

CHAPTER 15A
PIPING SYSTEMS

15A-01 General

a. Coordination of Work

(1) This chapter covers piping for the water, gas, drainage, heating, fire sprinkler and refrigeration/air conditioning systems, and condensate (drainage) pipelines. Refrigerator/air conditioning piping includes refrigerant, condenser and chilled water pipelines.

(2) Drawings indicate general layout. Pipe and equipment space and schedule for installation must be coordinated between the various subcontractors doing the work.

(3) Check and eliminate interferences between electrical, mechanical, architectural and structural features, especially in equipment rooms, and above ceilings.

b. Layout

(1) The contractor will provide equipment and mechanical room layout drawings which must be reviewed and approved.

(2) Pipe sleeve layout drawings will be useful. Check for clearances and proper sleeve sizes to include the pipe insulation thicknesses.

(3) Check layout for space to operate valves.

(4) Check layout for space to maintain and repair piping, especially at equipment spaces.

(5) Check for sufficient space for required swing joints at branch connections.

(6) Check space for anchors and expansion loops.

(7) Check space for support of hangers for piping.

(8) Check space for slope in pipe lines. Remember that all piping systems carrying liquids must be drainable.

(9) Pipe lines should not pass thru footings; locate beneath footings before the footings are placed.

(10) Check equipment dimension to assure all equipment can be removed and replaced thru the doorways provided, once ceiling/roof is installed.

15A-02 Materials

a. Submittals

(1) These usually include information on compliance with specifications using labels, listings or certificates. Shop drawings are required for layout of mechanical rooms and should include the special support for heavy piping and fittings.

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(2) The mechanical specialist will check submittals for compliance with requirements.

(3) After determining that the submittal is in compliance, use its descriptive information to check the material at delivery. You will use the layout drawings to check actual installation.

b. Storage and Handling

(1) Insure that materials are handled safely and carefully to prevent damage.

(a) Reject damaged materials.

(b) Have damaged coatings repaired.

(2) Insure proper handling for coated pipe; use wide belt slings.

(3) Check for storage off of the ground and weather tight storage when required.

(4) Store pipe and fittings to eliminate entry of dirt, etc.

(5) Refrigerant pipe is cleaned and capped at the factory. The pipe must remain capped in storage.

(6) Check for piping that is factory cleaned and purged with inert gas and capped. Check for gas tight capping.

c. Water Pipe and Fittings

(1) There are about 23 different pipe materials which can be selected for above ground cold water pipelines. Many are plastic materials. Plastic pipes cannot be used in water systems for buildings greater than two stories in height.

(2) Plastic type pipe cannot extend through the roof or through fire rated walls or floors.

(3) There are almost as many selections for above ground hot water pipelines. Check your specifications.

(4) Seamless copper water tube must be hard drawn: Type M above ground and Type L below ground.

d. Fuel Gas Pipe and Fittings

comply with the Fuel Gas Code as given in National Fire Protection Association (NFPA) Standard No. V54.

(2) Check for permitted pipe options; either all or only steel, aluminum alloy, metal tubing and plastic materials may be specified.

(3) Check for specific materials required in insulating couplings.

(4) Aluminum alloy tubing and pipe is not permitted underground or at exterior locations.

(5) Plastic pipe is not permitted in or under the building and is permitted only underground outside of the building.

(6) Check the specifications for ambient temperature limitations to the use of plastic pipe.

e. Drainage Pipe and Fittings

These consist of the waste system, the stormdrains and rainwater conductors and the condensate drainage pipelines from air conditioning and refrigeration units.

(1) There are many optional pipe materials and use is dependent on locations in the building and in the drainage system.

(2) Suggest you use the pipe material submittal for identification or the pipe material table in the specifications.

(3) Check for drainage pattern type fittings as they are required in the wet pipe portion of the waste system.

(4) Hubless cast iron pipe cannot be used underground and may not be permitted in crawl spaces.

(5) Check for use of proper pipe and fittings in corrosive waste and vent systems.

f. Heating Pipe and Fittings

(1) Check for use of black steel pipe or copper tubing for low temperature hot water pipelines.

(2) Steam piping must be black steel: vent piping must be the same type.

