Ohio Board of Building Standards

AMENDMENTS GROUP XCIX (99)
OBC, OMC, and OPC

PUBLIC HEARING DRAFT

March 27, 2020
Notice is hereby given that the Board of Building Standards will convene for a public hearing in accordance with Chapter 119. of the Revised Code, at 1:00 P.M., Friday, March 27, 2020 in Hearing Room #1, at 6606 Tussing Road, Reynoldsburg, Ohio, 43068. The purpose of the hearing is to solicit testimony on proposed actions taken on select rules of the Administrative Code, identified as Amendments Group XCIX (99) pursuant to Chapters 119., 3781., 3791., and 4104. of the Revised Code.

Synopsis of the proposed rule changes:

**PART A – OHIO BUILDING CODE RULES**

The Board proposes to amend the Ohio Administrative Code rules as follows: 4101:1-1-01 to clarify in section 101.1 that the IBC model code text is incorporated within the rule, to clarify in section 101.2 that model homes are within the scope of the RCO, to clarify in Section 101.2 the pipeline exemption, and to make other grammatical and editorial corrections within the rule; 4101:1-10-01 to change the occupant load factor for business spaces from 100 gross to 150 gross and add a reference to a new section for concentrated business use areas in Table 1004.1.2, to adjust the occupant load factor for certain concentrated business use areas in section 1004.7, to allow flexibility and relief for sprinklered buildings in the design of exterior areas for assisted rescue in section 1009.7.2, to correct a typographical error in Section 1010.1.9.4, to add new section 1010.3.3 addressing security access turnstiles in the means of egress, to reorganize the existing table 1020.1 for ease of application and to coordinate the table with Ohio changes found elsewhere in the code, to provide an exception in Section 1023.3.1 to the separation requirement between an interior exit stairway and the exit passageway extension if both are pressurized, to clarify code Section 1029.6 to be used to determine aisle capacity for assembly occupancies, to reorganize section 1030.1 to clarify intent, to add Group R-4 to the occupancies requiring emergency escape and rescue openings, and to add an exception for sprinklered dwelling units and sleeping units having prescribed egress characteristics; 4101:1-13-01 to modify the exception to allow certain Group R-3 occupancies to use all paths of the RCO, including the OHBA path, to demonstrate energy code compliance; 4101:1-15-01 to recognize and provide requirements for building-integrated photovoltaic (BIPV) roof panels in Section 1507.18 and to incorporate ICC errata; 4101:1-29-01 to add an exception in Section 2902.1 to the distribution of plumbing fixtures by gender, to allow single-user or separate facilities to be used in the calculation of the required number of plumbing fixtures, to clarify in Table 2902.1 that ambulatory care facilities are business occupancies, and to add design flexibility in Section 2902.2 by allowing mixed-gender facilities; and 4101:1-35-01 to update the IFGC to the 2018 edition, to update the IFGC referenced standard ANSI LC1/CSA 6.26 to the 2018 edition, and to adopt the NFPA 70 TIA 17-8 which eliminates a conflict between NFPA 99 and NFPA 70 with regard to wiring protection for emergency systems in health care occupancies where persons are not capable of self-preservation.
PART B – OHIO MECHANICAL CODE RULES

The Board proposes to amend the Ohio Administrative Code rules as follows: 4101:2-5-01 to add a new exception in Section 507.2.6 which allows for less than an 18-inch hood clearance to combustibles if the hood is listed and labeled for such clearance; 4101:2-9-01 to clarify language in Section 908.3, to increase cooling tower distance from building inlets, and to mention ASHRAE Guideline 12 which was proposed to address Legionellosis associated with building water systems (BBS Petition 19-02); 4101:2-11-01 to reorganize Section 1107.2 addressing refrigerant piping location prohibitions and corrects terminology to clarify intent and to incorporate ICC errata; and 4101:2-15-01 to delete the IECC as a referenced standard because it is not referenced in the OMC, to update the IFGC to the 2018 edition, to update the IFGC referenced standard ANSI LC1/CSA 6.26 to the 2018 edition, to adopt the NFPA 70 TIA 17-8 which eliminates a conflict between NFPA 99 and NFPA 70 with regard to wiring protection for emergency systems in health care occupancies where persons are not capable of self-preservation, and to incorporate ICC errata.

