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Plumbing works — Code of practice —Part 4: Sanitary and drainage system installation

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 644-4 was prepared by Technical Committee RSB/TC 17, *Urban planning*.

In the preparation of this standard, reference was made to the following standard:

Uniform Plumbing Code (2024 Edition, IAPMO)

The assistance derived from the above source is hereby acknowledged with thanks.

DRS 644 consists of the following parts, under the general title *Plumbing works — Code of practice*:

- *Part 1: General*
- *Part 2: Plumbing fixtures and fixture fittings*
- *Part 3: Water supply and distribution*
- *Part 4: Sanitary and drainage system installation*
- *Part 5: Water heaters*
- *Part 6: Fuel gas piping and firestop protection*
- *Part 7: Healthcare facilities and medical gas and medical vacuum systems*
- *Part 8: Alternate water sources for non-potable applications and non-potable rainwater catchment systems*

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Committee membership

The following organizations were represented on the Technical Committee on *Urban planning* (RSB/TC 17) in the preparation of this standard.

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Institute of Engineering Rwanda (IER)

Ministry of Infrastructure (MININFRA)

Rwanda Housing Authority (RHA)

Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)

Rwanda Plumbers Organization (RPO)

Rwanda Polytechnic – Kigali College

Rwanda Polytechnic – Musanze College

Rwanda Transport Development Agency (RTDA)

Rwanda Utility Regulatory Authority (RURA)

Rwanda Water Resources Board (RWB)

University of Rwanda – College of Science and Technology (UR-CST)

Water and Sanitation Corporation (WASAC)

Water for People

Rwanda Standards Board (RSB) – Secretariat

Plumbing works — Code of practice — Part 4: Sanitary and drainage system installation

1 Scope

This Draft Rwanda Standard provides recommendations and guidelines for materials, design and installation of sanitary drainage systems, building sewers, storm water drainage systems and plumbing systems.

It also specifies the requirements for materials, design, and installation of indirect waste piping, receptors, and connections; and provisions for discharge and disposal of condensate wastes, chemical wastes, industrial wastes, and clear water wastes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM E84 *Test for Surface Burning Characteristics of Building Materials*

ASTM D3212, *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*

ASTM E84(UL 723), *Standard Test Method for Surface Burning Characteristics of Building Materials*

ASTM D2661, *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings*

ASTM D2680-2020, *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping*

ASTM A74, *Standard Specification for Cast Iron Soil Pipe and Fittings*

ASTM A888—2021, *Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications*

ASTM A74-2020, *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping*

ASTM F628-2012, *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core*

ASTM F1488-2014 (R2019), *Standard Specification for Coextruded Composite Pipe*

ASTM F794, *Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter*

ASTM F1866, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings*

ASTM F891, *Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core*

ASTM F1760-2016, *Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed Recycled Content*

ASTM D2665-2020, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*

ASTM F794-2021, *Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter*

ASTM F1336-2020, *Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings*

ASTM F1866, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings*

ASTM B43-2020, *Standard Specification for Seamless Red Brass Pipe, Standard Sizes*

ASTM B75/B75M-2020, *Standard Specification for Seamless Copper Tube*

ASTM B251/B251M-2017, *Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube*

ASTM B302-2017, *Standard Specification for Threadless Copper Pipe, Standard Sizes*

ASTM D3138-2004 (R2016), *Standard Specification for Solvent Cement for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components*

ASTM C1460, *Standard Specification for Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground*

ASTM C1461-2021, *Standard Specification for Mechanical Couplings Using Thermoplastic Elastomeric (TPE) Gaskets for Joining Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems for Above and Below Ground Use*

ASTM C1173-2018, *Standard Specification for Flexible Transition Couplings for Underground Piping Systems*

ASTM F1216-2021, *Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube*

ASTM F2561-2020, *Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One-Piece Main and Lateral Cured-in-Place Liner*

ASTM F2599, *Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One-Piece Main and Lateral Cured-in-Place Liner*

ASTM F3240, *Standard Practice for Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Watertightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines*

ASTM F714, *Standard Specification for Polyethylene (PE) Plastic Pipe (DR- PR) Based on Outside Diameter*

ASTM F1412-2016, *Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems*

ASTM F2618, *Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems*

ASTM C1053-2000 (R2015), *Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications*

ASTM A861-2004 (R2017), *Standard Specification for High-Silicon Iron Pipe and Fittings*

ASTM B306-2020, *Standard Specification for Copper Drainage Tube (DWV)*

ASTM B88-2020, *Standard Specification for Seamless Copper Water Tube*

ASTM B29-2019, *Standard Specification for Refined Lead*

UL 723, *Test for Surface Burning Characteristics of Building Materials*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in WDRS xxx-1 apply.

4 Symbols (and abbreviated terms)

A paragraph.

ABS: Acrylonitrile-butadiene-styrene

PVC: Polyvinylidene Fluoride

DWV: Drainage Waste and Vent system

DFU: Drainage Fixture Unit

DPM: Damp Proof Membrane

5 Sanitary drainage

5.1 Drainage systems

5.1.1 Drainage piping

Materials for drainage piping shall be in accordance with one of the referenced standards in Table 6, except that:

- (1) No galvanized wrought-iron or galvanized steel pipe shall be used underground and shall be kept not less than 6 inches (152 mm) aboveground.
- (2) ABS and PVC DWV piping installations shall be installed in accordance with applicable standards referenced in Table 6 and DRS 644-6. Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a flame-spread index of not more than 25 and a smoke-developed index of not more than 50, where tested in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.
- (3) No vitrified clay pipe or fittings shall be used aboveground or where pressurized by a pump or ejector. They shall be kept not less than 305 mm (12 inches) below ground.
- (4) Copper or copper alloy tube for drainage and vent piping shall have a weight of not less than that of copper or copper alloy drainage tube type DWV.
- (5) Stainless steel 304 pipe and fittings shall not be installed underground and shall be kept not less than 152 mm (6 inches) aboveground.
- (6) Cast-iron soil pipe and fittings and the stainless-steel couplings used to join these products shall be listed and tested in accordance with standards referenced in TABLE 5

Such pipe and fittings shall be marked with the country of origin, manufacturer's name or registered trademark as defined in the product standards, the third-party certifier's mark, and the class of the pipe or fitting.

5.1.2 Drainage fittings

Materials for drainage fittings shall comply with the applicable standards referenced in Table 6. (1) of the same diameter as the piping served, and such fittings shall be compatible with the type of pipe used.

5.1.2.1 Screwed pipe

Fittings on screwed pipe shall be of the recessed drainage type. Burred ends shall be reamed to the full bore of the pipe.

5.1.2.2 Threads

The threads of drainage fittings shall be tapped to allow 20.8 mm/m (1/4 inch per foot) grade.

5.1.2.3 Type

Fittings used for drainage shall be of the drainage type, have a smooth interior water-way, and be constructed to allow 1/4 inch per foot (20.8 mm/m) grade.

5.1.3 Continuous wastes

Continuous wastes and fixture tailpieces shall be constructed from the materials specified in Table 3 for drainage piping, provided, however, that such connections where exposed or accessible shall be permitted to be of seamless drawn brass not less than No. 20 B & S Gauge (0.8 mm) (0.032 inches).

5.1.4 Lead

(Reference to DRS 644-2) Sheet lead shall comply with the following:

- (1) For safe pans – not less than 4 pounds per square foot (lb/ft²) (19 kg/m²) or 1/16 of an inch (1.6 mm) thick.
- (2) For flashings or vent terminals – not less than 3 lb/ft² (15 kg/m²) or 0.0472 of an inch (1.2 mm) thick.
- (3) Lead bends and lead traps shall be not less than 1/8 of an inch (3.2 mm) in wall thickness.

5.1.5 Caulking ferrules

Caulking ferrules shall be manufactured from copper or copper alloy and shall be in accordance with Table 1.

Table 1 — Caulking ferrules

PIPE SIZE (inches)	INSIDE DIAMETER (inches)	LENGTH (inches)	MINIMUM WEIGHT EACH	
			Pounds	Ounces
2	2 1/4	4 1/2	1	0
3	3 1/4	4 1/2	1	12
4	4 1/4	4 1/2	2	8

5.1.6 Soldering bushings

Soldering bushings shall be of copper or copper alloy and shall be in accordance with Table 2.

Table 2 — Soldering bushings

Pipe size (inches)	Minimum weight each		Pipe size (inches)	Minimum weight each	
	Pounds	Ounces	-	Pounds	Ounces
1 1/4	0	6	2 1/2	1	6
1 1/2	0	8	3	2	0
2	0	14	4	3	8

6 Fixture unit equivalents

6.1 Trap size

The unit equivalent of plumbing fixtures shown in Table 3 shall be based on the size of the trap required, and the unit equivalent of fixtures and devices not shown in Table 3.

(1) shall be based on the size of trap or trap arm. Maximum drainage fixture units for a fixture trap and trap arm loadings for sizes up to 100 mm (4 inches) shall be in accordance with Table 4.

Table 3 — Drainage fixture unit values (DFU)

Plumbing appurtenances, or fixtures	Minimum size trap and trap arm ⁷ (inches)	Private	Public	Assembly ⁸
--	---	---------	--------	-----------------------

Bathtub or Combination Bath/Shower	1 - 1/2	2.0	2.0	—
Bidet	1 1/4	1.0	—	—
Bidet	1 1/2	2.0	—	—
Clothes Washer, domestic, standpipe ⁵	2	3.0	3.0	3.0
Dental Unit, cuspidor	1 1/4	—	1.0	1.0
Dishwasher, domestic, with independent drain ²	1 1/2	2.0	2.0	2.0
Drinking Fountain or Water Cooler	1 1/4	0.5	0.5	1.0
Food Waste Disposer, commercial	2	—	3.0	3.0
Floor Drain, emergency	2	—	0.0	0.0
Floor Drain (for additional sizes see clause 6 Section 702.0)	2	2.0	2.0	2.0
Shower, single-head trap	2 9	2.0	2.0	2.0
Multi-head, each additional	2	1.0	1.0	1.0
Lavatory	1 1/4	1.0	1.0	1.0
Lavatories in sets	1 1/2	2.0	2.0	2.0

Washfountain	1 1/2	—	2.0	2.0
Washfountain	2	—	3.0	3.0
Mobile Home, trap	3	12.0	—	—
Receptor, indirect waste ^{1,3}	1 1/2	See footnote ^{1,3}		
Receptor, indirect waste ^{1,4}	2	See footnote ^{1,4}		
Receptor, indirect waste ¹	3	See footnote ¹		
Sinks	—	—	—	—
Bar	1 1/2	1.0	—	—
Bar ²	1 1/2	—	2.0	2.0
Clinical	3	—	6.0	6.0
Commercial with food waste ²	1 1/2	—	3.0	3.0
Exam Room	1 1/2	—	1.0	—
Special Purpose ²	1 1/2	2.0	3.0	3.0
Special Purpose	2	3.0	4.0	4.0
Special Purpose	3	—	6.0	6.0

Kitchen, domestic ² (with or without food waste disposer, dishwasher, or both)	1 1/2	2.0	2.0	—
Laundry ² (with or without discharge from a clothes washer)	1 1/2	2.0	2.0	2.0
Service or Mop Basin	2	—	3.0	3.0
Service or Mop Basin	3	—	3.0	3.0
Service, flushing rim	3	—	6.0	6.0
Wash, each set of faucets	—	—	2.0	2.0
Nonwater Urinal with Drain Cleansing Action	2	1.0	1.0	1.0
Urinal, integral trap 1.0 GPF ²	2	2.0	2.0	5.0
Urinal, integral trap greater than 1.0 GPF	2	2.0	2.0	6.0
Urinal, exposed trap ²	1 1/2	2.0	2.0	5.0
Water Closet, 1.6 GPF Gravity Tank ⁶	3	3.0	4.0	6.0
Water Closet, 1.6 GPF Flushometer Tank ⁶	3	3.0	4.0	6.0
Water Closet, 1.6 GPF Flushometer Valve ⁶	3	3.0	4.0	6.0

Water Closet, greater than 1.6 GPF Gravity Tank ⁶	3	4.0	6.0	8.0
Water Closet, greater than 1.6 GPF Flushometer Valve ⁶	3	4.0	6.0	8.0

For SI units: 1 inch = 25 mm

Notes:

¹ Indirect waste receptors shall be sized based on the total drainage capacity of the fixtures that drain thereinto, in accordance with Table 5.

² Provide a 2 inch (50 mm) minimum drain.

³ For refrigerators, coffee urns, water stations, and similar low demands.

⁴ For commercial sinks, dishwashers, and similar moderate or heavy demands.

⁵ Buildings having a clothes-washing area with clothes washers in a battery of three or more clothes washers shall be rated at 6 fixture units each for purposes of sizing common horizontal and vertical drainage piping.

⁶ Water closets shall be computed as 6 fixture units where determining septic tank sizes based on XXXX of this code.

⁷ Trap sizes shall not be increased to the point where the fixture discharge is capable of being inadequate to maintain their self-scouring properties.

⁸ Assembly [Public Use (see Table XXXX)].

⁹ For a bathtub to shower retrofit, a 1½ inch (40 mm) trap and trap arm shall be permitted with a maximum shower size of 36 inches (914 mm) in width and 60 inches (1524 mm) in length. See Section XXXX and Section XXXX.

Table 4 — Maximum drainage fixture units for a trap and trap arm

Size of trap and trap arm inches	Drainage fixture unit values (DFU)
1¼	1 unit
1½	3 units
2	4 units
3	6 units
4	8 units

6.2 Intermittent flow

Drainage fixture units for intermittent flow into the drainage system shall be computed on the rated discharge capacity in gallons per minute (gpm) (L/s) in accordance with Table 5.

Table 5 — Discharge capacity in gallons per minute for intermittent flow only*

GPM	Fixture units
Up to 7½	Equals 1 Fixture Unit
Greater than 7½ to 15	Equals 2 Fixture Units
Greater than 15 to 30	Equals 4 Fixture Units
Greater than 30 to 50	Equals 6 Fixture Units

For SI units: 1 gallon per minute = 0.06 L/s

* Discharge capacity exceeding 50 gallons per minute (3.15 L/s) shall be determined by the Competent Authority.

Table 6 — Materials for drain, waste, vent pipe and fittings

Material	Underground drain, waste, vent pipe and fittings	Aboveground drain, waste, vent pipe and fittings	Building sewer pipe and fittings	Referenced standard(s) pipe	Referenced standard(s) fittings
ABS (Schedule 40)	X	X	X	ASTM D2661, ASTM D2680*	ASME A112.4.4, ASTM D2661, ASTM D2680*
Cast-Iron	X	X	X	ASTM A74, ASTM A888, CISPI 301	ASME B16.12, ASTM A74, ASTM A888, CISPI 301
Co-Extruded ABS (Schedule 40)	X	X	X	ASTM F628	ASME A112.4.4, ASTM D2661, ASTM D2680*
Co-Extruded Composite (Schedule 40)	X	X	X	ASTM F1488	ASME A112.4.4, ASTM D2661,

					ASTM D2665, ASTM F794*, ASTM F1866
Co-Extruded PVC (Schedule 40)	X	X	X	ASTM F891, ASTM F1760	ASME A112.4.4, ASTM D2665, ASTM F794*, ASTM F1336*, ASTM F1866
Copper and Copper Alloys (Type DWV)	X	X	X	ASTM B43, ASTM B75, ASTM B251, ASTM B302, ASTM B306	ASME B16.23, ASME B16.29
Galvanized Malleable Iron	—	X	—	—	ASME B16.3
Galvanized Steel	—	X	—	ASTM A53	—
Polyethylene	—	—	X	ASTM F714, ASTM F894	—
PVC (Schedule 40)	X	X	X	ASTM D1785, ASTM D2665, ASTM F794*	ASME A112.4.4, ASTM D2665, ASTM F794*, ASTM F1866
PVC (Sewer and Drain)	—	—	X	ASTM D2729	ASTM D2729
PVC PSM	—	—	X	ASTM D3034	ASTM D3034
Stainless Steel 304	—	X	—	ASME A112.3.1	ASME A112.3.1

Stainless Steel 316L	X	X	X	ASME A112.3.1	ASME A112.3.1
Vitrified Clay (Extra strength)	—	—	X	ASTM C700	ASTM C700

6.3 Trap size

The unit equivalent of plumbing fixtures shown in Table 6 shall be based on the size of the trap required, and the unit equivalent of fixtures and devices not shown in Table 6. (shall be based on the size of trap or trap arm. Maximum drainage fixture units for a fixture trap and trap arm loadings for size up to 4 inches (1000 mm) shall be in accordance to clause 5

6.4 Continuous flow

For a continuous flow into a drainage system, such as from a pump, sump ejector, air conditioning equipment, or similar device, 2 fixture units shall be equal to each gallon per minute (gpm) (L/s) of flow.

7 Size of drainage piping

7.1 Minimum size

The minimum sizes of vertical, horizontal, or both drainage piping shall be determined from the total of fixture units connected thereto, and additionally, in the case of vertical drainage pipes, in accordance with their length.

7.2 Maximum number of fixture units

Table 7 shows the maximum number of fixture units allowed on a vertical or horizontal drainage pipe, building drain, or building sewer of a given size; the maximum number of fixture units allowed on a branch interval of a given size; and the maximum length (in feet and meters) of a vertical drainage pipe of a given size.

Table 7 — Maximum unit loading and maximum length of drainage and vent piping

Size of pipe (inches)	1 1/4	1 1/2	2	3	4	5	6	8	10	12
Maximum units										
Drainage Piping ¹	1	2 ^{2, 7}	16 ³	48 ⁴	256	600	1380	3600	5600	8400
Vertical	1	1 ⁷	8 ³	35 ⁴	216 ⁵	428 ⁵	720 ⁵	2640 ⁵	4680 ⁵	8200 ⁵
Horizontal										
Maximum Length										

Drainage Piping Vertical, (feet) Horizontal (unlimited)	45	65	85	212	300	390	510	750	–	–
Vent Piping Horizontal and Vertical ⁶ Maximum Units Maximum Lengths, (feet)	1 45	8 ³ 60	24 120	84 212	256 300	600 390	1380 510	3600 750	–	–
For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm Notes: 1 Excluding trap arm. 2 Except for sinks, urinals, and dishwashers – exceeding 1 fixture unit. 3 Except for six-unit traps or water closets. 4 Not to exceed six water closets or five six-unit traps. 5 Based on 20.8 mm/m (1/4 inch per foot) slope. For (10.4 mm/m) (1/8 of an inch per foot) slope, multiply horizontal fixture units by a factor of 0.8. 6 The diameter of an individual vent shall be not less than 32 mm (1 1/4 inches) nor less than one-half the diameter of the drain to which it is connected. Fixture unit load values for drainage and vent piping shall be computed from Table 3. and Table 5. Not to exceed one-third of the total permitted length of a vent shall be permitted to be installed in a horizontal position. Where vents are increased one pipe size for their entire length, the maximum length limitations specified in this table do not apply. This table is in accordance with the requirements of WDRS xxx-5 part 5 7 Up to 8 public lavatories are permitted to be installed on a 40 mm (1 1/2 inch) vertical branch or horizontal sanitary branch sloped at 20.8 mm/m (1/4 inch per foot).f										

7.3 Sizing

For alternate method of sizing drainage piping, see Annex C.

8 Fixture connections (Drainage)

8.1 Inlet fittings

Drainage piping shall be provided with approved inlet fittings for fixture connections, correctly located according to the size and type of fixture proposed to be connected.

8.2 Single vertical drainage pipe

Two fixtures set back-to-back, or side-by-side, within the distance allowed between a trap and its vent, shall be permitted to be served by a single vertical drainage pipe provided that each fixture wastes separately into an approved double-fixture fitting having inlet openings at the same level.

8.3 Commercial sinks

Pot sinks, scullery sinks, dishwashing sinks, silverware sinks, and other similar fixtures shall be connected directly to the drainage system. A floor drain shall be provided adjacent to the fixture and shall be connected on the sewer side of the sink. No other drainage line shall be connected between the floor drain waste connection and the fixture drain. The fixture and floor drain shall be trapped and vented in accordance with this standard.

9 Joints and connections

9.1 ABS and ABS co-extruded plastic pipe and joints

Joining methods for ABS plastic pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with WDRS xxx-1

9.1.1 Mechanical joints

Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint. The push-on joint shall include an elastomeric gasket that complies with ASTM D3212 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal.

9.1.2 Solvent cement joints

Solvent cement joints for ABS pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square and shall be deburred. Where surfaces to be joined are cleaned, and free of dirt, moisture, oil, and other foreign material, the solvent cement that complies with ASTM D2235 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 minute after assembly.

9.1.3 Threaded joints

Threads shall comply ASME B1.20.1. A minimum of schedule 80 shall be permitted to be threaded. Molded threads on adapter fittings for the transition to threaded joints shall be permitted. Thread sealant compound shall be applied to male threads, insoluble in water, and nontoxic. The joint between the pipe and transition fitting shall be of the solvent cement type. Caution shall be used during assembly to prevent over tightening of the ABS components once the thread sealant compound has been applied.

9.2 Cast-iron pipe and joints

Joining methods for cast-iron pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with 9.2.1 or 9.2.2

9.2.1 Caulked joints

Caulked joints shall be firmly packed with oakum or hemp and filled with molten lead to a depth of not less than 25.4 mm (1 inch) in one continuous pour. The lead shall be caulked thoroughly at the inside and outside edges of the joint. After caulking, the finished joint shall not exceed 3.2 mm ($\frac{1}{8}$ of an inch) below the rim of the hub. No paint, varnish, or other coatings shall be permitted on the joining material until after the joint has been tested and approved.

9.2.2 Mechanical joints and compression joints

Mechanical joints for cast-iron pipe and fittings shall be of the elastomeric compression type or mechanical joint couplings. Compression type joints with an elastomeric gasket for cast-iron hub and spigot pipe shall comply with ASTM C564 and be tested in accordance with ASTM C1563. Hub and spigot shall be clean and free of dirt, mud, sand, and foreign materials. Cut pipe shall be free from sharp edges. Fold and insert gasket into the hub. Lubricate the joint following manufacturer's instructions. Insert spigot into hub until the spigot end of the pipe bottom out in the hub. Use the same procedure for the installation of fittings.

A mechanical joint shielded coupling type for hubless cast-iron pipe and fittings shall have a metallic shield that complies with ASTM A1056, ASTM C1277, ASTM C1540, or CISPI 310. The elastomeric gasket shall comply with ASTM C564. Hubless cast-iron pipe and fittings shall be clean and free of dirt, mud, sand, and foreign materials. Cut pipe shall be free from sharp edges. Gasket shall be placed on the end of the pipe or fitting and the stainless steel shield and clamp assembly on the end of the other pipe or fitting. Pipe or fittings shall be seated against the center stop inside the elastomeric sleeve. Slide the stainless steel shield and clamp assembly into a position centered over the gasket and tighten. Bands shall be tightened using an approved calibrated torque wrench specifically set by the manufacturer of the couplings.

9.3 Copper or copper alloy pipe (DWV) and joints

Joining methods for copper or copper alloy pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with 9.3.2 through 9.3.4.

9.3.1 Blazed joints

Brazed joints between copper or copper alloy pipe and fittings shall be made with brazing alloys having a liquid temperature above 1000 °F (538 °C). The joint surfaces to be brazed shall be cleaned bright by either manual or mechanical means. Piping shall be cut square and reamed to full inside diameter. Brazing flux shall be applied to the joint surfaces where required by manufacturer's recommendation. Brazing filler metal shall conform to AWS A5.8 and shall be applied at the point where the pipe or tubing enters the socket of the fitting.

9.3.2 Mechanical joints

Mechanical joints in copper or copper alloy piping shall be made with a mechanical coupling with grooved end piping or approved joint designed for the specific application.

9.3.3 Soldered joints

Soldered joints between copper or copper alloy pipe and fittings shall be made in accordance with ASTM B828 with the following sequence of joint preparation and operation as follows: measuring and cutting, reaming, cleaning, fluxing, assembly and support, heating, applying the solder, cooling, and cleaning. Pipe shall be cut square and reamed to the full inside diameter including the removal of burrs on the outside of the pipe. Surfaces to be joined shall be cleaned bright by manual or mechanical means. Flux shall be applied to pipe and fittings and shall conform to ASTM B813, and shall become noncorrosive and nontoxic after soldering. Insert pipe into the base of the fitting and remove excess flux. Pipe and fitting shall be supported to ensure a uniform capillary space around the joint. Heat shall be applied using air or fuel torch with the flame perpendicular to the pipe using acetylene or an LP gas. Preheating shall depend on the size of the joint. The flame shall be moved to the fitting cup and alternate between the pipe and fitting. Solder conforming to ASTM B32 shall be applied to the joint surfaces until capillary action draws the molten solder into the cup. Joint surfaces shall not be disturbed until cool, and any remaining flux residue shall be cleaned.

9.3.4 Threaded joints

Threaded joints for copper or copper alloy pipe shall be made with pipe threads that comply with ASME B1.20.1. Thread sealant tape or compound shall be applied only to male threads, and such material shall be approved types, insoluble in water, and nontoxic.

9.4 Galvanized steel pipe and joints

Joining methods for galvanized steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with WDRS xxx-1.

9.4.1 Mechanical joints

Mechanical joints shall be made with an elastomeric gasket.

9.4.2 Threaded joints

Threaded joints shall be made with pipe threads that comply with ASME B1.20.1. Thread sealant tape or compound shall be applied only to male threads, and such material shall be of approved types, insoluble in water, and nontoxic.

9.5 Polyethylene (PE) sewer pipe

Polyethylene (PE) sewer pipe or tubing and fitting joining methods shall be installed in accordance with the manufacturer's installation instructions and shall comply with Section 105.5.1 through Section 105.5.1.3.

9.5.1 Heat-fusion joints

Heat-fusion joints between PE sewer pipe or tubing and fittings shall be assembled in accordance with Section 9.5.1.1 through Section 9.5.1.3 using butt-fusion, electro-fusion, or socket-fusion heat methods. Do not disturb the joint until cooled to ambient temperature.