(3) Check for use of Schedule 40, black steel, in high temperature pipelines of 2 inches and larger.

(4) Use welded joints for high temperature water pipelines over 3/4 inch diameter.

g. Refrigeration and Air Conditioning Pipe and Fittings

(1) Check the steel pipe or the copper or steel tubing and fittings for intended service. Refrigerant service rating is required for lines carrying a refrigerant.

(2) Check for galvanized steel pipe or hard drawn copper tubing for condenser water lines, except lines 4-inches and larger require black steel which must be coated and wrapped for underground use.

(3) Chilled water. Check the type of piping specified for chilled water lines.

(4) The drainage lines for condensate water are usually given in the plumbing section of the specifications.

h. Fire Sprinkler Pipe and Fittings

(1) Insure that materials are in accordance with approved submittals.

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(2) The type system is designed to use a specific water supply and distribution for specific occupancy. More information can be found in National Fire Protection Association (NFPA) Standard No. 13.

(3) Contractor*s working plans shall be approved and shall be used when installing the system.

15A-03 INSTALLATION

a. General

(1) Laying underground pipe lines is covered in Chapter 2C, Volume 1 of the Construction Inspector*s Guide.

(2) Installation of exposed pipelines inside the building should follow building lines. The building structure cannot be cut or otherwise weakened for pipelines without written approval.

(3) Check for required slope in horizontal runs; liquid systems must be drainable.

(4) Check for drains at low points.

(5) Check for air cocks at high points.

(6) Check for required access to drains, air cocks and valves.

(7) Check for contact between dissimilar metals such as copper to iron or steel. Isolation (separation) will be required. Dissimilar pipe must be coupled with a dielectric connection.

(8) Are hangers proper style, size and at required intervals? Are ferrous hangers coated where used against copper pipe? Size hangers to encompass the pipe insulation.

(9) Are pipelines restrained from lateral movement at trapeze.

(10) Wall or floor supports must also restrain the pipeline from lateral movement.

(11) Check for support needs at each floor but not more than 15 foot intervals. Support is not necessary at the floor slab on grade hangers with "U" bolts or other type clips.

(12) Check for extra hangers or supports required at fittings and devices. A hanger is usually required within one foot of each change of direction.

(13) Suspended heavy pipelines must have proper support without overloading support points. This should be covered in the preparatory inspection by the contractor*s quality control representative. Be aware of:

(a) Excess loads on steel bar joints or beams.

(b) A hanger load or multiple hangers at the same location with more than 100 pounds of load.

(c) Check with your supervisor where you have a suspicious condition and he will request a structural evaluation.

(14) Check for required anchors and expansion loops or joints, especially on long pipelines. Also check for guides at the expansion points.

(15) Check for union or flanged connections at equipment and elsewhere in order to break and repair or replace piping, etc.

(16) Check for proper size pipe sleeves. Sleeves shall be large enough for the pipe insulation thickness when required.

(17) Pipe sleeves through waterproofing must have a clamping device to hold the flashing.

(18) Sleeves must protrude above finished floor surfaces in wet areas. Space between pipe and sleeve must be sealed.

(19) Check for proper fireproofing of openings between pipes and fire-rated construction.

(20) Check that escutcheons are used around pipes penetrating finished surfaces.

(21) Use soft drawn copper tubing, as permitted, when not using fittings.

(22) Steel pipe bending with proper equipment is permitted in sizes to 4-inch diameter. Bend radius must be at least 6 times pipe diameter.

b. Pipe Connections - Screwed

(1) Examine the threading operation for:

(a) Square cut pipe

(b) Proper reaming before threading

(c) Sharp cutters so that threads are not shaved

(d) Tapered threads - not running threads

(e) Thread run - not more than three threads should be exposed after connection is tight. The specifications may have a threading table you can refer to.

(f) Use of cutting oil - pipe shall be cleaned of oil and metal "filings". This is critical for refrigerant lines.

(g) Protect floor surfaces - Use a sand box or other adequate protection under the threading/cutting operation.

(h) Plastic pipe and metallic tubing will not be threaded.

