Cleveland Clinic Design Guidelines: Division 22 - Plumbing

The following pages contain guidelines for the design and construction of new and renovated facilities at the Cleveland Clinic domestic locations. They shall be used by A/E firms in the preparation of drawings and specifications for construction of facilities.

The general purpose of each Facilities Standard Guideline is to provide minimal criteria for construction materials and equipment at Cleveland Clinic facilities regarding Codes and FM Global compliance, warranty, approved products, execution and uniformity.

The Guidelines are not Contract Specifications, but used to prepare more detailed, project specific specifications. The Guidelines are intended to be used to address system design aspects of equipment that Cleveland Clinic desires to standardize among facilities, and identify prohibited materials and construction practices.

The use of these Guidelines is mandatory for all design or maintenance projects. Deviations are discouraged. If project conditions arise which require a deviation, it shall be thoroughly documented by the user and submitted to the Cleveland Clinic for review and approval using the Design Guideline Revision request form.
1. DOMESTIC WATER DISTRIBUTION
2. SANITARY WASTE
3. STORM DRAINAGE
4. DOMESTIC-WATER HEAT EXCHANGERS
5. PLUMBING FIXTURES
6. MEDICAL GAS AND VACUUM SYSTEMS
7. LABORATORY WATER AND WASTE SYSTEMS
8. FACILITY NATURAL GAS PIPING

** End of List **
PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general design requirements for domestic cold, hot and hot water return distribution systems within and to five feet beyond the building perimeter.

B. Related Sections
1. 220513 – Common Motor Requirements for Plumbing Equipment
2. 220516 – Expansion Fittings and Loops for Plumbing Equipment
3. 220517 – Sleeves and Sleeve Schedules for Plumbing Piping
4. 220518 – Escutcheons for Plumbing Piping
5. 220519 – Meters and Gauges for Plumbing Piping
6. 220523 – General Duty Valves for Plumbing Piping
7. 220529 – Hangers and Supports for Plumbing Piping and Equipment
8. 220533 – Heat Tracing for Plumbing Piping
9. 220548 – Vibration and Seismic Controls for Plumbing Piping and Equipment
10. 220553 – Identification for Plumbing Piping and Equipment
11. 220716 – Plumbing Equipment Insulation
12. 220719 – Plumbing Piping Insulation
13. 221116 – Domestic Water Piping
14. 221119 – Domestic Water Piping Specialties
15. 221123 – Domestic Water Pumps

1.2 DOMESTIC WATER DISTRIBUTION REQUIREMENTS

A. Domestic water shall be provided for all plumbing fixtures, food service fixtures and equipment, and all other systems, equipment, and devices that require domestic water supply.

B. Building domestic water distribution systems shall be metered and isolated from the municipal water supply in accordance with the municipality’s requirements.

C. The design of building supply and distribution systems shall provide a volume of water at the required flows, pressures and temperatures to ensure safe, efficient and code compliant operation during periods of peak demand. Piping shall be sized at a velocity not exceeding six feet per second (fps) for cold and hot water and four fps for hot water return.

D. Main distribution piping risers shall utilize chases within the building footprint for vertical routing to multiple floor levels where possible. Accessible shut-off valves shall be provided at the base of each riser and at each branch connection to risers. Shut-off valves shall be ball valves 1-1/2” and below, and double lug butterfly valves for 2” and above.

E. Do not locate water piping within stairways, electrical or telecommunications rooms.

F. All interior domestic water supply and recirculation piping shall be insulated to prevent condensation.
G. Provide water softener systems to reduce hardness as required to supply food service equipment, water heating equipment, pure water production equipment, and other systems, fixtures and equipment which hard water may adversely affect operation or longevity.

H. Provide freeze-proof wall hydrants with backflow preventers on exterior walls a maximum of 150 feet apart, at loading docks, near building entrances, at mechanical yard and within 50 feet of exterior grease interceptors. Hydrants should be located at approximately 18 inches above finished grade. Coordinate the location of all wall hydrants with the architectural features of the building and obtain approval of locations from the Project Architect.

I. Provide freeze-proof wall hydrant with backflow preventer on at least one exterior wall of the roof penthouse for maintenance use and one near curb.

J. Provide a hose bibb 24” above finished floor with backflow preventer and a minimum of one floor drain in each mechanical room.

K. Provide manufactured water hammer arrestors in water supply lines in accordance with Standard PDI-WH201.

L. Provide accessible check valves in the individual cold and hot water fixture supply lines serving mixing valve type faucets or assemblies having hose connection outlets that are not equipped with integral check stops.

M. Provide line shut-off valves at locations required for proper operation, servicing and troubleshooting of the domestic water distribution system and connected components. Locations shall include but not be limited to the following; at each fixture and piece of equipment, at each branch take-off from mains, at the base of each riser, at each battery of fixtures, where recommended by equipment manufacturers and at strategic locations to allow sectional isolation while limiting disruption of services to large portions of the system.

N. Accessible full size capped valves shall be provided where required for future connections.

O. All valves shall be accessible for operation and servicing. Provide access panels for all concealed valves. Coordinate the location of access panels with the architectural features of the building and obtain approval of locations from the Project Architect.

P. Trap priming devices that rely upon line pressure differential shall be used for patient toilet rooms. Electronic trap priming devices shall be used in mechanical rooms and provided with a readily accessible serviceable strainer immediately upstream of the device solenoid valve.

Q. Static pressure at plumbing fixtures shall be limited to 55 psig (preferred), 80 psig (maximum), on each floor level by accessible redundant pressure regulating valves. Provide additional pressure regulating valves as required for proper operation of individual equipment.

R. Pressure reducing valves shall be duplex parallel, one on one off. Engineer to evaluate size for design fixture load, where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
S. Provide isolation valve, pressure gauge, and one strainer on each side immediately upstream of each pressure regulating valve. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.

T. Design of pressure regulating assemblies shall incorporate prevention of over pressurization of downstream piping in the event of valve malfunction.

