlorine shall be retained in the piping systems for a period of not less than twenty-four (24) hours.
  - f. After the retention, the residual shall be not less than five parts per million. If less, then the process shall be repeated as described above.
  - g. If satisfactory, then all fixtures shall be flushed with clean potable water until residual chlorine by orthotolidine tests shall not be greater than the incoming water supply (this may be zero).
4. All work and certification of performance shall be performed by approved applicators or qualified personnel with chemical and laboratory experience. Certification of performance shall indicate:
    - a. Name and location of the job and date when disinfection was performed.
    - b. Material used for disinfection.
    - c. Retention period of disinfectant in piping system.
    - d. PPM chlorine during retention.
    - e. PPM chlorine after flushing.
    - f. Statement that disinfection was performed as specified.
    - g. Signature and address of company/person performing disinfection.
  5. Upon completion of final flushing (after retention period), obtain a minimum of one (1) water sample from each hot and cold water line and submit samples to a State approved laboratory. Samples shall be taken from the faucets located at highest floor and furthest from meter or main water supply. The laboratory report shall show the following:
    - a. Name and address of approved laboratory testing the samples.
    - b. Name and location of job and date the samples were obtained.
    - c. The coliform organism count. (An acceptable test shall show absence of coliform organisms.)
  6. If analysis does not satisfy the above minimum requirements, the disinfection procedure shall be repeated.
  7. Before acceptance of the systems, submit to the Architect for his review, three (3) copies of Certification of Performance as specified above.
  8. Under no circumstances permit the use of any portion of domestic water system until properly disinfected, flushed and certified.
- B. Cleaning and Adjusting
1. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by operation of the system for testing.
  2. Any stoppage or discoloration or other damage to parts of the building, its finish, or furnishings, due to this Contractor's failure to properly clean the piping system shall be repaired by this Contractor at no increase in Contract costs.
  3. At the completion of the work, all water systems shall be adjusted for quiet operation.
  4. All automatic control devices shall be adjusted for proper operation.

5. All plumbing fixtures and exposed metal work shall be adjusted for proper operation. Floor drain strainers and traps shall be cleaned of all debris.
6. All items of equipment shall be thoroughly inspected and any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match the original finish. All items so repaired and refinished shall be brought to the attention of the Architect for inspection and approval.

### 3.6 SPECIAL TOOLS

- A. Provide any and all special tools, recommended by the manufacturer of items furnished, noted as not being commonly available.

### 3.7 CERTIFICATES OF APPROVAL

- A. Upon completion of the work, furnish to the Owner through the Architect, in duplicate, certificates of inspection and/or approval from state and local inspection authorities having jurisdiction indicating the installed systems compliance to their requirements.

### 3.8 QUIET OPERATION

- A. All work provided under this section of the specifications shall operate under conditions of load without sound or vibration, which is abnormally objectionable for such equipment in the opinion of the Architect. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed, or annoyingly noticeable inside its own room will be considered objectionable shall be corrected in an approved manner by this Contractor at no change in Contract amount.

### 3.9 SYSTEMS

- A. Sanitary Piping (Interior)
  1. Although the trenching and backfilling will be performed under another section of the specifications, this Contractor will be responsible for the proper execution of this work and shall do all hand trimming of trench bottoms. All piping must be laid on good foundation with solid uniform bearing through the entire length. The bottom of all trenches shall be rounded so that half of the circumference of the pipes will rest firmly on compacted sand at proper line and grade. Hub holes shall be dug to insure pipe resting for its entire length upon the bottom of the trench.
  2. Be responsible for checking each pipe for alignment, centerline elevation and invert grade for underground installations.
  3. At times when work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipe or fittings. Pipe laid through rock excavation shall rest on a six-inch layer of well-compacted sand.
  4. The Sanitary (waste and vent), piping three (3) inches and smaller in diameter shall pitch a minimum of 1/4 inch per foot, and piping four (4) inches and larger in diameter shall pitch a minimum of 1/8 inch per foot.
  5. The vent stacks shall be connected as shown and extended through the roof a minimum of eighteen (18) inches. Waste and vent pipes shall be concealed unless otherwise noted.

