

**SECTION 2**  
**DIVISION 22**  
**PLUMBING**

## **DIVISION 22 – PLUMBING**

**Note: This is a guide for Designers only. Contents shall NOT be used in lieu of specifications as part of the Designer’s contract documents.**

### **PART 1 - PLUMBING GENERAL**

#### **1.1 PLUMBING DESIGNER:**

- A. Design for Maintainability. Plumbing systems and systems components shall be durable and easy to maintain. The Consultants shall incorporate into equipment and system design sufficient access and clearance for maintenance, repairs, and replacement. Incorporate instrumentation necessary for balance and initial adjustment, as well as for service and monitoring.
- B. Design for Reliability. Systems shall have a high degree of reliability. If an entire building system will be affected by lesser reliability of a component (for example, a pump serving building process chilled water system), then a redundant piece of equipment shall be provided to increase overall system reliability. Design for parallel operation is acceptable for redundancy.
- C. Design for Energy Conservation. The energy efficiency of building systems and equipment is an essential part of the University design philosophy. Any new project shall be designed with state of the art energy efficiency. Design standards published by American Institute of Architecture (AIA), American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) and the State of North Carolina shall be met or exceeded.
  - 1. Major energy consuming systems and equipment shall be specified and purchased based on Life Cycle Cost Analysis. Careful evaluation of energy conservation measures shall begin early in the design phase and continue throughout the design process.
  - 2. Three phase electric motors for mechanical equipment shall be specified to be Premium Efficiency.
  - 3. The thickness of insulation for chilled water, hot water, steam, and condensate shall be geared toward conserving energy. Insulation thickness shall be selected for optimum cost versus/ efficiency. Economic evaluation is desirable.
  - 4. The Designer shall submit a report indicating utility and energy use for new facilities. The total energy consumption shall indicate monthly use of electricity, water, and gas for the Water and associated energy requirements shall be shown for process water, irrigation and domestic hot water. Energy use estimates shall be submitted with each design phase as well as with each alternate design proposal. The Owner can make an exception for small-scale projects.

#### **1.2 OWNER INTENT**

- A. Plumbing Contract shall include:
  - 1. Gas piping systems, beginning with connections to piping provided by the gas utility or provider, to and including the connection with gas appliances or outlets. Where coordination with a gas utility or provider is required, such as in arranging for gas services to a building, coordination shall be through the Plumbing Contractor.
  - 2. Domestic water supply and sanitary sewer systems associated with buildings, from and including connection to existing mains, including provision of water meters, backflow preventers, vaults and manholes.
  - 3. Interior roof drainage piping systems, beginning with connections to roof drains fixtures to the point of disposition, five feet outside the building. Roof drains shall be specified by the Architect, and provided in the General Contract.

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

4. Fire sprinkler and standpipe systems shall be part of the General Contract.
5. Graywater systems should NOT be considered for buildings.
6. Rain water harvesting should be considered for all new construction. The collection system, storage cisterns and distribution system shall meet the requirements of the North Carolina State Plumbing Code. The water can be used for site irrigation and cooling tower make-up in the building. Mechanical condensate can be collected and harvested along with the roof rain water. The water should be treated prior to use in accordance with the State statutes. Currently there are no time limits on the storage of this water.
  - a. Detailed documentation must be provided to include operating instructions, PID loops, component wiring diagrams, sequences, and set points.
  - b. Provide above documentation on laminated 24 by 36 minimum sheet mounted in rain water mechanical room.
7. Domestic Solar Water Heating Systems should be considered for buildings with large shower, cooking and domestic hot water loads. The system shall be a complete solar water heating system designed to be a source of hot water and shall be provided by a representative of a NABCEP Certified Solar Distributor. The solar system controls shall be integrated into the BAS package and communication interfaces shall be included. The system shall be complete with all components necessary and shall be fully operational.
  - a. Detailed documentation must be provided to include operating instructions, PID loops, component wiring diagrams, sequences, and set points.
  - b. Provide above documentation on laminated 24 by 36 minimum sheet mounted in mechanical room.
  - c. Consideration must be given to removal/rejection of excess heat.