U. A packaged domestic water booster pump system shall elevate the incoming water pressure as required to serve fixtures and equipment. Selection of pumping system type shall be based upon flow and pressure demand, efficiency of operation, life expectancy and maintenance requirements of the equipment. Pumps shall be end suction or centrifugal double, stack pumps are not acceptable. Domestic water for all building levels shall be provided using at a minimum, a duplex pump.

V. Specify variable frequency drives for all booster pump systems.

W. Booster pump systems shall be designed to deliver calculated peak flow at required pressure with one pump out of service.

X. Connect booster pump system to emergency power source.

Y. Design of domestic water systems shall avoid all cross connections and eliminate the possibility of water contamination. On each water supply line serving a plumbing fixture, item of equipment, or other device which has a water supply discharge outlet below the overflow rim, or where cross contamination may occur, provide an approved vacuum breaker or testable backflow preventer, 1020 or 1013. Location of vacuum breakers shall prevent any possible backflow through them.

Z. Testable backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and any area or equipment where un-interruptible (24 hour) water service is required. Coordinate with the Cleveland Clinic to determine areas and equipment that require un-interruptible service.

AA. Avoid providing individual backflow preventers for each piece of equipment where domestic water serves centralized multiple equipment such as sterilization equipment, fume hoods, etc. Cold and hot water shall be provided by dedicated services separated from the domestic water distribution system by duplexed reduced pressure backflow preventers with soft seated Teflon check downstream. All piping downstream of the backflow preventers shall be identified as non-potable water.

BB. Backflow preventer test ports shall not be located more than 72 inches above finished floor or permanent platform in an accessible manner.

CC. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.

DD. Provide integral strainers on all principle or primary type backflow preventers.

EE. Vacuum breakers for hose connections in health care or laboratory areas shall not be less than 72 inches above the floor with the following exceptions:
1. Vacuum breakers integral with faucets or equipment;  
2. Vacuum breakers for bedpan washer hoses shall not be located less than 60 inches above the floor.

FF. Do not install vacuum breakers above equipment, concealed within walls or any location where water leakage can cause damage. Above ceiling vacuum breakers shall be ASSE approved 1056 anti-spill.

GG. Vacuum breakers (including vacuum breakers that are integral with faucets) shall not be installed under exhaust hoods or similar locations that may contain toxic fumes or vapors.

HH. Air chambers, dead-legs, or any other piping arrangement that may allow water to stagnate shall not be allowed within domestic water systems. Shock absorbers (water hammer arrestors) shall be located as close as possible to the piping served. Pipe extensions shall not be used to connect shock absorbers to piping.

II. Valves provided for future connections shall not extend more than 24 inches from an active main.

JJ. Where permanently disconnecting domestic water supplies serving fixtures or equipment, remove all associated piping back to active main to avoid stagnation.

KK. Propress is allowed on domestic water soft copper lines up to 4”.

LL. The only acceptable location for iron butterfly valves is within the vault.

MM. The only acceptable location for iron pipe is underground.

NN. Galvanized steel pipe may be used on pipe 4” and larger.

OO. Grooved fittings are acceptable on piping ≥2”.

PP. Coordinate purveyor meters with utility company and deduct meters with Cleveland Clinic.

QQ. Review non-potable water labeling requirements per applicable job.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made. Refer to construction specifications for acceptable manufacturers.

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PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general design requirements for sanitary waste within and to five feet beyond the building perimeter.

B. Related Sections
   1. 221316 – Sanitary Waste and Vent Piping
   2. 221319 – Sanitary Waste Piping Specialties
   3. 221323 – Sanitary Waste Interceptors
   4. 221329 – Sanitary Sewerage Pumps

C. As a minimum, design per state and local building code.

1.2 SANITARY WASTE REQUIREMENTS

A. Waste and vent systems shall be designed using fixture drain loads that are code compliant for sizing and provide proper operation during periods of peak demand.

B. Main waste and vent stacks shall utilize chases or be located adjacent to columns where possible for vertical routing to multiple floor levels.

C. Laundry utility boxes shall be provided where connections to laundry equipment are required. Provide 3” pipe at the base of the box, 24” of 2” pipe and a 2” trap.

D. Dialysis wall boxes shall tie in to the nearest fixture through a wye connection.

E. Trap primers shall be provided to floor drains in public restrooms, janitor closets, floor sinks, indoor air handling unit condensate drains 5 tons and larger, and any floor drains that may be susceptible to trap seal evaporation.

F. Public restrooms shall be provided with full size floor drains.

G. Private restrooms shall be provided with 2” emergency floor drains. The emergency floor drain shall discharge into the trap of the private restroom shower drain with an air break.

H. The building system is anticipated to flow by gravity to the exterior municipal sanitary sewer. Sanitary drains that cannot be discharged by gravity shall be routed to a sump and be pumped out to a point in the sanitary system that is capable of flowing by gravity. Cast iron body submersible pumps are acceptable for elevator sumps. Provide duplex, lead-lag pumps with local and building management system high water alarms. Locate gate and check valves outside the pit.

I. Above ground floor drains, P-traps and connected drainage piping receiving cold condensate or ice machine waste shall be properly insulated to the point of receiving to prevent condensation.
J. Provide cleanouts at the base of each vertical sanitary stack and at intervals not exceeding 75 feet in horizontal building drain. All interior cleanouts shall be accessible from walls or floors. Provide wall cleanouts in lieu of floor cleanouts wherever possible. A floor cleanout shall be installed only where installation of a wall cleanout is not practical. Provide a wall cleanout for each water closet or battery of water closets. Locate wall cleanouts above the flood level rim of the highest water closet but no more than twenty four inches above the finished floor. For horizontal cleanouts, provide an access door and blind plug. For vertical cleanouts, provide an access door, wye, and blind plug. Plumbing engineer is responsible for coordinating access door locations for incorporation on the architectural plans.

K. No buried waste line shall be smaller than 3 inches. No buried vent line shall be smaller than the full size of the sanitary pipe that it is serving. No above ground vent line shall be smaller than 1-1/2”. No roof vent terminal shall be smaller than 3 inches. Waste piping serving water closets shall not be smaller than 4 inches.

