Section 2.3. Piping

2.3.1. Application

2.3.1.1. General

1) This Section applies to the construction and use of joints and connections, and the arrangement, protection, support and testing of piping.

2.3.2. Construction and Use of Joints

2.3.2.1. Caulked Lead Drainage Joints

1) Caulked lead drainage joints shall not be used except for cast-iron pipe in a *drainage system* or *venting system*, or between such pipe and

a) other ferrous pipe,

b) brass and copper pipe,

c) a caulking ferrule, or

d) a *trap standard*.

2) Every caulked lead drainage joint shall be firmly packed with oakum and tightly caulked with lead to a depth of not less than 25 mm.

3) No paint, varnish or other coating shall be applied on the lead until after the joint has been tested.

4) A length of hub and spigot pipe and pipe fittings in a *drainage system* shall be installed with the hub at the upstream end.

2.3.2.2. Wiped Joints

1) Wiped joints shall not be used except for sheet lead or lead pipe, or between such pipe and copper pipe or a ferrule.

2) Wiped joints in straight pipe shall

a) be made of solder,

b) have an exposed surface on each side of the joint at least 19 mm wide, and

c) be not less than 10 mm thick at the thickest part.

3) Wiped flanged joints shall be reinforced with a lead flange that is not less than 19 mm wide.

2.3.2.3. Screwed Joints

1) In making a screwed joint, the ends of the pipe shall be reamed or filed out to the size of the bore and all chips and cuttings shall be removed.

2) No pipe-joint cement or paint shall be applied to the internal threads.

2.3.2.4. Soldered Joints

1) Soldered joints shall be made in accordance with ASTM B 828, "Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings."

2.3.2.5. Flared Joints

1) In making a flared joint, the pipe shall be expanded with a proper flaring tool.

2) Flared joints shall not be used for hard (drawn) copper tube.

2.3.2.6. Mechanical Joints

1) Mechanical joints shall be made with compounded elastomeric rings that are held in compression by

a) stainless steel or cast-iron clamps, or

b) groove and shoulder type mechanical couplings.

(See Note A-2.3.2.6.(1).)

2.3.2.7. Cold-Caulked Joints

1) Cold-caulked joints shall not be used except for bell and spigot pipe in a *water system*, a *drainage system* or a *venting system*.

2) Caulking compound used in cold-caulked joints shall be applied according to the manufacturer's directions.

3) Cold-caulked joints in a *drainage system* shall be firmly packed with oakum and tightly caulked with cold caulking compound to a depth of not less than 25 mm.

2.3.2.8. Stainless Steel Welded Joints

1) Stainless steel welded joints shall conform to ASME B31.9, "Building Services Piping."

2) Butt weld pipe fittings shall be at least as thick as the wall of the pipe used.

2.3.3. Joints and Connections

2.3.3.1. Drilled and Tapped Joints

1) Drilled and tapped joints shall not be made in a *soil-or-waste pipe* or *vent pipe* and fittings unless suitable provision has been made for drilling and tapping.

2.3.3.2. Extracted Tees

1) Tees may be extracted from the wall thickness of Types K and L copper tube used in a *water distribution system* provided that

a) a tool specifically designed for the purpose is used,

b) the branch is at least one *size* smaller than the tube in which the tee is formed,

c) the end of the branch incorporates a means to prevent it from penetrating into the run and thereby obstructing flow, and

d) the joint at the tee is brazed with a filler metal having a melting point not below 540°C.

2.3.3.3. Prohibition of Welding of Pipes and Fittings

1) Cast-iron soil pipe and fittings shall not be welded.

2) Galvanized steel pipe and fittings shall not be welded.

2.3.3.4. Unions and Slip Joints

(See Note A-2.2.3.1.(1) and (3).)

1) Running thread and packing nut connections and unions with a gasket seal shall not be used downstream of a *trap weir* in a *drainage system* or in a *venting system*.

2) Slip joints shall not be used

a) in a *venting system*, or

b) in a *drainage system*, except to connect a *fixture trap* to a *fixture drain* in an accessible location.

2.3.3.5. Increaser or Reducer

1) Connections between 2 pipes of different *sizes* shall be made with an increaser or a reducer fitting installed so that it permits the system to be completely drained.