9.5.1.1 Butt-fusion joints

Butt-fusion joints for PE pipe shall be installed in accordance with ASTM F2620 and shall be made by heating the prepared ends of two pipes, pipe and fitting, or two fittings by holding ends against a heated element. The heated element shall be removed when the required melt or times are obtained and heated ends shall be placed together with applied force. Do not disturb the joint until cooled to ambient temperature.

9.5.1.2 Electro-fusion joints

Electro-fusion joints shall be heated internally by a conductor at the interface of the joint. Fittings shall comply with ASTM F1055 for the performance requirements of polyethylene electro-fusion fittings. The specified electro-fusion cycle used to form the joint requires consideration of the properties of the materials being joined, the design of the fitting being used, and the environmental conditions. Align and restrain fitting to pipe to prevent movement and apply electric current to the fitting. Turn off the current when the required time has elapsed to heat the joint. Do not disturb the joint until cooled to ambient temperature.

9.5.1.3 Socket-fusion joints

Socket fusion joints shall be installed in accordance with ASTM F2620 and shall be made by simultaneously heating the outside surface of a pipe end and the inside of a fitting socket. Where the required melt is obtained, the pipe and fitting shall be joined by inserting one into the other with applied force. Do not disturb the joint until cooled to ambient temperature.

9.6 PVC and PVC co-extruded plastic pipe and joining methods

Joining methods for PVC plastic pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with clause 9.6.1 through clause 9.6.3.

9.6.1 Mechanical joints

Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint type. The push-on joint shall include an elastomeric gasket that complies with ASTM D3212 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal.

9.6.2 Solvent cement joints

Solvent cement joints for PVC pipe and fittings shall be clean from dirt and moisture. Pipe shall be cut square, and pipe shall be deburred. Where surfaces to be joined are cleaned and free of dirt, moisture, oil, and other foreign material, apply primer purple in color that complies with ASTM F656. Primer shall be applied to the surface of the pipe and fitting is softened. Solvent cement that conforms to ASTM D2564 shall be applied to all joint surfaces. Joints shall be made while both the inside socket surface and outside surface of pipe are wet with solvent cement. Hold joint in place and undisturbed for 1 min after assembly.

9.6.3 Threaded joints

Threads shall comply with ASME B1.20.1. A minimum of Schedule 80 shall be permitted to be threaded. Molded threads on adapter fittings for the transition to threaded joints shall be permitted. Thread sealant compound that is compatible with the pipe and fitting, insoluble in water and nontoxic shall be applied to male threads. The joint between the pipe and transition fitting shall be of the solvent cement type. Caution shall be used during assembly to prevent over tightening of the PVC components once the thread sealant has been applied. Female PVC threaded fittings shall be used with plastic male threads only.

9.7 Stainless steel pipe and joints

Joining methods for stainless steel pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with clause 9.7.1 or clause 9.7.2.

9.7.1 Mechanical joints

Mechanical joints between stainless steel pipe and fittings shall be of the compression, grooved coupling, hydraulic press-connect fittings, or flanged.

9.7.2 Welded joints

Welded joints between stainless steel pipe and fittings shall be made in accordance with ASME A112.3.1 and shall be welded autogenously. Pipe shall be cleaned, free of scale and contaminating particles. Pipe shall be cut with a combination cutting and beveling tool that provides a square cut, and free of burrs. Mineral oil lubricant shall be used during the cutting and beveling process.

9.8 Vitrified clay pipe and joints

Joining methods for vitrified clay pipe and fittings shall be installed in accordance with the manufacturer's installation instructions and shall comply with clause 9.8.1.

9.8.1 Mechanical joints

Mechanical joints shall be designed to provide a permanent seal and shall be of the mechanical or push-on joint type. The push-on joint shall include an elastomeric gasket that complies with ASTM C425 and shall provide a compressive force against the spigot and socket after assembly to provide a permanent seal.

9.9 Special joints

Special joints shall comply with clause 9.9.1 through clause 9.9.4.

9.9.1 Slip joints

In fixture drains and traps, slip joints of approved materials shall be permitted to be used in accordance with their approvals.

9.9.2 Expansion joints

Expansion joints shall be accessible, except where in vent piping or drainage stacks, and shall be permitted to be used where necessary to provide for expansion and contraction of the pipes.

9.9.3 Ground joint, flared, or ferrule connections

Copper or copper alloy ground joint flared, or ferrule-type connections that allow adjustment of tubing, but provide a rigid joint where made up, shall not be considered as slip joints.

9.9.4 Transition joint

A solvent cement transition joint between ABS and PVC building drain and building sewer shall be made using listed transition solvent cement in accordance with ASTM D3138.

9.10 Joints between various materials

Joints between various materials shall be installed in accordance with the manufacturer's installation instructions and with clause 9.10.1 through clause 9.10.4. Mechanical couplings used to join different materials shall comply

with ASTM C1173 for belowground use, ASTM C1460 for aboveground use, or ASTM C1461 for aboveground and belowground use.

9.10.1 Copper or copper alloy pipe to cast-iron pipe

Joints from copper or copper alloy pipe or tubing to cast-iron pipe shall be made with a listed compression-type joint or copper alloy ferrule. The copper or copper alloy pipe or tubing shall be soldered or brazed to the ferrule, and the ferrule shall be joined to the cast-iron hub by a compression or caulked joint.

9.10.2 Copper or copper alloy pipe to threaded pipe joints

Joints from copper or copper alloy pipe or tubing to threaded pipe shall be made by the use of a listed copper alloy adapter or dielectric fitting. The joint between the copper or copper alloy pipe and the fitting shall be a soldered or brazed, and the connection between the threaded and the fittings shall be made with a standard pipe size threaded joint.

9.10.3 Plastic pipe to other materials

Where connecting plastic pipe to other types of plastic or other types of piping material; approved listed adapter or transition fittings and listed for the specific transition intended shall be used. Except as provided in clause 9.9.4, PVC and ABS pipe and fittings shall not be solvent welded to any other unlike material.

9.10.4 Stainless steel pipe to other materials

Where connecting stainless steel pipe to other types of piping, listed mechanical joints of the compression type and listed for the specific transition intended shall be used.

10 Changes in direction of drainage flow

10.1 Approved fittings

Changes in the direction of drainage piping shall be made by the appropriate use of approved fittings and shall be of the angles presented by a one-sixteenth bend, one-eighth bend, or one-sixth bend, or other approved fittings of equivalent sweep.

10.2 Horizontal to vertical

Horizontal drainage lines, connecting with a vertical stack, shall enter through 45 degree (0.79 rad) wye branches, 60 degree (1.05 rad) wye branches, combination wye and one-eighth bend branches, sanitary tee or sanitary tapped tee branches, or other approved fittings of equivalent sweep. No fitting having more than one inlet at the same level shall be used unless such fitting is constructed so that the discharge from one inlet cannot readily enter any other inlet. Double sanitary tees shall be permitted to be used where the barrel of the fitting is not less than two pipe sizes larger than the largest inlet, (pipe sizes recognized for this purpose are (50 mm, 65 mm, 80 mm, 90 mm, 100 mm, 115 mm, 125 mm, 150 mm, etc.) 2 inches, 2½ inches, 3 inches, 3½ inches, 4 inches, 4½ inches, 5 inches, 6 inches, etc.)

10.3 Horizontal to horizontal

Horizontal drainage lines connecting with other horizontal drainage lines shall enter through 45 degree (0.79 rad) wye branches, combination wye and one-eighth bend branches, or other approved fittings of equivalent sweep.

10.4 Vertical to horizontal

Vertical drainage lines connecting with horizontal drainage lines shall enter through 45 degree (0.79 rad) wye branches, combination wye and one-eighth bend branches, or other approved fittings of equivalent sweep. Branches or offsets of 60 degrees (1.05 rad) shall be permitted to be used where installed in a true vertical position.

11 Cleanouts

11.1 Plug

Each cleanout fitting for cast-iron pipe shall consist of a cast-iron or copper alloy body and an approved plug. Each cleanout for galvanized wrought iron, galvanized steel, copper, or copper alloy pipe shall consist of a plug as specified in Table 8. or a standard weight copper alloy cap, or an approved ABS or PVC plastic plug, or an approved stainless steel cleanout or plug. Plugs shall have raised square heads or approved countersunk rectangular slots.

Table 8 — Cleanouts

Size of pipe inches	Size of cleanout inches	Threads Per inches
1 1/2	1 1/2	1 1/2
2	1 1/2	1 1/2
2 1/2	2 1/2	8
3	2 1/2	8
4 and larger	3 1/2	8

For SI units: 1 inch = 25 mm

11.2 Approved

Each cleanout fitting and each cleanout plug or cap shall be of an approved type. A list of approved standards for cleanouts are referenced in Table 9.

Table 9 — Cleanout materials for drain, waste, and vent

Material	Standard
ABS	ASTM D2661, CSA B79, IAPMO IGC 78, IAPMO IGC 224
Cast Iron	ASME A112.36.2M, ASTM A888, CISPI 301, CSA B79, IAPMO IGC 224
Copper or Copper Alloy	ASME A112.36.2M, CSA B79
Ductile Iron	CSA B79
Elastomers	CSA B79, IAPMO PS 90
Polyethylene (PE)	CSA B79
Polypropylene (PP)	CSA B79
PVC	ASTM D2665, CSA B79, IAPMO IGC 78, IAPMO IGC 224
Polyvinylidene Fluoride (PVDF)	CSA B79
Stainless Steel	CSA B79

11.3 Watertight and gastight

Cleanouts shall be designed to be watertight and gastight.

11.4 Location

Each horizontal drainage pipe shall be provided with a cleanout at its upper terminal, and each run of piping, that is more than 30480 mm (100 feet) in total developed length, shall be provided with a cleanout for each 30480 mm, (100 feet) or fraction thereof, in length of such piping. An additional cleanout shall be provided in a drainage line for each aggregate horizontal change in direction exceeding 135 degrees (2.36 rad). A cleanout shall be installed above the fixture connection fitting, serving each urinal, regardless of the location of the urinal in the building.

Exceptions:

- (1) Cleanouts shall be permitted to be omitted on a horizontal drain line less than 5 feet (1524 mm) in length unless such line is serving sinks or urinals.
- (2) Cleanouts shall be permitted to be omitted on a horizontal drainage pipe installed on a slope of 72 degrees (1.26 rad) or less from the vertical angle (one-fifth bend).
- (3) Excepting the building drain, its horizontal branches, kitchen sinks, and urinals, a cleanout shall not be required on a pipe or piping that is above the floor level of the lowest floor of the building.

(4) An approved type of two-way cleanout fitting, installed inside the building wall near the connection between the building drain and the building sewer or installed outside of a building at the lower end of a building drain and extended to grade, shall be permitted to be substituted for an upper terminal cleanout.

11.4.1 Load rated cover

Cleanout floor covers and top rims meant to take loads shall be rated for the loading in accordance with ASME A112.36.2M.

11.5 Cleaning

Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of the soil or waste or at right angles thereto and, except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

11.6 Extension

Each cleanout extension shall be considered as drainage piping and each 90-degree (1.57 rad) cleanout extension shall be extended from a wye-type fitting or other approved fitting of equivalent sweep.

11.7 Interceptor

Each cleanout for an interceptor shall be outside of such interceptor.

11.8 Access

Each cleanout, unless installed under an approved cover plate, shall be above grade, readily accessible, and so located as to serve the purpose for which it is intended. Cleanouts located under cover plates shall be so installed as to provide the clearances and accessibility required by this Clause.

11.9 Clearance

Each cleanout in piping 2 inches (50 mm) or less in size shall be so installed that there is a clearance of not less than 18 inches (457 mm) by 18 inches (457 mm) in front of the cleanout. Cleanouts in piping exceeding 2 inches (50 mm) shall have a clearance of not less than 24 inches (610 mm) by 24 inches (610 mm) in front of the cleanout. Cleanouts in under-floor piping shall be extended to or above the finished floor or shall be extended outside the building where there is less than 18 inches (457 mm) vertical overall, allowing for obstructions such as ducts, beams, and piping, and 30 inches of (762 mm) horizontal clearance from the means of access to such cleanout. No under-floor cleanout shall be located exceeding 5 feet (1524 mm) from an access door, trap door, or crawl hole.

11.10 Fittings

Cleanout fittings shall be not less in size than those given in Table 707.1.

11.11 Pressure drainage systems

Cleanouts shall be provided for pressure drainage systems as classified under .clause 14.7

11.12 Countersunk cleanout plugs

Countersunk cleanout plugs shall be installed where raised heads cause a hazard.

11.13 Hubless blind plugs

Where a hubless blind plug is used for a required cleanout, the complete coupling and plug shall be accessible for removal or replacement.

11.14 Trap arms

Cleanouts for trap arms shall be installed in accordance with .clause 44.3

12 Grade of horizontal drainage piping

12.1 General

Building drain and other horizontal drainage piping shall be run in practical alignment and a uniform slope of not less than 1/4 inch per foot (20.8 mm/m) or 2 percent toward the point of disposal.

Where it is impractical due to the depth of the street sewer, structural features, or to the arrangement of a building or structure to obtain a slope of 1/4 inch per foot (20.8 mm/m) or 2 percent, building drain piping 4 inches (100 mm) or larger in diameter shall be permitted to have a slope of not less than 1/8 inch per foot (10.4 mm/m) or 1 percent, when first approved by the Competent Authority.

13 Gravity drainage required

13.1 General

Where practicable, plumbing fixtures shall be drained to the public sewer or private sewage disposal system by gravity.

14 Drainage of fixtures located below the next upstream manhole or below the main sewer level

14.1 Backflow protection

Fixtures installed on a floor level that is lower than the next upstream manhole cover of the public, or private sewer shall be protected from backflow of sewage by installing an approved type of backwater valve. Fixtures on such floor level that are not below the next upstream manhole cover shall not be required to be protected by a backwater valve. Fixtures on floor levels above such elevation shall not discharge through the backwater

valve. Cleanouts for drains that pass through a backwater valve shall be clearly identified with a permanent label stating "backwater valve downstream."

14.2 Sewage discharge

Drainage piping serving fixtures that are located below the crown level of the main sewer shall discharge into an approved watertight sump or receiving tank, so located as to receive the sewage or wastes by gravity. From such sump or receiving tank, the sewage or other liquid wastes shall be lifted and discharged into the building drain or building sewer by approved ejectors, pumps, or other equally efficient approved mechanical devices.

14.3 Sewage ejector and pumps

A sewage ejector or sewage pump receiving the discharge of water closets or urinals:

- (1) Shall have a discharge capacity of not less than 20 gpm (1.26 L/s).
- (2) In single dwelling units, the ejector or pump shall be capable of passing an 1 1/2 inch (38 mm) diameter solid ball, and the discharge piping of each ejector or pump shall have a backwater valve and gate valve, and be not less than 2 inches (50 mm) in diameter.
- (3) In other than single-dwelling units, the ejector or pump shall be capable of passing a 2 inch (51 mm) diameter solid ball, and the discharge piping of each ejector or pump shall have a backwater valve and gate valve, and be not less than 3 inches (80 mm) in diameter.

14.4 Discharge line

The discharge line from such ejector, pump, or another mechanical device shall be of approved pressure rated material and be provided with an accessible backwater or swing check valve and gate or ball valve. Where the gravity drainage line to which such discharge line connects is horizontal, the method of connection shall be from the top through a wye branch fitting. The gate or ball valve shall be located on the discharge side of the backwater or check valve.

Gate or ball valves, where installed in drainage piping, shall be fullway type with working parts of corrosion-resistant metal. Sizes 4 inches (100 mm) or more in diameter shall have cast-iron bodies and sizes less than 4 inches (100 mm), cast-iron or copper alloy bodies.

14.5 Size of building drains and sewers

Building drains or building sewers receiving a discharge from a pump or ejector shall be adequately sized to prevent overloading. Two fixture units shall be allowed for each gallon per minute (L/s) of flow.

14.6 Backwater valves

Backwater valves, gate valves, fullway ball valves, unions, motors, compressors, air tanks, and other mechanical devices required by this clause shall be located where they will be accessible for inspection and repair and, unless continuously exposed, shall be enclosed in a masonry pit fitted with an adequately sized removable cover.

Backwater valves shall comply with IAPMO IGC 305 or other relevant applicable standards and have bodies of cast-iron, plastic, copper alloy, or other approved materials; shall have noncorrosive bearings, seats, and self-aligning discs; and shall be constructed to ensure a positive mechanical seal. Such backwater valves shall remain open during periods of low flows to avoid screening of solids and shall not restrict capacities or cause excessive turbulence during peak loads. Unless otherwise listed, valve access covers shall be bolted type with gasket, and each valve shall bear the manufacturer's name cast into the body and the cover.

14.7 Drainage and venting systems

The drainage and venting systems, in connection with fixtures, sumps, receiving tanks, and mechanical waste-lifting devices shall be installed under the same requirements as provided for in this standard for gravity systems.

14.8 Sump and receiving tank construction

Sumps and receiving tanks shall be watertight and shall be constructed of concrete, metal, or other approved materials. Where constructed of poured concrete, the walls and bottom shall be adequately reinforced and designed to recognized acceptable standards. Metal sumps or tanks shall be of such thickness as to serve their intended purpose and shall be treated internally and externally to resist corrosion.

14.9 Alarm

Such sumps and receiving tanks shall be automatically discharged and, wherein a "public use" occupancy, shall be provided with dual pumps or ejectors arranged to function alternately in normal use and independently. Such pumps shall be capable of running continuously in case of overload or mechanical failure of one of the pumps or ejectors. The pumps shall have an audio and visual alarm, readily accessible, that signals pump failure or an overload condition. The lowest inlet shall have a clearance of not less than 2 inches (51 mm) from the high-water or "starting" level of the sump.

14.10 Sump and receiving tank covers and vents

Sumps and receiving tanks shall be provided with substantial covers having a bolt-and-gasket-type manhole or equivalent opening to permit access for inspection, repairs, and cleaning. The top shall be provided with a vent pipe that shall extend separately through the roof or, where permitted, be combined with other vent pipes. Such vent shall be large enough to maintain atmospheric pressure within the sump under normal operating conditions and, in no case, shall be less in size than that required by Table 8 for the number and type of fixtures discharging into the sump, nor less than 1½ inches (40 mm) in diameter. Where the preceding requirements are met and the vent, after leaving the sump, is combined with vents from fixtures discharging into the sump, the size of the combined vent need not exceed that required for the total number of fixtures discharging into the sump. No vent from an air-operating sewage ejector shall combine with other vents.

14.11 Air tanks

Air tanks shall be so proportioned as to be of equal cubical capacity to the ejectors connected in addition to that in which there shall be maintained an air pressure of not less than 2 pounds per foot (lb/ft) (3 kg/m) of height the sewage is to be raised. No water-operated ejectors shall be permitted.

14.12 Grinder pump ejector

Grinder pumps shall be permitted to be used.

14.12.1 Discharge piping

The discharge piping shall be sized in accordance with the manufacturer's installation instructions and shall be not less than 1¼ inches (32 mm) in diameter. A check valve and fullway-type shutoff valve shall be located on the discharge line.

14.13 Macerating toilet systems and pumped waste systems

Fixtures shall be permitted to discharge to a macerating toilet system, or pumped waste system shall be permitted as an alternate to a sewage pump system where approved by the Competent Authority. Such systems shall comply with ASME A112.3.4/CSA B45.9 and shall be installed in accordance with the manufacturer's installation instructions.

14.13.1 Sumps

The sump shall be watertight and gastight.

14.13.2 Discharge piping

The discharge piping shall be sized in accordance with manufacturer's instructions and shall be not less than ¾ of an inch (20 mm) in diameter. The developed length of the discharge piping shall not exceed the manufacturer's instructions. A check valve and fullway-type shutoff valve shall be located within the discharge line or internally within the device.

14.13.3 Venting

The plumbing fixtures that discharge into the macerating device shall be vented in accordance with this standard. The sump shall be vented in accordance with the manufacturer's instructions, and such vent shall be permitted to connect to the fixture venting.

15 Suds relief

15.1 General

Drainage connections shall not be made into a drainage piping system within 8 feet (2438 mm) of a vertical to horizontal change of direction of a stack containing suds-producing fixtures. Bathtubs, laundries, washing machine standpipes, kitchen sinks, and dishwashers shall be considered suds-producing fixtures. Where parallel vent stacks are required, they shall connect to the drainage stack at a point 8 feet (2438 mm) above the lowest point of the drainage stack.

Exceptions:

- (1) Single-family residences.
- (2) Stacks receiving the discharge from less than three stories of plumbing fixtures.

16 Testing

16.1 Media

The piping of the plumbing, drainage, and venting systems shall be tested with water or air except that plastic pipe shall not be tested with air. The Competent Authority shall be permitted to require the removal of cleanouts, etc., to ascertain whether the pressure has reached all parts of the system. After the plumbing fixtures have been set and their traps filled with water, they shall be submitted to a final test.

16.2 Water test

The water test shall be applied to the drainage and vent systems either in its entirety or in sections. Where the test is applied to the entire system, openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. Where the system is tested in sections, each opening shall be tightly plugged, except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot head of water (30 kPa). In testing successive sections, not less than the upper 10 feet (3048 mm) of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet (3048 mm) of the system) shall have been submitted to a test of less than a 10 foot head of water (30 kPa). The water shall be kept in the system, or in the portion under test, for not less than 15 minutes before inspection starts. The system shall then be tight at all points.

16.3 Air test

The air test shall be made by attaching an air compressor testing apparatus to a suitable opening and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 pounds-force per square inch (psi) (34 kPa) or sufficient to balance a column of mercury 10 inches (34 kPa) in height. The pressure shall be held without the introduction of additional air for a period of not less than 15 minutes.

Part II – Building Sewers

17 Sewer required

17.1 Where required

A building in which plumbing fixtures are installed and premises having drainage piping thereon shall have a connection to a public or private sewer, except as provided in clause 17.2, and clause 17.4

17.2 Private sewage disposal system

Where no public sewer intended to serve a lot or premises is available in a thoroughfare or right of way abutting such lot or premises, drainage piping from a building or works shall be connected to a private sewage disposal system as approved by the Competent Authority. See Annex C.

17.3 Public sewer

Within the limits prescribed by clause 17.4 hereof, the rearrangement or subdivision into smaller parcels of a lot that abuts and is served by a public sewer shall not be deemed cause to permit the construction of a private

sewage disposal system, and plumbing or drainage systems on a smaller parcel or parcels shall connect to the public sewer.

17.4 Public sewer availability

The public sewer shall be permitted to be considered as not being available where such public sewer or a building or an exterior drainage facility connected thereto is located more than 200 feet (60 960 mm) from a proposed building or exterior drainage facility on a lot or premises that abut and is served by such public sewer.

17.5 Permit

No permit shall be issued for the installation, alteration, or repair of a private sewage disposal system, or part thereof, on a lot for which a connection with a public sewer is available.

17.6 Lot

On every lot or premises hereafter connected to a public sewer, plumbing, and drainage systems or parts thereof on such lot or premises shall be connected with such public sewer.

17.7 Installation

In cities, counties, or both where the installation of building sewers is under the jurisdiction of a department other than the Competent Authority, the provisions of this standard relating to building sewers need not apply.

Exception

Single-family dwellings and buildings or structures accessory thereto, existing and connected to an approved private sewage disposal system prior to the time of connecting the premises to the public sewer shall be permitted, where no hazard, nuisance, or insanitary condition is evidenced, and written permission has been obtained from the Competent Authority, remain connected to such properly maintained private sewage disposal system where there is insufficient grade or fall to permit drainage to the sewer by gravity.

18 Damage to public sewer or private sewage disposal system

18.1 Unlawful practices

It shall be unlawful for a person to deposit, by means whatsoever, into a plumbing fixture, floor drain, interceptor, sump, receptor, or device which is connected to a drainage system, public sewer, private sewer, septic tank, or cesspool, ashes; cinders; solids; rags; flammable, poisonous, or explosive liquids or gases; oils; grease; and whatsoever that is capable of causing damage to the public sewer, private sewer, or private sewage disposal system.

18.2 Prohibited water discharge

No rain, surface, or subsurface water shall be connected to or discharged into a drainage system unless first approved by the Competent Authority.

18.3 Prohibited sewer connection

No cesspool, septic tank, seepage pit, or drain field shall be connected to a public sewer or to a building sewer leading to such public sewer.

18.4 Commercial food waste disposer

The Competent Authority shall review before approval, the installation of a commercial food waste disposer connecting to a private sewage disposal system.

18.5 Tanks

An approved type, watertight sewage or wastewater holding tank, the contents of which, due to their character, shall be periodically removed and disposed of at some approved off-site location, shall be installed where required by the Competent Authority or the Health Officer to prevent anticipated surface or subsurface contamination or pollution, damage to the public sewer, or other hazardous or nuisance conditions.

19 Building sewer materials

19.1 Materials

The building sewer, beginning 2 feet (610 mm) from a building or structure, shall be of such materials as prescribed in this standard.

19.2 Joining methods and materials

Joining methods and materials shall be as prescribed in this standard.

19.3 Existing sewers

Where permitted by the Competent Authority, trenchless methods of rehabilitation of existing building sewer and building storm sewers shall be installed in accordance with clause 19.3.1 or clause 19.3.2.

19.3.1 Sewer pipe lining

For trenchless installation of resin-impregnated flexible tubing to line existing building sewers and building storm sewers installation shall be in accordance with ASTM F1216, ASTM F2561, ASTM F2599, or ASTM F3240.

19.3.2 Sewer pipe replacement

For trenchless installation of polyethylene (PE) pipe using the pipe bursting method to replace existing building sewers and building storm sewers materials shall be in accordance with ASTM F714.

20 Marking

20.1 General

Pipe, brick, block, prefabricated septic tanks, prefabricated septic tank or seepage pit covers, or other parts or appurtenances incidental to the installation of building sewers or private sewage disposal systems shall be in accordance with the approval requirements of WDRS xxx-3 of this standard.

21 Size of building sewers

21.1 General

The minimum size of a building sewer shall be determined on the basis of the total number of fixture units drained by such sewer, in accordance with Table 10. No building sewer shall be smaller than the building drain.

For alternate methods of sizing building sewers, see ANNEX C.