L. Locate all sanitary vent terminals a minimum of 30 feet horizontally from or 3 feet vertically above all air intakes, operable windows, doors and any other building openings, unless a written variance is accepted where 25 feet horizontally would be the minimum.

M. Avoid locating drains above sensitive equipment or areas where water leakage would cause major property loss or contamination. Where this is unavoidable, provide a stainless steel drain pan with drain and leak detection alarms tied into building management system and seal floor above with 20 year floor seal.

N. Do not locate drainage or vent piping within stairways, electrical, telecommunications rooms or to be leased spaces. Where this is unavoidable, provide a stainless steel drain pan with drain and leak detection alarms tied into the building management system and seal floor above with 20 year floor seal.

O. Do not locate floor drains within pharmacy drug preparation areas, operating rooms or areas where hazardous materials are handled or stored.

P. All drains shall be vented according to the latest version of the International Plumbing Code or local code, whichever is more stringent.

Q. Provide submersible sump pump(s) with screen and high water alarm in each elevator pit.

R. PVC is only acceptable below ground. Transition from cast iron to schedule 40 PVC below ground.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made such as but not limited to Tyler Pipe and Charlotte Pipe. Refer to construction specifications for acceptable manufacturers.
PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general requirements for storm drainage within and to five feet beyond the building perimeter.

B. Related Sections
   1. 221413 – Facility Storm Drainage Piping
   2. 221423 – Storm Drainage Piping Specialties
   3. 221429 – Sump Pumps

1.2 FACILITY STORM DRAINAGE REQUIREMENTS

A. Includes the following:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
   3. Roof drains
   4. Cleanouts

B. Determine storm drainage piping and support and installation seismic requirements for each project based on ASCE/SEI7.

C. Primary and secondary roof drain systems shall be designed using the applicable rainfall rate in conjunction with code established areas-to-pipe sizes allowed.

D. Storm water drainage systems shall be provided to convey rainwater from roof and area drains to the site municipal storm sewer system. Secondary emergency overflow systems shall be installed to protect parapeted roof structures in the event of primary system blockage. Provide catch basin at secondary discharge location. On systems with large roof or cooling towers provide primary drains, secondary drains and scuppers.

E. Avoid locating sumps or piping above sensitive equipment (i.e. MRI’s, CT’s, radiology imaging equipment) or areas where water leakage would cause major property loss or contamination. Where this is unavoidable, provide a stainless steel drain pan with drain, leak detection and seal floor above with 20 year floor seal.

F. Do not locate drain sumps or piping within stairways, electrical or telecommunications rooms. Where this is unavoidable, provide a stainless steel drain pan with drain and leak detection alarms tied into the building management system and seal floor above with 20 year floor seal.

G. No roof drain shall have an outlet connection smaller than 3 inches.

H. Storm drains that cannot be discharged by gravity shall be routed to a sump and be pumped out to a point in the storm system that is capable of flowing by gravity. Provide duplex, lead-lag
pumps with local and building management system high water alarms. Locate gate and check valves outside of the pit.

I. Provide cleanouts at the base of each vertical downspout and at intervals not exceeding 75 feet in horizontal building drain. All interior cleanouts shall be accessible from walls or floors. For horizontal cleanouts, provide an access door and blind plug. For vertical cleanouts, provide an access door, wye, and blind plug. Plumbing engineer is responsible for coordinating access door locations for incorporation on the architectural plans.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made such as but not limited to Tyler Pipe and Charlotte Pipe. Refer to construction specifications for acceptable manufacturers.

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR PLUMBING INSTALLATION

A. Roof drain and emergency overflow drain sumps and horizontal piping to first vertical rainwater conductor shall be insulated to prevent condensation.

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PART I - GENERAL

1.1  SUMMARY

A. This section addresses the general design requirements for domestic water heat exchangers within and to five feet beyond the building perimeter.

B. Related Sections
   1. 223400 – Fuel-Fired, Domestic Water Heat Exchangers
   2. 223500 – Domestic Water Heat Exchangers

1.2  DOMESTIC WATER HEAT EXCHANGERS REQUIREMENTS

A. Domestic hot water systems shall be designed to reasonably assure an expeditious flow of hot water at all outlets. Provide pumped circulating systems where required. Electric heat maintenance cable is not allowed.
   1. Size hot water return lines by the heat loss method as outlined in the ASHRAE Systems and Equipment Data Book, not to exceed 10 degrees F. heat loss. Developed length of branch piping from fixture outlet to circulated mains shall not exceed 20 feet (Refer to Exceptions in the following sub-paragraphs):
      a. Hot water piping serving public lavatory faucets shall be circulated to within eighteen inches of the fixture hot water supply stop.
      b. Provide a check valve and flow control valve at the end of each line on each floor.
      c. A single point-of-use instantaneous electric water heater shall serve no more than three lavatory faucets. The length of hot water piping from the heater to each faucet stop shall not exceed thirty-six inches (36”).

B. Water heaters installed and utilized for food service areas shall comply with National Sanitation Foundation (NSF) Standard Number 5 and be separate from water heating equipment and piping serving other areas of the building. Hot water serving food service commercial dishwasher and pot sink shall be 140 degrees F. All other hot water shall be 110 degrees F maximum at outlets.

C. Hot water heating equipment serving areas other than food service may be generated by centralized heaters or point-of-use heaters as determined by economics, space requirements and good engineering practices. All hot water shall be generated to 118 degrees F and mixed to 110 degrees F. maximum at plumbing fixture outlets or as determined by local code.
   1. Separate water heating equipment should be considered to serve equipment and/or processes that require water temperatures that exceed 110 degrees F.
   2. Sterilization water that is not exposed to general staff shall be 160 degrees F.
   3. Separate water heating equipment and circulation pumps shall be provided for each pressure zone within a high-rise building. AE may recommend and submit alternative designs for Cleveland Clinic approval provided that the design insures total circulation of the distribution system.