1.3 DIVISION OF WORK

- A. This section delineates the Division of Work between Division 22 (Plumbing Contracts) and Division 26 (Electrical Contracts).
  1. Specific work to be done under Division 26 is hereinafter listed or described. All other work necessary for the operation of Division 22 equipment shall be performed under Division 22.
    - a. All individual motor starters for mechanical equipment (pumps) shall be furnished and installed under Division 22 unless indicated as a part of a motor control center. Motor starters for equipment provided in motor control centers shall be furnished under Division 26.
    - b. Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter or disconnect switch. Under Division 26 line side terminations shall be provided. Wiring from the termination point to the plumbing equipment, including final connections, shall be provided under Division 22.
    - c. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 22 shall be furnished, installed and wired under Division 22.
    - d. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 22.
    - e. The sequence of control for all equipment shall be as indicated on the Division 22 Drawings and specified in the appropriate section.
    - f. Where electrical wiring is required by trades other than covered by Division 26, specifications for that section shall refer to same wiring materials and methods as specified under Division 26. No Exceptions.

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

2. Many of the items covered in the plumbing guidelines pertain to those items which may be unique to The University of North Carolina at Charlotte, its systems or preference or requirements mandated by Facilities Management. Any item not specifically outlined or commented upon in these guidelines is left to the judgment of the engineering design professional to use current accepted good engineering practice. The construction documents are subject to review and comment by Facilities Management at any time during the course of design or construction of the project.
3. Deviation from concepts noted in these guidelines requires approval of the Project Manager and Facilities Mechanical Engineer for The University of North Carolina at Charlotte. **RESIDENCE LIFE PROJECTS HAVE PLUMBING VARIANCES GRANTED BY THE STATE CONSTRUCTION OFFICE.** Verify applicability prior to beginning design.
4. All floor plans and enlargements of floor plans shall bear North arrows, room numbers, and column lines conforming with the designations found on the Architectural floor plans. All floor plans and enlargements shall have the same directional orientation as the architectural floor plans. Site plans and floor plan directional orientation shall agree.

#### 1.4 ADDITIONAL REQUIREMENTS FOR DRAWINGS

- A. Capacity of new equipment shall be described on drawings by way of equipment schedules. Equipment schedules shall indicate, in addition to technical data, the location of equipment and areas served by it. Schedules for air-handling units shall indicate minimum and maximum outdoor airflow in cubic feet per minute in addition to other information.
- B. Flow diagrams for water and gas shall be shown on drawings with all piping sized. Direction of flow shall be indicated. The Consultant shall incorporate schematic piping diagrams for the following:
  1. Pressure-reducing stations
  2. Domestic hot water heaters
  3. Gas meter installations
  4. Others as they may apply to a specific project
- C. Piping sizes shall be clearly indicated. All valves shall be shown. Valves shall be placed in locations with adequate access.
- D. Mechanical equipment room layouts shall be drawn in 1/4" scale or larger. As many sections as necessary shall be provided to clarify installation of equipment, piping, and ductwork, and to show clearances for service. All large valves, particularly gate valves, shall be drawn to scale showing the location of the hand wheels.
- E. The automatic temperature control schematic shall be shown on drawings. Sequence of operation description shall be included.

### PART 2 - PRODUCTS

#### 2.1 VALVES

- A. All valves (except plumbing fixture faucets, convenience hose bibs, shut offs at plumbing fixtures, and similar rough-in connections and end-use fixtures) shall be provided with 19-gage polished brass valve tags with the stamp-engraved piping system abbreviation and sequenced valve numbers. Valve tags shall be attached with brass chains or S-hooks.
- B. Valve schedules shall be mounted in glazed display frames at the facility and shall include valve number, piping system, system abbreviation (as shown on valve tag) and location of valve

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

(room and space). Valves intended for emergency shut-off and similar special uses shall be marked by “flags” in the margin of the schedule.

- C. All water valves to operate by turning the square nut clock-wise (right) to close and counter-clockwise (left) to open, as per UNCC requirements.
- D. Provide all underground valves with extensions and donuts around valve boxes.

**2.2 LABELING**

- A. Plumbing equipment shall be labeled with name, number as designated on designer’s contract documents, service and operational requirements, safety, and emergency precautions, design capacity, and other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.. Pipe shall be identified with colored signs and arrows indicating its respective system and direction of flow. New equipment will be pre-painted by the equipment supplier before shipment.