Table 10 — Maximum/minimum fixture unit loading on building sewer piping*

Size of pipe (inches)	Slope (inches per foot)		
	1/16	1/8	1/4
6 and smaller	(As specified in Table X/ No minimum loading)		
8	1950/1500	2800/625	3900/275
10	3400/1600	4900/675	6800/300
12	5600/1700	8000/725	11 200/325

For SI units: 1 inch = 25 mm, 1 inch per foot = 83.3 mm/m

* See also Appendix H, Private Sewage Disposal Systems. For alternate methods of sizing drainage piping, see Appendix C.

22 Grade, support, and protection of building sewers

22.1 Slope

Building sewers shall be run in practical alignment and at a uniform slope of not less than 1/4 inch per foot (20.8 mm/m) toward the point of disposal.

Exception:

Where approved by the Competent Authority and where it is impractical, due to the depth of the street sewer, the structural features or the arrangement of a building or structure, to obtain a slope of 1/4 inch per foot (20.8 mm/m), piping 4 inches (100 mm) through 6 inches (150 mm) shall be permitted to have a slope of not less than 1/8 inch per foot (10.4 mm/m) and piping 8 inches (200 mm) and larger shall be permitted to have a slope of not less than 1/16 inch per foot (5.2 mm/m). The maximum and minimum fixture unit loading shall be in accordance with Table 10

22.2 Support

Building sewer piping shall be laid on a firm bed throughout its entire length, and such piping laid in made or filled-in ground shall be laid on a bed of approved materials and shall be properly supported as required by the Competent Authority.

22.3 Protection from damage

No building sewer or other drainage piping or part thereof, which is constructed of materials other than those approved for use under or within a building, shall be installed under or within 610 mm (2 feet) of a building or structure, or part thereof, nor less than 1 foot (305 mm) below the surface of the ground. The provisions of this sub clause include structures such as porches and steps, whether covered or uncovered; breezeways; roofed porte cochere; roofed patios; carports; covered walks; covered driveways; and similar structures or appurtenances.

23 Cleanouts

23.1 Locations

Cleanouts shall be placed inside the building near the connection between the building drain and the building sewer or installed outside the building at the lower end of the building drain and extended to grade.

Additional building sewer cleanouts shall be installed at intervals not to exceed 100 feet (30 480 mm) in straight runs and for each aggregate horizontal change in direction exceeding 135 degrees (2.36 rad).

23.2 No additional cleanouts

Where a building sewer or a branch thereof does not exceed 3048 mm (10 feet) in length and is a straight-line projection from a building drain that is provided with a cleanout, no cleanout will be required at its point of connection to the building drain.

23.3 Building sewer cleanouts

Required building sewer cleanouts shall be extended to grade and shall be in accordance with the appropriate sections of cleanouts, Subclause 107.0 t, for sizing, construction, and materials. Where building sewers are located under buildings, the cleanout requirements of Subclause 107.0 shall apply.

23.4 Cleaning

Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of the soil or waste or at right angles thereto and, except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

23.5 Access

Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or by extending flush with paving with approved materials and shall be adequately protected.

23.6 Manholes

Approved manholes shall be permitted to be installed in lieu of cleanouts, where first approved by the Competent Authority. The maximum distance between manholes shall not exceed 91 440 mm (300 feet).

The inlet and outlet connections shall be made by the use of a flexible compression joint not less than 12 inches (305 mm) and not exceeding 914 mm (3 feet) from the manhole. No flexible compression joints shall be embedded in the manhole base.

24 Subclause 120.0 Sewer and water pipes

24.1 General

Building sewers or drainage piping of clay or materials that are not approved for use within a building shall not be run or laid in the same trench as the water pipes unless the following requirements are met:

- (1) The bottom of the water pipe, at points, shall be not less than 305 mm (12 inches) above the top of the sewer or drain line.
- (2) The water pipe shall be placed on a solid shelf excavated at one side of the common trench with a clear horizontal distance of not less than 305 mm (12 inches) from the sewer or drain line.
- (3) Water pipes crossing sewer or drainage piping constructed of clay or materials that are not approved for use within a building shall be laid not less than 305 mm (12 inches) above the sewer or drainpipe.

For the purpose of this clause, "within a building" shall mean within the fixed limits of the building foundation.

25 Location

25.1 Building sewer

Except as provided in clause 25.2, no building sewer shall be located in a lot other than the lot that is the site of the building or structure served by such sewer nor shall a building sewer be located at a point having less than the minimum distances referenced in Table 11.

Table 11 — Minimum horizontal distance required from building sewer (feet)

Buildings or structures ¹	2
Property line adjoining private property	Clear ²
Water supply wells	50 ³
Streams	50
On-site domestic water service line	14
Public water main	10 ^{5, 6}

For SI units: 1 foot = 304.8 mm

Notes:

1 Including porches and steps, whether covered or uncovered; breezeways; roofed porte-cochere; roofed patios; carports; covered walks; covered driveways; and similar structures or appurtenances.

2 See also DRS 644-2

3 Drainage piping shall clear domestic water supply wells by not less than 15240 mm (50 feet). This distance shall be permitted to be reduced to not less than 7620 mm (25 feet) where the drainage piping is constructed of materials approved for use within a building.

4 See DRS 644-5

5 For parallel construction.

6 For crossings, approval by Competent Authority shall be required.

25.2 Abutting lot

Nothing contained in this standard shall be construed to prohibit the use of all or part of an abutting lot to:

(1) Provide access to connect a building sewer to an available public sewer where proper cause and legal easement, not in violation of other requirements, has been first established to the satisfaction of the Competent Authority.

(2) Provide additional space for a building sewer where the proper cause, transfer of ownership, or change of boundary, not in violation of other requirements, has been first established to the satisfaction of the Competent Authority. The instrument recording such action shall constitute an agreement with the Competent Authority and shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such an agreement shall be recorded in the office of the County Recorder as part of the conditions of ownership of said properties, and shall be binding on heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Competent Authority.

26 Abandoned sewers and sewage disposal facilities

26.1 Building (house) sewer

An abandoned building (house) sewer, or part thereof, shall be plugged or capped in an approved manner within 5 feet (1524 mm) of the property line.

26.2 Cesspools, septic tanks, and seepage pits

A cesspool, septic tank, and seepage pit that has been abandoned or has been discontinued otherwise from further use, or to which no waste or soil pipe from a plumbing fixture is connected, shall have the sewage removed therefrom and be completely filled with earth, sand, gravel, concrete, or other approved material.

26.3 Filling

The top cover or arch over the cesspool, septic tank, or seepage pit shall be removed before filling, and the filling shall not extend above the top of the vertical portions of the sidewalls or above the level of the outlet pipe until inspection has been called and the cesspool, septic tank, or seepage pit has been inspected. After such inspection, the cesspool, septic tank, or seepage pit shall be filled to the level of the top of the ground.

26.4 Ownership

No person owning or controlling a cesspool, septic tank, or seepage pit on the premises of such person or in that portion of a public street, alley, or other public property abutting such premises, shall fail, refuse, or neglect to comply with the provisions of this clause or upon receipt of notice so to comply from the Competent Authority.

26.5 Disposal facilities

Where disposal facilities are abandoned consequent to connecting premises with the public sewer, the permittee making the connection shall fill abandoned facilities in accordance with the Competent Authority within 30 days from the time of connecting to the public sewer.

27 Building sewer test

27.1 General

Building sewers shall be tested by plugging the end of the building sewer at its points of connection to the public sewer or private sewage disposal system and completely filling the building sewer with water from the lowest to the highest point thereof, or by approved equivalent low-pressure air test. Plastic DWV piping systems shall not be tested by the air test method. The building sewer shall be watertight.

28 Indirect wastes

28.1 General

28.1.1 Air gap or air break required

Indirect waste piping shall discharge into the building drainage system through an air gap or air break as set forth in this standard. Where a drainage air gap is required by this standard, the minimum vertical distance as measured from the lowest point of the indirect waste pipe or the fixture outlet to the flood-level rim of the receptor shall be not less than 25.4 mm (1 inch).

28.1.2 Food and beverage handling establishments

Establishments engaged in the storage, preparation, selling, serving, processing, or other handling of food and beverage involving the following equipment that requires drainage shall provide indirect waste piping for refrigerators, refrigeration coils, freezers, walk-in coolers, iceboxes, ice-making machines, steam tables, egg boilers, coffee urns and brewers, hot-and-cold drink dispensers, and similar equipment.

28.1.3 Size of indirect waste pipes

Except for refrigeration coils and ice-making machines, the size of the indirect waste pipe shall be not smaller than the drain on the unit, but shall be not smaller than 25 mm (1 inch), and the maximum developed length shall not exceed 4572 mm (15 feet). Indirect waste pipe for ice-making machines shall be not less than the drain on the unit and in no case less than 20 mm ($\frac{3}{4}$ of an inch).

28.1.4 Walk-in coolers

For walk-in coolers, floor drains shall be permitted to be connected to a separate drainage line discharging into an outside receptor. The flood-level rim of the receptor shall be not less than 152 mm (6 inches) lower than the lowest floor drain. Such floor drains shall be trapped and individually vented. Cleanouts shall be provided at 90° (1.57 rad) turns and shall be accessibly located. Such waste shall discharge through an air gap or air break into a trapped and vented receptor, except that a full-size air gap is required where the indirect waste pipe is under vacuum.

28.1.5 Food-handling fixtures

Food-preparation sinks, steam kettles, potato peelers, ice cream dipper wells, and similar equipment shall be indirectly connected to the drainage system by means of an air gap. Bins, sinks, and other equipment having drainage connections and used for the storage of unpackaged ice used for human ingestion, or used in direct contact with ready-to-eat food, shall be indirectly connected to the drainage system by means of an air gap.

Each indirect waste pipe from food-handling fixtures or equipment shall be separately piped to the indirect waste receptor and shall not combine with other indirect waste pipes. The piping from the equipment to the receptor shall be not less than the drain on the unit and in no case less than $\frac{1}{2}$ of an inch (15 mm).

28.1.6 Bar and fountain sink traps

Where the sink in a bar, soda fountain, or counter is so located that the trap serving the sink cannot be vented, the sink drain shall discharge through an air gap or air break (WDRS xxx-8 clause 8.3.1) into an approved receptor that is vented. The developed length from the fixture outlet to the receptor shall not exceed 1524 mm (5 feet).

28.1.7 Connections from water distribution system

Indirect waste connections shall be provided for drains, overflows, or relief pipes from potable water pressure tanks, water heaters, boilers, and similar equipment that is connected to the potable water distribution system. Such indirect waste connections shall be made using a water-distribution air gap constructed in accordance with Table 12.

Table 12 — Minimum air gaps for water distribution⁴

Fixtures	Where not affected by sidewalls ¹	Where affected by sidewalls ²
	inches	inches
Effective openings ³ not greater than $\frac{1}{2}$ of an inch in diameter	1	1 $\frac{1}{2}$
Effective openings ³ not greater than $\frac{3}{4}$ of an inch in diameter	1 $\frac{1}{2}$	2 $\frac{1}{4}$
Effective openings ³ not greater than 1 inch in diameter	2	3
Effective openings ³ greater than 1 inch in diameter	Two times the diameter of effective opening	Three times the diameter of effective opening

28.1.8 Sterilizers

Lines, devices, or apparatus such as stills, sterilizers, and similar equipment requiring waste connections and used for sterile materials shall be indirectly connected using an air gap. Each such indirect waste pipe shall be separately piped to the receptor and shall not exceed 4572 mm (15 feet). Such receptors shall be located in the same room.

28.1.9 Drip or drainage outlets

Appliances, devices, or apparatus not regularly classified as plumbing fixtures, but which have a drip or drainage outlets, shall be permitted to be drained by indirect waste pipes discharging into an open receptor through either an air gap or air break (see WDRS xxx-5).

29 Indirect waste piping

29.1 Materials

Pipe, tube, and fittings conveying indirect waste shall be of such materials and design as to perform their intended function to the satisfaction of the Competent Authority.

29.2 Copper and copper alloys

Joints and connections in copper and copper alloy pipe and tube shall be installed in accordance with WDRS xxx-1 Clause 1.3

29.3 Pipe size and length

Except as hereinafter provided, the size of indirect waste piping shall be in accordance with other parts of this standard applicable to drainage and vent piping. No vent from indirect waste piping shall combine with a sewer-connected vent. Vents from indirect waste piping shall extend separately to the outside air. Indirect waste pipes exceeding 5 feet (1524 mm), but less than 4572 mm (15 feet) in length shall be directly trapped, but such traps need not be vented.

Indirect waste pipes less than 4572 mm (15 feet) in length shall be not less than the diameter of the drain outlet or tailpiece of the fixture, appliance, or equipment served, and in no case less than 1/2 of an inch (15 mm). Angles and changes of direction in such indirect waste pipes shall be provided with cleanouts to permit flushing and cleaning.

30 Indirect waste receptors

30.1 Standpipe receptors

Plumbing fixtures or other receptors receiving the discharge of indirect waste pipes shall be approved for the use proposed and shall be of such shape and capacity as to prevent splashing or flooding and shall be located where they are readily accessible for inspection and cleaning. No standpipe receptor for a clothes washer shall extend more than 762 mm (30 inches), or not less than 457 mm (18 inches) above its trap weir. No trap for a clothes washer standpipe receptor shall be installed below the floor, but shall be roughed in not less than 152 mm (6 inches) and not more than 457 mm (18 inches) above the floor. No indirect waste receptor shall be installed in a toilet room, closet, cupboard, or storeroom, or in a portion of a building not in general use by the occupants thereof, except standpipes for clothes washers shall be permitted to be installed in toilet and bathroom areas where the clothes washer is installed in the same room.

31 Pressure drainage connections

31.1 General

Indirect waste connections shall be provided for drains, overflows, or relief vents from the water supply system, and no piping or equipment carrying wastes or producing wastes or other discharges under pressure shall be directly connected to a part of the drainage system.

The preceding shall not apply to an approved sump pump or to an approved pressure-wasting plumbing fixture or device where the Competent Authority has been satisfied that the drainage system is adequately sized to accommodate the anticipated discharge thereof.

32 Sterile equipment

32.1 General

Appliances, devices, or apparatus such as stills, sterilizers, and similar equipment requiring water and waste and used for sterile materials shall be drained through an air gap.

33 Appliances

33.1 Non-classed apparatus

Commercial dishwashing machines, silverware washing machines, and other appliances, devices, equipment, or other apparatus not regularly classed as plumbing fixtures, which are equipped with pumps, drips, or drainage outlets, shall be permitted to be drained by indirect waste pipes discharging through an air break into an approved type of open receptor.

33.2 Undiluted condensate waste

Where undiluted condensate waste from a fuel-burning condensing appliance is discharged into the drainage system, the material in the drainage system shall be cast-iron, galvanized iron, plastic, or other materials approved for this use.

Exceptions:

- (1) Where the above condensate is discharged to an exposed fixture tailpiece and trap, such tailpiece and trap shall be permitted to be a copper alloy.
- (2) Materials approved in WDRS xxx-5 clause 5 shall be permitted to be used where data is provided that the condensate waste is adequately diluted.

33.3 Domestic dishwashing machine

No domestic dishwashing machine shall be directly connected to a drainage system or food waste disposer without the use of an approved dishwasher air gap fitting on the discharge side of the dishwashing machine. Listed dishwasher air gap fittings shall be installed with the flood-level (FL) marking at or above the flood level of the sink or drainboard, whichever is higher.

34 Cooling water

34.1 General

Where permitted by the Competent Authority, clean running water used exclusively as a cooling medium in an appliance, device, or apparatus shall be permitted to discharge into the drainage system through the inlet side of a fixture trap in the event that a suitable fixture is not available to receive such discharge. Such trap connection shall be by means of a pipe connected to the inlet side of an approved fixture trap, the upper end terminating in

a funnel-shaped receptacle set adjacent, and not less than 152 mm (6 inches) above the overflow rim of the fixture.

35 Drinking fountains

35.1 General

Drinking fountains shall be permitted to be installed with indirect wastes through an air break.

36 Steam and hot water drainage condensers and sumps

36.1 High-temperature discharge

No steam pipe shall be directly connected to plumbing or drainage system, nor shall water having a temperature above 140 °F (60 °C) be discharged under pressure directly into a drainage system. Pipes from boilers shall discharge by means of indirect waste piping as determined by the Competent Authority or the boiler manufacturer's recommendations. Such pipes shall be permitted to be indirectly connected by discharging into an open or closed condenser or an intercepting sump of an approved type that will prevent the entrance of steam or such water under pressure into the drainage system. Closed condensers or sumps shall be provided with a vent that shall be taken off the top and extended separately, full size above the roof. Condensers and sumps shall be properly trapped at the outlet with a deep seal trap extending to within 152 mm (6 inches) of the bottom of the tank. The top of the deep seal trap shall have a 19.1 mm ($\frac{3}{4}$ of an inch) opening located at the highest point of the trap to serve as a siphon breaker. Outlets shall be taken off from the side in such a manner as to allow a waterline to be maintained that will permanently occupy not less than one-half the capacity of the condenser or sump. Inlets shall enter above the waterline. Wearing plates or baffles shall be installed in the tank to protect the shell. The sizes of the blowoff line inlet, the water outlets, and the vent shall be as shown in Table 12. The contents of condensers receiving steam or hot water under pressure shall pass through an open sump before entering the drainage system.

Table 13 — Pipe connections in blowoff condensers and sumps (inches)

Boiler blowoff	Water outlet	Vent
$\frac{3}{4}$ *	$\frac{3}{4}$ *	2
1	1	2½
1¼	1¼	3
1½	1½	4
2	2	5
2½	2½	6

For SI units: 1 inch = 25 mm

* To be used only with boilers of 100 square feet (9.29 m²) of heating sur- face or less.

36.2 Sumps, condensers, and intercepting tanks

Sumps, condensers, or intercepting tanks that are constructed of concrete shall have walls and bottom, not less than 4 inches (102 mm) in thickness, and the inside shall be cement plastered not less than 1/2 of an inch (12.7 mm) in thickness. Condensers constructed of metal shall be not less than No. 12 U.S. standard gauge (0.109 inch) (2.77 mm), and such metal condensers shall be protected from external corrosion by an approved bituminous coating.

36.3 Cleaning

Sumps and condensers shall be provided with suitable means of access for cleaning and shall contain a volume of not less than twice the volume of water removed from the boiler or boilers connected to it where the normal water level of such boiler or boilers is reduced not less than 4 inches (102 mm).

36.4 Strainers

An indirect waste interceptor is receiving discharge-containing particles that would clog the receptor drain shall have a readily removable beehive strainer.

37 Chemical wastes

37.1 Pretreatment

Chemical or liquid industrial wastes that are likely to damage or increase maintenance costs on the sanitary sewer system, detrimentally affect sewage treatment or contaminate surface or subsurface waters shall be pretreated to render them innocuous before discharge into a drainage system. Detailed construction documents of the pretreatment facilities shall be required by the Competent Authority.

Piping conveying industrial, chemical, or process wastes from their point of origin to sewer-connected pretreatment facilities shall be of such material and design as to adequately perform its intended function to the satisfaction of the Competent Authority. Drainage discharge piping from pretreatment facilities or interceptors shall be in accordance with standard drainage installation procedures.

Copper or copper alloy tube shall not be used for chemical or industrial wastes as defined in this clause.

37.2 Waste and vent pipes

Each waste pipe receiving or intended to receive the discharge of a fixture into which acid or corrosive chemical is placed, and each vent pipe connected thereto, shall be constructed of chlorinated polyvinyl chloride (CPVC), polypropylene (PP), polyvinylidene fluoride (PVDF), chemical-resistant glass, high-silicon iron pipe, or lead pipe with a wall thickness of not less than 1/8 of an inch (3.2 mm); an approved type of ceramic glazed or unglazed vitrified clay; or other approved corrosion-resistant materials. CPVC pipe and fittings shall comply with ASTM F2618. PP pipe and fittings shall comply with ASTM F1412 or CSA B181.3. PVDF pipe and fittings shall comply with ASTM F1673 or CSA B181.3. Chemical-resistant glass pipe and fittings shall comply with ASTM C1053. High-silicon iron pipe and fittings shall comply with ASTM A861.

37.3 Joining materials

Joining materials shall be of approved type and quality.

37.4 Access

Where practicable, the piping shall be readily accessible and installed with the maximum of clearance from other services.

37.5 Permanent record

The owner shall make and keep a permanent record of the location of piping and venting carrying chemical waste.

37.6 Chemical vent

No chemical vent shall intersect vents for other services.

37.7 Discharge

Chemical wastes shall be discharged in a manner approved by the Competent Authority.

37.8 Diluted chemicals

The provisions of this clause about materials and methods of construction shall not apply to installations such as photographic or x-ray darkrooms or research or control laboratories where minor amounts of adequately diluted chemicals are discharged.

38 Clear water wastes

38.1 General

Water lifts, expansion tanks, cooling jackets, sprinkler systems, drip or overflow pans, or similar devices that discharge clear wastewater into the building drainage system shall discharge through an indirect waste.

39 Swimming pools

39.1 General

Pipes carrying wastewater from swimming or wading pools, including pool drainage and backwash from filters, shall be installed as an indirect waste. Where a pump is used to discharge pool waste water to the drainage system, the pump discharge shall be installed as an indirect waste.

40 Condensate waste and control

40.1 Condensate disposal

Condensate from air washers, air-cooling coils, condensing appliances, and the overflow from evaporative coolers and similar water-supplied equipment or similar air-conditioning equipment shall be collected and discharged to an approved plumbing fixture or disposal area. Where discharged into the drainage system, equipment shall drain using an indirect waste pipe. The waste pipe shall have a slope of not less than 10.4 mm/m (1/8 inch per foot) or 1 percent slope and shall be of an approved corrosion-resistant material not smaller than the outlet size in accordance with DRS 644-2 for air-cooling coils or condensing appliances, respectively. Condensate or wastewater shall not drain over a public way.

40.2 Condensate pumps

Where approved by the Competent Authority, condensate pumps shall be installed in accordance with the manufacturer's installation instructions. Pump discharge shall rise vertically to a point where it is possible to connect to a gravity condensate drain and discharged to an approved disposal point. Each condensing unit shall be provided with a separate sump and interlocked with the equipment to prevent the equipment from operating during a failure. Separate pumps shall be permitted to connect to a single gravity indirect waste where equipped with check valves and approved by the Competent Authority.

40.3 Condensate control

Where any equipment or appliance is installed in a space where damage is capable of resulting from condensate overflow, a drain line shall be provided and shall be drained in accordance with WDRS xxx-2. An additional protection method for condensate overflow shall be provided in accordance with one of the following:

- (1) A water level detecting device that will shut off the equipment or appliance in the event the primary drain is blocked. Such detecting device shall be in accordance with the manufacturer's installation instructions.
- (2) An additional watertight pan of corrosion-resistant material, with a separate drain line, installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain.
- (3) An additional separate drain line at a level that is higher than the primary drain line connection of the drain pan.
- (4) An additional watertight pan of corrosion-resistant material with a water level detection device installed beneath the cooling coil, unit, or the appliance to catch the overflow condensate due to a clogged primary condensate drain and to shut off the equipment.

The additional pan or the additional drain line connection shall be provided with a drainpipe of not less than $\frac{3}{4}$ of an inch (20 mm) nominal pipe size, discharging at a point that is readily observed.

40.3.1 Protection of appurtenances

Where insulation or appurtenances are installed where damage is capable of resulting from a condensate drain pan overflow, such installations shall occur above the rim of the drain pan with supports. Where the supports are in contact with the condensate waste, the supports shall be of approved corrosion-resistant material.

40.4 Condensate waste pipe material and sizing

Condensate waste pipes from air-cooling coils shall be sized in accordance with the equipment capacity as specified in Table 814.3. The material of the piping shall comply with the pressure and temperature rating of the appliance or equipment and shall be approved for use with the liquid being discharged.

Table 14 — Minimum condensate pipe size

Equipment capacity in tons of refrigeration	Minimum condensate pipe diameter (inches)
Up to 20	3/4
21 – 40	1
41 – 90	1 1/4
91 – 125	1 1/2
126 – 250	2

For SI units: 1 ton of refrigerant = 3.52 kW, 1 inch = 25 mm

The size of condensate waste pipes is for one unit or a combination of units, or as recommended by the manufacturer. The capacity of waste pipes assumes a 10.4 mm/m (1/8 inch per foot) or 1% slope, with the pipe running three-quarters full at the following pipe conditions:

Outside Air – 20%		Room Air – 80%	
DB	WB	DB	WB
90°F	73°F	75°F	62.5°F

For SI units: °C = (°F-32)/1.8

Condensate drain sizing for other slopes or other conditions shall be approved by the Competent Authority.

Air-conditioning waste pipes, 32 mm (1¼ of an inch) and larger in size, shall be constructed of materials specified in WDRS xxx-7. Condensate waste piping less than 32 mm (1¼ of an inch) in size shall be permitted to be PVC, CPVC, PE, PP, copper, or other rigid materials approved by the Competent Authority.

40.4.1 Cleanouts

Condensate drain lines shall be configured or provided with a cleanout to permit the clearing of blockages and for maintenance without requiring the drain line to be cut.

40.5 Appliance condensate drains

Condensate drain lines from individual condensing appliances shall be sized as required by the manufacturer's instructions. Condensate drain lines serving more than one appliance connecting to a common indirect waste pipe shall have the connections to the indirect waste pipe protected by a sanitary waste valve complying with ASME A112.18.8, condensate trap complying with IAPMO IGC 196, or trap with a trap primer.

40.6 Point of discharge

Air-conditioning condensate waste pipes shall connect indirectly to the drainage system through an air gap or air break to trapped and vented receptors, dry wells, mop sinks, leach pits, or the tailpiece of plumbing fixtures. An individual condensate drain shall be trapped in accordance with the appliance manufacturer's instructions or in accordance with 40.5.

40.7 Condensate waste from air-conditioning coils

Where the condensate waste from air-conditioning coils discharges by direct connection to a lavatory tailpiece or to an approved accessible inlet on a bathtub overflow, the connection shall be located in the area controlled by the same person controlling the air-conditioned space.

40.8 Plastic fittings

Female plastic screwed fittings shall be used with male plastic fittings and plastic threads.

41 Vents

41.1 General

41.1.1 Vents required

Each plumbing fixture trap, except as otherwise provided in this WDRS xxx-5, shall be protected against siphonage and backpressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vent pipes installed in accordance with the requirements of this chapter and as otherwise required by this WDRS xxx-5.