D. Where centralized heaters are provided, utilize semi-instantaneous type with steam to hot water or hot water to hot water double wall heat exchangers. Natural gas fired heaters may be
provided where natural gas service is readily available and when considered applicable by the AE and approved by the Cleveland Clinic.

E. Water heating equipment shall meet latest ASHRAE standard A90.1 Table 7.2.2.

F. Water heating equipment shall not be subjected to system pressures beyond its ASME stamped working pressure.

G. Provide NSF and ASME compliant pre-pressurized steel thermal expansion tank with membrane on the cold water supply line of all water heating equipment where cold water service contains check valves, pressure reducing valves or backflow preventers. Thermal expansion tanks shall be sized in accordance with manufacturer’s published recommendations.

H. Fuel-fired domestic water tanks shall be a pair sized as N+1.

I. Condensing domestic water heaters are acceptable.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made. Refer to construction specifications for acceptable manufacturers.

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PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general requirements for plumbing fixtures, trim and associated accessories.

B. Related Sections
1. 224213.13 – Commercial Water Closets
2. 224213.16 – Commercial Urinals
3. 224216.13 – Commercial Lavatories
4. 224216.16 – Commercial Sinks
5. 224223 – Commercial Showers, Receptors, and Basins
6. 224300 – Healthcare Plumbing Fixtures
7. 224500 – Emergency Plumbing Fixtures
8. 224600 – Security Plumbing Fixtures
9. 224716 – Pressure Water Coolers

PLUMBING FIXTURE REQUIREMENTS

1.2 GENERAL

A. Fixtures and trim specified for renovation of existing facilities shall match existing installation where possible.

B. Fixtures, trim and accessories shall be new institutional/commercial grade quality.

C. Vitreous china plumbing fixtures shall be white or bone in color with chrome-plated brass fixture trim and accessories.

D. Wall mounted fixtures not exposed to the general public shall be supported with commercial carriers, bolted to the floor. Fixtures exposed to the general public shall be supported with bariatric carriers, bolted to the floor. Fixture weight shall not be transmitted to walls or partitions.

E. Fixtures exposed to the public shall be provided with vandal resistant trim.

F. Determine per project if each water cooler shall be provided with a gooseneck water dispenser in addition to the bubbler head.

1.3 ELECTRONIC SENSOR ACTIVATED FIXTURE TRIM

A. Electronic faucet and flush valve sensors shall be AC power. Sensors shall be hardwired and concealed. Battery operated faucets and flush valves are only acceptable if they exceed the 3 year manufacturer warranty.
B. AC powered Electronic faucet and flush valve sensors located within Patient Care areas and critical Research areas shall be connected to the emergency electrical system.

C. All electronic flush valve sensors shall be provided with a manual override button except when located within specimen collecting toilet rooms.

1.4 **LAVATORIES AND SINKS**

A. Stainless steel sinks shall be 18 gauge Type 304 stainless steel with insulation undercoating. Fixture trim and accessories shall be heavily chrome-plated.

B. Provide faucets with laminar flow outlets. Aerators will not be acceptable.

C. All lavatories and sinks within patient care areas shall be provided with a gooseneck spout having outlet a minimum of five inches above the flood level rim of the fixture. EXCEPTION: All lavatory faucets within non-patient room toilets shall have low-profile (non-gooseneck) spouts.

D. Lavatories shall be provided with grid strainer drain with 5/16” holes. Drain stoppers or mechanical (pop-up) waste fittings will not be acceptable.

E. All sinks primarily used for hand washing shall be provided with grid strainer drain with 5/16” holes. Drain stoppers or crumb-cup strainers will not be acceptable.

F. Lavatories located in public and staff washrooms shall be provide with electronic sensor activated faucets.

G. Lavatories faucets located in specimen collecting toilet rooms shall be provided with AC powered electronic sensors. The electrical power shall be controlled by a keyed wall switch located outside of the toilet room to allow nursing staff to prevent use of faucet during collection of specimen. The key shall activate a 110/24V solenoid. Coordinate with Cleveland Clinic staff for exact location of wall switch.

H. Scrub sinks shall be trimmed with electronic sensor controls.

I. Each lab room shall be provided with at least one hand washing sink having electronic sensor activated faucet and hot and cold water.

J. Sinks located in BL-2 or higher tissue culture rooms shall be provided with foot pedal or electronic sensor activated faucets with programmable run time.

K. Faucets used by medical and nursing staff for cleanup or general use shall be trimmed with valves that can be manually operated without the use of hands. Wrist blade handles are acceptable for this purpose and shall be four inches in length minimum (including, nurse lounge, nourishment station, soiled utility, clean utility, film processing, etc.).

L. Lavatories located in patient room toilets shall be provided with manually operated four-inch minimum wrist blade handles and gooseneck spouts.
M. Clinical sinks used for bedpan cleansing shall be provided with hot/cold, foot pedal operated faucet with hand held attachment for bedpan washer.

N. Lab sinks used for general research shall be provided with manually operated faucets served with cold water only.

O. Housekeeping faucets shall be provided with automatic return stems that require the handle to be manually held open for water to flow.

1.5 WATER CLOSETS

A. Toilets shall be wall mounted vitreous china with elongated bowl, siphon jet flushing action and one and one half inch top inlet spud.

B. Toilet bowls within patient rooms shall be provided with integral bedpan lugs.

C. Seats shall have open front and stainless steel self-sustaining check hinges.

D. Flush valves shall be chrome plated brass exposed type. Flush valves in public toilet rooms shall be electronic sensor operated. Flush valves in patient room toilets shall be manually operated.

E. All patient room water closets shall be mounted at ADA height.

F. Flush valves in non-ambulatory patient toilet rooms shall be manually operated and have integral bedpan washer.

G. Coordinate flush valve height with grab bar locations to avoid interference.

H. Flush valves located in specimen collecting toilet rooms shall be provided with AC powered electronic sensors. The electrical power shall be controlled by a keyed wall switch located outside of the toilet room to allow nursing staff to prevent use of faucet during collection of specimen. Coordinate with Cleveland Clinic staff for exact location of wall switch.