6. Branch connections to each drainage system shall be made with "Wye" and long turn "Tee Wye" fittings. Installation of short radius 1/4 bends, common offsets; double hub fittings and saddles will not be approved. Only fittings conforming to the Code shall be installed.
  7. The changes in direction of each drainage system shall be made with "Wye" branches and 1/8 bends. Provide long sweep bends at bottom of stacks with a vertical cleanout just above the floor at places where a "Wye" and 1/8 bends at bottom of stacks and end cleanouts cannot be installed.
  8. Every fixture shall be separately trapped and the traps must be vented unless an approved battery or wet vented system is being installed. Floor drains shall be considered as a fixture.
  9. Vents shall be connected to the discharge of each trap in the sanitary system, thence carried individually to a point above the flood level of the fixture before connecting with any other vent pipes. Pitch the branch vents back to the fixtures.
  10. Collect individual vent pipe together in branch vent lines and connect to vent stacks. Wherever possible, vent stack offsets shall be made with 45 degree fittings. The vents passing through the roof shall be a minimum size of four (4) inches in diameter.
  11. Cleanouts shall be provided in drainage piping at changes in directions, at foot of stacks or other required points so that all portions of the lines will be readily accessible for cleaning or rodding out.
  12. Cleanouts shall be of the same size as the pipe installed in up to four (4) inches in diameter and not less than four (4) inches in diameter for piping larger than four (4) inches in diameter.
  13. The maximum horizontal distance between cleanouts; in piping four (4) inches in diameter and smaller shall not be more than fifty (50) feet apart; in piping five (5) inches in diameter and larger shall not be more than one hundred (100) feet apart.
  14. Traps on sanitary piping not integral with fixtures and in accessible locations shall be provided with a brass trap screw protected by the water seal, and will be regarded as a cleanout.
  15. Test tees with brass cleanout plugs shall be provided at the foot of all vertical waste and storm drainage stacks and at each floor. Wherever cleanouts on vertical lines occur concealed behind finished walls, they shall be extended to back of finished wall and a wall plate shall be provided.
- B. Cold, Hot, and Hot Water Piping
1. Vacuum breakers and/or backflow preventers shall be installed on supplies to each piece of equipment, and valved connection, as required, to prevent back-siphonage and backflow.
  2. Branch lines from water service or main lines shall be taken off the top or bottom of main, using such crossover fittings as may be required by structural or installation conditions. All water service pipes, fittings, and valves shall be kept a sufficient distance from other work and not less than one (1) inch between coverings on the different services.
  3. Provide shock absorbers at equipment, tops of the risers, at each individual or each group of fixtures as required to prevent water hammer. Air chambers will not be accepted.
  4. Water piping shall be run parallel and graded evenly to the drainage points. There shall be a minimum 1/2 inch hose-end drain valve with hole-end vacuum breaker provided for each low point in the piping, so that all parts of each water system can be drawn off. Piping two (2) inches and larger shall have a 3/4 inch size drain valve.

5. Provide suitable means of thermal expansion for the hot water piping using swing joints, expansion loops and long turn offsets as required to suit building conditions.
6. All piping connections to equipment shall be provided with unions or flanges to permit convenient disassemble for alterations and repairs.
7. No piping shall be installed in a manner to permit back siphonage or backflow of any flow of water from the waste non-potable or process system into the domestic water systems or their distribution piping under any conditions. Approved backflow preventers shall be installed where cross-connections are required.
8. Where flanges are installed in the water systems, install red rubber gaskets between each pair of flanges.
9. Heating and/or bending of copper tubing to eliminate the installation of fittings will not be permitted (exception: flexible risers between fixture stop and kitchen/lavatory faucet).
10. Piping systems shall be kept clean during all phases of work. Open ends of incomplete piping shall be protected to prevent the entrance of foreign materials.
11. Pipe shall be cut accurately to measurements established at the site and shall be worked into place without springing or forcing.
12. Provide copper plated friction clamps on the cold water supplies to each water closet and urinal flushometer. Friction clamp shall be firmly clamped to the pipe and shall be firmly attached to the adjacent wall structure.

