

**SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING**

PART 1 – GENERAL

1. DEFINITIONS

- A. Exposed: Piping and equipment exposed to view in finished rooms.
- B. Option or optional: Contractor's choice of an alternate material or method.

2. RELATED WORK

- A. The requirements of this section relate to all Division 23 sections included with this project.

3. QUALITY ASSURANCE

- A. Plumbing and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality commercial class products from manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in commercial plumbing systems.
- B. After water balancing work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
- C. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
 - 2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 100 miles of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
 - 3. All items furnished shall be free from defects that would adversely affect the

performance, maintainability and appearance of individual components and overall assembly.

4. The products and execution of work specified in Division 23 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. In event of conflict, the more stringent shall generally apply.
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos shall not be used.

D. Equipment Service Organizations:

1. Plumbing: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and have factory certified technicians on staff.

E. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:

1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

F. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Project Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

G. Execution (Installation, Construction) Quality:

1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract drawings and specifications shall be referred to the Project Engineer for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided at least two weeks prior to commencing installation of any item.
2. Complete layout shop drawings required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved. Layout drawings shall be prepared and shall indicate other building systems requiring coordination.
3. All plumbing systems shall be installed in accordance with the prevailing code and all relevant standards (ASPE, NFPA, etc.) in effect at the time of permitting.

4. WARRANTIES

- A. All equipment, materials and workmanship shall be warrantied against defect for a period of (1) year from the date of substantial completion. Warranties listed herein shall cover the costs associated with the repair or replacement of the defective item or system within a reasonable timeframe.

5. DRAWINGS

- A. The drawings as included as a part of the construction document package are diagrammatic in nature. They are meant to convey design intent and are not meant to be absolute in their content. It shall be the responsibility of the installing contractor to ensure that all equipment, materials, components and labor are provided required for a fully functional, code compliant system in accordance with the design intent. Should questions arise or additional clarity be required, the contractor shall issue an RFI in written format to the prime design professional. Written communication will be the only form of correspondence between the design and construction teams and will be the only format by which changes, modifications or clarifications will be formally issued and is the only means by which the construction documents will be modified.

6. SUBMITTALS

- A. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements. Contractor to ensure that all manufacturer or code required clearances are maintained for all installed equipment. Submittals shall be made as a single submission no later than 45 days after award of construction contract and shall be reviewed and approved by the project General Contractor or CM prior to submitting for approval. Approval of shop drawings or submittals does not constitute an acceptance from the Design Team and does not modify the Contractor's responsibility to provide equipment, materials and workmanship in accordance with the intent of the construction documents. Further, approval does not modify the requirement for the

contractor to provide equipment, materials and workmanship as indicated in the contract documents whether it is indicated or discovered in the submittal review process or not. Contractor shall be responsible for providing all equipment, materials and workmanship in accordance with the construction documents regardless of level of approval.

- B. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract documents. This contractor shall be responsible for the cost associated with all modifications required as a result of equipment or material substitutions. This shall include the cost associated with all electrical, plumbing, structural and architectural modifications required as a result of the substitution. The Architect and Engineer of Record shall be duly compensated for the cost associated with making these modifications and updating the construction drawings accordingly. Shop drawing or submittal approval does not relinquish the contractor from the responsibility of providing equipment, materials and workmanship in accordance with the general intent of the construction documents and in compliance with all codes and standards in effect at the time of construction. In cases where there is confusion or there appears to be conflicting information contained within the construction documents, the Architect or Engineer of Record shall be consulted through the RFI process and shall make the final determination as to the intent of the construction documents. The contractor shall proceed with the construction process in accordance with the interpretation of the Architect or Project Engineer at no additional cost to the owner or project.
- C. Prior to submitting shop drawings for approval, contractor shall ensure that manufacturers or vendors of all equipment have each reviewed drawings and specifications and have jointly coordinated and properly integrated their equipment and controls to provide a complete, functional, efficient and code compliant installation in accordance with the intent of the construction documents.
- D. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible installation.
- E. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 1) Electric motor data and variable speed drive data shall be submitted with the driven equipment.
 - 2) Equipment and materials identification.
 - 3) Fire stopping materials.
 - 4) Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
 - 5) Wall, floor, and ceiling plates.
- F. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The

drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1/4-inch equal to one foot. Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping until layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

- 1) Mechanical and plumbing equipment rooms.
- 2) Interstitial and plenum space.
- 3) Hangers, inserts, supports, and bracing.
- 4) Pipe sleeves.
- 5) Equipment penetrations of floors, walls, ceilings, or roofs.