1.6 URINALS

A. Urinals shall be wall mounted with carrier, vitreous china with elongated rim (14 inch minimum), washout flushing action and ¾ inch top inlet spud.

B. Urinal flush valves shall be electronic sensor operated, chrome plated brass exposed type.

1.7 SHOWERS AND BATHTUBS

A. Shower and bathtub mixing valves shall be combination thermostatic and pressure-balancing type with water temperature limit stops set at 110 degrees F. Mixing valves shall have integral check stops accessible for servicing.

B. Shower finished floor and bathtub bottom shall be slip resistant.
C. Bathtubs shall be enameled cast iron or high strength composite material with porcelain finish. Enameled steel bathtubs are not acceptable.

1.8 EMERGENCY SHOWERS AND EYEWASHES

A. Emergency showers and eyewashes shall be Hawes.

B. Emergency shower and eyewash equipment design, installation and location shall meet current ANSI Z358.1, NFPA 99 -11.6 and OSHA 29 CFR 1910.151 standards and deliver clean water to users.

C. Emergency equipment location shall be based on the estimated time of travel for a person with compromised vision. Safety drenching equipment shall be located in accessible locations on the same level as the hazard and the path of travel shall be free of obstructions that may inhibit the immediate use of the equipment. A door is considered to be an obstruction. If the hazard is not a corrosive, one intervening door can be present between hazard and emergency equipment so long as:
   1. The door opens in the same direction of travel as the person attempting to reach the emergency equipment.
   2. The door is equipped with a closing mechanism that cannot be locked to impede access to the emergency equipment.

D. Emergency equipment shall be located within 10 seconds travel distance and not more than 75 feet of where toxic chemicals or infectious materials are used. For strong acids or caustics, the unit shall be located immediately adjacent to the hazard but far enough away from the hazard so that additional exposure to the hazard or exposure does not occur. The AE shall utilize Material Safety Data Sheets in determining hazard of chemicals or materials.

E. Coordinate location of all safety drenching equipment with structural members, walls, doors, windows, ceilings or other building components that may interfere with the installation. This task shall be accomplished during the schematic design phase of the Project.

F. Coordinate location of safety drenching equipment on upper levels with spaces below to avoid areas where water leakage would cause major property loss or contamination, including but not limited to computer data centers, MRI rooms, electrical rooms, telecommunications rooms, food preparation, food storage, food serving, critical patient care areas, etc. This task shall be accomplished during the schematic design phase of the Project. The AE shall insure that all holes in floor slabs are sealed to prevent water from flowing to lower floors due to discharge of emergency equipment.

G. Safety drenching equipment shall not be located within eighteen inches of electrical apparatus, telephones, thermostats, or power outlets.

H. Emergency shower heads shall be positioned 82 inches to 96 inches from the floor and shall have a spray pattern of a minimum diameter of 20 inches at 60 inches above the floor. The center of the spray pattern shall be located at least 16 inches from wall or nearest obstruction. Emergency shower flow rate shall be a minimum of 20 gpm.
I. Emergency eyewash nozzles shall be positioned 33 inches to 45 inches from the floor and at least 6 inches from the wall or nearest obstruction.

J. The emergency equipment location must provide a level surface area for user.

K. A hand held drench hose or personal eyewash station may be installed in laboratory or shop areas as a supplement, not a substitute, for eyewash devices.

L. Emergency eye wash and shower equipment shall be provided with mixing valves that are factory set to deliver tepid water outlet flow. Provide Lawler mixing valve with anti-tamper screws for emergency eye washes.

M. Safety drenching equipment shall be identified with a highly visible sign and area lighting shall be adequate to facilitate use.

N. Combination showers with eye and eye/face wash shall be connected to a potable water system capable of supplying adequate flushing fluid to meet the requirements of each component when all components are operated simultaneously. Combination units shall be positioned so they can be used simultaneously by the user under the shower.

O. Provide and accessible ball type shutoff valve in individual water supply line serving safety drenching equipment. Valves shall be labeled for identification and locked in the open position.

P. Floor drains are required for emergency showers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made. Refer to construction specifications for acceptable manufacturers.
PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general design requirements for medical vacuum, waste anesthetic gas disposal, compressed air, oxygen, nitrous oxide, nitrogen, carbon dioxide, laboratory vacuum and gaseous nitrogen systems within and to five feet beyond the building perimeter.

B. Related Sections
   1. 226000 – Medical Gas, Vacuum and WAGD Systems

1.2 GAS AND VACUUM SYSTEMS REQUIREMENTS


B. Review the location, quantity and type of gas outlets, inlets and alarm panels with Cleveland Clinic gas commissioning consultant during the design development phase of the Project.

C. Medical vacuum and gas systems serving patients shall be independent of all other vacuum and gas systems serving laboratory, research and/or animal areas.

D. Medical and laboratory compressed air systems serving patients or labs shall not be used to serve non-respiratory equipment, such as sterilizers, pneumatic doors, operating room service columns, etc.

E. Design medical gas and vacuum systems to deliver the following nominal pressures at the points of use: All pressure systems, except nitrogen and nitrous oxide shall be 50 to 55 psig at maximum flow; Nitrogen shall be 160 to 185 psig at maximum flow; Nitrous oxide shall be 46 to 48 psig at maximum flow; Vacuum shall be 15 to 19 inches Hg at most distant inlets.

F. Design lab gas and vacuum systems to deliver the following nominal pressures at the points of use: All pressure systems shall be 45 to 50 psig at maximum flow; Vacuum shall be 19 inches Hg at most distant inlets.

G. Coordinate the requirement for the use of ventilators with the Cleveland Clinic user groups. Design the oxygen and medical air systems to accommodate required flow demands.

H. Include waste anesthetic gas disposal (WAGD) terminal inlets and piping in appropriate projects. The source for WAGD inlets shall be an independent system from the medical vacuum system.