### 3.10 PATCHING, REPLACEMENT AND MODIFICATION OF EXISTING WORK

- A. After installation of pipe lines, neatly patch, repair, and replace existing work where damaged, removed or altered for pipe line installation. This work shall be similar and equal in quality to the work removed or damaged, unless otherwise shown or specified. Such work shall include replacement of existing lines at points of connections to new lines, patching of masonry work, and wherever any such patching work is indicated on drawings or otherwise required.

### 3.11 GENERAL INSTALLATION REQUIREMENTS

- A. Piping Installation
  1. Install piping approximately as shown on the drawings and as directed during installation by the General Contractor or the Architect.
  2. Piping shall be installed as straight and direct as possible forming right angles or parallel lines with building walls, other piping and neatly spaced.
  3. The horizontal runs of piping, except where concealed in partitions, shall be installed as high as possible.
  4. Piping or other apparatus shall not be installed in such a manner so as to interfere with the full swing of the doors and access to other equipment.
  5. The arrangement, positions and connections of pipes, fixtures, drains, valves, and the like, indicated on the drawings shall be followed as closely as possible, but the right is reserved by the General Contractor or the Architect to change locations and elevations to accommodate the work, without additional compensation for such change.
  6. It shall be possible to drain the water from all sections of each sprinkler cold, and hot water piping system. Pitch piping back to drain valves.
  7. Screwed piping of brass or chrome plated brass shall be made up with special care to avoid marring or damaging pipe and fitting exterior and interior surfaces.

8. Small fittings shall be screwed up close to the shoulders of male threads. Lampwick, cord, wool, or any other similar material shall not be used to make up thread joints.
9. Screwed pipe and copper tubing shall be reamed smooth before installation.
10. All exposed piping in connection with fixtures and where exposed on finished walls or to view, shall be chrome plated. Where chrome plated piping is installed, cut and thread pipe so that no unplated pipe threads are visible when the work is completed.
11. Reducing fittings, unless otherwise approved in special cases, shall be provided in making reduction in size of pipe. Bushings will not be allowed unless specifically approved.
12. Remove and replace with new materials, any copper or brass piping (chrome plated or unplated) and valves showing visible tool marks.
13. Vertical risers shall be firmly supported by riser clamps, properly installed to relieve all weight from the fittings.
14. Any piece of pipe six (6) inches or less in length shall be considered a nipple.
15. All water service piping shall be kept a sufficient distance from other work to permit finished covering to be not less than one (1) inch from other work.
16. The pipe and fittings shall be manufactured in the United States of America and in accordance with the Commercial Standards, American National Standards Institute and American Society of Testing Materials.

B. Specialty Installation

1. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - a. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - b. Locate at each change in direction of piping greater than 45 degrees.
  - c. Locate at minimum intervals of fifty (50) feet (15 m) for piping NPS 4 and smaller and one hundred (100) feet for larger piping.
  - d. Locate at base of each vertical soil and waste stack.
2. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

3.12 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in General Specification Sections for Vibration and Seismic Controls for Plumbing Piping and Equipment
- B. Comply with requirements for pipe hanger, support products, and installation.
  1. Vertical Piping: MSS Type 8 or 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. One hundred (100) feet and less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than one hundred (100) feet: MSS Type 43, adjustable roller hangers.
    - c. Longer than one hundred (100) feet if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping runs one hundred (100) feet or longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one (1) size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install supports for vertical PVC piping every forty-eight (48) inches.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- G. Hanger Installation
  - 1. All piping shall be supported from the building structure by means of approved hangers and supports, to maintain proper grading and pitching of lines, to prevent vibration and to secure piping in place, and shall be so arranged as to provide for expansion and contraction.
  - 2. Maximum spacing of hangers on runs of pipe (vertical and horizontal) having no concentration of weight shall be as follows:

MATERIAL	Steel	Copper
Pipe Size (Inches)	Hanger Spacing in Feet/Pipe	
.50	6	6
.75	8	6
1.00	10	6
1.25	10	10
1.50	10	10
2.00	10	10
2.50	10	10
3.00	10	10
3.50	10	10
4.00	10	10
5.00	10	
6.00	10	
8.00	10	

- 3. Maximum spacing of hangers on soil pipe shall be five (5) feet or at each fitting on straight lengths to maximum of 10' and hangers shall be provided at either side of all changes in direction. Vertical Hanger rods to support piping from the structure or supplementary steel shall not exceed four (4) feet in total length vertically, provide factory fabricated channels and all associated accessories.
- 4. Friction clamps shall be installed at the base of the plumbing risers and at each floor (above or below floor slabs). Friction clamps installed above floor slabs shall not be supported from or rest on floor sleeves.
- 5. Provide hangers at a maximum distance of two (2) feet from both sides of all changes in direction (horizontal and vertical), on both sides of concentrated loads (equipment) and at valves.

6. Hangers, in general, for all horizontal piping shall be A Band type hangers for piping up to four (4) inch size and Clevis type for piping five (5) inches and larger. These hangers shall be sized to fit the outside diameter of the pipe insulation protectors (sheet metal shields) specified herein. Gang type hangers may be used for supply piping up to three (3) inch size where applicable and in conformance with manufacturer's recommendations.
7. All vertical drops and runouts including insulated pipes shall be supported by split ring hangers with extension rods and wall plates or stamped type up to two (2) inch size only.
8. Provide on all horizontal insulated lines, pipe covering protectors (shields) at each hanger. Each protector shall be sized to fit the outside diameter of the Pipe insulation.
9. Lock nuts or retaining straps shall be provided with all beam clamps.
10. All supplementary steel including factory fabricated channels and associated accessories, including twelve (12) inch long sheet metal shields, throughout both suspended and floor mounted shall be provided by this Contractor and shall be subject to the approval of the Architect.
11. Hangers shall not pierce the insulation on any insulated pipe except when prior approval is given.
12. Wire, tape or wood fastenings for shims or support of any pipe or tubing shall not be used.
13. Remove all rust from the ferrous hanger equipment (hangers, rods, and bolts) and apply one (1) coat of red lead immediately after erection.
14. Piping at all equipment and each control valve shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping and equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.
15. All piping shall be independently supported from the building structure and not from the piping, ductwork, conduit or ceiling suspension systems of other systems.
16. Installation of hangers which permit wide lateral motion of any pipe will not be acceptable.
17. All hangers in contact with uninsulated piping shall be compatible with piping material.

#### H. Pipe Covering Installation

1. Before pipe covering is applied, all pressure tests shall have been performed and approved.
2. Pipe covering shall be applied over clean, dry surfaces.
3. Pipe covering shall be continuous and shall be carefully fitted with side and end joints butted firmly and tightly together finished as specified herein.
4. Pipe covering and auxiliaries shall be kept dry during storage and application.
5. Adhesives, cements and coatings shall not be applied when the ambient temperature is below 40°F.
6. Valve bodies shall have covering applied up to the stem.
7. It is the intent of this specification that all vapor barriers be sealed and be continuous throughout. Staples shall not be used on vapor barrier jackets.
8. Where pipe-covering ends occur at equipment or fixtures, end caps on the covering shall be provided.
9. Adequate operating clearances shall be provided at control mechanisms.
10. Pipe covering for flanges shall overlap the adjoining pipe by a minimum of three (3) inches on each side.