(2) Examine screwed pipe connections for:

(a) Use of approved thread lubricant or tape applied to male threads only. Some piping may not permit use of tape at screwed joints check for requirements

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(b) Tighten connection, but do not overtighten to strain the fittings.

(3) Be alert for distorted valves. See that wrenches are used on the end of valves being screwed onto the pipes in order to prevent damage to the valve bore. If it is necessary to put wrench on the opposite end of valve from the end being screwed onto pipe, use a nipple that has been screwed into the valve.

(4) Do not screw pipes against the web of globe valves, or against the underside of seat rings of gate valves.

(5) Use threaded connections to angle stops at plumbing fixtures.

c. Pipe Connections - Mechanical

(1) Check proper alignment of flanges, couplings and gaskets.

(2) Check the gasket material, it must be compatible with the liquid or gas in the pipeline.

(3) Gaskets with high temperature water shall be metallic asbestos type.

(4) Do not use the drift pin or spud wrench handle to align flanges.

(5) Mechanical couplings and fittings must be compatible and manufactured by the same concern.

(6) Mechanical couplings are usually permitted on ferrous metal pipelines in the building for domestic hot and cold water systems.

d. Pipe Connections - Hub and Hubless Types

(1) Check for proper rubber gasket installation in the hub or bell. Spigot end must be pushed "home into the hub.

(2) When molten lead is used to make the joint, check for:

- Jute compacted into base of joint to seal the end, and center the spigot end in the hub.
- Depth of joint.
- Pouring the molten lead joint in a continuous operation.
- Caulking the lead with proper size irons.
- Caulking each joint at least three times around.

(3) Hubless joint uses a rubber sleeve with stainless steel band; the assembly must be approved by the Cast Iron Soil Pipe Institute (CISPI).

(4) Check for proper torque wrench set to 5 foot-pounds for tightening the stainless steel band in hubless joints.

e. Pipe Connections - Soldered

- (1) Surfaces of the fitting and pipe must be cleaned to bright metal with an abrasive material before the joint is made.
- (2) The 50/50 solder is half tin/half lead and can be used in drainage, waste and vent (DWV) pipelines. It is also known as soft solder.
- (3) Silver solder is 95/5, 95 percent tin - 5 percent antimony, and must be used in all other pipelines.
- (4) Core solder is not permitted.
- (5) Joint must be well heated before solder is applied. Approximately 400F for soft solder and 1150F for silver solder.
- (6) Check for use of a multiframe torch for uniformly heating joints where 2 1/2 inch diameter and larger pipe are soldered.

f. Pipe Connections - Solvent Cement (Adhesive)

- (1) For plastic pipe connections use compatible materials.
- (2) Use in accordance with the pipe manufacturer*s instructions.
- (3) Do not join different kinds of plastic pipe together.
- (4) Only heat-fusion connection is used to join polyethylene pipe, tubing or fittings.

g. Pipe Connections - Welded

- (1) Check for use of welding fittings.
- (2) Making fittings by notching or mitering pipe is not permitted.
- (3) Check for the approved welding procedures before welding begins.
- (4) Check for the individual welder certification in the type welding each welder must perform.
- (5) Welders must stamp each weld with an assigned symbol so that the individual*s weld can always be identified. Painted stamps are not permanent and may not be used to identify welds.
- (6) Check welding of refrigerant pipe as the fittings and pipe must be filled with inert gas such as nitrogen, during welding. This prevents the formation of scale inside the pipe.
- (7) welding for fire sprinkler systems must be performed in a shop and in accordance with NFPA 13 requirements. Jobsite welding is not permitted.

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(8) Check Chapter 5B, Volume 3 of the "Construction Inspector*s Guide" for additional information on welding.

h. Fittings and Valves

(1) Check riser diagrams and floor plans on drawings for proper valve locations.

(2) Are valves proper type?

(3) Valves must be oriented with stems in horizontal position or above. Only the horizontal position is allowed for refrigerant pipelines.

(4) Check and globe valves have an arrow cast in housing to indicate direction of flow. Check these valves for proper orientation in the pipeline flow.

(5) Check for access to all valves. Are access locations marked on ceiling panels.