PART C – OHIO PLUMBING CODE RULES

The Board proposes to amend the Ohio Administrative Code rules as follows: 4101:3-4-01 to add an exception in Section 403.1 to the distribution of plumbing fixtures by gender, to allow single-user or separate facilities to be used in the calculation of the required number of plumbing fixtures, to clarify in Table 403.1 that ambulatory care facilities are business occupancies, to add design flexibility in Section 403.2 by allowing mixed-gender facilities, and to incorporate ICC errata; 4101:3-7-01 to remove the prohibition of drainage piping running above food prep, storage, or eating areas in Section 701.8, and to address the reuse of existing sanitary drainage piping in new Section 701.8 by referencing the OBC Chapter 34; 4101:3-8-01 to bring back old IPC language in Section 802.1 to allow food utensils, dishes, pots and pans sinks to directly connect to the sanitary drainage system (BBS Petition 18-06) and to clarify that food handling sinks are required to be indirectly connected to the drainage system; 4101:3-9-01 to revert Section 915.2 back to the IPC model code text (BBS Petition 18-05), and to incorporate ICC errata; 4101:3-10-01 to reorganize the Section 1002.1 fixture trap section and to delete floor drains, floor sinks, and hub drains from the exception for traps (BBS Petition 18-04), to add new Section 1002.4.1.5 that allows the waste from certain indirectly connected fixtures to serve as the trap seal for emergency floor drains, trench drains, or floor sinks located in the same room (BBS Petition 18-12), and to incorporate ICC errata; and 4101:3-15-01 to update the IFGC to the 2018 edition, to update the IFGC referenced standard ANSI LC1/CSA 6.26 to the 2018 edition, and to adopt the NFPA 70 TIA 17-8 which eliminates a conflict between NFPA 99 and NFPA 70 with regard to wiring protection for emergency systems in health care occupancies where persons are not capable of self-preservation.

The full text of this public hearing draft can be viewed on the Board’s website at (http://www.com.ohio.gov/dico/bbs).

The full text of the proposed rules were filed electronically with the Legislative Service Commission (LSC), the Joint Committee on Agency Rule Review (JCARR), and the Secretary of State as required in section 119.03 of the Revised Code. Prior to electronic filing of the rules, stakeholder meetings were held and electronic notification was provided to all stakeholders. The proposed rules and a Business Impact Analysis were posted and submitted to the Common Sense Initiative (CSI) Office. Additionally, the Clerks of the 88 County Commissioners were notified of the filings as required by statute.

The rule filing can be viewed on the Register of Ohio (http://www.registerofohio.state.oh.us).
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On the date and at the time and place of this hearing, any person affected by these rules may appear and be heard in person, by his attorney, or both. Any person may present their positions, arguments and contentions orally, or in writing. Any person may offer and examine witnesses and present evidence.

Proposed new wording in an amended rule is indicated by **underlining** and proposed deleted wording is shown as **stricken text** as follows: **deleted**.
PART A - OHIO BUILDING CODE RULES

4101:1-1-01  Administration.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:1-35-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

Section 101
General

101.1 Title. Chapters 4101:1-1 to 4101:1-35 of the Administrative Code shall be designated as the “Ohio Building Code” for which the designation “OBC” may be substituted. The “International Building Code 2015, first printing, Chapters 2 to 35,” as published by the “International Code Council, Inc.” is used as the basis of this document and is incorporated fully except as modified herein. References in these chapters to “this code” or to the “building code” in other sections of the Administrative Code shall mean the “Ohio Building Code.”

101.2 Scope. The provisions of the “Ohio Building Code”, the “Ohio Mechanical Code”, and the “Ohio Plumbing Code” shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures. As provided in division (B) of section 3791.04 of the Revised Code, no plans or specifications shall be approved or inspection approval given unless the building represented by those plans or specifications would, if constructed, repaired, erected, or equipped according to those plans or specifications, comply with Chapters 3781. and 3791. of the Revised Code and any rules adopted by the board. An owner may exceed the requirements of the “Ohio Building Code” in compliance with section 102.9. This code applies to detached one-, two-, and three-family dwellings and structures accessory to those dwellings only to the extent indicated in section 310 of this code.

Exceptions:
1. Detached one-, two-, or three- family dwellings, structures accessory to those dwellings, one-, two-, and three-family dwellings used as models, or those single family dwellings with five or fewer persons receiving care in a supervised environment but capable of self-preservation with or without limited verbal or physical assistance are within the scope of the “Residential Code of Ohio for One-, Two-, or Three-Family Dwellings”.