<u>Piping System</u>	<u>Pipe Abbreviation</u>	<u>Paint Color (Devoe)</u>
Acid Waste	ACID	Safety Yellow (DC9400)
Chilled Water	CHW (S, R)	Safety Blue (DC 9800)
Chilled Beam Water	CB(S, R)	Car Blue (DC4035)
DI	DI(R)	Green
Condenser Water	CW (S, R)	Car Blue (DC4035)
Hot Water (heating)	HW (S, R)	Oxide Yellow (DC8800)
Rain Harvesting	RH (S, R)	Purple
Steam	S (HPS, MPS, LPS)	Safety Yellow (DC9400)
Steam Condensate	LPC, HPC	Safety Orange (DC9200)
Pumped Condensate	CPD	Oxide Red (DC7821)
Natural Gas	GAS (FG, ID)	Medium Yellow (DC 8600)
Relief Valve Vents		Orange
Duct work		White
Equipment		White
Hanger Rods		Flat Black
Domestic Cold Water	DCW	Medium Green (DC6650)
Non-Potable Cold Water	NP CW	Spruce (DC5323)
Lab Cold Water	LCW	Light Green (DC5574)
Domestic Hot Water	DHW	Light Buff (DC1810)
Lab Hot Water (S, R)	LHW	Interna'l Orange (DC6900)
Lab Vacuum	LV	Blue
Lab Waste	LW	Black (DC9903/9990)
Tempered Water	TW	Medium Brown (DC1400)
Domestic Hot Water Return	DHWR	Desert Sand (DC1046)
Lab Compressed Air	LA	Plymouth Grey (DC2100)
Nitrogen	N2	Light Grey (DC2973)
Sanitary Drain / Vent	SAN	Match Surrounding
Sprinkler / Fire Line		Safety Red (DC9000)

**UNDERGROUND PIPING IDENTIFICATION**

- A. Permanent, bright colored, continuous plastic tape, intended for direct burial, shall be installed 8” below finished grade directly over all buried utilities for first stage of underground piping identification. Tape shall be printed to most accurately indicate type of buried utility.

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

- B. Tracer Wire: A #12 AWG or heavier (smaller AWG number), solid, insulated (RHW, THW, or polyethylene insulation is recommended); copper wire shall be taped to pipe at 15 to 20 foot intervals to be second stage of underground piping identification. Do not wrap wire around pipe. The wire must be one continuous, unbroken length. Coil tracer wire at meter location and street end with enough wire to extend a minimum of two feet above grade.
- C. Tracer Wire Boxes: Plastic gas services longer than 1000 feet in length from curb valve to meter riser must have tracer wire boxes installed at customer's expense in accordance with Company standards.

### 2.3 METERING

- A. The University operates utility distribution systems for electricity, potable water, steam/condensate, hot water and chilled water. Natural gas is provided by Piedmont Natural Gas Co. Cost distribution for utilities is accomplished through a metering system and a prorated assignment of cost.
  - 1. Meters shall be approved for interface to the Building Automation System (BAS) for real time monitoring and trending.
  - 2. Potable Domestic Water metering shall be by turbine or nutating disk meter with magnetic drive. Meter to be located in mechanical room, easily accessible, read in cubic feet, and provide output to building automation.
  - 3. Non-sewered water (consumed but not returned to the sewer, e.g. irrigation, cooling tower makeup, etc.) should be metered at its source. Meter should be located in mechanical room, easily accessible, read in cubic feet and provide output to building automation. Meters and transmitters must conform to Charlotte Mecklenburg Utilities (CMU) Standards for providing sewer credits.
  - 4. Natural Gas metering shall comply with all requirements of Piedmont Natural Gas (PNG), and interface to the Building Automation System through a PNG provided pulse.
  - 5. Contact Facilities Engineering for metering requirements on special systems to include reclaimed water and solar water heating.

### 2.4 SOUND AND VIBRATION CONTROL

- A. The Consultant shall provide vibration isolation where required. There shall be no objectionable transmission of vibration from equipment to the building structure.
- B. Appropriate vibration isolation of equipment, piping and ductwork shall be specified. Attention shall be paid to the proper use of flexible duct and pipe connectors, the use of resilient pipe hangers and supports, anchors and guides, and the treatment of pipe and duct penetrations through building walls.
- C. Mechanical equipment rooms shall be placed preferably at ground level and away from occupied spaces to minimize transmission of vibrations and noise into the building.