2.3.3.6. Dissimilar Materials

1) Adaptors, connectors or mechanical joints used to join dissimilar materials shall be designed to accommodate the required transition.

2.3.3.7. Connection of Roof Drain to Leader

1) *Roof drains* shall be securely connected to a *leader* and provision shall be made for expansion.

2.3.3.8. Connection of Floor Outlet Fixtures

1) Pedestal urinals, floor-mounted water closets and S-*trap standards* shall be connected to a *fixture drain* by a floor flange or other means of connection, except that a cast-iron *trap standard* may be caulked to a cast-iron pipe.

2) Except as provided in Sentence (3), floor flanges shall be brass.

3) Where cast-iron or plastic pipe is used, a floor flange of the same material is permitted to be used.

4) Floor flanges and *fixtures* shall be securely set on a firm base and fastened to the floor or *trap* flange of the *fixture*.

5) Joints in a floor flange or between a *fixture* and the *drainage system* shall be sealed with a resilient watertight and gas-tight seal.

6) Where a lead water-closet stub is used, the length of the stub below the floor flange shall be not less than 75 mm.

2.3.3.9. Expansion and Contraction

(See Note A-2.3.3.9.)

1) The design and installation of every piping system shall include means to accommodate its expansion and contraction caused by temperature changes, movement of the soil, *building* shrinkage or structural settlement. (See Note A-2.3.3.9.(1).)

2.3.3.10. Copper Tube

1) Types M and DWV copper tube shall not be bent.

2.3.3.11. Indirect Connections

1) Where a *fixture* or device is *indirectly connected*, the connections shall be made by terminating the *fixture drain* above the *flood level rim* of a *directly connected fixture* to form an *air break*.

2) The size of the *air break* shall at least equal the *size* of the *fixture drain*, *branch* or pipe that terminates above the *directly connected fixture*, and it shall be not less than 25 mm. (See Note A-2.3.3.11.(2).)

2.3.3.12. Copper Joints Used Underground

1) Except as provided in Sentence (2), joints in copper tubes installed underground shall be made with either flared or compression fittings, or be brazed using a brazing alloy within the American Welding Society's AWS-BCuP range.

2) Compression fittings shall not be used underground under a *building*.

2.3.4. Support of Piping

2.3.4.1. Capability of Support

1) Piping shall be provided with support that is capable of keeping the pipe in alignment and bearing the weight of the pipe and its contents.

2) Floor-mounted and wall-mounted water-closet bowls shall be securely attached to the floor or wall by means of a flange and shall be stable.

3) Wall-mounted *fixtures* shall be supported so that no strain is transmitted to the piping.

2.3.4.2. Independence of Support

1) Piping, *fixtures*, tanks or devices shall be supported independently of each other.

2.3.4.3. Insulation of Support

1) Where a hanger or support for copper tube or brass or copper pipe is of a material other than brass or copper, it shall be suitably separated and electrically insulated from the pipe or tube.

2) Where a hanger or support for stainless steel pipe or tube is of a material other than stainless steel, it shall be suitably separated and electrically insulated from the pipe or tube.

2.3.4.4. Support for Vertical Piping

1) Except as provided in Sentence (2), vertical piping shall be supported at its base and at the floor level of alternate *storeys* by rests, each of which can bear the weight of pipe that is between it and the rest above it.

2) The maximum spacing of supports shall be 7.5 m.

2.3.4.5. Support for Horizontal Piping

1) *Nominally horizontal* piping that is inside a *building* shall be braced to prevent swaying and buckling and to control the effects of thrust.

2) *Nominally horizontal* piping shall be supported as stated in Table 2.3.4.5.

3) Where PVC, CPVC or ABS plastic pipe is installed

a) the pipe shall be aligned without added strain on the piping,

b) the pipe shall not be bent or pulled into position after being welded, and

c) hangers shall not compress, cut or abrade the pipe.

4) Where PEX, PP-R, PE/AL/PE or PEX/AL/PEX plastic pipe is installed, hangers shall not compress, cut or abrade the pipe.