41.1.2 Trap seal protection

The vent system shall be designed to prevent a trap seal from being exposed to a pressure differential that exceeds 1 inch water column (0.24 kPa) on the outlet side of the trap.

42 Vents not required

42.1 Interceptor

Vent piping shall be permitted to be omitted on an interceptor where such interceptor acts as a primary settling tank and discharges through a horizontal indirect waste pipe into a secondary interceptor. The second interceptor shall be properly trapped and vented.

42.2 Bars, soda fountains, and counter

Traps serving sinks that are part of the equipment of bars, soda fountains, and counters need not be vented where the location and construction of such bars, soda fountains, and counters are such as to make it impossible to do so. Where such conditions exist, said sinks shall discharge using approved indirect waste pipes into a floor sink or other approved type of receptor.

42.3 Materials

42.3.1 Applicable standards

Vent pipe and fittings shall comply with the applicable standards referenced in Table 6, except that:

(1) No galvanized steel or 304 stainless steel pipe shall be installed underground and shall be not less than 6 inches (152 mm) aboveground.

(2) ABS and PVC DWV piping installations shall be in accordance with WDRS xxx-6 "Firestop Protection." Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a flame-spread index of not more than 25 and a smoke-developed index of not more than 50 where tested in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

42.3.2 Use of copper or copper alloy tubing

Copper or copper alloy tube for underground drainage and vent piping shall have a weight of not less than that of copper or copper alloy drainage tube type DWV.

42.3.2.1 Aboveground

Copper or copper alloy tube for aboveground drainage and vent piping shall have a weight of not less than that of copper or copper alloy drainage tube type DWV.

42.3.2.2 Prohibited use

Copper or copper alloy tube shall not be used for chemical or industrial wastes as defined in WDRS xxx-1.

42.3.2.3 Marking

Copper or copper alloy tubing, in addition to the required incised marking, shall be marked in accordance with either ASTM B306 or ASTM B88. The colors shall be Type K, green; Type L, blue; Type M, red; and Type DWV, yellow.

42.4 Changes in direction

Changes in the direction of vent piping shall be made by the appropriate use of approved fittings, and no such pipe shall be strained or bent. Burred ends shall be reamed to the full bore of the pipe.

42.5 Size of vents**42.5.1 Size**

The size of vent piping shall be determined from its length and the total number of fixture units connected thereto, in accordance with Table 8. The diameter of an individual vent shall be not less than 1 1/4 inches (32 mm) nor less than one-half the diameter of the drain to which it is connected. In addition, the drainage piping of each building and each connection to a public sewer or a private sewage disposal system shall be vented by means of one or more vent pipes, the aggregate cross-sectional area of which shall be not less than that of the largest required building sewer as determined from Table 8. Vent pipes from fixtures located upstream from pumps, ejectors, backwater valves, or other devices that obstruct the free flow of air and other gases between the building sewer and the outside atmosphere shall not be used for meeting the cross-sectional area venting requirements of this clause.

Exception:

Where connected to a common building sewer, the drainage piping of two or more buildings located on the same lot and under one ownership shall be permitted to be vented by means of piping sized in accordance with Table 8, provided the aggregate cross-sectional area of vents is not less than that of the largest required common building sewer.

42.5.2 Length

Not more than one-third of the total permitted length, in accordance with Table 8, of a minimum-sized vent shall be installed in a horizontal position. Where a minimum-sized vent is increased one pipe size for its entire length, the maximum length limitation shall not apply.

42.6 Vent pipe grades and connections**42.6.1 Grade**

Vent and branch vent pipes shall be free from drops or sags, and each such vent shall be level or shall be so graded and connected as to drip back by gravity to the drainage pipe it serves.

42.6.2 Horizontal drainage pipe

Where vents connect to a horizontal drainage pipe, each vent pipe shall have its invert taken off above the drainage centerline of such pipe downstream of the trap being served.

42.6.3 Vent pipe rise

Unless prohibited by structural conditions, each vent shall rise vertically to a point not less than 152 mm (6 inches) above the flood-level rim of the fixture served before offsetting horizontally, and where two or more vent pipes converge, each such vent pipe shall rise to a point not less than 152 mm (6 inches) in height above the flood-level rim of the plumbing fixture it serves before being connected to any other vent. Vents less than 152 mm (6 inches) above the flood-level rim of the fixture shall be installed with approved drainage fittings, material, and grade to the drain.

42.6.4 Roof termination

Vent pipes shall extend undiminished in size above the roof, or shall be reconnected with soil or waste vent of the proper size.

42.6.5 Location of opening

The vent pipe opening from soil or waste pipe shall not be below the weir of the trap.

Exception: Water closets and similar fixtures.

42.6.6 Common vertical pipe

Two fixtures shall be permitted to be served by a common vertical pipe where each such fixture wastes separately into an approved double fitting having inlet openings at the same level.

42.6.7 Vent termination

42.6.7.1 Roof Termination

Each vent pipe or stack shall extend through its flashing and shall terminate vertically not less than 152 mm (6 inches) above the roof nor less than 305 mm (1 foot) from a vertical surface. ABS and PVC piping exposed to sunlight shall be protected by water based synthetic latex paints.

42.6.7.2 Clearance

Each vent shall terminate not less than 3048 mm (10 feet) from, or not less than 914 mm (3 feet) above, an openable window, door, opening, air intake, or vent shaft, or not less than 914 mm (3 feet) in every direction from a lot line, alley and street excepted.

42.6.7.3 Use of roof

Vent pipes shall be extended separately or combined, of full required size, not less than 152 mm (6 inches) above the roof or firewall. Flagpoling of vents shall be prohibited except where the roof is used for assembly

purposes or parking. Vents within 3048 mm (10 feet) of a part of the roof that is used for assembly purposes or parking shall extend not less than 2134 mm (7 feet) above such roof and shall securely stay.

42.6.7.4 Outdoor installations

Vent pipes for outdoor installations shall extend not less than 10 feet (3048 mm) above the surrounding ground and shall be securely supported.

42.6.7.5 Joints

Joints at the roof around vent pipes shall be made watertight by the use of approved flashings or flashing material.

42.6.7.6 Lead

Reference to Sheet lead shall comply with the following:

- (1) For safe pans – not less than 4 pounds per square foot (lb/ft²) (19 kg/m²) or 1/16 of an inch (1.6 mm) thick.
- (2) For flashings or vent terminals – not less than 3 lb/ft² (15 kg/m²) or 0.0472 of an inch (1.2 mm) thick.
- (3) Lead bends and lead traps shall be not less than 3.2 mm (1/8 of an inch) in wall thickness.

42.6.7.7 Frost or snow closure

Where frost or snow closure is likely to occur in locations having minimum design temperature below 0 °F (-17.8 °C), vent terminals shall be not less than 76 mm (3 inches) in diameter, but in no event smaller than the required vent pipe. The change in diameter shall be made inside the building not less than 305 mm (1 foot) below the roof in an insulated space and terminate not less than 254 mm (10 inches) above the roof, or in accordance with the Competent Authority.

42.6.7.8 Vent stacks and relief vents

42.6.7.8.1 Drainage stack

Each drainage stack that extends 10 or more stories shall be served by a parallel vent stack, which shall extend undiminished in size from its upper terminal and connect to the drainage stack at or immediately below the lowest fixture drain. Each such vent stack shall also be connected to the drainage stack at each fifth floor, counting down from the uppermost fixture drain, using a yoke vent, the size of which shall be not less in diameter than either the drainage or the vent stack, whichever is smaller.

42.6.7.8.2 Yoke vent

The yoke vent connection to the vent stack shall be placed not less than 1067 mm (42 inches) above the floor level, and the yoke vent connection to the drainage stack shall be using a wye-branch fitting placed below the lowest drainage branch connection serving that floor.

42.6.7.9 Wet venting

42.6.7.9.1 Vertical wet venting

Wet venting is limited to vertical drainage piping receiving the discharge from the trap arm of one and two fixture unit fixtures that also serves as a vent not exceeding four fixtures. Wet-vented fixtures shall be within the same story; provided, further, that fixtures with a continuous vent discharging into a wet vent shall be within the same story as the wet-vented fixtures. No wet vent shall exceed 1829 mm (6 feet) in developed length.

42.6.7.9.2 Size

The vertical piping between two consecutive inlet levels shall be considered a wet-vented section. Each wet-vented section shall be not less than one pipe size exceeding the required minimum waste pipe size of the upper fixture or shall be one pipe size exceeding the required minimum pipe size for the sum of the fixture units served by such wet-vented section, whichever is larger, but in no case less than 50 mm (2 inches) in diameter.

42.6.7.9.3 Vent connection

Common vent sizing shall be the sum of the fixture units served but, in no case, smaller than the minimum vent pipe size required for a fixture served, or by Appendix C .

42.6.7.9.4 Horizontal wet venting for a bathroom group

A bathroom group located on the same floor level shall be permitted to be vented by a horizontal wet vent where all of the conditions of WDRS xxx-1 Section 42.6.7.9.4.1 through Section 42.6.7.9.4.5 are met.

42.6.7.9.4.1 Vent connection

The dry vent connection to the wet vent shall be an individual vent for the bidet, shower, or bathtub. One or two vented lavatory(s) shall be permitted to serve as a wet vent for a bathroom group. Only one wet-vented fixture drain or trap arm shall discharge upstream of the dry-vented fixture drain connection. Dry vent connections to the horizontal wet vent shall be in accordance with WDRS xxx-3.

42.6.7.9.4.2 Size

The wet vent shall be sized based on the fixture unit discharge into the wet vent. The wet vent shall be not less than 2 inches (50 mm) in diameter for 4 drainage fixture units (dfu) or less, and not less than 3 inches (80 mm) in diameter for 5 dfu or more. The dry vent shall be sized in accordance with Table 7 and Table 11 based on the total fixture units discharging into the wet vent.

42.6.7.9.4.3 Trap arm

The length of the trap arm shall not exceed the limits in DRS 644-5, Table 15. The trap size shall be in accordance with clause 45.3. The vent pipe opening from the horizontal wet vent, except for water closets and similar fixtures, shall not be below the weir of the trap.

Table 15 — Horizontal lengths of trap arms (except for water closets and similar fixtures)^{1, 2,3}

TRAP ARM PIPE DIAMETER (inches)	DISTANCE TRAP TO VENT MINIMUM (inches)	LENGTH MAXIMUM (inches)
1 1/4	2 1/2	30
1 1/2	3	42
2	4	60
3	6	72
4	8	120
Exceeding 4	2 x Diameter	120

For SI units: 1 inch = 25.4 mm

Notes:

1 Maintain 1/4 inch per foot slope (20.8 mm/m).

2 The developed length between the trap of a water closet or similar fixture (measured from the face of the closet flange to the inner edge of the vent) and its vent shall not exceed 6 feet (1829 mm).

3 Horizontally wet vented bathtubs, showers and similar fixtures shall be limited to a maximum of 6 feet (1829 mm) for 1 1/2 inch (40 mm) fixture drains and 8 feet (2438 mm) for 2 inch (50 mm) fixture drains, maintaining 1/4 inch per foot slope (20.8 mm/m).

42.6.7.9.4.4 Water closet

The water closet fixture drain or trap arm connection to the wet vent shall be downstream of fixture drain or trap arm connections to the horizontal wet vent.

42.6.7.9.4.5 Additional fixtures

Additional fixtures shall discharge downstream of the wet vent system and be conventionally vented. Only the fixtures within the bathroom group shall connect to the wet-vented horizontal branch.

42.6.8 Special venting for island fixtures**42.6.8.1.1 General**

Traps for island sinks and similar equipment shall be roughed in above the floor and shall be permitted to be vented by extending the vent as high as possible, but not less than the drainboard height and then returning it downward and connecting it to the horizontal sink drain immediately downstream from the vertical fixture drain. The return vent shall be connected to the horizontal drain through a wye-branch fitting and shall, in addition, be provided with a foot vent taken off the vertical fixture vent by means of a wye branch immediately below the floor and extending to the nearest partition and then through the roof to the open air, or shall be permitted to be connected to other vents at a point not less than 6 inches (152 mm) above the flood-level rim of the fixtures served. Drainage fittings shall be used on the vent below the floor level, and a slope of not less than 1/4 inch per foot (20.8 mm/m) back to the drain shall be maintained. The return bend used under the drainboard shall be a

one-piece fitting or an assembly of a 45 degree (0.79 rad), a 90 degree (1.57 rad), and a 45 degree (0.79 rad) elbow in the order named. Pipe sizing shall be as elsewhere required in this standard. The island sink drain, upstream of the returned vent, shall serve no other fixtures. An accessible cleanout shall be installed in the vertical portion of the foot vent.

42.6.8.1.2 Combination waste and vent systems

42.6.8.1.2.1 Where permitted

Combination waste and vent systems shall be permitted where structural conditions preclude the installation of conventional systems as otherwise prescribed by this standard.

42.6.8.1.2.2 Approval

Construction documents for each combination waste and vent system shall first be approved by the Competent Authority before a portion of such system is installed.

42.6.8.1.2.3 Vents

Each combination waste and vent system, as defined in in DRS 644-1, shall be provided with a vent or vents adequate to ensure free circulation of air. A branch exceeding 4572 mm (15 feet) in length shall be separately vented in an approved manner. The area of a vent installed in a combination waste and vent system shall be not less than one-half the inside cross-sectional area of the drainpipe served. The vent connection shall be downstream of the uppermost fixture.

42.6.8.1.2.4 Connections and size

Branches serving traps shall connect to the main line at an angle not exceeding 2 %. Each waste pipe and each trap in such a system shall be not less than two pipe sizes exceeding the sizes required by Clause 1 of this standard, and not less than two pipe sizes exceeding a fixture tailpiece or connection.

42.6.8.1.2.5 Vertical waste pipe

No vertical waste pipe shall be used in such a system, except the tailpiece or connection between the outlet of a plumbing fixture and the trap. Such tailpieces or connections shall be as short as possible, and in no case shall exceed 610 mm (2 feet).

Exception: Branch lines shall be permitted to have 45 degree (0.79 rad) vertical offsets.

42.6.8.1.2.6 Cleanouts

An accessible cleanout shall be installed in each vent for the combination waste and vent system. Cleanouts shall not be required on a wet-vented branch serving a single trap where the fixture tailpiece or connection is not less than 2 inches (50 mm) in diameter and provides ready access for cleaning through the trap.

42.6.8.1.2.7 Fixtures

No water closet or urinal shall be installed on such a system. Other one, two, or three unit fixtures remotely located from the sanitary system and adjacent to a combination waste and vent system shall be permitted to be connected to such system in the conventional manner by means of waste and vent pipes of regular sizes, providing that the two pipe size increase required in clause 42.6.8.9.2.4 is based on the total fixture unit load connected to the system. See Annex B of this code for explanatory notes on the design of combination waste and vent systems.

42.6.8.1.3 Circuit venting**42.6.8.1.3.1 Circuit vent permitted**

A maximum of eight floor-outlet water closets, showers, bathtubs, or floor drains connected to a horizontal branch shall be permitted to be circuit vented. Each trap arm shall connect horizontally to the horizontal branch being circuit vented in accordance with Table 15. The horizontal branch shall be classified as a drain and a vent from the most downstream trap arm connection to the most upstream trap arm connection to the horizontal branch.

Exception: Back-outlet and wall-hung water closets shall be permitted to be circuit vented provided that no floor-outlet fixtures are connected to the same horizontal branch. Back-outlet and wall-hung water closets shall connect horizontally to the horizontal circuit vented drain.

42.6.8.1.3.2 Circuit vent size and connection

The circuit vent size shall be in accordance with Table 7 according to the number of circuit vented fixtures connected to the horizontal branch but shall be not less than 2 inches (50 mm) in diameter. The vent shall connect to the horizontal branch on the vertical between the two most upstream trap arms. The circuit vent pipe shall not receive the discharge of soil or waste.

42.6.8.1.3.3 Multiple circuit vents

When multiple circuit vents are interconnected according to clause 42.6.8.9.5.1, each individual circuit vent shall be sized according to clause 42.6.8.9.3.2. The vent pipe connecting each circuit vent shall be sized according to Table 7.

42.6.8.1.4 Relief vent

A 2 inch (50 mm) relief vent shall be provided for circuit-vented horizontal branches receiving the discharge of four or more water closets when connecting to a drainage stack that receives the discharge of soil or waste from upper horizontal branches.

42.6.8.1.4.1 Connection and Installation

The relief vent shall connect to the horizontal branch between the stack and the most downstream trap arm of the circuit vent. The relief vent shall be installed on the vertical to the horizontal branch.

42.6.8.1.4.2 Fixture drain

The relief vent is permitted to serve as a fixture drain. Fixtures discharging to a relief vent shall be one or two fixture unit fixtures but shall not exceed a total of 4 fixture units.

42.6.8.1.5 Slope and size of horizontal branch

The vented section of the horizontal branch shall be uniformly sloped and not more than 1 inch per foot (83.3 mm/m). The entire length of the vented section of the horizontal branch shall be sized for the total drainage discharge to the branch according to Table 11.

42.6.8.1.5.1 Multiple circuit-vented branches

Circuit-vented horizontal branches are permitted to be connected together. Each group of a maximum of eight fixtures shall be considered a separate circuit vent and shall be in accordance with 42.6.8.9.5.2.

42.6.8.1.5.2 Size of parallel horizontal branches

Parallel horizontal circuit vented branches shall be permitted to connect on the same floor level. Each separate circuit-vented horizontal branch that is interconnected shall be sized independently in accordance with clause 42.6.8.9.5.

42.6.8.1.5.3 Size of continuous horizontal branches

Two or more circuit vented systems continuous on the same horizontal branch shall be uniformly sized for the total discharge into the branch.

42.6.8.1.6 Additional fixtures

Fixtures, other than the circuit-vented fixtures, are permitted to discharge to the horizontal branch drain. Such fixtures shall be located on the same floor as the circuit-vented fixtures and shall be either individually or common vented.

42.6.8.2 Engineered vent system

42.6.8.2.1 General

The design and sizing of a vent system shall be permitted to be determined by accepted engineering practices. The system shall be designed by a registered design professional.

42.6.8.2.2 Minimum requirements

An engineered vent system shall provide protection of the trap seal in accordance with Clause 41.1.2.

43 Traps and interceptors

43.1 Applicability

This clause shall govern the materials, design, and installation of traps and interceptors.

43.2 Where required

Each plumbing fixture shall be separately trapped by an approved type of liquid seal trap. This section shall not apply to fixtures with integral traps. Not more than one trap shall be permitted on a trap arm. Food waste disposers installed with a set of restaurant, commercial, or industrial sinks shall be connected to a separate trap.

Each domestic clothes washer and each laundry sink shall be connected to a separate and independent trap, except that a trap serving a laundry sink shall also be permitted to receive the waste from a clothes washer set adjacent to it.

The vertical distance between a fixture outlet and the trap weir shall be as short as practicable, but in no case shall the tailpiece exceed 24 inches (610 mm) in length.

One trap shall be permitted to serve a set of not more than three single-compartment sinks or laundry sinks of the same depth or three lavatories immediately adjacent to each other and in the same room where the waste outlets are not more than 30 inches (762 mm) apart, and the trap is centrally located where three compartments are installed.

44 Traps protected by vent pipes

44.1 Vent Pipes

Each plumbing fixture trap, except as otherwise provided in this standard, shall be protected against siphonage, backpressure, and air circulation shall be assured throughout the drainage system using a vent pipe installed in accordance with the requirements of this standard.

44.2 Fixture Traps

Each fixture trap shall have a protecting vent so located that the developed length of the trap arm from the trap weir to the inner edge of the vent shall be within the distance given in Table 15 but in no case less than two times the diameter of the trap arm.

44.3 Change of direction

A trap arm shall be permitted to change direction without the use of a cleanout where such change of direction does not exceed 90 degrees (1.57 rad). Horizontal changes in the direction of trap arms shall be in accordance with clause 10.3.

Exception: For trap arms, 3 inches (80 mm) in diameter and larger, the change of direction shall not exceed 135 degrees (2.36 rad) without the use of a cleanout.

44.4 Vent Pipe Opening

The vent pipe opening from soil or waste pipe, except for water closets and similar fixtures, shall not be below the weir of the trap

45 Traps – Described

45.1 General requirements

Each trap, except for traps within an interceptor or similar device shall be self-cleaning. Traps for bathtubs, showers, lavatories, sinks, laundry sinks, floor drains, urinals, drinking fountains, dental units, and similar fixtures shall be of standard design, weight and shall be of ABS, cast-brass, cast-iron, lead, PP, PVC, or other approved material. An exposed and readily accessible drawn-copper alloy tubing trap, not less than 17 B & S Gauge (0.045 inch) (1.143 mm), shall be permitted to be used on fixtures discharging domestic sewage.

Exception: Drawn-copper alloy tubing traps shall not be used for urinals. Each trap shall have the manufacturer's name stamped legibly in the metal of the trap, and each tubing trap shall have the gauge of the tubing in addition to the manufacturer's name. A trap shall have a smooth and uniform interior waterway.

45.2 Slip Joint Fittings

A maximum of one approved slip joint fitting shall be permitted to be used on the outlet side of a trap, and no tubing trap shall be installed without a listed tubing trap adapter. Listed plastic trap adapters shall be permitted to be used to connect listed metal tubing traps.

45.3 Size

The size (nominal diameter) of a trap for a given fixture shall be sufficient to drain the fixture rapidly but in no case less than nor more than one pipe size larger than given in Table 3. The trap shall be the same size as the trap arm to which it is connected.

46 Traps

46.1 Prohibited

No form of trap that depends for its seal upon the action of movable parts shall be used. No trap that has concealed interior partitions, except those of plastic, glass, or similar corrosion-resisting material, shall be used. "S" traps, bell traps, and crown-vented traps shall be prohibited. No fixture shall be double trapped. Drum and bottle traps shall be installed for special conditions. No trap shall be installed without a vent, except as otherwise provided in this standard.

46.2 Movable Parts

Bladders, check valves or another type of devices with moveable parts shall be prohibited to serve as a trap.

47 Trap Seals

47.1 General

Each fixture trap shall have a liquid seal of not less than 2 inches (51 mm) and not more than 4 inches (102 mm), except where a deeper seal is found necessary by the Competent authority. Traps shall be set true with respect to their liquid seals and, where necessary, they shall be protected from freezing.

48 Floor Drain Traps

48.1 General

Floor drains shall connect into a trap so constructed that it can be readily cleaned and of a size to serve efficiently the purpose for which it is intended. The drain inlet shall be so located that it is in full view. Where subject to the reverse flow of sewage or liquid waste, such drains shall be equipped with an approved backwater valve.

49 Trap Seal Protection

49.1 General

Floor drain or similar traps directly connected to the drainage system and subject to infrequent use shall be protected with a trap seal primer, except where not deemed necessary for safety or sanitation by the Competent authority. Trap seal primers shall be accessible for maintenance. Potable water supply trap seal primer valves shall comply with ASSE 1018. Drainage or electronic design type trap seal primer devices shall comply with ASSE 1044 or IAPMO PS 76.

50 Building Traps

50.1 General

Building traps shall not be installed except where required by the Competent authority. Each building trap where installed shall be provided with a cleanout and with a relieving vent or fresh-air intake on the inlet side of the trap, which needs not be larger than one-half the diameter of the drain to which it connects. Such relieving vent or fresh-air intake shall be carried above grade and terminate in a screened outlet located outside the building.

51 Interceptors (Clarifiers) and Separators

51.1 Where Required

Interceptors (clarifiers) (including grease, oil, sand, solid interceptors, etc.) shall be required by the Competent authority where they are necessary for the proper handling of liquid wastes containing grease, flammable wastes, sand, solids, acid or alkaline substances, or other ingredients harmful to the building drainage system, the public or private sewer, or to public or private sewage disposal. A list of acceptable interceptor standards is referenced in Table 16

Table 16 — Approved interceptors (clarifiers)

APPLICATION	STANDARD
Fats, Oil, Grease (FOG)	ASME A112.14.3, ASME A112.14.4, ASME A112.14.6, CSA B481, ANSI/CAN/IAPMO Z1001, PDI G-101, PDI G-102
Solid Waste	IAPMO IGC 167
Non-petroleum Oil	ASME A112.14.6, IAPMO PS 80, PDI G-102
Petroleum Oil	ASTM D6104, IAPMO IGC 183, IAPMO IGC 325

51.2 Approval

The size, type, and location of each interceptor (clarifier) or separator shall be approved by the Competent authority. Except where otherwise specifically permitted, no wastes other than those requiring treatment or separation shall be discharged into an interceptor (clarifier).

51.3 Design

Interceptors (clarifiers) for sand and similar heavy solids shall be so designed and located as to be readily accessible for cleaning and shall have a water seal of not less than 6 inches (152 mm).

51.4 Relief Vent

Interceptors (clarifiers) shall be so designed that they will not become air-bound where closed covers are used. Each interceptor (clarifier) shall be properly vented.

51.5 Location

Each interceptor (clarifier) cover shall be readily accessible for servicing and maintaining the interceptor (clarifier) in working and operating condition. The use of ladders or the removal of bulky equipment to service interceptors (clarifiers) shall constitute a violation of accessibility. Location of interceptors (clarifiers) shall be shown on the approved building plan.

51.6 Maintenance of Interceptors

Interceptors shall be maintained in efficient operating condition by periodic removal of accumulated grease, scum, oil, or other floating substances and solids deposited in the interceptor.

51.7 Discharge

The waste pipe from oil and sand interceptors shall discharge as approved by the Competent authority.

52 Slaughterhouses, Packing Establishments, etc.

52.1 General

A fish, fowl, and animal slaughterhouse or establishment; a fish, fowl, and meat packing or curing establishment; a soap factory, tallow-rendering, fat-rendering, and a hide-curing establishment shall be connected to and shall drain or discharge into an approved grease interceptor (clarifier).

53 Minimum Requirements for Auto Wash Racks

53.1 General

A private or public wash rack or floor or slab used for cleaning machinery or machine parts shall be adequately protected against storm or surface water and shall drain or discharge into an approved interceptor (clarifier).