(6) Use dielectric connectors where required at locations where different metals connect together in the pipeline.

i. Pipelines

(1) Water pipelines.

(a) Are air chambers installed at fixtures?

(b) Are water hammer arrestors shown instead of air chambers? Check your riser diagrams on the drawings for locations and sizes of these arrestors.

(c) Are valves located as shown?

(d) Does the water service have a gate valve and drain at its point of building entry?

(e) Check for use of a backflow prevention device in each branch waterline connected to another system. Also check for the correct type device, especially where toxic fluids are involved.

(f) Check for a vacuum breaker at each fitting or fixture with hose connection. The vacuum breaker will prevent back-siphonage.

(2) Fuel gas pipelines.

(a) Avoid installation under buildings. Fuel gas service should be installed above grade on the outside. Do not install service pipeline in the trench with other utilities.

(b) Do not permit soldered joints. Use pressure- threaded joints for copper pipe.

(c) When piping is to be embedded in concrete, check for special requirements such as:

- Should be acceptable to the gas service company

- Check concrete mix for compatibility with pipe material. Certain additives and aggregates may not be compatible.

(d) Don't embed gas pipelines in solid walls and partitions.

(e) Check for protective coating on underground metallic pipelines.

(f) Where piping must be buried under the building it should be encased in a gas tight conduit for its full length of run. Space between the pipe and conduit must be safely vented to the atmosphere. Check your details.

(g) Check for pipe slope and drains at low points.

(h) Check for required pipeline bonding and grounding in accordance with the National Electric Code.

(i) Check for shutoff valves as required.

(3) Drainage lines.

(a) Hubless cast-iron pipelines require support next to each joint.

(b) Hub type pipelines require support at 10 feet intervals and within 3 feet of each fitting.

(c) Check for required expansion joint at floors in plastic pipeline risers.

(d) Install cleanouts so they are flush with finish surfaces. Close each cleanout with a brass plug installed with graphite thread lubricant.

(e) Check the elevation of each floor drain before finished floor is placed to assure drainage slope.

(f) Check floor drain for type specified. Does it require a special item such as a sediment basket, a backwater valve or a self-priming valve?

(g) On roof drains check for the clamping ring to hold the metal flashing and for the cast iron strainer.

(4) Heating pipelines.

(a) Check for slope of at least 1 inch in 10 feet.

(b) Reducing fittings on horizontal lines must be eccentric type with bottom of pipelines flat for positive drainage flow.

(c) Check for proper branch line take off from the high temperature pipeline supply and return. Should be from the upper half of pipeline, at a 45 degree angle in direction of flow.

(d) Check for special piping from high temperature waterline air vents to funnel drain.

(5) Refrigeration and air conditioning pipelines.

(a) Refrigerant steel pipeline joints shall be welded.

(b) Refrigerant tubing of copper or steel shall have brazed joints.

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(6) Fire sprinkler pipelines.

(a) The approved shop drawings will be your guide in checking the fire sprinkler system layout and pipe sizes.

(b) Check for possible conflict between final sprinkler head location and user items which would interrupt flow coverage or cause damage to the system.

(c) Review Chapter 3 of the National Fire Protection Association Standard 13 for supports, hangers, slope and drainage.

(d) Do not allow paint on sprinkler heads. Check heads for proper temperature rating indicated by color code or stamped numbers.

(a) Where required, outside connection shall be the size indicated and shall mate with fire department hose.

(f) Check for required sprinklers in concealed spaces.

(g) Check for special protection against freezing, corrosion and earthquakes, and for sprinkler head clearance from heat sources.

(h) Check electric power and alarm for:

- Electric power correction ahead of the main switch.

- Alarm tie-in with fire department, as required.

- Effective location of the local alarm.

15A-04 TESTING

a. Preparation

Testing is the responsibility of the contractor unless stated as a Government responsibility in the specifications. Check with supervisor for recommended presence of user personnel during certain testing such as sprinkler, etc. The system or portion of the system will be prepared for testing by the craftsman who installed the pipeline. The contractor's quality control representative will be responsible for verifying the extent of test, the method and results which will be reported. The following items must be checked:

(1) Determine extent of test.