Table 2.3.4.5.
Support for Nominally Horizontal Piping
Forming Part of Sentence 2.3.4.5.(2)

Piping Material	Maximum Horizontal Spacing of Supports, m	Additional Support Conditions
Galvanized iron or steel pipe • diameter ≥ 6 inches • diameter < 6 inches	 3.75 2.5	None
Stainless steel pipe • diameter ≥ 1 inch • diameter < 1 inch	 3.0 2.5	None
Stainless steel tube • diameter ≥ 1 inch • diameter < 1 inch	 3.0 2.5	None
Lead pipe	Throughout length of pipe	None
Cast-iron pipe	3	At or adjacent to each hub or joint
Cast-iron pipe with mechanical joints that is ≤ 300 mm long between adjacent fittings	1	None
ABS or PVC plastic pipe	1.2	At the end of *branches* or *fixture drains* and at changes in direction and elevation
ABS or PVC plastic *trap arm* or *fixture drain* pipe > 1 m long	n/a	As close as possible to the *trap*

Table 2.3.4.5. *(continued)*
Support for Nominally Horizontal Piping
Forming Part of Sentence 2.3.4.5.(2)

Piping Material	Maximum Horizontal Spacing of Supports, m	Additional Support Conditions
CPVC pipe	1	None
Copper tube or copper and brass pipe, hard temper, diameter > 1 inch	3	None
Copper tube or copper and brass pipe, hard temper, diameter ≤ 1 inch	2.5	None
Copper tube, soft temper	2.5	None
PE/AL/PE composite pipe	1	None
PEX/AL/PEX composite pipe	1	None
PEX plastic pipe	0.8	None
PP-R plastic pipe	1	At the end of *branches* and at changes in direction and elevation

5) Where hangers are used to support *nominally horizontal* piping, the hangers shall be

a) supported by metal rods of not less than

i) 6 mm diam to support piping 2 inches or less in *size*,

ii) 8 mm diam to support piping 4 inches or less in *size*, and

iii) 13 mm diam to support piping over 4 inches in *size*, or

b) solid or perforated metal straps of not less than

i) 0.6 mm nominal thickness and 12 mm wide to support piping 2 inches or less in *size*, and

ii) 0.8 mm nominal thickness and 18 mm wide to support piping 4 inches or less in *size*.

6) Where a hanger is attached to concrete or masonry, it shall be fastened by metal or expansion-type plugs that are inserted or built into the concrete or masonry.

2.3.4.6. Support for Underground Horizontal Piping

1) Except as provided in Sentence (2), *nominally horizontal* piping that is underground shall be supported on a base that is firm and continuous under the whole of the pipe. (See Note A-2.3.4.6.(1).)

2) *Nominally horizontal* piping installed underground that is not supported as described in Sentence (1) may be installed using hangers fixed to a foundation or structural slab provided that the hangers are capable of

a) keeping the pipe in alignment, and

b) supporting the weight of

i) the pipe,

ii) its contents, and

iii) the fill over the pipe.

2.3.4.7. Support for Vent Pipe above a Roof

1) Where a *vent pipe* that may be subject to misalignment terminates above the surface of a roof, it shall be supported or braced. (See Article 2.5.6.5. for location of *vent pipe* terminals.)

2.3.5. Protection of Piping

2.3.5.1. Backfilling of Pipe Trench

1) Where piping is installed underground, the backfill shall be

a) carefully placed and tamped to a height of 300 mm over the top of the pipe, and

b) free of stones, boulders, cinders and frozen earth. (See Note A-2.3.5.1.(1).)

2.3.5.2. Protection of Non-Metallic Pipe

1) Where vitrified clay is located less than 600 mm below a basement floor and the floor is constructed of other than 75 mm or more of concrete, the pipe shall be protected by a 75-mm layer of concrete installed above the pipe. (See Note A-2.3.5.2.(1).)

2.3.5.3. Isolation from Loads

1) Where piping passes through or under a wall, it shall be installed so that the wall does not bear on the pipe.

2.3.5.4. Protection Against Freezing

(See Note A-2.3.5.4.)

1) Where piping may be exposed to freezing conditions, it shall be protected from the effects of freezing.

2.3.5.5. Protection from Mechanical Damage

1) Plumbing, piping and equipment exposed to mechanical damage shall be protected.

2.3.5.6. Protection from Condensation

(See Note A-2.3.5.4.)