## PART 3 - PIPING INSULATION

### PART 1 - EXECUTION

#### 1.1 INSULATION FOR PIPING

- A. The Designer shall evaluate thermal insulation properties and moisture migration to prevent surface condensation. Designer shall evaluate insulation vapor permeability and potential for surface sweating to recommend type of insulation. In areas where insulated pipes are subject to physical abuse, an aluminum covering shall be applied around the insulation.

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

- B. Insulation of underground piping shall receive special attention. Adequate protection against ground water and electrolytic forces shall be provided.
- C. All valves and fittings shall be insulated with preformed fitting insulation. Provide also for insulation of all cold and hot surfaces of equipment when available from the manufacturer.

**SECTION 22 4000 - PLUMBING FIXTURES**

**PART 1 – PRODUCTS**

**1.1 GENERAL**

Plumbing Fixtures must meet the following maximum water usage requirement which are based upon North Carolina Session Law 2007-546 (Senate Bill 668), OR existing NC Plumbing and Energy codes – whichever are more stringent.

- 1. Lavatory Faucets to be furnished with aerators with maximum flow of 0.5 gpm based on inlet pressure of 60 psi.
- 2. Showerheads, flow of 1.5 gpm or less based on inlet pressure of 60 psi.
- 3. Urinal Flush Valves 0.75 gpm per flush or less
- 4. Water Closet Flush Valves of 1.0 gpm per flush or less

**1.2 PLUMBING FIXTURES**

- A. All plumbing fixtures shall be as manufactured by American Standard, Crane, Eljer, Kohler, Zurn or Toto.
- B. Flush valve type fixtures are preferred over tank type fixtures. Flush valves shall be automatic unless otherwise approved by owner.
- C. Urinals – Urinals shall be low flow 0.125 gallons per flush.

**1.3 PLUMBING FIXTURE TRIM**

- A. Provide lavatory faucets manufactured by Zurn, Toto, Sloan, Kohler or Chicago.
- B. Provide laboratory faucets and accessories manufactured by Chicago.
- C. Automatic faucets should be used for all restroom lavatory faucets.

**SECTION 22 4400 - WATER SYSTEMS**

**PART 1 - GENERAL**

**1.1 RISER DIAGRAMS**

- A. Provide supply and waste riser diagrams for all multistory (more than one floor) buildings

**PART 2 - PRODUCTS**

**2.1 PIPING**

- A. Sanitary sewer piping shall be cast iron. Joints for underground piping shall be bell and spigot with compression gaskets. Joints for piping above grade may be bell and spigot with compression gaskets or no-hub.

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

- B. Vent piping shall be cast iron or galvanized steel except that galvanized steel shall not be used underground.
- C. Drain, waste and vent piping for acid waste systems shall be of high silicon cast iron, borosilicate glass (above grade only) or polypropylene piping.
- D. Roof drain leaders above grade shall be galvanized steel or cast iron piping with no-hub or bell and spigot joints with compression gaskets. All roof drain piping below grade shall be cast iron piping with bell and spigot joints with compression gaskets.
- E. Water piping inside the building and above grade shall be type L hard drawn copper unless other approved by owner.
- F. Water piping below slab shall be type K soft annealed copper tubing with no joints below the slab. Water service shall be stubbed above floor as near the exterior wall as practical, rather than running below slab to an interior space.
- G. Solder joints in copper pipe shall be made with 95 percent tin, 5 percent antimony solder in sizes up to and including 1 1/4". Joints in pipe sizes above 1 1/4" shall be made with brazing solder.
- H. All piping shall be routed as to remain clear of transformer vaults, refrigerated spaces, switch rooms, elevator shafts, or other critical areas, and vault spaces over same. Do not specify drain pans under piping routed over this equipment. Reroute the piping.
- I. Undersides of roof drains, and horizontal storm water drains or roof leaders inside the building shall be insulated to prevent the formation of condensation. Undersides of floor drains receiving condensate drainage from a cooling coil, and associated traps and horizontal drain piping to point of connection with other sanitary sewer piping shall be insulated to prevent the formation of condensation.
- J. No piping except soil, waste or drain piping shall be installed in or below concrete slabs on grade.
- K. Cold water and hot water plumbing piping is not permitted in exterior walls except to supply hose bibbs.
- L. All main piping shall have accessible shut-off valves for isolation purposes. All branch piping from main shall have shut-off valves.
- M. Floor drains connected to the sanitary sewer shall be provided in all mechanical equipment rooms, custodial closets, restrooms and locker rooms.
- N. Hose bibbs shall be provided in all mechanical equipment rooms, kitchens, rooms that require wash down, and rooms with floor drains. All hose bibbs shall be provided with vacuum breakers.
- O. Provide supply and waste piping riser diagrams for all multistory (more than one floor) buildings.
- P. Verify with the local authority how elevator sump pump discharge shall be handled. This office prefers that pump discharge be routed to the sanitary sewer with an indirect (air-gap) connection. It is recommended that the pump also trigger an alarm to alert the building management system and/or maintenance personnel.
- Q. Specify testing in accordance with the plumbing code.