G. Maintenance Data and Operating Instructions:

- 1) Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
- 2) The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- 3) Close-out documentation shall be provided to the owner at the completion of the project. Close-out documentation shall be completely contained within a binder or series of binders and shall include the approved submittals, test & balance report, manufacturer provided O&M manuals, as-built drawings, start-up reports, warranty registrations, warranty contact information, maintenance/repair contact information and complete operating instructions. In addition to the required binders, a complete copy of the close-out documents shall be provided in PDF format on DVD. Unless otherwise noted in the front-end documents or as requested by the owner, a total of (3) sets of close-out documents shall be provided at the completion of the construction process.
- 4) All new and temporary equipment and all elements of each assembly shall be included.
- 5) Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- 6) Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.
- 7) Lubrication instructions, type and quantity of lubricant shall be included.

- 8) Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
 - 9) Set points of all interlock devices shall be listed.
 - 10) Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.
 - 11) The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
 - 12) Emergency procedures.
- H. As-built documents shall be prepared using the latest versions of either AutoCAD or REVIT (depending on the software used in the design process) and shall indicate any modifications made during the construction process. An electronic copy of all as-built drawings shall be provided to the Design Team in either (.dwg) format or (.rvt) format upon completion. Both full size printed copies and electronic copies of the as-built drawings shall be provided with the close-out document package. Electronic files shall be stored on DVD and shall be provided with the project close-out documents and shall be provided in PDF format.
- I. All close-out documents must be received by the owner and electronic files received by the Design Team prior to approval and release of the final pay-application.

7. DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
- B. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
- C. Damaged equipment shall be replaced with an identical unit as determined and directed by the Project Engineer. Such replacement shall be at no additional cost to the owner.
- D. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
- E. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- F. Cleanliness of Piping and Equipment Systems:

- 1) Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
- 2) Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
- 3) The interior of all tanks shall be cleaned prior to delivery and beneficial use by the owner. All piping shall be tested in accordance with the specifications and the latest edition of the prevailing plumbing code. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
- 4) Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems

PART 2 - PRODUCTS

1. FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit. All components of an assembled unit need not be products of same manufacturer. Constituent parts that are alike shall be products of a single manufacturer. Components shall be compatible with each other and with the total assembly for intended service. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment. Major items of equipment, which serve the same function, shall be the same make and model.

2. COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

3. SAFETY GUARDS

- A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4-inch bolts. Reinforce guard as necessary to prevent side play forcing guard onto

couplings.

- B. All Equipment shall have moving parts protected from personal injury.

4. LIFTING ATTACHMENTS

- A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

5. ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING

- A. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements:
 - 1) Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical modifications as required without additional time or cost to the owner.
 - 2) Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
 - 3) Motor sizes shall be selected so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
 - 4) Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1.
 - 5) Motor Efficiency and Power Factor: All motors, when specified as "high efficiency or Premium Efficiency" by the project specifications on driven equipment.

6. VARIABLE SPEED MOTOR CONTROLLERS

- A. The combination of controller and motor shall be provided by the respective pump manufacturer, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps, shall be product of a single manufacturer.
- B. Motors shall be premium efficient type, "inverter duty", and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

- C. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

7. EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black plastic with white letters and shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 3/16-inch high riveted or bolted to the equipment.
- D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
 - 1) Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
 - 2) Valve tags: Engraved black filled numbers and letters not less than 1/2-inch high for number designation, and not less than 1/4-inch for service designation on 19 gage, 1-1/2 inches round brass disc, attached with brass "S" hook or brass chain.
 - 3) Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 8-1/2" by 11" shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.
 - 4) A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.
- F. Pipe & Plumbing:
 - 1) All state and local codes and amendments shall be adhered to.
 - a. Where these codes conflict with Genesis Engineering specifications, the AHJ requirements shall be adhered to.
 - b. Where these codes do not conflict but are not identical, the more stringent of the two requirements shall be adhered to.

- 2) All pipe shall be provided with clear, pre-printed, pre-colored manufactured pipe labels indicating the contents of the pipe, size of the pipe, and flow of the content within.
- 3) Text shall be a minimum of 1.5" lettering clearly red from the ground or floor below.
- 4) Labels shall be placed no more than 50' apart in open areas.
- 5) In congested areas, each system shall be clearly identifiable within the space, not to exceed 25' spacing.
- 6) State and local codes for non-potable and bundled pipe shall be adhered to.
- 7) Where insulation is present on pipe systems, labels shall be placed on the exterior of the piping insulation as to be seen without removal of the insulation.

8. PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. For Attachment to Concrete Construction: Concrete insert: Type 18, MSS SP-58. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 4 inches thick when approved by the Project Engineer for each job condition.
- B. Power-driven fasteners: Permitted in existing concrete or masonry not less than 4 inches thick when approved by the Project Engineer for each job condition.
- C. For Attachment to Steel Construction: MSS SP-58. Welded attachment: Type 22. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8-inch outside diameter.
- D. Attachment to Metal Pan or Deck: As required for materials specified herein.
- E. For Attachment to Wood Construction: Wood screws or lag bolts.
- F. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Trapeze hangers are not permitted for steam supply and condensate piping.
 - 1) Allowable hanger load: Manufacturers rating less 200 pounds.
 - 2) Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch u-bolt fabricated from steel rod. Provide type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports

or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.

- 1) General Types (MSS SP-58): Standard clevis hanger: Type 1; provide locknut.
- 2) Riser clamps: Type 8.
- 3) Wall brackets: types 31, 32 or 33.
- 4) Roller supports: type 41, 43, 44 and 46.
- 5) Saddle support: type 36, 37 or 38.
- 6) Turnbuckle: types 13 or 15.
- 7) U-bolt clamp: Type 24.
- 8) Copper Tube:
 - a) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with isolation tape to prevent electrolysis.
 - b) For vertical runs use epoxy painted or plastic coated riser clamps.
 - c) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - d) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
 - e) Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
 - f) Spring hangers are required on all plumbing system pumps one horsepower and greater.
 - g) Plumbing Piping (Other Than General Types):
 1. Horizontal piping: Type 1, 5, 7, 9, and 10.
 - h) Chrome plated piping: Chrome plated supports.
 - i) Hangers and supports in pipe chase: Prefabricated system ABS

self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.

- j) Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.

9. PIPE PENETRATIONS

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all fire stopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
 - 1) For sleeves: Extend sleeve 1 inch above finished floor and provide sealant for watertight joint.
 - 2) For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
 - 3) For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of the Project Architect.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass pipe sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.

- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 1 inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 1 inch in diameter. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

10. TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the Project Architect.

11. WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025-inch for up to 3 inch pipe, 0.035-inch for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

PART 3 - EXECUTION

1. ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating personnel access and observation provisions: all equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gases and

indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
 - 1) Holes through concrete and masonry shall be cut by rotary core drill.
 - 2) Holes shall be located to avoid interference with structural members such as beams, tendons, PT cables or grade beams. Holes shall be laid out in advance and drilling done only after approval. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Project Architect for approval.
 - 3) Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- G. Interconnection of Instrumentation or Control Devices: Generally, electrical interconnections are not shown but must be provided.
- H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- I. Protection and Cleaning:
 - 1) Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations.
 - 2) Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Concrete and shrink compensating grout 3000 psi minimum, shall be used for all pad or floor mounted equipment. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

- K. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- L. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
- M. Switchgear drip protection: every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- N. Inaccessible Equipment:
 - 1) Where the Project Architect determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Owner.
 - 2) The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

2. TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities as a part of the base scope of work and shall be provided at no additional cost to owner.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3. RIGGING

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered and will be considered by the Owner under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed when not required for rigging operations to

maintain proper environment in the facility for Owner operation and maintenance of service.

- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to Project Architect for evaluation prior to actual work.

4. PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the Project Architect.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 1/2-inch clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the latest edition of the prevailing plumbing code and these specifications.
- E. Overhead Supports:
 - 1) The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2) Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 3) Tubing and capillary systems shall be supported in channel troughs.
- F. Floor Supports:
 - 1) Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under

operating and seismic conditions (if applicable) without excessive displacement or structural failure.

- 2) Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 2 inch excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
- G. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

5. LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- C. All lubrication points shall be extended to one side of the equipment.

6. CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, the facilities, equipment and systems shall be thoroughly cleaned and painted.
- B. In addition, the following special conditions apply: Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
- C. The following Material And Equipment shall NOT be painted:
 - 3) Motors, controllers, control switches, and safety switches.
 - 4) Control and interlock devices.
 - 5) Regulators.
 - 6) Pressure reducing valves.
 - 7) Control valves and thermostatic elements.
 - 8) Lubrication devices and grease fittings.

- 9) Copper, brass, aluminum, stainless steel and bronze surfaces.
- 10) Valve stems and rotating shafts.
- 11) Pressure gages and thermometers.
- 12) Glass.
- 13) Name plates.
- D. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint obtained from manufacturer or computer matched.
- E. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer.
- F. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
- G. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this.

7. IDENTIFICATION & VALVESIGNS

- A. Laminated plastic signs, with engraved lettering not less than 3/16-inch high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance shall be placed on factory built equipment.

8. STARTUP AND TEMPORARY OPERATION

- A. Start up of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation.

9. OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, all required tests shall be performed and submit the test reports and records to the Commissioning Agent.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

- END OF SECTION -