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2. Buildings owned by and used for a function of the United States government.
3. Buildings or structures which are incident to the use for agricultural purposes of the land on which said buildings or structures are located, provided such buildings or structures are not used in the business of retail trade; for the purposes of this section, a building or structure is not considered used in the business of retail trade if fifty per cent or more of the gross income received from sales of products in the building or structure by the owner or operator is from sales of products produced or raised in a normal crop year on farms owned or operated by the seller (see sections 3781.06 and 3781.061 of the Revised Code).
4. Agricultural labor camps.
5. Type A or Type B family day-care homes, except for the inspection required for licensure by the “Ohio Department of Jobs and Family Services (ODJFS)”. This required inspection shall be conducted by the certified building department having jurisdiction or the division of industrial compliance and labor in accordance with the inspection checklist found on the board of building standard’s website.
6. Buildings or structures which are designed, constructed, and maintained in accordance with federal standards and regulations and are used primarily for federal and state military purposes where the U.S. secretary of defense, pursuant to 10 U.S.C. Sections 18233(A)(1) and 18237, has acquired by purchase, lease, or transfer, and constructs, expands, rehabilitates, or corrects and equips, such buildings or structures as he determines to be necessary to carry out the purposes of Chapter 1803 of the U.S.C.
7. Manufactured homes constructed under “24 CFR Part 3280,” “Manufactured Home Construction and Safety Standards” and within the scope of the rules adopted by the Ohio Manufactured Home Commission, including additions, alterations and all utility connections from the utility service point to the manufactured home. This exception does not apply to changes of occupancy of manufactured homes, except that a manufactured home located within a manufactured home park and used by the park operator to promote the sale/rental of manufactured homes in that park remains exempt.
8. Sewerage systems, treatment works, and disposal systems (tanks, piping, and process equipment associated with these systems) regulated by the legislative authority of a municipal corporation or the governing board of a county or special district owning or operating a publicly owned treatment works or sewerage system as stated in division (A) of section 6111.032 of the Revised Code, however, a building that houses such process equipment is within the scope of this code.
10. Amusement rides and portable electric generators and wiring supplying carnival and amusement rides regulated by the Ohio Department of Agriculture pursuant to sections 1711.50 to 1711.57 of the Revised Code.

11. Structures on the premises of and directly related to the operation of a generating plant defined as a major utility facility regulated by the power siting board, including the structures associated with generation, transmission, and distribution. As a condition of the power siting board’s approval, the building department may be requested to review and inspect these structures for compliance with the rules of the board of building standards. However, the building department has no enforcement authority.

12. Structures associated with pipelines used for the transmission of natural gas and other hydrocarbons. Buildings or structures used for equipment housings and enclosures, telemetry enclosures, and associated tanks, foundations, platforms, process piping and equipment on the premises of and directly associated with the operation of pipelines regulated by federal or state agencies and used for the gathering, transmission, or distribution of natural gas or other gas or liquid hydrocarbons.

13. Public water systems (the tanks, foundations, piping, and process equipment associated with these systems) regulated by the Ohio Environmental Protection Agency in accordance with division (A) of section 6109.07 of the Revised Code, however, a building that houses such process equipment is within the scope of this code.

14. Private water systems (the tanks, foundations, piping, and process equipment associated with these systems) regulated by the Ohio Department of Health in accordance with section 3701.344 of the Revised Code, however, a building that houses such process equipment is within the scope of this code.

15. Fixed or floating docks (including the electrical wiring, lighting, and fire protection systems serving the docks) at marinas or boatyards, unless the docks directly serve as a means of egress from, or an accessible route to, a regulated building located at the marina or boatyard.

16. Portable mobile vehicles which have been issued a Vehicle Identification Number (VIN) by the United States department of transportation. The vehicles have wheels and license plates and are intended for transportation on the public streets and highways. Examples of the exempt vehicles include, but are not limited to, recreational vehicles, book mobiles, blood mobiles, mobile medical imaging units, mobile concession trailers, network television transmission and production trailers used at sporting events, mobile restroom facilities, mobile pet grooming units, etc.

17. Wind turbines, pumps, site lighting, and flagpoles not connected to building
services equipment.
18. Mine elevator shafts and structures.
19. Unless otherwise required by this code, ground signs not over six feet in
    height above the adjacent grade.
20. Oil or gas beam pumping units and derricks.
22. Retaining walls, bridges, walkways or site stairs unless associated with or
    necessary for the building or the building egress to comply with the rules of
    the board.
23. Primitive transient lodging structures with only provisions for sleeping,
    with no building services equipment or piping, and not greater than 400 sq.
    ft. in area.