54 Commercial and Industrial Laundries

54.1 General

Laundry equipment in commercial and industrial buildings that do not have integral strainers shall discharge into an interceptor having a wire basket or similar device that is removable for cleaning and that will prevent passage into the drainage system of solids $\frac{1}{2}$ of an inch (12.7 mm) or larger in maximum dimensions, such as string, rags, buttons, or other solid materials detrimental to the public sewerage system.

55 Bottling Establishments

55.1 General

Bottling plants shall discharge their process wastes into an interceptor that will provide for the separation of broken glass or other solids, before discharging liquid wastes into the drainage system.

56 Grease Interceptors

56.1 General

Where it is determined by the Competent authority that waste pretreatment is required, an approved type of grease interceptor(s) shall comply with ASME A112.14.3, ASME A112.14.4, CSA B481, ANSI/CAN/IAPMO Z1001, PDI G-101, or PDI G-102, and sized in accordance with clause 56.2.1 or clause 56.3.5, shall be installed in accordance with the manufacturer's installation instructions to receive the drainage from fixtures or equipment that produce grease-laden waste. Grease-laden waste fixtures shall include, but not be limited to, sinks and drains, such as floor drains, floor sinks, and other fixtures or equipment in serving establishments, such as restaurants, cafes, lunch counters, cafeterias, bars and clubs, hotels, hospitals, sanitariums, factory or school kitchens, or other establishments where grease is introduced into the drainage or sewage system in

quantities that can effect line stoppage or hinder sewage treatment or private sewage disposal systems. A combination of hydromechanical, gravity grease interceptors and engineered systems shall be allowed to meet this standard and other applicable requirements of the Competent authority where space or existing physical constraints of existing buildings necessitate such installations. A grease interceptor shall not be

required for individual dwelling units or private living quarters. Water closets, urinals, and other plumbing fixtures conveying human waste shall not drain into or through the grease interceptor.

56.1.1 Trapped and Vented

Each fixture discharging into a grease interceptor shall be individually trapped and vented in an approved manner.

56.1.2 Maintenance

Grease interceptors shall be maintained in efficient operating condition by periodic removal of the accumulated grease and latent material. No such collected grease shall be introduced into drainage piping or a public or private sewer. Where the Competent authority determines that a grease interceptor is not being properly cleaned or maintained, the Competent authority shall have the authority to mandate the installation of additional equipment or devices and to mandate a maintenance program.

56.1.3 Food Waste Disposers and Dishwashers

No food waste disposer or dishwasher shall be connected to or discharge into a grease interceptor. Commercial food waste disposers shall be permitted to discharge directly into the building’s drainage system.

Exception: Food waste disposers shall be permitted to discharge to grease interceptors that are designed to receive the discharge of food waste.

56.2 Hydromechanical Grease Interceptors

Plumbing fixtures or equipment connected to a Type A and B hydromechanical grease interceptor shall discharge through an approved type of vented flow control installed in a readily accessible and visible location. Flow control devices shall be designed and installed so that the total flow through such device or devices shall at no time be greater than the rated flow of the connected grease interceptor. No flow control device having adjustable or removable parts shall be approved. The vented flow control device shall be located such that no system vent shall be between the flow control and the grease interceptor inlet. The vent or air inlet of the flow control device shall connect with the sanitary drainage vent system, as elsewhere required by this standard, or shall terminate through the roof of the building, and shall not terminate to the free atmosphere inside the building.

Exception: Listed grease interceptors with integral flow controls or restricting devices shall be installed in an accessible location in accordance with the manufacturer’s installation instructions.

56.2.1 Capacity

The total capacity in gallons (gal) (L) of fixtures discharging into a hydromechanical grease interceptor shall not exceed two and one-half times the certified gallon per minute (gpm) (L/s) flow rate of the interceptor in accordance with Table 17

Table 17 — Hydromechanical grease interceptor sizing using gravity flow rate

DIAMETER OF GREASE WASTE PIPE (inches)	MAXIMUM FULL PIPE FLOW (gpm) ²	SIZE OF GREASE INTERCEPTOR	
		ONE-MINUTE DRAINAGE PERIOD	TWO-MINUTE DRAINAGE PERIOD

		(gpm)	(gpm)
2	20	20	10
3	60	75	35
4	125	150	75
5	230	250	125
6	375	400	200

For this clause, the term “fixture” shall mean and include each plumbing fixture, appliance, apparatus, or other equipment required to be connected to or discharged into a grease interceptor by a provision of this section.

56.2.2 Vent

A vent shall be installed downstream of hydromechanical grease interceptors in accordance with the requirements of this standard.

EXAMPLE FOR CLAUSE 56.2.2

SIZING HYDROMECHANICAL GREASE INTERCEPTOR(S) USING FIXTURE CAPACITY

Step 1: Determine the flow rate from each fixture

[Length] X [Width] X [Depth] / [231] = Gallons X [0.75 fill factor] / [Drain Period (1 minute or 2 minutes)]

Step 2: Calculate the total load from fixtures that discharge into the interceptor

FIXTURES	COMPARTMENTS	LOAD (gallons)	SIZE OF GREASE INTERCEPTOR ONE-MINUTE DRAINAGE PERIOD (gpm)	TWO-MINUTE DRAINAGE PERIOD (gpm)
Compartment size	—	—	—	—
24 inches x 24inches x 12 inches	2	44.9	—	—
Hydrant	—	3	—	—
Rated Appliance	—	2	—	—
-	—	49.9	50	25
For SI units: 1 inch = 25.4 mm, 1 gallon per minute = 0.06 L/s, 1 gallon = 3.785 L				

56.3 Gravity Grease Interceptors

Required gravity grease interceptors shall comply with the provisions of clause 56.3.1 through clause 56.3.7

56.3.1 General

The provisions of this section shall apply to the design, construction, installation, and testing of commercial kitchen gravity grease interceptors.

56.3.2 Waste Discharge Requirements

Waste discharge in establishments from fixtures and equipment which contain grease, including but not limited to, scullery sinks, pot and pan sinks, dishwashers, soup kettles, and floor drains located in areas where grease-containing materials exist, shall be permitted to be drained into the sanitary waste through the interceptor where approved by the Competent authority.

56.3.2.1 Toilets and Urinals

Toilets, urinals, and other similar fixtures shall not drain through the interceptor.

56.3.2.2 Inlet Pipe

Waste shall enter the interceptor through the inlet pipe.

56.3.3 Design

Gravity interceptors shall be constructed in accordance with the applicable standard in Chapter 17 or the design approved by the Competent authority.

56.3.4 Location

Each grease interceptor shall be so installed and connected that it shall be easily accessible for inspection, cleaning, and removal of the intercepted grease. A gravity grease interceptor that complies with ANSI/CAN/IAPMO Z1001 shall not be installed in a building where food is handled. Location of the grease interceptor shall meet the approval of the Competent authority.

56.3.4.1 Interceptors

Interceptors shall be placed as close as practical to the fixtures they serve.

56.3.4.2 Business Establishment

Each business establishment for which a gravity grease interceptor is required shall have an interceptor which shall serve that establishment unless otherwise approved by the Competent authority.

56.3.4.3 Access

Each gravity grease interceptor shall be located to be readily accessible to the equipment required for maintenance.

56.3.5 Construction Requirements

Gravity grease interceptors shall be designed to remove grease from effluent and shall be sized in accordance with this section. Gravity grease interceptors shall also be designed to retain grease until accumulations can be removed by pumping the interceptor. When provided, a sample box shall be located at the outlet end of gravity grease interceptors so that the Competent authority can periodically sample effluent quality.

56.3.6 Sizing Criteria

The volume of the interceptor shall be determined by using Table 19. Where drainage fixture units (DFUs) are not known, the interceptor shall be sized based on the maximum DFUs allowed for the pipe size connected to the inlet of the interceptor. Refer to Table 7, Drainage Piping, Horizontal.

Table 19 — GRAVITY GREASE INTERCEPTOR SIZING

DRAINAGE FIXTURE UNITS ^{1,3} (DFUs)	INTERCEPTOR VOLUME ² (gallons)
8	500
21	750
35	1000
90	1250
172	1500
216	2000
307	2500
342	3000
428	4000
576	5000
720	7500
2112	10 000
2640	15 000

For SI units: 1 gallon = 3.785 L

Notes:

¹ The maximum allowable DFUs plumbed to the kitchen drain lines that will be connected to the grease interceptor.

² This size is based on DFUs, the pipe size from this standard; Table 7; Useful Tables for flow in half-full pipes (ref: Mohinder Nayyar Piping Handbook, 3rd Edition, 1992). Based on 30-minute retention time (ref.: George Tchobanoglous and Metcalf & Eddy. Wastewater Engineering Treatment, Disposal, and Reuse, 3rd Ed. 1991 & Ronald Crites and George Tchobanoglous. Small and Decentralized Wastewater Management Systems, 1998). Rounded up to nominal interceptor volume.

³ Where the flow rate of directly connected fixture(s) or appliance(s) have no assigned DFU values, the additional grease interceptor volume shall be based on the known flow rate (gpm) (L/s) multiplied by 30 minutes.

EXAMPLE FOR CLAUSE 56.3.6

GRAVITY GREASE INTERCEPTOR SIZING EXAMPLE

Given: A restaurant with the following fixtures and equipment.

One food preparation sink; three-floor drains - one in the food prep area, one in the grill area, and one receiving the indirect waste from the ice machine and a mop sink.

Kitchen Drain Line DFU Count (from Table 702.1):

3 floor drains at 2 DFUs each = 6 DFUs

Mop sink at 3 DFUs each	=	3 DFUs
Food prep sink at 3 DFUs each	=	3 DFUs
Total	=	12 DFUs

Using Table 1014.3.6, the grease interceptor will be sized at 750 gallons (2389 L).

56.3.7 Abandoned Gravity Grease Interceptors

Abandoned grease interceptors shall be pumped and filled as required for abandoned sewers and sewage disposal facilities in clause 26.

57 FOG (Fats, Oils, and Greases) Disposal System

57.1 Purpose

The purpose of this section is to provide the necessary criteria for the sizing, application, and installation of FOG disposal systems designated as apretreatment or discharge water quality compliance strategy.

57.2 Components, Materials, and Equipment

FOG disposal systems, including components, materials, and equipment necessary for the proper function of the system, shall comply with ASME A112.14.6.

57.3 Sizing and Installation

FOG disposal systems shall be sized and installed in accordance with the manufacturer's installation instructions.

57.4 Performance

FOG disposal systems shall produce an effluent quality not to exceed 5.84 grains per gallon (gr/gal) (100 mg/L) FOG.

58 Sand Interceptors

58.1 Discharge

Where the discharge of a fixture or drain contains solids or semi-solids heavier than water that would be harmful to a drainage system or cause a stoppage within the system, the discharge shall be through a sand interceptor. Multiple floor drains shall be permitted to discharge into one sand interceptor.

58.2 Competent Authority

Sand interceptors are required where the Competent authority deems it advisable to have a sand interceptor to protect the drainage system.

58.3 Construction and Size

Sand interceptors shall be built of brick or concrete, prefabricated coated steel, or other watertight material. The interceptor shall have an interior baffle for full separation of the interceptor into two sections. The outlet pipe shall be the same size as the inlet pipe of the sand interceptor, the minimum being 3 inches (80 mm), and the baffle shall have two openings of the same diameter as the outlet pipe and at the same invert as the outlet pipe. These openings shall be staggered so that there cannot be a straight-line flow between the inlet pipe and the outlet pipe. The invert of the inlet pipe shall be no lower than the invert of the outlet pipe.

The sand interceptor shall have a minimum dimension of 2 square feet (0.2 m²) for the net free opening of the inlet section and a minimum depth under the invert of the outlet pipe of 2 feet (610 mm).

For each 5 gpm (0.3 L/s) flow or fraction thereof over 20 gpm (1.26 L/s), the area of the sand interceptor inlet section is to be increased by 1 square foot (0.09 m²). The outlet section shall at all times have a minimum area of 50 percent of the inlet section.

The outlet section shall be covered by a solid removable cover, set flush with the finished floor, and the inlet section shall have an open grating, set flush with the finished floor and suitable for the traffic in the area in which it is located.

58.4 Separate Use

Sand and similar interceptors for every solid shall be so designed and located as to be readily accessible for cleaning, shall have a water seal of not less than 6 inches (152 mm), and shall be vented.

59 Oil and Flammable Liquid Interceptors

59.1 Interceptors Required

Repair garages and gasoline stations with grease racks or grease pits, and factories that have oily, flammable, or both types of wastes as a result of manufacturing, storage, maintenance, repair, or testing processes, shall be provided with an oil or flammable liquid interceptor. Floor drains in such locations shall be connected directly to oil and flammable liquid interceptors.

59.2 Interceptor Design Alternatives

Oil interceptors shall comply with IAPMO IGC 183 or be in accordance with Clause 59.3 through Clause 59.4.

59.3 Interceptor Details

Oil and flammable liquid interceptors shall be in accordance with the following:

- (1) The separation or vapor compartment shall be independently vented to the outer air. Where two or more separation or vapor compartments are used, each shall be vented to the outer air or shall be permitted to connect to a header that is installed at a minimum of 6 inches (152 mm) above the spill line of the lowest floor drain and vented independently to the outer air.
- (2) The minimum size of a flammable vapor vent shall be not less than 2 inches (50 mm), and, where vented through a sidewall, the vent shall be not less than 10 feet (3048 mm) above the adjacent level at an approved location.
- (3) The interceptor shall be vented on the sewer side and shall not connect to a flammable vapor vent. Oil and flammable interceptors shall be provided with gastight cleanout covers that shall be readily accessible.
- (4) The waste line shall be not less than 3 inches (80 mm) in diameter with a full-size cleanout to grade.

- (5) Where an interceptor is provided with an overflow, it shall be provided with an overflow line [not less than 2 inches (50 mm) in diameter] to an approved waste oil tank having a minimum capacity of 550 gallons (2082 L) and meeting the requirements of the Competent authority.
- (a) The waste oil from the separator shall flow by gravity or shall be pumped to a higher elevation by an automatic pump.
 - (b) Pumps shall be adequately sized and accessible.
 - (c) Waste oil tanks shall have a 2 inch (50 mm) minimum pump-out connection at grade and an 1/2 inch (40 mm) minimum vent to atmosphere at an approved location not less than 10 feet (3048 mm) above grade.

59.4 Design of Interceptors

Each manufactured interceptor that is rated shall be stamped or labelled by the manufacturer with an indication of its full discharge rate in gpm (L/s). The following shall apply:

- (1) The full discharge rate to such an interceptor shall be determined at full flow. Each interceptor shall be rated equal to or greater than the incoming flow and shall be provided with an overflow line to an underground tank.
- (2) Interceptors not rated by the manufacturer shall have a depth of not less than 2 feet (610 mm) below the invert of the discharge drain. The outlet opening shall have not less than an 18-inch (457 mm) water seal and shall have a minimum capacity as follows:
 - (a) Where not more than three motor vehicles are serviced, stored, or both, interceptors shall have a minimum capacity of 6 cubic feet (0.2 m³), and 1 cubic foot (0.03 m³) of capacity shall be added for each vehicle up to 10 vehicles.
 - (b) Above 10 vehicles, the Competent authority shall determine the size of the interceptor required.
 - (c) Where vehicles are serviced and not stored, interceptor capacity shall be based on a net capacity of 1 cubic foot (0.03 m³) for each 100 square feet (9.29 m²) of the surface to be drained into the interceptor, with a minimum of 6 cubic feet (0.2 m³).

60 Storm drainage

60.1 Applicability

This chapter shall govern the materials, design, and installation of storm water drainage systems.

60.2 Where required

Roofs, paved areas, yards, courts, courtyards, vent shafts, light wells, or similar areas having rainwater, shall be drained into a separate storm sewer system, or into a combined sewer system where a separate storm sewer system is not available, or to some other place of disposal satisfactory to the Competent authority. In the case of one- and two-family dwellings, storm water shall be permitted to be discharged on flat areas, such as streets or lawns, so long as the storm water shall flow away from the building and away from adjoining property, and shall not create a nuisance.

60.3 Storm Water Drainage to Sanitary Sewer Prohibited

Storm water shall not be drained into sewers intended for sanitary drainage.

60.4 Material Uses

Pipe, tube, and fittings conveying rainwater shall be of such materials and design as to perform their intended function to the satisfaction of the Competent authority. Conductors within a vent or shaft shall be of cast-iron, galvanized steel, wrought iron, copper, copper alloy, lead, Schedule 40 ABS DWV, Schedule 40 PVC DWV, stainless steel 304 or 316L [stainless steel 304 pipe and fittings shall not be installed underground and shall be

kept not less than 6 inches (152 mm) aboveground], or other approved materials, and changes in direction shall be in accordance with the requirements of Section 706.0. ABS and PVC DWV piping installations shall be installed in accordance with applicable standards referenced in Chapter 17 and Chapter 14 "Firestop Protection." Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a flame-spread index of not more than 25 and a smoke-developed index of not more than 50, where tested in accordance with ASTM E84 or UL 723. Plastic piping installed in plenums shall be tested in accordance with all requirements of ASTM E84 or UL 723. Mounting methods, supports and sample sizes of materials for testing that are not specified in ASTM E84 or UL 723 shall be prohibited.

60.4.1 Copper and Copper Alloys

Joints and connections in copper and copper alloy pipe and tube shall be installed in accordance with Section 705.3.

60.4.2 Conductors

Conductors installed aboveground in buildings shall comply with the applicable standards referenced in Table 701.2 for aboveground drain, waste, and vent pipe. Conductors installed aboveground level shall be of seamless copper water tube, Type K, L, or M; Schedule 40 copper pipe or Schedule 40 copper alloy pipe; Type DWV copper drainage tube; service weight cast-iron soil pipe or hubless cast-iron soil pipe; standard weight galvanized steel pipe; stainless steel 304 or 316L [stainless steel 304 pipe and fittings shall not be installed underground and shall be kept not less than 6 inches (152 mm) aboveground], or Schedule 40 ABS or Schedule 40 PVC plastic pipe.

60.4.3 Leaders

Leaders installed outside shall comply with the applicable standards referenced in Table 701.2 for aboveground drain, waste, and vent pipe; aluminum sheet metal; galvanized steel sheet metal; or copper sheet metal.

60.4.4 Underground Building Storm Drains

Underground building storm drains shall comply with the applicable standards referenced in Table 701.2 for underground drain, waste, and vent pipe.

60.4.5 Building Storm Sewers

60.4.6 Subsoil Drains

Subsoil drains shall be open jointed, perforated, or both and constructed of materials in conformance with Table 20.

Table 20 — MATERIALS FOR SUBSOIL DRAINPIPE AND FITTINGS

MATERIAL	REFERENCED STANDARD(S)
PE	ASTM F667
PVC	ASTM D2729
Vitrified Clay (Extra strength)	ASTM C4, ASTM C700

60.5 Expansion Joints Required

Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

60.6 Subsoil Drains

Subsoil drains shall be provided around the perimeter of buildings having basements, cellars, crawl spaces, or floors below grade. Such subsoil drains shall be permitted to be positioned inside or outside of the footing, shall be of perforated or open-jointed approved drain tile or pipe, not less than 3 inches (80 mm) in diameter, and shall be laid in gravel, slag, crushed rock, approved $\frac{3}{4}$ of an inch (19.1 mm) crushed, recycled glass aggregate, or other approved porous material with not less than 4 inches (102 mm) surrounding the pipe. Filter media shall be provided for exterior subsoil piping.

60.6.1 Discharge

Subsoil drains shall be piped to a storm drain, to an approved water course, to the front street curb or gutter, to an alley, or the discharge from the subsoil drains shall be conveyed to the alley by a concrete gutter. Where a continuously flowing spring or groundwater is encountered, subsoil drains shall be piped to a storm drain or an approved water course.

60.6.2 Sump

Where it is not possible to convey the drainage by gravity, subsoil drains shall discharge to an accessible sump provided with an approved automatic electric pump. The sump shall be not less than 15 inches (381 mm) in diameter, 18 inches (457 mm) in depth, and provided with a fitted cover. The sump pump shall have an adequate capacity to discharge water coming into the sump as it accumulates to the required discharge point, and the capacity of the pump shall be not less than 15 gallons per minute (gpm) (0.95 L/s). The discharge piping from the sump pump shall be not less than 1½ inches (40 mm) in diameter and have a union or other approved quick-disconnect assembly to make the pump accessible for servicing.

60.6.3 Splash Blocks

For separate dwellings not serving continuously flowing springs or groundwater, the sump discharge pipe shall be permitted to discharge onto a concrete splash block with a minimum length of 24 inches (610 mm). This pipe shall be within 4 inches (102 mm) of the splash block and positioned to direct the flow parallel to the recessed line of the splash block.

60.6.4 Backwater Valve

Subsoil drains subject to backflow where discharging into a storm drain shall be provided with a backwater valve in the drain line so located as to be accessible for inspection and maintenance.

60.6.5 Open Area

Nothing in clause 60.6 shall prevent drains that serve either subsoil drains or areaways of a detached building from discharging to a properly graded open area, provided that:

- (1) They do not serve continuously flowing springs or groundwater.
- (2) The point of discharge is not less than 10 feet (3048 mm) from a property line.
- (3) It is impracticable to discharge such drains to a storm drain, to an approved water course, to the front street curb or gutter, or to an alley.

60.7 Building Subdrains

Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps.

60.8 Areaway Drains

Open subsurface space adjacent to a building, serving as an entrance to the basement or cellar of a building, shall be provided with a drain or drains. The areaway drains shall be not less than 2 inches (50 mm) in diameter for areaways at a maximum of 100 square feet (9.29 m²) in area, and shall be discharged in the manner provided for subsoil drains not serving continuously flowing springs or groundwater (clause 60.6.1). Areaways exceeding 100 square feet (9.29 m²) shall not drain into subsoil drains. The drains for areaways exceeding 100 square feet (9.29 m²) shall be sized in accordance with Table 24.

60.9 Window Areaway Drains

Window areaways at a maximum of 10 square feet (0.93 m²) in area shall be permitted to discharge to the subsoil drains through a 2 inch (50 mm) diameter pipe. However, window areaways exceeding 10 square feet (0.93 m²) in area shall be handled in the manner provided for entrance areaways (see Section 1101.8).

60.10 Filling Stations and Motor Vehicle Washing Establishments

Public filling stations and motor vehicle washing establishments shall have the paved area sloped toward sumps or gratings within the property lines. Curbs not less than 6 inches (152 mm) high shall be placed where required to direct water to gratings or sumps.

60.11 Paved Areas

Where the occupant creates surface water drainage, the sumps, gratings, or floor drains shall be piped to a storm drain or an approved water course.

60.12 Roof Drainage

Roof drainage shall comply with clause 60.12.1 and clause 60.12.2

60.12.1 Primary Roof Drainage

Roof areas of a building shall be drained by roof drains or gutters. The location and sizing of drains and gutters shall be coordinated with the structural design and pitch of the roof. Unless otherwise required by the Competent authority, roof drains, gutters, vertical conductors or leaders, and horizontal storm drains for primary drainage shall be sized based on a storm of 60 minutes duration and 100 year return period. The 100 years, and 60-minute storms at various locations can be obtained from local meteorological data.

60.12.2 Secondary Drainage

Secondary (emergency) roof drainage shall be provided by one of the methods specified in clause 60.12.2.1 or clause 60.12.2.

60.12.2.1 Roof Scuppers or Open Side

Secondary roof drainage shall be provided by an open-sided roof or scuppers where the roof perimeter construction extends above the roof in such a manner that water will be entrapped. An open-sided roof or scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by clause 60.12.1. Scupper openings shall be not less than 4 inches (102 mm) high and have a width equal to the circumference of the roof drain required for the area served, sized in accordance with Table 1103.1.

60.12.2.2 Secondary Roof Drain

Secondary roof drains shall be provided. The secondary roof drains shall be located not less than 2 inches (51 mm) above the roof surface. The maximum height of the roof drains shall be a height to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by clause 60.12.1. The secondary roof drains shall connect to a piping system in accordance with clause 60.12.1 or clause 60.12.2.2

60.12.2.2.1 Separate Piping System

The secondary roof drainage system shall be a separate system of piping, independent of the primary roof drainage system. The discharge shall be above grade, in a location observable by the building occupants or maintenance personnel. Secondary roof drain systems shall be sized in accordance with Section 1101.12.1 based on the rainfall rate for which the primary system is sized.

60.12.2.2.2 Combined System

The secondary roof drains shall connect to the vertical piping of the primary storm drainage conductor downstream of the last horizontal offset located below the roof. The primary storm drainage system shall connect to the building storm water that connects to an underground public storm sewer. The combined secondary and primary roof drain systems shall be sized in accordance with Section 1103.0 based on double the rainfall rate for the local area.

60.13 Cleanouts

Cleanouts for building storm drains shall comply with the requirements of clause 23 of this standard.

60.13.1 Rain Leaders and Conductors

Rain leaders and conductors connected to a building storm sewer shall have a cleanout installed at the base of the leader or conductor before it connects to the horizontal drain.

60.13.2 Rainwater Sumps

Rainwater sumps serving "public use" occupancy buildings shall be provided with dual pumps arranged to function alternately in the case of overload or mechanical failure. Pumps rated 600 V or less shall comply with UL 778 and shall be installed in accordance with the manufacturer's installation instructions.

60.14 Traps on Storm Drains and Leaders

Leaders and storm drains, where connected to a combined sewer, shall be trapped. Floor and area drains connected to a storm drain shall be trapped.

Exception: Traps shall not be required where roof drains, rain leaders, and other inlets are at locations permitted under clause 42.6.7.1, Vent Termination.

60.14.1 Where Not Required

No trap shall be required for leaders or conductors that are connected to a sewer carrying storm water exclusively.

60.14.2 Trap Size

Traps, where installed for individual conductors, shall be the same size as the horizontal drain to which they are connected.

60.14.3 Method of Installation of Combined Sewer

Individual storm-water traps shall be installed on the stormwater drain branch serving each storm-water inlet, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer. Such traps shall be provided with an accessible cleanout on the outlet side of the trap.

60.15 Leaders, Conductors, and Connections

Leaders or conductors shall not be used as soil, waste, or vent pipes nor shall soil, waste, or vent pipes be used as leaders or conductors.