**SECTION 22 4500 - FUEL GAS SYSTEMS**



**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

PART 1 - GENERAL

1.1 GAS PIPING

- A. Gas piping shall be schedule 40 black steel and comply with ANSI B36.10, ASTM A 53 or ASTM A 106 in accordance with Section 306.1, page 45 of the North Carolina State Building Code. Volume VI -Gas.
- B. Indicate the location of the gas pressure regulator(s) and the gas meter. Indicate which contractor or utility will provide the regulator(s) or meter.
- C. Interior gas piping shall be painted yellow and identified or labeled "GAS" with stencils or labels in accordance with ANSI A13.1.

**SECTION 22 8000 – PLUMBING SYSTEMS COMMISSIONING**

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. North Carolina General Statute 143-135.37(d) requires commissioning of major projects.
- B. Performance Verification. – In order to be able to verify performance of a building component or an energy or water system component, the construction contract shall include provisions that require each building component and each energy and water system component to be commissioned, and these provisions shall be included at the earliest phase of the construction process as possible and in no case later than the schematic design phase of the project. Such commissioning shall continue through the initial operation of the building. **The project design and construction teams and the public agency shall jointly determine what level of commissioning is appropriate for the size and complexity of the building or its energy and water system components.**
- C. Design for Commissioning. The plumbing designer will be responsible for ensuring and developing "... a systematic process of assuring that a building (*mechanical, electrical and plumbing systems*) performs in accordance with the design intent and the owner's operational needs." The Owner considers the following elements as a minimum requirement for building acceptance and inherently integral to the Plumbing Designer responsibilities, unless specifically notified otherwise by the Owner.
  - 1. Design Phase – Provide documentation to the commissioning agent with copy to owner for following:
    - a. Owner's project requirements and Basis of Design, to include single line drawings for Design Narrative.
    - b. Commissioning reviews of design documents.
    - c. Verification that operations and maintenance staff training through the plumbing contractor is specified.
    - d. Metering and sub metering to accomplish analysis of annual energy and utilities consumption versus projected consumption.
    - e. Clarify the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
  - 2. Construction Phase  
NOTE: Commissioning shall in no way reduce the designer scope and responsibility for Construction Administration to include verifying quality of system installation. Designer team is to:

**University of North Carolina at Charlotte Design and Construction Manual**  
**Section 2, Division 22 – Plumbing**

- a. Attend the commissioning scoping meeting and selected commissioning team meetings.
  - b. Provide Installation Verification.
  - c. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
  - d. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. On site observations should be completed just prior to system startup.
  - e. The designers shall continue to assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
  - f. Startup and Checkout.
  - g. From the Contractor's red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the plumbing systems.
  - h. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
3. Post Construction Phase
- a. Designer will provide classroom overview to university operations staff to include Basis of Design, potable water systems, lab systems, rainwater systems, emergency operations, system capacities and limitations, and metering.
  - b. M&V. Assist in reconciling discrepancies between actual energy/utilities usage and the submitted projection model.
- D. The Designer will include in bid documents the specific support and documentation required of the General Contractor (CM), Mechanical Contractor, Electrical Contractor, Plumbing Contractor, Controls Contractor, Designer, Owner and others as applicable to ensure acceptable commissioning.

Reference Division 01 General Requirements for commissioning guidelines. **Guidelines will be modified as appropriate for each project.**