101.2.1 Appendices. The content of the appendices to the Administrative Code
is not adopted material but is approved by the board of building standards and
provided as a reference for code users.

101.3 Intent. The purpose of this code is to establish uniform minimum
requirements for the erection, construction, repair, alteration, and maintenance of
buildings, including construction of industrialized units. Such requirements shall
relate to the conservation of energy, safety, and sanitation of buildings for their
intended use and occupancy with consideration for the following:

1. Performance. Establish such requirements, in terms of performance
   objectives for the use intended.

2. Extent of use. Permit to the fullest extent feasible, the use of materials and
technical methods, devices, and improvements which tend to reduce the cost
of construction without affecting minimum requirements for the health,
safety, and security of the occupants of buildings without preferential
treatment of types or classes of materials or products or methods of
construction.

3. Standardization. To encourage, so far as may be practicable, the
standardization of construction practices, methods, equipment, material
and techniques, including methods employed to produce industrialized
units.

The rules of the board and proceedings shall be liberally construed in order to
promote its purpose. When the building official finds that the proposed design is a
reasonable interpretation of the provisions of this code, it shall be approved.
Materials, equipment, and devices approved by the building official pursuant to
section 114 shall be constructed and installed in accordance with such approval.
101.4 **Referenced codes.** The other codes listed in sections 101.4.1 to 101.4.7 and referenced elsewhere in this code shall be considered part of the requirements of this code to the prescribed extent of each such reference.

101.4.1 **Mechanical.** Chapters 4101:2-1 to 4101:2-15 of the Administrative Code, designated as the “Ohio Mechanical Code,” shall apply to the installation, alterations, repairs, and replacement of mechanical systems, including equipment, appliances, fixtures, fittings and/or appurtenances, including ventilating, heating, cooling, air-conditioning and refrigeration systems, incinerators, and other energy-related systems.

101.4.2 **Plumbing.** Chapters 4101:3-1 to 4101:3-15 of the Administrative Code, designated as the “Ohio Plumbing Code,” shall apply to the installation, alterations, repairs and replacement of plumbing systems, including equipment, appliances, fixtures, fittings and appurtenances, and where connected to a water or sewerage system and all aspects of a medical gas system.

101.4.3 **Elevator.** The provisions of the “Ohio Elevator Code” (Chapters 4101:5-1 to 4101:5-3 of the Administrative Code) shall apply to the design, construction, repair, alteration and maintenance of elevators and other lifting devices as listed and defined therein.

101.4.4 **Fire prevention.** The provisions of the “Ohio Fire Code” (Chapters 1301:7-1 to 1301:7-7 of the Administrative Code) shall apply to the preventive measures which provide for fire-safe conduct and operations in buildings and includes the maintenance of fire-detection, fire alarm, and fire extinguishing equipment and systems, exit facilities, opening protectives, safety devices, good housekeeping practices and fire drills.

101.4.5 **Boiler.** The provisions of the “Ohio Boiler and Pressure Vessel Rules” (Chapters 4101:4-1 to 4101:4-10 of the Administrative Code) shall apply to the design, construction, repair, alteration and maintenance of boilers and unfired pressure vessels as listed and defined therein.

### Section 102
Applicability and Jurisdictional Authority

102.1 **General.** Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.
102.2 Other laws. The provisions of this code shall not be deemed to nullify any provisions of state or federal law. Municipal corporations may make further and additional regulations, not in conflict with Chapters 3781. and 3791. of the Revised Code or with the rules of the board of building standards. However approval by the board of building standards of any fixture, device, material, system, assembly or product of a manufacturing process, or method or manner of construction or installation shall constitute approval for their use anywhere in Ohio.

102.3 Other rules. As provided in division (B) of section 3781.11 of the Revised Code, the rules of the board of building standards shall supersede and govern any order, standard, or rule of the divisions of the fire marshal or industrial compliance in the department of commerce, and the department of health and of counties and townships, in all cases where such orders, standards or rules are in conflict with the rules of the board of building standards, except that rules adopted and orders issued by the fire marshal pursuant to Chapter 3743. of the Revised Code prevail in the event of a conflict.