(2) Is pipeline isolated at limits of the test with valves closed and the plugs and caps tightly in place?

(3) Are pipeline valves open within the test area?

(4) Are pipelines adequately blocked and anchored for pressure tests? Pipelines should be in the permanent, fixed position before the test is permitted.

(5) Will joints be exposed for the visual or soap test requirements?

(6) When testing pipeline to be concealed, does extent of test include all of the affected pipeline.

(7) For a pressure test, have diaphragms or other internal parts of valves, regulations, etc. which may be damaged by the pressure been removed?

(8) Review the test method to be used.

(9) Inspect the test instruments and apparatus for proper type, calibration and operation.

(10) When flushing to clean the pipeline, check to determine that coils for heating, air conditioning and refrigerant lines are bypassed to prevent flushing-water from passing through coils.

b. performing Tests

(1) Water pipelines.

(a) Pneumatic or hydrostatic test shall be used.

(b) Check ambient temperature at beginning and end of test period for temperature differential and the correction factor for the final gauge reading.

(c) For the hydrostatic test, was the tested segment vented to ensure it was completely filled with water?

(2) Fuel gas pipelines.

(a) An air pressure test, similar to the waterline test, is usually made. Do not use oxygen.

(b) Refer to National Fire Protection Association (NFPA) Bulletin 565 test requirements for nitrous oxide and oxygen system test requirements.

(c) Check the gas system for leakage immediately when beginning the test using fuel gas.

(3) Gravity drainage lines.

(a) Is the test stack high enough to provide the 10 foot head for all of the tested line.

(b) Check each joint for leakage.

(c) The final smoke or peppermint test is made with all fixtures attached.

(4) Heating pipelines.

(a) Hydrostatic pressure testing is required. Usually 45 psig for four hours for low temperature waterlines.

(b) High pressure waterlines are tested at 1 ½ times design pressure.

(5) Refrigeration and Air Conditioning pipelines.

(a) Pneumatic pressure test used on refrigerant pipelines using dry nitrogen. Check each joint with soap solution.

(b) Refrigerant pipelines also are charged with refrigerant gas and joints checked for leaks with a halide torch.

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(c) Refrigerant pipelines also require an evacuation test. Check the specifications for details.

(d) Check the hydrostatic pressure test on water pipelines for use of appropriate pressure and time requirements.

(6) Fire Sprinkler pipelines.

(a) Refer to Chapter 1, NEPA 13 for specific test requirements.

(b) Assure that feeder piping has been flushed before testing.

(c) Check for approved contractor*s test procedure and adequate monitoring of the tests by contractor*s quality control person.

(d) Check the adequacy of contractor*s required material and test certificates to be submitted after completion of tests.

(e) Test blanks used in the system during testing shall be approved type and each blank shall be numbered and accounted for at activation of the system.

15A-05 CLEANING ADJUSTING AND OPERATION

a. Cleaning

(1) Pipelines constructed with properly stored and protected pipe should need very little cleaning.

(2) Close ends of unfinished lines during work stoppages.

(3) On occassion, craftsmen temporarily place tools or other items in the end of pipes. This habit must be stopped.

(4) Check the specification for flushing requirements. Flushing may be ordered for dirty pipelines.

(5) The completed potable water system must be sterilized by chlorination. This process, as given in the specification, is required reading.

(6) Heating pipelines must be cleaned with a chemical solution after successful completion of the pressure tests. Check for proper solution, temperature and time.

(7) Fire sprinkler systems must be flushed and disinfected after testing.

b. Adjusting

(1) When beginning the operating phase each piping system must be closely inspected for necessary adjustment and proper operation.

(2) Adjust flow and flush valves.

(3) Check air cocks for leakage, clean and adjust as required.

(4) Condenser and chilled water pipelines must be balanced after testing.

(5) Check for heating system approved balancing procedure. This must be performed by a qualified engineer.

c. Operation

(1) Specifications require that user personnel be instructed in proper system operation. Make a note of the identification of these personnel for the record.

(2) Check the posted operating instructions. Are posting requirements met? Do they include the required diagrams, layouts and specific written instructions?

(3) Are pipelines coded as required?

(4) Check for required spare parts.