60.16 Protection of Leaders

Leaders installed along alleyways, driveways, or other locations where exposed to damage shall be protected by metal guards, recessed into the wall, or constructed from the ferrous pipe.

60.16.1 Combining Storm with Sanitary Drainage

The sanitary and storm drainage system of a building shall be entirely separate, except where a combined sewer is used, in which case the building storm drain shall be connected in the same horizontal plane through a single wye fitting to the combined building sewer not less than 10 feet (3048 mm) downstream from a soil stack.

61 Roof Drains

61.1 Applications

Roof drains shall be constructed of aluminum, cast-iron, copper alloy of not more than 15 percent zinc, leaded nickel bronze, stainless steel, ABS, PVC, polypropylene, polyethylene, or nylon and shall comply with ASME A112.3.1 or ASME A112.6.4.

61.2 Dome Strainers Required

Roof drains shall have domed strainers.

Exception: Roof drain strainers for use on sun decks, parking decks, and similar areas that are normally serviced and maintained, shall be permitted to be of the flat surface type. Such roof drain strainers shall be level with the deck.

61.3 Roof Drain Flashings

The connection between the roof and roof drains that pass through the roof and into the interior of the building shall be made watertight by the use of proper flashing material.

61.3.1 Lead Flashing

Where lead flashing material is used, it shall be not less than 4 pounds per square foot (lb/ft²) (19 kg/m²).

61.3.2 Copper Flashing

Where copper flashing material is used, it shall be not less than 12 ounces per square foot (oz/ft²) (3.7 kg/m²).

62 Size of Leaders, Conductors, and Storm Drains

62.1 Vertical Conductors and Leaders

Vertical conductors and leaders shall be sized by the maximum projected roof area and Table 1103.1.

62.2 Size of Horizontal Storm Drains and Sewers

The size of building storm drains, or building storm sewers or their horizontal branches shall be based on the maximum projected roof or paved area to be handled and Table 1103.2.

62.3 Size of Roof Gutters

The size of semi-circular gutters shall be based on the maximum projected roof area and Table 1103.3.

62.4 Side Walls Draining onto a Roof

Where vertical walls project above a roof to permit storm water to drain into the roof area below, the adjacent roof area shall be permitted to be computed from Table 1103.1 as follows:

- (1) For one wall – add 50 percent of the wall area to the roof area figures.
- (2) For two adjacent walls of equal height – add 35 percent of the total wall areas.
- (3) For two adjacent walls of unequal height – add 35 percent of the total common height and add 50 percent of the remaining height of the highest wall.
- (4) Two opposite walls of same height – add no additional area.
- (5) Two opposite walls of differing heights – add 50 percent of the wall area above the top of the lower wall.
- (6) Walls on three sides – add 50 percent of the area of the inner wall below the top of the lowest wall, plus an allowance for the area of the wall above the top of the lowest wall, in accordance with Section 1103.4(3) and Section 1103.4(5) above.
- (7) Walls on four sides – no allowance for wall areas below the top of the lowest wall – add for areas above the top of the lowest wall in accordance with Section 1103.4(1), Section 1103.4(3), Section 1103.4(5), and Section 1103.4(6) above.

Table 21 — SIZING ROOF DRAINS, LEADERS, AND VERTICAL RAINWATER PIPING^{2, 3}

SIZE OF DRAIN, LEADER, OR PIPE	FLOW	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)											
		1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)	7 (in/h)	8 (in/h)	9 (in/h)	10 (in/h)	11 (in/h)	12 (in/h)
2	30	2880	1440	960	720	575	480	410	360	320	290	260	240
3	92	8800	4400	2930	2200	1760	1470	1260	1100	980	880	800	730
4	192	18 400	9200	6130	4600	3680	3070	2630	2300	2045	1840	1675	1530
5	360	34 600	17 300	11 530	8650	6920	5765	4945	4325	3845	3460	3145	2880
6	563	54 000	27 000	17 995	13 500	10 800	9000	7715	6750	6000	5400	4910	4500
8	1208	116 000	58 000	38 660	29 000	23 200	19 315	16 570	14 500	12 890	11 600	10 545	9600

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m²

Notes:

¹ Maximum discharge capacity, gpm (L/s) with approximately 1¼ inch (44 mm) head of water at the drain.

² For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.

³ Vertical piping shall be round, square, or rectangular. Square pipe shall be sized to enclose its equivalent round pipe. Rectangular pipe shall have not less than the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions shall not exceed 3 to 1.

63 Values for Continuous Flow

63.1 General

Where there is a continuous or semi-continuous discharge into the building storm drain or building storm sewer, as from a pump, ejector, air-conditioning plant, or similar device, 1 gpm (0.06 L/s) of such discharge shall be computed as being equivalent to 24 square feet (2.2 m²) of roof area, based upon a rate of rainfall of 4 inches per hour (in/h) (102 mm/h).

64 Controlled-Flow Roof Drainage

64.1 Application

Instead of sizing the storm drainage system in accordance with Section 1103.0, the roof drainage shall be permitted to be sized by controlled flow and storage of the storm water on the roof, provided the following conditions are met:

- (1) The water from a 25-year frequency storm shall not be stored on the roof exceeding 24 hours.
- (2) During the storm, the water depth on the roof shall not exceed the depths specified in Table 1105.1(1).
- (3) Not less than two drains shall be installed in roof areas of 10 000 square feet (929 m²) or less, and not less than one additional drain shall be installed for each 10 000 square feet (929 m²) of roof area exceeding 10 000 square feet (929 m²).
- (4) Each roof drain shall have a precalibrated, fixed (non-adjustable), and proportional weir (notched) in a standing water collar inside the strainer. No mechanical devices or valves shall be permitted.
- (5) Pipe sizing shall be based on the pre-calibrated rate of flow (gpm) (L/s) of the pre-calibrated weir for the maximum allowable water depth, and Table 1103.1 and Table 1103.2.
- (6) The height of stones or other granular material above the waterproofed surface shall not be considered in water depth measurement, and the roof surface in the vicinity of the drain shall not be recessed to create a reservoir.
- (7) Roof design, where controlled-flow roof drainage is used, shall be such that the design roof live load is not less than 30 lb/ft² (146 kg/m²) to provide a safety factor exceeding the 15 lb/ft² (73 kg/m²) represented by the depth of water stored on the roof in accordance with Table 1105.1(1).
- (8) Scuppers shall be provided in parapet walls. The distance of scupper bottoms above the roof level at the drains shall not exceed the maximum distances specified in Table 1105.1(2).
- (9) Scupper openings shall be not less than 4 inches (102 mm) high and have a width equal to the circumference of the roof drain required for the area served, sized in accordance with Table 1103.1.
- (10) Flashings shall extend above the top of the scuppers.
- (11) At a wall or parapet, 45 degree (0.79 rad) cants shall be installed.
- (12) Separate storm and sanitary drainage systems shall be provided within the building.
- (13) Calculations for the roof drainage system shall be submitted along with the plans to the Competent authority for approval.

Table 22 — CONTROLLED-FLOW MAXIMUM ROOF WATER DEPTH

ROOF RISE* (inches)	MAXIMUM WATER DEPTH AT DRAIN (inches)
Flat	3

2	4
4	5
6	6

For SI units: 1 inch = 25.4 mm

* Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring a local depression immediately adjacent to the drain.

Table 23 — DISTANCE OF SCUPPER BOTTOMS ABOVE ROOF

ROOF RISE* (inches)	ABOVE ROOF LEVEL AT DRAIN (inches)
Flat	3
2	4
4	5
6	6

For SI units: 1 inch = 25.4 mm

* Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring a local depression immediately adjacent to the drain.

64.2 Setback Roofs

Drains on setback roofs shall be permitted to be connected to the controlled-flow drainage systems provided:

- (1) The setback is designed for storing water, or
- (2) The square footage of the setback drainage area is converted as outlined in Section 1105.0 to gpm, and the storm-water pipe sizes in the controlled-flow system are based on the sum of the loads.
- (3) The branch from each of the roof drains that are not provided with controlled flow shall be sized in accordance with Table 1103.1.

65 Engineered Storm Drainage System

65.1 General

The design and sizing of a storm drainage system shall be permitted to be determined by accepted engineering practices. The system shall be designed by a registered design professional and approved in accordance with WDRS xxx - Part 1.

65.2 Siphonic Roof Drainage Systems

The design of a siphonic roof drainage system shall comply with ASPE/ANSI 45.

65.3 Siphonic Roof Drains

Siphonic roof drains shall comply with ASME A112.6.9.

66 Testing

66.1 Testing Required

New building storm drainage systems and parts of existing systems that have been altered, extended, or repaired shall be tested in accordance with clause 66.2.1 or clause 67 to disclose leaks and defects.

66.2 Methods of Testing Storm Drainage Systems

Except for outside leaders and perforated or open-jointed drain tile, the piping of storm drain systems shall be tested upon completion of the rough piping installation by water or air, except that plastic pipe shall not be tested with air, and proved tight. The Competent authority shall be permitted to require the removal of cleanout plugs to ascertain whether the pressure has reached parts of the system. One of the following test methods shall be used in accordance with Clause 66.2 through clause 67.2.1.

66.2.1 Water Test

After piping has been installed, the water test shall be applied to the drainage system, either to the entire system or sections. Where the test is applied to the entire system, all openings in the piping shall be tightly closed except for the highest opening, and the system shall be filled with water to the point of overflow. Where the system is tested in sections, each opening shall be tightly plugged except for the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot (3048 mm) head of water. In testing successive sections, not less than the upper 10 feet (3048 mm) of the next preceding section shall be tested so that no joint of pipe in the building except the uppermost 10 feet (3048 mm) of a roof drainage system, which shall be filled with water to the flood level of the uppermost roof drain, shall have been submitted to a test of less than 10-foot (3048 mm) head of water. The water shall be kept in the system or the portion of the test for not less than 15 minutes before inspection starts; the system shall then be tight.

67 Air Test

The air test shall be made by attaching an air compressor testing apparatus to a suitable opening after closing other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 5 pounds-force per square inch (psi) (34 kPa) or sufficient pressure to balance a column of mercury 10 inches (34 kPa) in height. This pressure shall be held without the introduction of additional air for not less than 15 minutes.

67.1.1 Exceptions

Where circumstances exist that make air and water tests described in Section 1107.2.1 and Section 1107.2.2 impractical, see Section 105.3.

Table 24 — SIZING OF HORIZONTAL RAINWATER PIPING^{1,2}

SIZE OF PIPE	FLOW ($\frac{1}{8}$ inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
		1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches	gpm						
3	34	3288	1644	1096	822	657	548
4	78	7520	3760	2506	1880	1504	1253
5	139	13 360	6680	4453	3340	2672	2227
6	222	21 400	10 700	7133	5350	4280	3566
8	478	46 000	23 000	15 330	11 500	9200	7670
10	860	82 800	41 400	27 600	20 700	16 580	13 800
12	1384	133 200	66 600	44 400	33 300	26 650	22 200
15	2473	238 000	119 000	79 333	59 500	47 600	39 650

SIZE OF PIPE	FLOW ($\frac{1}{4}$ inch per foot slope)	MAXIMUM ALLOWABLE HORIZONTAL PROJECTED ROOF AREAS AT VARIOUS RAINFALL RATES (square feet)					
		1 (in/h)	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches	gpm						
3	48	4640	2320	1546	1160	928	773
4	110	10 600	5300	3533	2650	2120	1766
5	196	18 880	9440	6293	4720	3776	3146
6	314	30 200	15 100	10 066	7550	6040	5033
8	677	65 200	32 600	21 733	16 300	13 040	10 866
10	1214	116 800	58 400	38 950	29 200	23 350	19 450
12	1953	188 000	94 000	62 600	47 000	37 600	31 350
15	3491	336 000	168 000	112 000	84 000	67 250	56 000

For SI units: 1 inch = 25 mm, 1 gallon per minute = 0.06 L/s, $\frac{1}{4}$ inch per foot = 10.4 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m²

Notes:

¹ The sizing data for horizontal piping are based on the pipes flowing full.

² For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch per hour (25.4 mm/h) column by the desired rainfall rate.

Table 25 — SIZE OF GUTTERS

DIAMETER OF GUTTER ($\frac{1}{16}$ inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches					
3	340	226	170	136	113
4	720	480	360	288	240
5	1250	834	625	500	416
6	1920	1280	960	768	640
7	2760	1840	1380	1100	918
8	3980	2655	1990	1590	1325
10	7200	4800	3600	2880	2400

DIAMETER OF GUTTER ($\frac{1}{8}$ inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches					
3	480	320	240	192	160
4	1020	681	510	408	340
5	1760	1172	880	704	587
6	2720	1815	1360	1085	905
7	3900	2600	1950	1560	1300
8	5600	3740	2800	2240	1870
10	10 200	6800	5100	4080	3400

DIAMETER OF GUTTER (¼ inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches					
3	680	454	340	272	226
4	1440	960	720	576	480
5	2500	1668	1250	1000	834
6	3840	2560	1920	1536	1280
7	5520	3680	2760	2205	1840
8	7960	5310	3980	3180	2655
10	14 400	9600	7200	5750	4800

DIAMETER OF GUTTER (½ inch per foot slope)	MAXIMUM RAINFALL RATES BASED ON ROOF AREA (square feet)				
	2 (in/h)	3 (in/h)	4 (in/h)	5 (in/h)	6 (in/h)
inches					
3	960	640	480	384	320
4	2040	1360	1020	816	680
5	3540	2360	1770	1415	1180
6	5540	3695	2770	2220	1850
7	7800	5200	3900	3120	2600
8	11 200	7460	5600	4480	3730
10	20 000	13 330	10 000	8000	6660

For SI units: 1 inch = 25 mm, ¼ inch per foot = 5.2 mm/m, 1 inch per hour = 25.4 mm/h, 1 square foot = 0.0929 m²

Annex A (informative)

Drainage fixture unit values (DFU) for building sewer applications

Table B.1 — **Table title**

PLUMBING APPLIANCES, APPURTANCES, OR FIXTURES	MINIMUM SIZE TRAP AND TRAP ARM ⁷ (INCHES)	PRIVATE	PUBLIC	ASSEMBLY ⁸
Bathtub or combination Bath/shower	1 1/2	2.0	2.0	—
Bidet	1 1/4	1.0	—	—
Bidet	1 1/2	3.0	—	—
Clothes washer, domestic, standpipe ⁵	2	3.0	3.0	3.0
Dental unit, cuspidor	1 1/4	—	1.0	1.0
Dishwasher, domestic, with independent drain ²	1 1/2	2.0	2.0	2.0
Drinking fountain or water cooler	1 1/4	0.5	0.5	1.0
Food waste Disposer, commercial	2	—	3.0	3.0
Floor drain, emergency	2	—	0.0	0.0

Floor drain (for additional sizes see section 702.0)	2	2.0	2.0	2.0
Shower, single head trap	2 ⁹	2.0	2.0	2.0
Multi head, each additional	2	1.0	1.0	1.0
Lavatory	1 1/4	1.0	1.0	1.0
Lavatories in sets	1 1/2	2.0	2.0	2.0
Washfountain	1 1/2	—	2.0	2.0
Washfountain	2	—	3.0	3.0
Mobile home, trap	3	12.0	—	—
Receptor, indirect waste ^{1,3}	1 1/2	See footnote ^{1,3}		
Receptor, indirect waste ^{1,4}	2	See footnote ^{1,4}		
Receptor, indirect waste ¹	3	See footnote ¹		
Sinks	—	—	—	—
Bar	1 1/2	1.0	—	—
Bar ²	1 1/2	—	2.0	2.0
Clinical	3	—	6.0	6.0

Commercial with food waste ²	1 1/2	—	3.0	3.0
Exam room	1 1/2	—	1.0	—
Special purpose ²	1 1/2	2.0	3.0	3.0
Special purpose	2	3.0	4.0	4.0
Special purpose	3	—	6.0	6.0
Kitchen, Domestic ² (with or without food waste disposer, dishwasher, or both)	1 1/2	2.0	2.0	—
Laundry ² (with or without discharge from clothes washer)	1 1/2	2.0	2.0	2.0
Service or Mop Basin	2	—	3.0	3.0
Service or Mop Basin	3	—	3.0	3.0
Service, Flushing rim	3	—	6.0	6.0
Wash, each set of faucets	—	—	2.0	2.0
Nonwater urinal with Drain Cleansing Action	2	1.0	1.0	1.0
Urinal, Integral trap 1.0 GPF ²	2	2.0	2.0	5.0

Urinal, Integral trap greater than 1.0 GPF ²	2	2.0	2.0	6.0
Urinal, exposed trap ²	1 1/2	2.0	2.0	5.0
Water closet, 1.6 GPF Gravity Tank ^{—6}	3	3.0	4.0	6.0
Water closet 1.6 GPF Flushometer Tank ⁶	3	3.0	4.0	6.0
Water closet 1.6 GPF Flushometer Valve ^{— 6}	3	3.0	4.0	6.0
Water Closet, greater than 1.6 GPF Gravity Tank ^{—6}	3	4.0	4.0	8.0
Water closet, greater than 1.6 GPF Flushometer valve	3	4.0	6.0	8.0

ANNEX B 102.2

DRAINAGE FIXTURE UNIT VALUES (DFU)

For SI units: 1 inch = 25 mm

Notes:

¹ Indirect waste receptors shall be sized based on the total drainage capacity of the fixtures that drain thereinto, in accordance with Annex B101.2.

² Provide a 2 inch (50 mm) minimum drain.

³ For refrigerators, coffee urns, water stations, and similar low demands.

⁴ For commercial sinks, dishwashers, and similar moderate or heavy demands.

⁵ Buildings having a clothes-washing area with clothes washers in a battery of three or more clothes washers shall be rated at 6 fixture units each for purposes of sizing common horizontal and vertical drainage piping.

⁶ Water closets shall be computed as 6 fixture units where determining septic tank sizes based on Annex C of this standard.

⁷ Trap sizes shall not be increased to the point where the fixture discharge is capable of being inadequate to maintain their self-scouring properties.

⁸ Assembly [Public Use (Part 2: Plumbing fixtures and fixture fittings A122.1)].

⁹ For a bathtub to shower retrofit, a 1 1/2 inch (40 mm) trap and trap arm shall be permitted with a maximum shower size of 36 inches (914 mm) in width and 1524 mm (60 inches) in length.

Annex B **(informative)**

Alternate plumbing systems

B.1 General

B.1.1 Applicability

The intent of this appendix is to provide clarification of procedures for the design and approval of engineered plumbing systems, alternate materials, and equipment not specifically covered in other parts of the code.

B.1.2 Provisions

The provisions of this appendix apply to the design, installation, and inspection of an engineered plumbing system, alternate material, and equipment.

B.1.3 Competent Authority

The Competent Authority has the right to require descriptive details of an engineered plumbing system, alternate material, or equipment including pertinent technical data to be filed.

B.1.4 Standards and specifications

Components, materials, and equipment shall comply with standards and specifications listed in all the series or parts of the plumbing code and other national consensus standards applicable to plumbing systems and materials.

B.1.5 Alternate materials and equipment

Where such standards and specifications are not available, alternate materials and equipment shall be approved in accordance with the provisions of Section WDRS xxx-1.

B.2 Definitions

B.2.1 General. For the purpose of this appendix, the following definitions shall apply:

Branch Interval

A length of soil or waste stack corresponding in general to a story height, but in no case less than 8 feet (2438 mm), within which the horizontal branches from one floor or story of the building are connected to the stack.

B.2.2 Engineered Plumbing System

A system designed for a specific building project with drawings and specifications indicating plumbing materials to be installed, all as prepared by a registered design professional.

B.3 Engineered Plumbing Systems

B.3.1 Inspection and Installation

In other than one- and two-family dwellings, the designer of the system is to provide periodic inspection of the installation on a schedule approved by the Competent Authority. Prior to the final approval, the designer shall verify to the Competent Authority that the installation is in accordance with the approved plans, specifications, and data and such amendments to it. The designer shall certify to the Competent Authority that the installation is in accordance with the applicable engineered design criteria.

B.3.2 Owner Information

The designer of the system shall provide the building owner with information concerning the system, considerations applicable for subsequent modifications to the system, and maintenance requirements as applicable.

B.3.3 Water Heat Exchangers

B.3.4 Protection from Contamination

Heat exchangers used for heat transfer, heat recovery, or solar heating shall protect the potable water system from being contaminated by the heat-transfer medium.

Single-Wall Heat Exchangers

Single-wall heat exchangers shall comply with the following requirements:

- (1) The heat-transfer medium is either potable water or contains essentially nontoxic transfer fluids having a toxicity rating or class of 1 (see Section XXXX).
- (2) The pressure of the heat-transfer medium is maintained at less than the normal minimum operating pressure of the potable water system.

Exception: Steam in accordance with Section XXXXX above.

- (3) The equipment is permanently labeled to indicate that only additives recognized as safe by the RFDA shall be used in the heat-transfer medium.

B.4 Alternate Designs

Other heat exchanger designs shall be permitted where approved by the Competent Authority.

B.5 Fixture Unit Values for Private or Private Use Bathroom Groups.

B.5.1 Fixtures.

Table B.1 and Table B.2 reflect the fixture unit loads for the fixtures in bathrooms as groups, rather than as individual fixtures. Such fixtures include water closets, lavatories, and bathtubs or showers. The tables reflect diversity in the use of fixtures within a bathroom and between multiple bathrooms.

B.5.2 Water Supply Fixture Unit Values

The listed water supply fixture unit values in Table B.1 reflect the load of entire bathroom groups on the cold water building supply. Individual hot and cold water branch piping to the fixtures shall be permitted to be sized in accordance with Chapter 6 and Appendix A.

B.5.3 Drainage Fixture Unit Values

The listed drainage fixture unit values in Table B.2 reflect a load of entire bathroom groups on the sanitary drainage system. Where fixtures within bathrooms connect to different branches of the drainage system, the fixture unit values for the individual fixtures shall be used, as listed in Table 3 of this standard.

B.6 Drainage System Sizing

B.6.1 Drainage Fixture Units

Drainage fixture unit values shall be sized in accordance with clause 6 and Table 3.

Table B.1 — ater supply fixture units (WSFU) for bathroom groups^{1, 2}

	PRIVATE USE BATHROOM GROUP		SERVING 3 OR MORE PRIVATE USE BATHROOM GROUPS	
	COLD	HOT ³	COLD	HOT
Bathroom Groups Having up to 1.6 GPF Gravity-Tank and Pressure Tank Water Closets				
Half-Bath or Powder Room	3.5	0.8	2.5	0.5
1 Bathroom Group	5.0	2.5	3.5	1.8
1½ Bathrooms	6.0	2.5	3.0	3.0
2 Bathrooms	7.0	3.5	3.4	3.4
2½ Bathrooms	8.0	3.6	3.8	3.8
3 Bathrooms	9.0	4.5	4.1	4.1
Each Additional ½ Bath	0.5	0.1	0.4	0.4
Each Additional Bathroom Group	1.0	0.5	0.8	0.8

Other Groups of Fixtures				
Bathroom Group (1.6 GPF Flushometer Value)	6.0	2.5	4.0	1.7
Kitchen Group (Sink and Dishwasher)	2.0	2.0	1.5	1.5
Laundry Group (Sink and Clothes Washer)	5.0	5.0	3.0	3.0

Notes:

¹ A bathroom group, for this table, consists of one water closet, up to two lavatories, and either one bathtub or one shower.

² A half-bath or powder room, for this table, consists of one water closet and one lavatory.

³ Multi-unit dwellings with individual water heaters use the same WSFU as for individual dwellings.

B.6.2 Size of Building Drain and Building Sewer

The maximum number of drainage fixture units allowed on the building drain or building sewer of a given size shall be in accordance with Table B.3. The size of a building drain or building sewer serving a water closet shall be not less than 3 inches (80 mm).

B.6.3 Size of Horizontal Branch or Vertical Stack

The maximum number of drainage fixture units allowed on a horizontal branch or vertical soil or waste stack of a given size shall be in accordance with Table B.4. Stacks shall be sized based on the total accumulated connected load at each story or branch interval.

B.6.3.1 Horizontal Stack Offsets

Horizontal stack offsets shall be sized in accordance with Table B.3 as required for building drains.

B.6.3.2 Vertical Stack Offsets

Vertical stack offsets shall be sized in accordance with Table B.4 as required for stacks.

B.6.3.3 Horizontal Stack Offset and Horizontal Branch Connections

Horizontal branch connections shall not connect to a horizontal stack offset or within 2 feet (610 mm) above or below the offset where such horizontal offset is located more than four branch intervals below the top of the stack.

B.7 Vent System Sizing

B.7.1 Size of Vents

The size of vent piping shall be determined from the developed length and the total number of drainage fixture units connected in accordance with Table . Vents shall be not less than one-half the required size of the drainage pipe size served as determined by Table B.4 for horizontal fixture branches and stacks nor less than 1¼ inches (32 mm) in diameter. The drainage system shall be vented by not less than one vent pipe which shall be not less than one-half the size of the required building drain and which shall extend from the building drain or extension of building drain to the outdoors. Vents shall be installed in accordance with this part.

B.7.2 Vent Stack

A vent stack shall be required for a drainage stack that extends five or more branch intervals above the building drain or horizontal branch. The developed length of the vent stack shall be measured from the lowest connection of a branch vent to the termination outdoors.

B.7.3 Branch Vents

Where branch vents exceed 40 feet (12 192 mm) in developed length, such vent shall be increased by one pipe size for the entire developed length of the vent pipe.

B.7.4 Venting Horizontal Offsets

Drainage stacks with horizontal offsets shall be vented where five or more branch intervals are located above the offset. The upper and lower section of the horizontal offset shall be vented in accordance with Section C 401.4.1 and Section C 401.4.2.

B.7.4.1 Venting Upper Section

The vent for the upper section of the stack shall be vented as a separate stack with a vent stack connection installed at the base of the drainage stack. Such vent stack shall connect below the lowest horizontal branch or building drain. Where vent stack connects to the building drain, the connection shall be located downstream of the drainage stack and within a distance of 10 times the diameter of the drainage stack.