I. Provide at least one instrument air control panel (ICP) within rooms containing instrument air outlets used for equipment. Verify need for instrument air use or electric for surgical tools with the Cleveland Clinic on each project.
J. Locate station inlets and outlets at an appropriate height to prevent physical damage to attached equipment and accessories. Station inlets and outlets located above countertops shall be provided with sufficient space to allow usage and attachment of equipment without interferences by countertop, backsplash or overhead cabinets. All other station inlets and outlets having centerline located less than 60 inches above finished floor shall be protected by guardrails, recessing into walls or by other means approved by the Cleveland Clinic. Outlets shall be free and clear for testing.

K. Provide sufficient spacing between station inlets and outlets to allow simultaneous use with vacuum collection bottles, regulators, adaptors or any other equipment attached. Provide slide retainer bracket for collection bottle attachment adjacent to each vacuum station inlet. Renovations shall be updated so that they are installed the same as installing new.

L. CO2 outlets shall be mounted separate from other outlets.

M. Ensure that all vacuum and gas source equipment and alarm systems are provided with both normal and emergency electrical power supply.

N. Drawings shall show all valves and pressure sensor locations.

O. All sourcing equipment needs to be able to report to the server.

P. Central Supply Systems
   1. Locate air compressors and vacuum pumps in a dedicated mechanical room in accordance with NFPA 99. Mechanical room shall provide a clean, relatively cool environment (i.e., not to exceed 100 degrees F ambient temperature). Equipment shall be located with adequate access space for regular monitoring and servicing. Provide floor drain adjacent to equipment pads. Floor drains serving vacuum pumps shall be provided with smooth, acid resistant interior coating. Provide a hose bibb within mechanical room.

   2. Locate the air compressor system intake outdoors above roof level, at least 25 feet (may require more depending upon prevailing wind direction and velocity) from all exhausts, vents, vacuum system discharges or any anticipated source of odor or particulate matter. Air that is filtered for breathable ventilation system use may be considered an acceptable source of intake air when approved by the Cleveland Clinic. Combined air intakes must be sized for no restriction while flowing the maximum intake possible, and shall be provided with an isolation valve at the header for each compressor served. Intake piping for air compressors shall be sized using the total SCFM for the system (both lead and lag pumps) and the total developed length of run. Coordinate with air compressor system technical representative and verify that proposed sizing of intake piping complies with manufacturer’s recommendations.

   3. Terminate vacuum exhaust discharge outdoors above roof level, at least 25 feet horizontally (may be more depending upon prevailing wind direction and velocity) from all air intakes, doors, windows, louvers or any other building openings. Combine exhaust from each vacuum pump into one discharge pipe, sized for no restriction while flowing maximum discharge possible, and provide with an isolation valve at the header for each pump served. Avoid traps, but where installed provide low point drains. Exhaust piping for vacuum pumps shall be sized using the total SCFM for the system (both lead and lag pumps) and the total developed length of run. Exhaust piping shall be sized and arranged to prevent moisture and back-pressure from entering pump. Provide valved drip-leg at base of exhaust stacks. Coordinate with vacuum pump system technical representative.
and verify that proposed sizing of exhaust piping complies with manufacturer’s recommendations.

4. Air compressors and vacuum pumps shall be multiplexed with receiver tanks and sized such that 100 percent of the design load is carried with the largest single unit out of service. Increase the calculated (SCFM) load by 25 percent to accommodate future system expansion.

5. In designing a medical air system where ventilators are expected to be utilized, add the ventilator requirement for each ventilator in use to the compressor sizing.

6. Design air dryers, filters and pressure regulators for the air system in duplex, each sized for 100 percent of the load using duplex twin tower desiccant dryers. Include continuous line dewpoint and carbon monoxide monitoring with sample connections on the discharge piping downstream of the filters and regulators. Locate monitors at, or integral with, the control panel.

7. Provide sufficiently sized, properly ventilated and constructed room for gas cylinder storage and manifold systems in accordance with NFPA 99. Coordinate with the Cleveland Clinic to determine space required for storage of additional non-manifolded cylinders. Gas cylinder storage rooms shall be located at a readily accessible location and be provided with a minimum 42 inch door. Allow for 25% expansion.

8. Provide local user alarms for cylinder manifolds.

9. Bulk liquid oxygen supply systems shall be designed and located in accordance with NFPA 55 and closely coordinated with the Cleveland Clinic and designated oxygen supplier. Provide emergency oxygen inlet on exterior wall of building served. Insure that location of inlet allows truck access and that concrete pavement is provided where truck will park during transfer of oxygen. Provide with user alarm wiring to report to alarm system.

Q. Alarm Systems
1. To ensure continuous responsible observation, provide two master system alarms, in separate warning locations, monitored 24/7, for all vacuum and gas source equipment systems. Coordinate both master alarm panel locations with the user facility and the other design services. When deciding upon alarm locations, consider emergency power circuits, engineering control center data relay interface locations, and the facility’s established procedures for monitoring alarm signals. The master alarm shall have extra wires for future capacity.

2. The primary warning location shall be located to assure 24-hour constant surveillance such as security office or other continuously staffed location. The secondary warning location shall be supervised by engineering personnel, and is required to be located at one of the following (in order of priority): Boiler plant control office, engineering control center, or in the office or principal working area of the individual responsible for the maintenance of the vacuum and gas systems.

3. All alarms from master alarm panel shall be monitored by the building management system if no other system exists.

4. Provide local area alarms for all branches serving medical vacuum and gas station outlets and inlets. Locate area alarms at nurse stations visible and accessible to staff for monitoring. All alarm sensor locations shall be in conformance with NFPA 99.

5. Provide high/low line pressure/vacuum sensors at most remote points from source equipment in each system. Status of remote monitoring points shall be annunciated at both master system alarm locations.

R. Piping Systems
1. Design pressure piping systems, except nitrogen, not to exceed 35 kPa (5 psi) loss from source to point of use. Design nitrogen piping systems not to exceed 138 kPa (20 psi) loss from source to point of use. Design vacuum piping systems not to exceed 10 kPa (3 inches Hg) from source to point of use.

2. Include ventilator demand in sizing calculations for oxygen and compressed air piping. Ventilator usage shall be based upon full flow with no diversity for each ventilator from the outlet back to the source.