1) Piping used as an internal *leader*, which may be subject to condensation, shall be installed in a manner that limits the risk of damage to the *building* due to condensation.

2.3.6. Testing of Drainage or Venting Systems

2.3.6.1. Tests and Inspection of Drainage or Venting Systems

1) Except in the case of an external *leader*, after a section of a *drainage system* or a *venting system* has been roughed in, and before any *fixture* is installed or piping is covered, a water pressure test or an air pressure test shall be conducted.

2) After every *fixture* is installed and before any part of the *drainage system* or *venting system* is placed in operation, a final test shall be carried out when requested.

3) Where a prefabricated system is assembled off the *building* site in such a manner that it cannot be inspected and tested on site, off-site inspections and tests shall be conducted.

4) Where a prefabricated system is installed as part of a *drainage system* or *venting system*, all other plumbing work shall be tested and inspected and a final test shall be carried out on the complete system when requested.

5) When requested, a ball test shall be made to any pipe in a *drainage system*.

2.3.6.2. Tests of Pipes in Drainage Systems

1) Pipes in a *drainage system*, except an external *leader* or *fixture outlet pipe*, shall be capable of withstanding without leakage a water pressure test, air pressure test and final test.

2) Pipes in a *drainage system* shall be capable of meeting a ball test.

2.3.6.3. Tests of Venting Systems

1) *Venting systems* shall be capable of withstanding without leakage a water pressure test, air pressure test and final test.

2.3.6.4. Water Pressure Tests

1) A water pressure test shall consist in applying a water column of at least 3 m to all joints.

2) In making a water pressure test,

a) every opening except the highest shall be tightly closed with a testing plug or a screw cap, and

b) the system or the section shall be kept filled with water for 15 min.

2.3.6.5. Air Pressure Tests

1) Air pressure tests shall be conducted in accordance with the manufacturer's instructions for each piping material, and

a) air shall be forced into the system until a pressure of 35 kPa is created, and

b) this pressure shall be maintained for at least 15 min without a drop in pressure.

2.3.6.6. Final Tests

1) Where a final test is made,

a) every *trap* shall be filled with water,

b) the bottom of the system being tested shall terminate at a *building trap*, test plug or cap,

c) except as provided in Sentence (2), smoke from smoke-generating machines shall be forced into the system,

d) when the smoke appears from all roof terminals they shall be closed, and

e) a pressure equivalent to a 25 mm water column shall be maintained for 15 min without the addition of more smoke.

2) The smoke referred to in Clauses (1)(c) and (d) is permitted to be omitted, provided the roof terminals are closed and the system is subjected to an air pressure equivalent to a 25 mm water column maintained for 15 min without the addition of more air.

2.3.6.7. Ball Tests

1) Where a ball test is made, a hard ball dense enough not to float shall be rolled through the pipe.

2) The diameter of the ball shall be not less than

a) 50 mm where the *size* of the pipe is 3 inches or more, or

b) 25 mm where the *size* of the pipe is less than 3 inches.

2.3.7. Testing of Potable Water Systems

2.3.7.1. Application of Tests

1) After a section of a *potable water system* has been completed, and before it is placed in operation, a water pressure test shall be conducted, except that an air pressure test may be used in freezing conditions.

2) A pressure test may be applied to each section of the system or to the system as a whole.

3) Where a prefabricated system is assembled off the *building* site in such a manner that it cannot be inspected and tested on site, off-site inspections and pressure tests shall be conducted.

4) Where a prefabricated system is installed as part of a *water system*,

a) all other plumbing work shall be tested and inspected, and

b) the complete system shall be pressure tested when requested.

2.3.7.2. Pressure Tests of Potable Water Systems

1) Except as required in Sentence (2), *potable water systems* shall be able to withstand

a) without leaking, a water pressure that is at least equal to the maximum in-service pressure, or

b) an air pressure of not less than 700 kPa for at least 2 h without a drop in pressure.

2) If a manufacturer states that an air pressure test is not recommended, a water pressure test shall be performed. (See Note A-2.3.7.2.(2).)

2.3.7.3. Water Pressure Tests

1) Where a water pressure test is made, all air shall be expelled from the system before *fixture* control valves or faucets are closed.

2) *Potable* water shall be used to test a *potable water system*.