B.7.4.2 Venting Lower Section

The vent for the lower section of the stack shall be vented by a yoke vent connecting between the offset and the next lower horizontal branch using a wye-branch fitting. The size of the yoke vent and connection shall be not less in diameter than the required size for the vent serving the drainage stack. The yoke vent connection shall be permitted to be a vertical extension of the drainage stack.

Table B.2 — DRAINAGE FIXTURE UNIT VALUES (DFU) FOR BATHROOM GROUPS^{1, 2}

	PRIVATE USE BATHROOM GROUP	SERVING 3 OR MORE PRIVATE USE BATHROOM GROUP
Bathroom Groups having 1.6 GPF Gravity-Tank Water Closets		
Half-Bath or Powder Room	3.0	2.0
1 Bathroom Group	5.0	3.0
1½ Bathrooms	6.0	3.5
2 Bathrooms	7.0	4.5
2½ Bathrooms	8.0	5.0
3 Bathrooms	9.0	5.5
Each Additional ½ Bath	0.5	0.5
Each Additional Bathroom Group	1.0	1.0
Bathroom Groups having 1.6 GPF Pressure-Tank Water Closets		
Half-Bath or Powder Room	3.5	2.5

1 Bathroom Group	5.5	3.5
1½ Bathrooms	6.5	4.0
2 Bathrooms	7.5	5.0
2½ Bathrooms	8.5	5.5
3 Bathrooms	9.5	6.0
Each Additional ½ Bath	0.5	0.5
Each Additional Bathroom Group	1.0	1.0
Bathroom Groups having 3.5 GPF Gravity-Tank Water Closets		
Half-Bath or Powder Room	3.0	2.0
1 Bathroom Group	6.0	4.0
1½ Bathrooms	8.0	5.5
2 Bathrooms	10.0	6.5
2½ Bathrooms	11.0	7.5
3 Bathrooms	12.0	8.0
Each Additional ½ Bath	0.5	0.5
Each Additional Bathroom	1.0	1.0
Bathroom Group (1.6 GPF Flushometer Valve)	3.0	3.0
Bathroom Group (3.5 GPF Flushometer Valve)	4.0	4.0
Notes: ¹ A bathroom group, for this table, consists of not more than one water closet, up to two lavatories, and either one bathtub or one shower. ² A half-bath or powder room, for this table, consists of one water closet and one lavatory.		

Table B.3 — BUILDING DRAINS AND BUILDING SEWERS¹

DIAMETER OF PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS FOR SANITARY BUILDING DRAINS AND RUNOUTS FROM STACKS			
	SLOPE (inches per foot)			
	1/16	1/8	1/4	1/2

2	–	–	21	26
2½	–	–	24	31
3	–	20	42 ₂	50 ₂
4	–	180	216	250
5	–	390	480	575
6	–	700	840	1000
8	1400	1600	1920	2300
10	2500	2900	3500	4200
12	3900	4600	5600	6700
15	7000	8300	10 000	12 000

For SI units: 1 inch = 25 mm, 1 inch per foot = 83.3 mm/m

Notes:

¹ On-site sewers that serve more than one building shall be permitted to be sized according to the current standards and specifications of the administrative authority for public sewers.

² A maximum of two water closets or two bathroom groups, except in single-family dwellings, where a maximum of three water closets or three bathroom groups shall be permitted to be installed.

TableB.4 — HORIZONTAL FIXTURE BRANCHES AND STACKS

DIAMETER OF PIPE (inches)	MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS			
	HORIZONTAL FIXTURE BRANCH ¹	ONE STACK OF THREE OR FEWER BRANCH INTERVALS	STACKS WITH MORE THAN THREE BRANCH INTERVALS	
			TOTAL FOR STACK	TOTAL AT ONE BRANCH INTERVAL
1½	3	4	8	2
2	6	10	24	6
2½	12	20	42	9
3	20 ²	48 ²	72 ²	20 ²
4	160	240	500	90
5	360	540	1100	200
6	620	960	1900	350

8	1400	2200	3600	600
10	2500	3800	5600	1000
12	3900	6000	8400	1500
15	7000	6000	8400	1500

For SI units: 1 inch = 25 mm

Notes:

¹ Does not include branches of the building drain.

² A maximum of two water closets or bathroom groups within each branch interval or more than six water closets or bathroom groups on the stack.

B.8 Vacuum Drainage Systems

B.8.1 General

This section regulates the design and installation provisions for vacuum waste drainage systems. Plans for vacuum waste drainage systems shall be submitted to the Competent Authority for approval and shall be considered an engineered designed system. Such plans shall be prepared by a registered design professional to perform plumbing design work. Details are necessary to ensure compliance with the requirements of this section, together with a full description of the complete installation including quality, grade of materials, equipment, construction, and methods of assembly and installation. Components, materials, and equipment shall comply with standards and specifications listed in XXXXX of this standard or approved by the Competent Authority and other national consensus standards applicable to plumbing systems and materials. Where such standards and specifications are not available, alternate materials and equipment shall be approved in accordance with Section XXXX.

Table B.5 — SIZE AND LENGTH OF VENTS

SIZE OF SOIL OR WASTE STACK (inches)	FIXTURE UNITS CONNECTED	DIAMETER OF VENT REQUIRED (inches)								
		1¼	1½	2	2½	3	4	5	6	8
MAXIMUM LENGTH OF VENT (feet)										
1½	8	50	150	—	—	—	—	—	—	—
2	12	30	75	200	—	—	—	—	—	—
2	20	26	50	150	—	—	—	—	—	—
2½	42	—	30	100	300	—	—	—	—	—
3	10	—	30	100	100	600	—	—	—	—
3	30	—	—	60	200	500	—	—	—	—

3	60	—	—	50	80	400	—	—	—	—
4	100	—	—	35	100	260	1000	—	—	—
4	200	—	—	30	90	250	900	—	—	—
4	500	—	—	20	70	180	700	—	—	—
5	200	—	—	—	35	80	350	1000	—	—
5	500	—	—	—	30	70	300	900	—	—
5	1100	—	—	—	20	50	200	700	—	—
6	350	—	—	—	25	50	200	400	1300	—
6	620	—	—	—	15	30	125	300	1100	—
6	960	—	—	—	—	24	100	250	1000	—
6	1900	—	—	—	—	20	70	200	700	—
8	600	—	—	—	—	—	50	150	500	1300
8	1400	—	—	—	—	—	40	100	400	1200
8	2200	—	—	—	—	—	30	80	350	1100
8	3600	—	—	—	—	—	25	60	250	800
10	1000	—	—	—	—	—	—	75	125	1000
10	2500	—	—	—	—	—	—	50	100	500
10	3800	—	—	—	—	—	—	30	80	350
10	5600	—	—	—	—	—	—	25	60	250

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

B.9 System Design

Vacuum waste drainage systems shall be designed and installed in accordance with the manufacturer's installation instructions. A vacuum waste drainage system shall include a vacuum generating system, waste collection center, piping network, vacuum valve, and control components used to isolate the vacuum piping network from atmospheric pressure and to collect waste at its point of origin. Where a vacuum system provides the only means of sanitation, the duplicate vacuum generating equipment set to operate automatically shall be installed to allow the system to continue in operation during periods of maintenance.

B.9.1 Vacuum Generating System

The vacuum generating station shall include vacuum pumps to create a constant vacuum pressure within the piping network and storage tanks. The operation of pumps, collection tanks, and alarms shall be automated by controls. The vacuum pumps shall be activated on demand and accessible for repair or replacement. The vent from the vacuum pump shall be provided for vacuum pump air exhaust and shall be of a size capable of handling the total air volume of the vacuum pump.

B.9.2 Waste Collection Center or Storage Tanks

Vacuum collection center or storage tanks shall be of such capacity as to provide storage of waste to prevent fouling of the system. Such collection or storage tank shall be capable of withstanding 150 percent of the rated vacuum (negative pressure) created by the vacuum source without leakage or collapse. Waste collection center or storage tanks shall be accessible for adjustment, repair, or replacement.

B.9.3 Piping Network

The piping network shall be under a continuous vacuum and shall be designed to withstand 150 percent of the vacuum (negative pressure) created by the vacuum source within the system without leakage or collapse. Sizing the piping network shall be in accordance with the manufacturer's instructions. The water closet outlet fitting shall connect with a piping network having not less than an 1½ inch (40 mm) nominal inside diameter.

B.9.4 Vacuum Interface Valve

A closed vacuum interface valve shall be installed to separate the piping network vacuum from atmospheric pressure. A control device shall open the vacuum interface valve where a signal is generated to remove waste from the plumbing fixture.

B.9.5 Control Components

Where a pneumatic signal is generated at the controller, a vacuum from the system to open the extraction valve shall be designed to operate where vacuum pressure exists to remove the accumulated waste. Each tank shall incorporate a level indicator switch that automatically controls the discharge pump and warns of malfunction or blockage as follows:

- (1) Start discharge.
- (2) Stop discharge.
- (3) Activate an audible alarm where the level of effluent is usually high.
- (4) Warning of system shutdown where the tank is full.

B.10 Fixtures

Fixtures utilized in a vacuum waste drainage system shall be in accordance with referenced standards listed in all the series of the code. Components shall be of corrosion resistant materials. The water closet outlet shall be able to pass a 1 inch (25.4 mm) diameter ball and shall have a smooth, impervious surface. The waste outlet and passages shall be free of obstructions, recesses, or chambers that are capable of permitting fouling. The mechanical valve and its seat shall be of such materials and design to provide a leak-free connection where at atmospheric pressure or under vacuum. The flushing mechanism shall be so designed as to ensure proper cleansing of the interior surfaces during the flushing cycle at a minimum operating flow rate. Mechanical seal mechanisms shall withdraw completely from the path of the waste discharge during the flushing operation. Each mechanical seal vacuum water closet shall be equipped with a listed vacuum breaker. The vacuum breaker

shall be mounted with the critical level or marking not less than 1 inch (25.4 mm) above the flood-level rim of the fixture. Vacuum breakers shall be installed on the discharge side of the last control valve in the potable water supply line and shall be located to be protected from physical damage and contamination.

B.11 Drainage Fixture Units

Drainage fixture units shall be determined by the manufacturer's instructions. The pump discharge load from the collector tanks shall be in accordance with this appendix.

B.12 Water Supply Fixture Units

Water supply fixture units shall be determined by the manufacturer's instructions.

B.13 Materials

Materials used for water distribution pipe and fittings shall be in accordance with Table 604.1. Materials used for aboveground drainage shall be in accordance with Table 701.2 and shall have a smooth bore, and be constructed of non-porous material.

B.14 Traps and Cleanouts

Traps and cleanouts shall be installed in accordance with of this standard

B.15 Testing

The entire vacuum waste system shall be subjected to a vacuum test of 29 inches of mercury (98 kPa) or not less than the working pressure of the system for 30 minutes. The system shall be gastight and watertight at all points. Verification of test results shall be submitted to the Competent Authority.

B.16 Manufacturer's Instructions

Manufacturer's instructions shall be provided to provide information regarding safe and proper operating instructions whether or not as part of the condition of listing to determine compliance. Such instructions shall be submitted and approved by the Competent Authority.

B.17 Single-Stack Vent System

B.17.1 Where Permitted

Single-stack venting shall be designed by a registered design professional as an engineered design. A drainage stack shall be permitted to serve as a single-stack vent system where sized and installed in accordance with Section B.17.2 through Section B.23. The drainage stack and branch piping in a single-stack vent system shall provide for the flow of liquids, solids, and air without exceeding the pressure differential described in clause 41.1.2.

B.17.2 Stack Size

Drainage stacks shall be sized in accordance with Table B.6. Not more than two water closets shall be permitted to discharge to a 3 inch (80 mm) stack. Stacks shall be uniformly sized based on the total connected drainage fixture unit load, with no reductions in size.

B.17.2.1 Stack Vent

The drainage stack vent shall have a stack vent of the same size terminating to the outdoors.

B.18 Branch Size

Horizontal branches connecting to a single-stack vent system shall be sized in accordance with Table 7.

Exceptions:

- (1) Not more than one water closet within 18 inches (457 mm) of the stack horizontally shall be permitted on a 3 inch (80 mm) horizontal branch.
- (2) A water closet within 18 inches (457 mm) of a stack horizontally and one other fixture with up to 1½ inch (40 mm) fixture drain size shall be permitted on a 3 inch (80 mm) horizontal branch where connected to the stack through a sanitary tee.

B.19 Length of Horizontal Branches

Water closets shall be not more than 4 feet (1219 mm) horizontally from the stack.

Exception: Water closets shall be permitted to be up to 8 feet (2438 mm) horizontally from the stack where connected to the stack through a sanitary tee.

B.19.1 Other Fixtures

Fixtures other than water closets shall be not more than 12 feet (3658 mm) horizontally from the stack.

B.19.2 Length of Vertical Piping

The length of vertical piping from a fixture trap to a horizontal branch shall not be considered in computing the fixture's horizontal distance from the stack.

B.19.3 Maximum Vertical Drops from Fixtures

Vertical drops from fixture traps to horizontal branch piping shall be one size larger than the trap size, but not less than 2 inches (50 mm) in diameter. Vertical drops shall be 4 feet (1219 mm) maximum length. Fixture drains that are not increased in size, or have a vertical drop exceeding 4 feet (1219 mm) shall be individually vented.

B.19.4 Additional Venting Required

Additional venting shall be provided where more than one water closet is on a horizontal branch and where the distance from a fixture trap to the stack exceeds the limits in clause B.19. Where additional venting is required, the fixture(s) shall be vented by one of the methods described in clause XXXX through clause XXXX. The dry vent extensions for the additional venting shall connect to a branch vent, vent stack, stack vent, or be extended outdoors and terminate to the open air.

Table B.6 — SINGLE STACK SIZE*

MAXIMUM CONNECTED DRAINAGE FIXTURE UNITS			
STACK SIZE (inches)	STACKS LESS THAN 75 FEET IN HEIGHT	STACK 75 FEET TO LESS THAN 160 FEET IN HEIGHT	STACK 160 FEET OR GREATER IN HEIGHT
3	24	NP	NP
4	225	24	NP
5	480	225	24
6	1015	480	225
8	2320	1015	480
10	4500	2320	1015
12	8100	4500	2320
15	13 600	8100	4500

For SI units: 1 inch = 25 mm, 1 foot = 304.8 mm

* NP = Not permitted

B.20 Stack Offsets

Where there are no fixture drain connections below a horizontal offset in a stack, the offset does not need to be vented. Where there are fixture drain connections below a horizontal offset in a stack, the offset shall be vented. There shall be no fixture connections to a stack within 2 feet (610 mm) above and below a horizontal offset.

B.21 Prohibited Connections Near Base of Stack

Where stacks are more than 75 feet (22 860 mm) high, a separate stack shall be provided for the fixtures on the lower two stories. The stack for the lower two stories shall be permitted to be connected to the branch of the building drain that serves the stack for the upper stories at a point that is not less than 8 feet (2438 mm) downstream from the base of the upper stack. Where stacks are less than 75 feet (22 860 mm) high but more than two stories high, the lowest story shall not connect within 8 feet (2438 mm) downstream from the base of the stack. Venting for the lowest story shall be provided in accordance with Section B.21.1 and Section B.21.2.

B.21.1 Conditional Vent

Venting of fixtures on the lowest floor shall be in accordance with clause 42.6.7.9 through clause Section XXXX and may connect into the single-stack as a conditional vent. The conditional vent connects into the stack by means of a wye-fitting to prevent ingress of drainage into the vent. No more than 12 drainage fixture units (DFU) may be connected into the conditional vent and shall connect not less than 8 feet (2438 mm) above the stack base.

B.21.2 Other Branch Vent

Other branch vents shall be vented in accordance with clause 42.6.7.9.

B.22 Sizing Building Drains and Sewers

In a single-stack vent system, the building drain and branches thereof shall be sized in accordance with Table 7.

B.23 Parallel Vent Stacks

Drainage stacks extending more than 75 feet (22 860 mm) shall be provided with a parallel vent stack and shall meet the requirements of clause 42.6.7.8

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Annex C (informative) Private sewage disposal systems

H 101.0 General.

H 101.1 Applicability.

This appendix provides general guidelines for the materials, design, and installation of private sewage disposal systems.

H 101.2 General Requirements.

Where permitted by Section XXXX, the building sewer shall be permitted to be connected to a private sewage disposal system in accordance with the provisions of this appendix. The type of system shall be determined on the basis of location, soil porosity, and groundwater level, and shall be designed to receive all sewage from the property. The system, except as otherwise approved, shall consist of a septic tank with effluent discharging into a subsurface disposal field, into one or more seepage pits, or into a combination of subsurface disposal field and seepage pits. The Competent authority shall be permitted to grant exceptions to the provisions of this appendix for permitted structures that have been destroyed due to fire or natural disaster, and that cannot be reconstructed in compliance with these provisions provided that such exceptions are the minimum necessary.

H 101.3 Quantity and Quality.

Where the quantity or quality of the sewage is such that the above system cannot be expected to function satisfactorily for commercial, agricultural, and industrial plumbing systems; for installations where appreciable amounts of industrial or indigestible wastes are produced; for occupancies producing abnormal quantities of sewage or liquid waste; or where grease interceptors are required by other parts of this code, the method of sewage treatment and disposal shall be first approved by the Competent authority. Special sewage disposal systems for minor, limited, or temporary uses shall be first approved by the Competent authority.

H 101.4 Septic Tank and Disposal Field Systems.

Disposal systems shall be designed to utilize the most porous or absorptive portions of the soil formation. Where the groundwater level extends to within 12 feet (3658 mm) or less of the ground surface or where the upper soil is porous, and the underlying stratum is rock or impervious soil, a septic tank and disposal field system shall be installed.

H 101.5 Flood Hazard Areas.

Disposal systems shall be located outside of flood hazard areas.

Exception: Where suitable sites outside of flood hazard areas are not available, disposal systems shall be permitted to be located in flood hazard areas on sites where the effects of inundation under conditions of the design flood are minimized.

H 101.6 Design.

Private sewage disposal systems shall be so designed that additional seepage pits or subsurface drain fields, equivalent to not less than 100 percent of the required original system, shall be permitted to be installed where the original system cannot absorb all the sewage. No division of the lot or erection of structures on the lot shall be made where such division or structure impairs the usefulness of the 100 percent expansion area.

H 101.7 Capacity.

No property shall be improved more than its capacity to absorb sewage effluent properly by the means provided in this code.

Exception: The Competent authority shall be permitted to, at its discretion, approve an alternate system.

H 101.8 Location.

No private sewage disposal system, or part thereof, shall be located in any lot other than the lot that is the site of the building or structure served by such private sewage disposal system, nor shall any private sewage disposal system or part thereof be located at any point having less than the minimum distances indicated in Table H 101.8.

Nothing contained in this code shall be construed to prohibit the use of all or part of an abutting lot to provide additional space for a private sewage disposal system or part thereof where proper cause, transfer of ownership, or change of boundary not in violation of other requirements has been first established to the satisfaction of the Competent authority. The instrument recording such action shall constitute an agreement with the Competent authority, which shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such agreement shall be recorded in the office of the County Recorder as part of the

conditions of ownership of said properties and shall be binding on heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Competent authority.

H 101.9 Building Permit.

Where there is insufficient lot area or improper soil conditions for sewage disposal for the building or land use proposed, and the Competent authority so finds, no building permit shall be issued, and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data, and test reports satisfactory to the Competent authority have been submitted and approved.

H 101.10 Additional Requirements.

Nothing contained in this appendix shall be construed to prevent the Competent authority from requiring compliance with additional requirements than those contained herein, where such additional requirements are essential to maintaining a safe and sanitary condition.

H 101.11 Alternate Systems.

Alternate systems shall be permitted to be used by special permission of the Competent authority after being satisfied with their adequacy. This authorization is based on extensive field and test data from conditions similar to those at the proposed site or requires such additional data as necessary to assure that the alternate system will produce continuous and long-range results at the proposed site, not less than equivalent to systems which are specifically authorized.

Where demonstration systems are to be considered for installation, conditions for installation, maintenance, and monitoring at each such site shall first be established by the Competent authority.

Approved aerobic systems shall be permitted to be substituted for conventional septic tanks provided the Competent authority is satisfied that such systems will produce results not less than equivalent to septic tanks, whether their aeration systems are operating or not.

TABLE H 101.8
LOCATION OF SEWAGE DISPOSAL SYSTEM

MINIMUM HORIZONTAL DISTANCE	BUILDING SEWER	SEPTIC TANK	DISPOSAL FIELD	SEEPAGE PIT OR CESSPOOL
Building or structures ¹	2 feet	5 feet	8 feet	8 feet
Property line adjoining private property	Clear ²	5 feet	5 feet	8 feet
Water supply wells	50 feet ³	50 feet	100 feet	150 feet
Streams and other bodies of water	50 feet	50 feet	100 feet ⁷	150 feet ⁷
Trees	—	10 feet	—	10 feet
Seepage pits or cesspools ⁸	—	5 feet	5 feet	12 feet
Disposal field ⁸	—	5 feet	4 feet ⁴	5 feet
On-site domestic water service line	1 foot ⁵	5 feet	5 feet	5 feet
Distribution box	—	—	5 feet	5 feet
Pressure public water main	10 feet ⁶	10 feet	10 feet	10 feet

For SI units: 1 foot = 304.8 mm

Notes:

¹ Including porches and steps, whether covered or uncovered, breezeways, roofed porte cocheres, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.

² See Section XXXX.

- ³ Drainage piping shall clear domestic water supply wells by not less than 50 feet (15 240 mm). This distance shall be permitted to be reduced to not less than 25 feet (7620 mm) where the drainage piping is constructed of materials approved for use within a building.
- ⁴ Plus 2 feet (610 mm) for each additional 1 foot (305 mm) of depth more than 1 foot (305 mm) below the bottom of the drain line. (See Section XXXX)
- ⁵ See Section XXXX.
- ⁶ For parallel construction – For crossings, approval by the Health Department shall be required.
- ⁷ These minimum clear horizontal distances shall also apply to disposal fields, seepage pits, and the mean high-tide line.
- ⁸ Where disposal fields, seepage pits, or both are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be 15 feet (4572 mm).

H 201.0 Capacity of Septic Tanks.

H 201.1 General.

The liquid capacity of septic tanks shall comply with Table H 201.1(1) and Table H 201.1(4) as determined by the number of bedrooms or apartment units in dwelling occupancies and the estimated waste/sewage design flow rate or the number of plumbing fixture units as determined from Table 702.1 of this code, whichever is greater in other building occupancies. The capacity of any one septic tank and its drainage system shall be limited to the soil structure classification in Table H 201.1(2), and as specified in Table H 201.1(3).

TABLE H 201.1(1)
CAPACITY OF SEPTIC TANKS^{1, 2, 3, 4}

SINGLE-FAMILY DWELLINGS - NUMBER OF BEDROOMS	MULTIPLE DWELLING UNITS OR APARTMENTS - ONE BEDROOM EACH	OTHER USES: MAXIMUM FIX- TURE UNITS SERVED PER TABLE 702.1	MINIMUM SEP- TIC TANK CAPACITY (gallons)
1 or 2	—	15	750
3	—	20	1000
4	2 units	25	1200
5 or 6	3	33	1500
—	4	45	2000
—	5	55	2250
—	6	60	2500
—	7	70	2750
—	8	80	3000
—	9	90	3250
—	10	100	3500

For SI units: 1 gallon = 3.785 L

Notes:

- ¹ Extra bedroom, 150 gallons (568 L) each.
- ² Extra dwelling units over 10: 250 gallons (946 L) each.
- ³ Extra fixture units over 100: 25 gallons (94.6 L) per fixture unit.
- ⁴ Septic tank sizes in this table include sludge storage capacity and the connection of domestic food waste disposers without further volume increase.

TABLE H 201.1(2)
DESIGN CRITERIA OF FIVE TYPICAL SOILS

TYPE OF SOIL	REQUIRED SQUARE FEET OF LEACHING AREA PER 100 GALLONS	MAXIMUM ABSORPTION CAPACITY IN GALLONS PER SQUARE FEET OF LEACHING AREA FOR A 24-HOUR PERIOD
Coarse sand or gravel	20	5.0
Fine sand	25	4.0
Sandy loam or sandy clay	40	2.5
Clay with considerable sand or gravel	90	1.1
Clay with small amount of sand or gravel	120	0.8
For SI units: 1 square foot = 0.0929 m ² , 1 gallon = 3.785 L, 1 gallon per square foot = 40.7 L/m ²		

TABLE H 201.1(3)
LEACHING AREA SIZE BASED ON SEPTIC TANK CAPACITY

REQUIRED SQUARE FEET OF LEACHING AREA PER 100 GALLONS SEPTIC TANK CAPACITY (square feet per 100 gallons)	MAXIMUM SEPTIC TANK SIZE ALLOWABLE (gallons)
20–25	7500
40	5000
90	3500
120	3000
For SI units: 1 square foot per 100 gallons = 0.000245 m ² /L, 1 gallon = 3.785 L	

TABLE H 201.1(4)
ESTIMATED WASTE/SEWAGE FLOW RATES^{1, 2, 3}

TYPE OF OCCUPANCY	GALLONS PER DAY
Airports (per employee)	15
Airports (per passenger)	5
Auto washers – check with equipment manufacturer	–
Bowling alleys – with snack bar only (per lane)	75
Campground – with central comfort station (per person)	35
Campground – with flush toilets – no showers (per person)	25
Camps (day) – no meals served (per person)	15
Camps (summer and seasonal camps) – (per person)	50
Churches – sanctuary (per seat)	5
Churches – with kitchen waste (per seat)	7
Dance halls – (per person)	5
Factories – no showers (per employee)	25
Factories – with showers (per employee)	35
Factories – with cafeteria (per employee)	5
Hospitals – (per bed)	250
Hospitals – kitchen waste only (per bed)	25
Hospitals – laundry waste only (per bed)	40
Hotels – no kitchen waste (per bed)	60
Institutions – resident (per person)	75

Nursing home – (per person)	125
Rest home – (per person)	125
Laundries – self-service with minimum 10 hours per day (per wash cycle)	50
Laundries – commercial check with manufacturer’s specification	–
Motel (per bed space)	50
Motel – with kitchen (per bed space)	60
Offices – (per employee)	20
Parks – mobile homes (per space)	250
Parks (picnic) – with toilets only (per parking space)	20
Parks (recreational vehicles) – without water hook-up (per space)	75
Parks (recreational vehicles) – with water and sewer hook-up (per space)	100
Restaurants – cafeteria (per employee)	20
Restaurants – with toilet waste (per customer)	7
Restaurants – with kitchen waste (per meal)	6
Restaurants – with kitchen waste disposable service (per meal)	2
Restaurants – with garbage disposal (per meal)	1
Restaurants – with cocktail lounge (per customer)	2
Schools staff and office (per person)	20
Schools – elementary (per student)	15
Schools – intermediate and high (per student)	20
Schools – with gym and showers (per student)	5

TABLE H 201.1(4) (continued)
ESTIMATED WASTE/SEWAGE FLOW RATES^{1, 2, 3}

TYPE OF OCCUPANCY	GALLONS PER DAY
Schools – with cafeteria (per student)	3
Schools (boarding) – total waste (per person)	100
Service station – with toilets for 1 st bay	1000
Service station – with toilets for each additional bay	500
Stores – (per employee)	20
Stores – with public restrooms (per 10 square feet of floor space)	1
Swimming pools – public (per person)	10
Theaters – auditoriums (per seat)	5
Theaters – with drive-in (per space)	10

For SI units: 1 square foot = 0.0929 m², 1 gallon per day = 3.785 L/day

Notes:

¹ Sewage disposal systems sized using the estimated waste/sewage flow rates shall be calculated as follows:

(a) Waste/sewage flow, up to 1500 gallons per day (5678 L/day)

Flow x 1.5 = septic tank size

(b) Waste/sewage flow, over 1500 gallons per day (5678 L/day)

Flow x 0.75 + 1125 = septic tank size

(c) Secondary system shall be sized for total flow per 24 hours.