3. Bulk oxygen vaporizers shall be based on full flow with no diversity.

4. Design medical gas and vacuum piping systems based upon the following minimum flow rates for any pipe section: Oxygen – 200 L/min (7 SCFM); Medical Air – 200 L/min (7 SCFM); Vacuum – 85 L/min (3 SCFM); Nitrous Oxide – 28 L/min (1 SCFM); Carbon Dioxide – 28 L/min (1 SCFM); Nitrogen – 425 L/min (15 SCFM).

5. Design laboratory gas and vacuum piping systems based upon the following simultaneous usage tables: Note: Minimum flow rates for any pipe section shall be: Laboratory Air – 57 L/min (2 SCFM); Vacuum – 85 L/min (3 SCFM); Carbon Dioxide – 57 L/min (2 SCFM); Nitrogen – 142 L/min (5 SCFM).

6. Include a 25 percent calculated (SCFM) load for sizing distribution mains to accommodate future system expansion.

7. Distribution piping shall be designed in accordance with the following minimum size parameters to allow for future expansion and minimize service interruptions during renovations:
   a. Pressure Gases
      1) Branch lines and drops to individual outlets for the pressure gases shall be a minimum of ½ inch.
      2) Branch lines serving more than one room or zone valve shall be a minimum of ¾ inch.
   b. Vacuum
      1) Branch lines and drops to individual vacuum inlets shall be a minimum of ¾ inch.
      2) Branch lines serving more than one room or zone valve shall be a minimum of 1 inch.
   c. Zone valves and associated piping within walls shall not be smaller than ¾ inch, except for zones valves and piping serving an individual room.

8. Place a source shut-off valve for each vacuum and gas system at the immediate outlet (or inlet, in the case of vacuum) of the source of supply, in the room with the equipment, so that the entire supply source, including all accessory equipment, can be isolated from the entire pipeline system. Provide each main line supply line with a shut-off valve. Locate valve accessible by authorized personnel only and locate downstream of the source valve and outside of the source room, enclosure, or where the main valve enters the building. Provide vacuum and gas services with line pressure and vacuum gauges at the source (and immediately inside the building, where source is remote from building).

9. Provide each riser supplied from the main line with an in-line shut-off valve located at the base of the riser. Provide each branch supplied from a riser with an in-line shut-off valve adjacent to the riser. In ICU’s provide additional service valves in each branch line at point of connections to mains. In other areas provide service valves to strategically subdivide areas for maintenance. Provide ½ inch valved and capped test/purge connection and a line pressure gauge downstream of all in-line service and shut-off valves to facilitate future modifications. Conceal in-line service and shut-off valves at secure locations (e.g. above ceiling with ceiling tag, or in a locked equipment room), and
specify that these valves be locked open and identified in accordance with NFPA 99. Dead end pipe is not acceptable. Service valves shall be lockable, dual purge port.

10. Provide zone valves within recessed wall cabinets for all branch piping serving station outlets and inlets. Locate zone valves in corridor, visible and accessible to staff for operation of valves. All zone valve locations shall be in conformance with NFPA 99. Zone boxes shall be dual purge port with back feed valves.

11. Design carbon dioxide distribution piping for total load, no diversity.

S. Renovations Projects
1. Survey current installation and coordinate with Cleveland Clinic to verify type, location, size and capacities of existing piping and source equipment for determining adequate tie-in points.
2. Survey current installation to ascertain the type of existing alarms, gas station outlets and vacuum terminal inlets. All new alarms shall match and be compatible with the existing installation. All new outlets and inlets shall match the existing terminal connections and not require the use of secondary adapters. In cases where existing alarms, station outlets or terminal inlets are no longer available, not U.L. approved, or are not NFPA 99 compliant, the AE shall coordinate with the Cleveland Clinic to determine types to be specified within Contract Documents. Outlets shall be DISS or quick connect, Beacon Medaes style.
3. Review the proposed alarm, outlet and inlet types, and connection locations to existing piping and alarms with Cleveland Clinic during the design development phase of the Project.
4. Provide a shut-off valve at the connection of new line to existing line.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made. Refer to construction specifications for acceptable manufacturers.

A. Pumps and compressors shall be by Beacon Medaes.

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR GAS AND VACUUM SYSTEMS INSTALLATION

A. Installers shall be 6010 certified.

B. The CHx program shall be used for all installer reports.

*****
PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general design requirements for laboratory water waste and vent systems within and to five feet beyond the building perimeter.

B. Related Sections
   1. 226600 – Chemical-Waste Systems for Laboratory and Healthcare Facilities
   2. 226700 – Processed Water Systems for Laboratory and Healthcare Facilities

1.2 LABORATORY WATER SYSTEMS REQUIREMENTS

A. Laboratory RO water system shall be provided for analysis equipment and testing locations within the laboratory.

B. A dedicated laboratory cold water and hot water system shall be provided for laboratory use at dirty sinks and where back siphonage can occur. These systems shall be separated from the normal domestic cold and hot water system using duplex reduced pressure backflow preventors.

C. Building domestic cold and hot water shall be used for remaining clean sink locations and for safety shower/eyewash tempering valves.

D. Central tempering valves shall be provided to serve multiple safety units on systems with more than three safety shower or eyewash units.

1.3 LABORATORY WASTE SYSTEMS REQUIREMENTS

A. Laboratory waste and vent systems shall be provided for all fixtures, floor drains, and equipment that may discharge corrosive liquids, spent acids or other harmful chemicals that could potentially destroy or injure cast iron or copper drainage and vent piping.
   1. Sinks which are designated as “clean” sinks shall connect to the sanitary system.

B. The AE shall obtain all necessary information from the Cleveland Clinic to determine system design, materials selection and waste treatment requirements. A proposed system design in either diagrammatic or narrative form shall be submitted to the Cleveland Clinic during the schematic phase of the Project.

C. Chemically resistant waste and vent piping is required for all lab sinks, dirty sinks, cup sinks, hub drains and floor drains within laboratory areas in the event that chemicals are discharged into the piping system.