11. Pipe covering shall be provided on all piping passing through ceilings and through the interior above ground sleeves (wall and floor).
  12. All voids and or seams in insulation shall be filled with insulating cement and finished as specified herein.
  13. In the event staples are used, they shall be coated with a vapor barrier mastic after insulation and taped. These staples shall not be visible on finished installation.
  14. End joints of each section of the installed pipe covering shall be tightly butted.
- I. Installation of Sleeves, Inserts and Escutcheons
1. Sleeves in floors shall set one (1) inch above the finished floor surface or as indicated on the Architectural Drawings.
  2. Sleeves through interior masonry or non-masonry walls or partitions shall be set flush with the finished surfaces of the wall or partition.
  3. Provide field drilling for inserts required for work under this section of the specifications.
  4. Each interior wall or floor sleeve shall be fire stopped to provide equivalent fire resistance to floor or wall penetration.
  5. Escutcheons shall be installed around all exposed insulated or bare pipe, passing through a finished floor, wall or ceiling. Escutcheons shall fit snugly around the bare or insulated pipe.
- J. Installation of Plumbing Fixtures
1. General
    - a. Refer to Architectural Drawings for locations and mounting heights of all plumbing fixtures.
    - b. Provide with all plumbing fixtures all trim, supports, fittings, connections and all incidentals necessary to make a complete installation in accordance with plumbing codes, and the Contract Documents.
  2. Fixture Supports
    - a. All fixtures shall be supported and fastened to the building structure. The method of support for each type fixture shall be as specified herein, except when the fixture designation on the Contract drawings indicate modifications.
    - b. Wall hung water closets shall be supported on combination drainage fittings and chair carriers with foot supports fastened to the floor slab with expansion lag screws.
    - c. Lavatories, unless otherwise specified herein, shall be generally supported on concealed arm chair carriers with tubular uprights, block bases enameled arms, leveling and securing eye bolts and chrome plated trim.
    - d. Urinals shall be supported by floor mounted carrier with support plate, bearing plate, adjustable extension, tubular uprights, block bases, and chrome plated trim.
    - e. Installations shall be complete with all necessary bolts, nuts and washers, iron or brass connecting nipples between fixtures and piping system of the proper length including gaskets for closet and urinal connections.
    - f. Where wall hung fixtures are secured to masonry walls or partitions they shall be fastened with 1/4 inch through bolts provided with nuts and washers at back. Bolt heads and nuts shall be hexagon and exposed bolts, nuts, washers and screws shall be chromium plated brass.



7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.15 FINAL DOCUMENTATION

- A. Upon completion of work and prior to request for Certificate of Occupancy, issue a certificate stating that work has been installed generally consistent with construction documents in accordance with 780 CMR, 9<sup>th</sup> Edition. All submittals, as-builts, O&M manuals, and balancing reports are to be provided for engineer's review, prior to request for engineer's completion certificates. In addition, and also prior to request for completion certificates, all punchlist items must be completed to the satisfaction of the engineer. Verify that all sequences of operations and controls have been incorporated and all systems and equipment are working per the sequences of operations as dictated by 780 CMR, Chapter 13. A blank Contractor's certificate form can be furnished by NV5 upon request.

### 3.16 FIXTURE PROTECTION AND CLEANING

- A. Water closets, lavatories and urinals shall be boarded over and all other fixtures protected with pasted on paper. Post notice prohibiting the use of all fixtures prior to acceptance.
- B. All plated or polished fittings, pipes and appliances shall be coated with Vaseline immediately after installation and shall be finally highly polished and free from all marks and foreign substances when directed by the Architect.
- C. Thoroughly clean all fixtures prior to final acceptance.

### 3.17 OPERATING AND MAINTENANCE PERSONNEL TRAINING

- A. Conduct a training course for the facility maintenance and operating staff. The training shall start after the system is functionally complete but before the final acceptance tests. The training shall include all the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations. The Owner's Representative shall be given at least two (2) weeks advance notice of such training.
- B. During all working hours of the one (1) week operation, the Plumbing Subcontractor's instruction personnel shall be available for and provide thorough and detailed training to the Owner's operating and maintenance personnel in operation, maintenance and adjustment of all equipment installed. The instructions shall be video recorded by the Subcontractor.

The master digital copy and two (2) additional copies shall be turned over to the Owner not more than ten (10) days following the completion of the training.

- C. Give sufficient notice to the designated operating personnel of the Owner in advance of this period. Upon completion of instruction, obtain written verification from the Owner's representative stating that the instruction noted above has been performed. Forward verification of Owner's instruction to the design team.
- D. Provide instruction time of four (4) hours.

END OF SECTION 22 00 00