² See Section H 201.1.

³ Because of the many variables encountered, it is not possible to set absolute values for waste/sewage flow rates for all situations. The designer should evaluate each situation and, where figures in this table need modification; they should be made with the concurrence of the Competent authority.

H 301.0 Area of Disposal Fields and Seepage Pits.

H 301.1 General. The minimum effective absorption area in disposal fields in square feet (m²), and in seepage pits in square feet (m²) of sidewall, shall be predicated on the required septic tank capacity of gallons (liters), estimated waste/sewage flow rate, or whichever is greater, and shall be in accordance with Table H 201.1(2) as determined by the type of soil found in the excavation, and shall be as follows:

(1) Where disposal fields are installed, not less than 150 square feet (13.9 m²) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay, or other impervious formations. Sidewall

area more than the required 12 inches (305 mm) and not exceeding 36 inches (914 mm) below the leach line shall be permitted to be added to the trench bottom area where computing absorption areas.

- (2) Where leaching beds are permitted instead of trenches, the area of each such bed shall be not less than 50 percent greater than the tabular requirements for trenches. Perimeter sidewall area more than the required 12 inches (305 mm) and not exceeding 36 inches (914 mm) below the leach line shall be permitted to be added to the trench bottom area where computing absorption areas.
- (3) No excavation for a leach line or leach bed shall be located within 5 feet (1524 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes.

Exception: In areas where the records or data indicate that the groundwaters are grossly degraded, the 5 foot (1524 mm) separation requirement shall be permitted to be reduced by the Competent authority. The applicant shall supply evidence of groundwater depth to the satisfaction of the Competent authority.

- (4) The minimum effective absorption area in any seepage pit shall be calculated as the excavated sidewall area below the inlet exclusive of any hardpan, rock, clay, or other impervious formations. The minimum required area of porous formation shall be provided in one or more seepage pits. No excavation shall extend within 10 feet (3048 mm) of the water table nor to a depth where sewage is capable of contaminating underground water stratum that is usable for domestic purposes.

Exception: In areas where the records or data indicate that the groundwaters are grossly degraded, the 10 foot (3048 mm) separation requirement shall be permitted to be reduced by the Competent authority.

The applicant shall supply evidence of groundwater depth to the satisfaction of the Competent authority.

- (5) Leaching chambers that comply with IAPMO PS 63 and bundled expanded polystyrene synthetic aggregate units that comply with IAPMO IGC 276 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2).
- (6) Systems that combine treatment and disposal of sewage within a single footprint and comply with NSF 40 Class 1 shall be sized using a 0.70 multiplier applied to the required area in Table H 201.1(2) for both leach lines and leach beds. No system component for a combined treatment and disposal leach line or leach bed shall be located within 2 feet (610 mm) of the water table nor to a depth where sewage is capable of contaminating the underground water stratum that is usable for domestic purposes. Combined treatment and disposal system operation and maintenance shall be in accordance with the manufacturer's instructions.

Exception: Combined treatment and disposal systems tested and certified in a bed configuration in accordance with NSF 40 Class 1 are exempted from the requirements of Section H 301.1(2).

H 401.0 Percolation Test.

H 401.1 Pit Sizes.

Where practicable, disposal field and seepage pit sizes shall be computed from Table H 201.1(2). Seepage pit sizes shall be computed by percolation tests unless use of Table H 201.1(2) is approved by the Competent authority.

H 401.2 Absorption Qualities.

The absorption qualities of seepage pits and questionable soils other than those listed in Table H 201.1(2), the proposed site, shall be subjected to percolation tests acceptable to the Competent authority.

H 401.3 Absorption Rates.

Where a percolation test is required, no private disposal system shall be permitted to serve a building where that test shows the absorption capacity of the soil is less than 0.83 gallons per square foot (gal/ft²) (33.8 L/m²) or more than 5.12 gal/ft² (208.6 L/m²) of leaching area per 24 hours. Where the percolation test shows an absorption rate greater than 5.12 gal/ft² (208.6 L/m²) per 24 hours, a private disposal system shall be permitted where the site does not overlie groundwaters protected for drinking water supplies, a minimum thickness of 2 feet (610 mm) of the native soil below the entire proposed system is replaced by loamy sand, and the system design is based on percolation tests made in the loamy sand.

H 501.0 Septic Tank Construction.

H 501.1 Plans.

Plans for septic tanks shall be submitted to the Competent authority for approval. Such plans shall show dimensions, reinforcing, structural calculations, and such other pertinent data as required.

H 501.2 Design.

Septic tank design shall be such as to produce a clarified effluent consistent with accepted standards and shall provide adequate space for sludge and scum accumulations.

H 501.3 Construction.

Septic tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight.

H 501.4 Compartments.

Septic tanks shall have not less than two compartments unless otherwise approved by the Competent authority. The inlet compartment of any septic tank shall be not less than two-thirds of the total capacity of the tank, nor less than 500 gallons (1892 L) liquid capacity, and shall be not less than 3 feet (914 mm) in width and 5 feet (1524 mm) in length. Liquid depth shall be not less than 2½ feet (762 mm) nor more than 6 feet (1829 mm). The secondary compartment of a septic tank shall have a capacity of not less than 250 gallons (946 L) and a capacity not exceeding one-third of the total capacity of such tank. In septic tanks having a 1500 gallon (5678 L) capacity, the secondary compartment shall be not less than 5 feet (1524 mm) in length.

H 501.5 Access.

Access to each septic tank shall be provided by not less than two manholes 20 inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole shall be located over the inlet, and one access manhole shall be located over the outlet. Where a first compartment exceeds 12 feet (3658 mm) in length, an additional manhole shall be provided over the baffle wall.

H 501.6 Pipe Opening Sizes.

The inlet and outlet pipe openings shall not be larger in size than the connecting sewer pipe. The vertical leg of round inlet and outlet fittings shall not be less in size than the connecting sewer pipe nor less than 4 inches (100 mm) in diameter. A baffle-type fitting shall have the equivalent cross-sectional area of the connecting sewer pipe and not less than a 4 inch (102 mm) horizontal dimension where measured at the inlet and outlet pipe inverts.

H 501.7 Pipe Extension.

The inlet and outlet pipe or baffle shall extend 4 inches (102 mm) above and not less than 12 inches (305 mm) below the water surface. The invert of the inlet pipe shall be at a level not less than 2 inches (51 mm) above the invert of the outlet pipe.

H 501.8 Free Vent Area.

Inlet and outlet pipe fittings or baffles and compartment partitions shall have a free vent area equal to the required cross-sectional area of the house sewer or private sewer discharging therein to provide free ventilation above the water surface from the disposal field or seepage pit through the septic tank, house sewer, and stack to the outer air.

H 501.9 Sidewalls.

The sidewalls shall extend not less than 9 inches (229 mm) above the liquid depth. The cover of the septic tank shall be not less than 2 inches (51 mm) above the back vent openings.

H 501.10 Partitions and Baffles.

Partitions or baffles between compartments shall be of solid, durable material and shall extend not less than 4 inches (102 mm) above the liquid level. The transfer port between compartments shall be a minimum size equivalent to the tank inlet, but in no case less than 4 inches (102 mm) in size, shall be installed in the inlet compartment side of the baffle so that the entry into the port is placed 65 percent to 75 percent in the depth of the liquid. Wooden baffles are prohibited.

H 501.11 Structural Design.

The structural design of septic tanks shall comply with the following requirements:

- (1) Each such tank shall be structurally designed to withstand all anticipated earth or other loads. Septic tank covers shall be capable of supporting an earth load of not less than 500 pounds per square foot (lb/ft²) (2441 kg/m²) where the maximum coverage does not exceed 3 feet (914 mm).
- (2) In flood hazard areas, tanks shall be anchored to counter buoyant forces during conditions of the design flood. The vent termination and service manhole of the tank shall be not less than 2 feet (610 mm) above the design flood elevation or fitted with covers designed to prevent the inflow of floodwater or the outflow of the contents of the tanks during conditions of the design flood.

H 501.12 Manholes.

Septic tanks installed under concrete or blacktop paving shall have the required manholes accessible by extending the manhole openings to grade in a manner acceptable to the Competent authority.

H 501.13 Materials.

The materials used for constructing a septic tank shall be in accordance with the following:

- (1) Materials used in constructing a concrete septic tank shall be in accordance with applicable standards in Chapter 17.
- (2) The minimum wall thickness of a steel septic tank shall be number 12 U.S. gauge (0.109 of an inch) (2.77 mm), and each such tank shall be protected from corrosion both externally and internally by an approved bituminous coating or by other acceptable means.
- (3) Septic tanks constructed of alternate materials shall be permitted to be approved by the Competent authority where in accordance with approved applicable standards. Wooden septic tanks shall be prohibited.

H 501.14 Prefabricated Septic Tanks.

Prefabricated septic tanks shall comply with the following requirements:

- (1) Manufactured or prefabricated septic tanks shall comply with IAPMO/ANSI Z1000, IAPMO IGC 262, or CSA B66 and be approved by the Competent authority. Prefabricated bituminous coated septic tanks shall comply with UL 70.
- (2) Independent laboratory tests and engineering calculations certifying the tank capacity and structural stability shall be provided as required by the Competent authority.

H 601.0 Disposal Fields.

H 601.1 Distribution Lines.

Distribution lines shall be constructed of clay tile laid with open joints, perforated clay pipe, perforated bituminous fiber pipe, perforated high-density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, or other approved materials, provided that approved openings are available for distribution of the effluent into the trench area.

H 601.1.1 Bundled Expanded Polystyrene Synthetic Aggregate Units.

Bundled expanded polystyrene synthetic aggregate units with an integrated distribution line consisting of perforated, corrugated high-density polyethylene pipe that complies with IAPMO IGC 276 shall be permitted.

H 601.2 Filter Material.

Before placing filter material or drain lines in a prepared excavation, smeared or compacted surfaces shall be removed from trenches by raking to a depth of 1 inch (25.4 mm) and the loose material removed. Clean stone, gravel, slag, or similar filter material acceptable to the Competent authority, varying in size from $\frac{3}{4}$ of an inch to $2\frac{1}{2}$ inches (19.1 mm to 64 mm), shall be placed in the trench to the depth and grade required by this section. Drainpipe shall be placed on filter material in an approved manner. The drain lines shall then be covered with filter material to the minimum depth required by this section, and this material covered with untreated building paper, straw, or similar porous material to prevent the closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

Exception: Listed or approved plastic leaching chambers, bundled expanded polystyrene synthetic aggregate units, and systems that treat and dispose of sewage within a single footprint, as described in Section H 301.1(5) and Section H 301.1(6), shall be permitted to be used in lieu of pipe and filter material. Chamber, bundled expanded polystyrene synthetic aggregate unit, and systems that treat and dispose of sewage within a single footprint, installations shall follow the rules for disposal fields, where applicable, and shall be in accordance with the manufacturer's instructions.

H 601.3 Grade Board.

A grade board staked in the trench to the depth of filter material shall be utilized where the distribution line is constructed with drain tile or a flexible pipe material that will not maintain alignment without continuous support.

H 601.4 Seepage Pits.

Where seepage pits are used in combination with disposal fields, the filter material in the trenches shall terminate not less than 5 feet (1524 mm) from the pit excavation, and the line extending from such points to the seepage pit shall be approved pipe with watertight joints.

H 601.5 Distribution Boxes.

Where two or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines shall be installed at the head of each disposal field. The invert of outlets shall be level, and the invert of the inlet shall be not less than 1 inch (25.4 mm) above the outlets. Distribution boxes shall be designed to ensure equal flow and shall be installed on a level concrete slab in natural or compacted soil.

H 601.6 Laterals.

Laterals from a distribution box to the disposal field shall be approved pipe with watertight joints. Multiple disposal field laterals, where practicable, shall be of uniform length.

H 601.7 Connections.

Connections between a septic tank and a distribution box shall be laid with approved pipe with watertight joints on natural ground or compacted fill.

H 601.8 Dosing Tanks.

Where the quantity of sewage exceeds the amount that is permitted to be disposed of in 500 lineal feet (152.4 m) of leach line, a dosing tank shall be used. Dosing tanks shall be equipped with an automatic siphon or pump that discharges the tank once every 3 or 4 hours. The tank shall have a capacity equal to 60 to 75 percent of the interior capacity of the pipe to be dosed at one time. Where the total length of pipe exceeds 1000 lineal feet (305 m), the dosing tank shall be provided with two siphons or pumps dosing alternately and each serving one-half of the leach field.

H 601.9 Construction.

Disposal fields shall be constructed in accordance with Table H 601.9.

Minimum spacing between trenches or leaching beds shall be not less than 4 feet (1219 mm) plus 2 feet (610 mm) for each additional foot (305 mm) of depth more than 1 foot (305 mm) below the bottom of the drain line. Distribution drain lines in leaching beds shall be not more than 6 feet (1829 mm) apart on centers, and no part of the perimeter of the leaching bed shall exceed 3 feet (914 mm) from a distribution drain line. Disposal fields, trenches, and leaching beds shall not be paved over or covered by concrete or a material that is capable of reducing or inhibiting a possible evaporation of sewer effluent.

**TABLE H 601.9
GENERAL DISPOSAL FIELD REQUIREMENTS**

ELEMENT	MINIMUM	MAXIMUM
Number of drain lines per field	1	-
Length of each line	-	100 feet
Bottom width of trench	18 inches	36 inches
Spacing of lines, center- to-center	6 feet	-
Depth of earth cover of lines (preferred 18 inches)	12 inches	-
Grade of lines	level	3 inches per 100 feet
Filter material under drain lines	12 inches	-
Filter material over drain lines	2 inches	-

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m

H 601.10 Joints.

Where necessary on sloping ground to prevent excessive line slope, leach lines or leach beds shall be stepped. The lines between each horizontal section shall be made with watertight joints and shall be designed, so each horizontal leaching trench or bed shall be utilized to the maximum capacity before the effluent shall pass to the next lower leach line or bed. The lines between each horizontal leaching section shall be made with approved watertight joints and installed on the natural or unfilled ground.

H 701.0 Seepage Pits.

H 701.1 Capacity.

The capacity of seepage pits shall be based on the quantity of liquid waste discharging therein and on the character and porosity of the surrounding soil, and shall be in accordance with Section H 301.0 of this appendix.

H 701.2 Multiple Installations.

Multiple seepage pit installations shall be served through an approved distribution box or be connected in series using a watertight connection laid on undistributed or compacted soil. The outlet from the pit shall have an approved vented leg fitting extending not less than 12 inches (305 mm) below the inlet fitting.

H 701.3 Construction.

A seepage pit shall be circular in shape and shall have an excavated diameter of not less than 4 feet (1219 mm). Each such pit shall be lined with approved-type whole new hard-burned clay brick, concrete brick, concrete circular-type cesspool blocks, or other approved materials. Approval shall be obtained before construction for any pit having an excavated diameter greater than 6 feet (1829 mm).

H 701.4 Lining.

The lining in a seepage pit shall be laid on a firm foundation. Lining materials shall be placed tight together and laid with joints staggered. Except in the case of approved-type precast concrete circular sections, no brick or block shall be greater in height than its width and shall be laid flat to form not less than a 4 inch (102 mm) wall. Brick or block greater than 12 inches (305 mm) in length shall have chamfered matching ends and be scored to provide for seepage. Excavation voids behind the brick, block, or concrete liner shall have not less than 6 inches (152 mm) of clean $\frac{3}{4}$ of an inch (19.1 mm) gravel or rock.

H 701.5 Brick and Block.

Brick or block used in seepage pit construction shall have a compressive strength of not less than 2500 pounds per square inch (lb/in²) (1 757 674 kg/m²).

H 701.6 Sidewall.

A seepage pit shall have a minimum sidewall (not including the arch) of 10 feet (3048 mm) below the inlet.

H 701.7 Arch and Dome.

The arch or dome of a seepage pit shall be permitted to be constructed in one of three ways:

- (1) Approved-type hard-burned clay brick or solid concrete brick or block laid in cement mortar.
- (2) Approved brick or block laid dry. In both of the above methods, an approved cement mortar covering of not less than 2 inches (51 mm) in thickness shall be applied, said covering to extend not less than 6 inches (152 mm) beyond the sidewalls of the pit.
- (3) Approved-type one or two-piece reinforced concrete slabs of not less than 2500 lb/in² (1 757 674 kg/m²) minimum compressive strength, not less than 5 inches (127 mm) thick, and designed to support an earth load of not less than 400 pounds per square foot (lb/ft²) (1953 kg/m²). Each such cover shall be provided with a 9 inch (229 mm) minimum inspection hole with plug or cover and shall be coated on the underside with an approved bituminous or other nonpermeable protective compound.

H 701.8 Location.

The top of the arch or cover shall be not less than 18 inches (457 mm) but not exceed 4 feet (1219 mm) below the surface of the ground.

H 701.9 Inlet Fitting.

An approved vented inlet fitting shall be provided in the seepage pit so arranged as to prevent the inflow from damaging the sidewall.

Exception:

Where using a one- or two-piece concrete slab cover inlet, fitting shall be permitted to be a one-fourth bend fitting discharging through an opening in the top of the slab cover. On multiple seepage pit installations, the outlet fittings shall comply with Section H 701.2 of this appendix.

H 801.0 Cesspools.

H 801.1 Limitations.

A cesspool shall be considered as a temporary expedient pending the construction of a public sewer; as an overflow facility where installed in conjunction with an existing cesspool; or as a means of sewage disposal for limited, minor, or temporary uses, where first approved by the Competent authority.

H 801.2 Septic Tanks.

Where it is established that a public sewer system will be available in less than 2 years, and soil and groundwater conditions are favorable to cesspool disposal, cesspools without septic tanks shall be permitted to be installed for single-family dwellings or for other limited uses where first approved by the Competent authority.

H 801.3 Construction.

Each cesspool, where permitted, shall be in accordance with the construction requirements set forth in Section H 701.0 of this appendix for seepage pits and shall have a sidewall (not including arch) of not less than 20 feet (6096 mm) below the inlet, provided, however, that where a strata of gravel or equally pervious material of 4 feet (1219 mm) in thickness is found, the depth of such sidewall shall not exceed 10 feet (3048 mm) below the inlet.

H 801.4 Existing Installations.

Where overflow cesspools or seepage pits are added to existing installations, the effluent shall leave the existing pit through an approved vented leg extending not less than 12 inches (305 mm) downward into such existing pit and having its outlet flow line not less than 6 inches (152 mm) below the inlet. The pipe between pits shall be laid with approved watertight joints.

H 901.0 Commercial or Industrial Special Liquid-Waste Disposal.

H 901.1 Interceptor.

Where liquid wastes contain excessive amounts of grease, garbage, flammable wastes, sand, or other ingredients that affect the operation of a private sewage disposal system, an interceptor for such wastes shall be installed.

H 901.2 Installation.

Installation of such interceptors shall comply with Section 1009.0 of this code, and their location shall comply with Table H 101.8 of this appendix.

H 901.3 Sampling Box.

A sampling box shall be installed where required by the Competent authoritycompetent authority.

H 901.4 Design and Structural Requirement.

Interceptors shall be of approved design and be not less than two compartments. Structural requirements shall comply with Section H 501.0 of this appendix.

H 901.5 Location.

Interceptors shall be located as close to the source as possible and be accessible for servicing. Necessary manholes for servicing shall be at grade level and be gastight.

H 901.6 Waste Discharge.

Waste discharge from interceptors shall be permitted to be connected to a septic tank or other primary system or be disposed into a separate disposal system.

H 901.7 Design Criteria.

A formula shall be permitted to be adapted to other types of occupancies with similar wastes. (See Chart H 901.7)

H 1001.0 Inspection and Testing.

H 1001.1 Inspection.

Inspection requirements shall comply with the following:

- (1) Applicable provisions of Section 105.0 of this code and this appendix shall be required. Plans shall be required in accordance with Section 103.3 of this code.
- (2) System components shall be properly identified as to manufacturer. Septic tanks or other primary systems shall have the rated capacity permanently marked on the unit.
- (3) Septic tanks or other primary systems shall be installed on dry, level, well-compacted soil.
- (4) Where design is predicated on soil tests, the system shall be installed at the same location and depth as the tested area.

H 1001.2 Testing.

Testing requirements shall comply with the following:

- (1) Septic tanks or other primary components shall be filled with water to flow line before requesting an inspection. Seams or joints shall be left exposed (except the bottom), and the tank shall remain watertight.
- (2) A flow test shall be performed through the system to the point of effluent disposal. All lines and components shall be watertight. Capacities required air space, and fittings shall comply with the provisions outlined in this appendix.

CHART H 901.7

RECOMMENDED DESIGN CRITERIA

GREASE AND GARBAGE, COMMERCIAL KITCHENS							
Number of meals per peak hour	x	Waste flow rate ¹	x	Retention time ²	x	Storage factor ³	= Interceptor size (liquid capacity)
SAND-SILT OIL, AUTO WASHERS							
Number of vehicles per hour	x	Waste flow rate ¹	x	Retention time ²	x	Storage factor ³	= Interceptor size (liquid capacity)
SILT-LINT GREASE, LAUNDRIES, LAUNDROMATS							
Number of machines	x	2 cycles per hour	x	Waste flow rate ¹	x	Retention time ²	= Storage factor ³ = Interceptor size (liquid capacity)

Notes:

¹ For waste flow rate see Table H 201.1(4).

² Retention Times:

- (a) Kitchen (commercial) – with dishwasher, garbage disposal, or both = 2.5 hours
- (b) Kitchen (single service) – with garbage disposal = 1.5 hours
- (c) Auto Washers (sand-silt oil) = 2.0 hours

(d) Laundries/Laundromats = 2.0 hours

³ Storage Factors:

- (a) Kitchen (commercial) – with 8 hours operation = 1
- (b) Kitchen (commercial) – with 16 hours operation = 2
- (c) Kitchen (commercial) – with 24 hours operation = 3
- (d) Kitchen (single service) = 1.5
- (e) Auto Washers (sand-silt oil) – with self service = 1.5
- (f) Auto Washers (sand-silt oil) – with employee operated = 2
- (g) Laundries/Laundromats – with rock filter = 1.5 hours

H 1101.0 Abandoned Sewers and Sewage Disposal Facilities.

H 1101.1 Plugged and Capped.

An abandoned building (house) sewer, or part thereof, shall be plugged or capped in an approved manner within 5 feet (1524 mm) of the property line.

H 1101.2 Fill Material.

A cesspool, a septic tank, or a seepage pit that has been abandoned or has been discontinued otherwise from further use, or to which no waste or soil pipe from a plumbing fixture is connected, shall have the sewage removed therefrom and be completely filled with the earth, sand, gravel, concrete, or other approved material.

H 1101.3 Filling Requirements.

The top cover or arch over the cesspool, septic tank, or seepage pit shall be removed before filling, and the filling shall not extend above the top of the vertical portions of the sidewalls or above the level of any outlet pipe until inspection has been called and the cesspool, septic tank, or seepage pit has been inspected. After such inspection, the cesspool, septic tank, or seepage pit shall be filled to the level of the top of the ground.

H 1101.4 Owner.

No person owning or controlling a cesspool, septic tank, or seepage pit on the premises of such person or in that portion of any public street, alley, or other public property abutting such premises shall fail, refuse, or neglect to be in accordance with the provisions of this section or upon receipt of notice so to be in accordance with the Competent authoritycompetent authority.

H 1101.5 Permittee.

Where disposal facilities are abandoned consequent to connecting any premises with the public sewer, the permittee making the connection shall fill all abandoned facilities in accordance with the Competent authoritycompetent authority within 30 days from the time of connecting to the public sewer.

H 1201.0 Drawings and Specifications.

H 1201.1 General.

The Competent authority, Health Officer, or other department having jurisdiction shall be permitted to require the following information before a permit is issued for a private sewage disposal system or at a time during the construction thereof:

- (1) Plot plan drawn to scale, completely dimensioned, showing direction and approximate slope of surface, location of present or proposed retaining walls, drainage channels, water supply lines or wells, paved areas and structures on the plot, number of bedrooms or plumbing fixtures in each structure, and location of the private sewage disposal system with relation to lot lines and structures.
- (2) Details of construction necessary to ensure compliance with the requirements of this appendix together with a full description of the complete installation including quality, kind, and grade of materials, equipment, construction, workmanship, and methods of assembly and installation.
- (3) A log of soil formations and groundwater levels as determined by test holes dug in close proximity to a proposed seepage pit or disposal field, together with a statement of water absorption characteristics of the soil at the proposed site, as determined by approved percolation tests.

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