D. Double wall piping shall be used for high hazard drainage such as BL3 labs.
E. When effluent is expected to have a pH less than 6 or more than 10, waste treatment shall be
provided to render the waste to a neutral pH before discharging into building sanitary or
municipal sewer systems.
   1. Treatment system shall be installed with a pH monitoring and leak detection system.
   2. Treatment tanks shall be double wall construction and be located in non-patient areas
      with adequate service space.

F. All piping shall be selected based upon the characteristics of the effluent expected to be
introduced and be of such material and design as to adequately perform its intended function as
required by code and to the satisfaction of the Cleveland Clinic.

G. All materials located within spaces utilized as air plenums shall meet ASTM E84 25/50 for
flame spread and smoke development and UL723 and UL910 for flame propagation and smoke
density in environmental spaces.

H. Waste and vent systems shall be designed using fixture drain loads established by code and
equipment manufacturers discharge flow rates. Waste and vent systems design shall provide
proper operation during periods of peak demand.

I. Main waste and vent stacks shall utilize chases or be located adjacent to columns where
possible for vertical routing through multiple floor levels.

J. Capped waste and vent connections for future extensions shall be located accessibly and not
extend more than 24 inches from an active line. Waste and vent connections shall be located at
elevations that will allow future installation of properly sloped piping without the need to
dismantle or relocate installed ductwork, piping, conduit, light fixtures, etc.

K. Provide cleanouts at the base of each vertical sanitary stack and at intervals not exceeding 75
feet in horizontal building drain. All interior cleanouts shall be accessible from walls or floors.
Provide wall cleanouts in lieu of floor cleanouts wherever possible. A floor cleanout shall be
installed only where installation of a wall cleanout is not practical. Locate wall cleanouts no
more than twenty four inches above the finished floor. For horizontal cleanouts, provide an
access door and blind plug. For vertical cleanouts, provide an access door, wye, and blind plug.
Plumbing engineer is responsible for coordinating access door locations for incorporation on the
architectural plans.

L. No buried laboratory waste line shall be smaller than 3 inches. No buried vent line shall be
smaller than the full size of the sanitary pipe that it is serving. No above ground vent line shall
be smaller than 1-1/2” No roof vent terminal shall be smaller than 3 inches.

M. Locate all vent terminals a minimum of 25 feet horizontally from or 3 feet vertically above all
air intakes, operable windows, doors and any other building openings.

N. Avoid locating drains above sensitive equipment or areas where water leakage would cause
major property loss or contamination. Where this is unavoidable, provide a stainless steel drain
pan with drain and leak detection alarms tied into building management system and seal floor
above with 20 year floor seal.

O. Do not locate drainage or vent piping within stairways, electrical, telecommunications rooms or
to be leased spaces. Where this is unavoidable, provide a stainless steel drain pan with drain and
leak detection alarms tied into the building management system and seal floor above with 20 year floor seal.

P. Do not locate floor drains within pharmacy drug preparation areas or areas where hazardous materials are handled or stored.

Q. All traps shall be properly vented in accordance with the International Plumbing Code.

R. Provide trap primers for all floor and hub drains that may be susceptible to trap seal evaporation.

S. Laboratory waste and vent piping shall be independent of all other waste and vent systems within the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Shall be American made. Refer to construction specifications for acceptable manufacturers.

*****
PART I - GENERAL

1.1 SUMMARY

A. This section addresses the general requirements for natural gas distribution systems within and to five feet beyond the building perimeter.

B. Related Sections
   1. 221122 – Facility Natural Gas Piping

1.2 NATURAL GAS DISTRIBUTION REQUIREMENTS

A. Includes the following:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.

B. All natural gas piping on the customer side of the utility meter shall be designed, installed and tested in accordance with NFPA 54, Fuel Gas Code, most current edition.

C. Building natural gas distribution shall be metered and valved in accordance with the gas supplier’s requirements. Sub-meter gas with Rosemont transmitter.

D. The design of building supply and distribution systems shall provide a volume of gas at the required flows and pressures to ensure safe, efficient and code compliant operation during periods of peak demand. Piping shall be sized in accordance with referenced codes and standards.

E. Natural gas pressures shall not exceed five pounds per square inch gauge on customer side of the meter, for non-utility buildings.

F. Provide readily accessible manual shut-off valve outside of building at service entrance.

G. Avoid locating gas piping within confined or unventilated spaces where leaking gas might collect.

H. Do not locate gas piping within stairways, electrical or telecommunications rooms.

I. Exposed and accessible shut-off valves shall be provided as required for proper operation, servicing and troubleshooting of the distribution system and connected components. Valves located above ceilings shall not be located in concealed areas or shall be provided with access panels in hard ceilings. Locations shall include but not be limited to the following; at the base of each riser, at each branch connection to risers, at each piece of equipment, where recommended by equipment manufacturer and at strategic locations to allow sectional isolation while limiting
disruption of services to large portions of the system. Provide gauges on each side of the valves with valves on risers to the gauges.

J. Valves, regulators, flanges, unions and similar appurtenances shall be accessible for operation and servicing and not be located above ceilings, within partitions or spaces utilized as return air plenums.

K. No natural gas line, including service drops shall be smaller than ¾ inches inside diameter. Local connections to individual equipment and outlets may be smaller than ¼ inches as required for that particular component. Transition and valve within 12” of connection.

L. All gas piping serving labs shall be routed below ceiling.

M. Provide a manual shut-off valve in each line serving individual laboratory rooms for maintenance and isolation of natural gas serving each room. Room manual isolation valves shall be labeled indicating room being controlled and located accessible to maintenance staff.

N. Provide an emergency shut-off valve located exposed on wall 54 inches above finished floor within each laboratory area adjacent to room exit.

O. Butterfly valves are not acceptable.

P. Provide labeling and flow direction arrows every 6 to 10 feet, every change of direction. Label per Cleveland Clinic standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Refer to construction specifications for acceptable manufacturers.

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR NATURAL GAS INSTALLATION

A. Accessible pipe shall be approved material with threaded connections. Concealed pipe shall be welded or with fittings approved for concealed spaces.

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