There may be other requirements owners may be required to meet as set forth by other licensing agencies such as the Ohio State Fire Marshal, Ohio Department of Health, the Ohio Department of Jobs and Family Services, Ohio Department of Mental Health and Addiction Services, Ohio Department of Developmental Disabilities, federal agencies, or other licensing authorities. Owners and designers should investigate these additional licensing agency requirements to ensure they are incorporated into the building design before submitting to the certified building department for plan approval.

The rules of the board of building standards adopted pursuant to section 3781.10 of the Revised Code shall govern any rule or standard adopted by the board pursuant to sections 4104.02 and 4105.011 of the Revised Code.

102.4 Application of references. References to chapter or section numbers, or to provisions not specifically identified by number, shall be construed to refer to such chapter, section or provision of this code.

102.5 Referenced codes and standards. When a reference is made within the building, mechanical, or plumbing codes to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in Chapter 35 of the building code, Chapter 15 of the mechanical code, or Chapter 15 of the plumbing code.
The codes and standards referenced in the building, mechanical, and plumbing codes shall be considered part of the requirements of these codes as though the text were printed in this code, to the prescribed extent of each such reference. Where differences occur between provisions of these codes and the referenced standards, the provisions of these codes shall apply.

102.6 Partial invalidity. In the event any part or provision of this code is held to be illegal or void, this shall not have the effect of making void or illegal any of the other parts or provisions thereof, and it shall be presumed that this code would have been adopted without such illegal or invalid parts or provisions.

102.7 Existing structures. The provisions of Chapter 34 shall control the alteration, repair, addition, maintenance, and change of occupancy of any existing structure. The occupancy of any structure currently existing on the date of adoption of this code shall be permitted to continue without change provided there are no orders of the building official pending, no evidence of fraud, or no serious safety or sanitation hazard. When requested, such approvals shall be in the form of a “Certificate of Occupancy for an Existing Building” in accordance with section 111.2. Buildings constructed in accordance with plans which have been approved prior to the effective date of this code are existing buildings.

102.8 Temporary Structures. The building official is authorized to issue approvals for temporary structures. Such approvals shall be in the form of a “Certificate of Occupancy for a Temporary Building” in accordance with section 111.1.6. This section does not apply to time-limited occupancies in existing structures. See section 111.1.5 for time-limited occupancies.

102.8.1 Conformance. Temporary structures shall conform to the structural strength, fire safety, means of egress, accessibility, light, ventilation and sanitary requirements of this code as necessary to ensure the public health, safety and general welfare. Temporary tents and membrane structures shall also comply with the applicable provisions in section 3103.

102.8.2 Termination of approval. The building official is authorized to terminate approval for a temporary structure and to order the temporary structure to be discontinued if conditions of the approval have been violated or the structure or occupancy poses an immediate hazard to the public or occupants of the structure.
102.9 **Non-required work.** Any component, building element, equipment, system or portion thereof not required by this code shall be permitted to be installed as a partial or complete system provided that it is constructed or installed in accordance with this code to the extent of the installation.

102.10 **Work exempt from approval.** Approval shall not be required for the following work; however, this work shall comply with all applicable provisions of the rules of the board:

**Building:**
1. One-story detached accessory structures used as tool and storage sheds, playhouses and similar uses, provided the floor area does not exceed one hundred twenty square feet (11.15 m²) and playground structures.
2. Fences not over six feet (1829 mm) high.
3. Retaining walls which are not over four feet (1219 mm) in height measured from the bottom of the footing to the top of the wall, unless supporting a surcharge or impounding Class I, II or III-A liquids.
4. Water tanks supported directly upon grade if the capacity does not exceed five thousand gallons (18 927 L) and the ratio of height to diameter or width does not exceed two to one.
5. Sidewalks and driveways not more than thirty inches (762 mm) above grade and not over any basement or story below and which are not part of an accessible route.
6. Finishes not regulated by this code, decorating, or other work defined as maintenance or minor repair.
7. Temporary motion picture, television and theater stage sets and scenery.
8. Window awnings supported by an exterior wall of Group R-3.
9. Tents and membrane structures exempted in section 3103.1.3.
10. Above-ground storage tanks as defined in rule 4101:1-2-01 of the Administrative Code and the associated tank foundations.
11. Battery operated smoke or carbon monoxide alarms installed in existing buildings where no construction is taking place.

**Electrical:**
1. Minor repair work, including the replacement of lamps or the connection of approved portable electrical equipment to approved permanently installed receptacles.
2. Electrical equipment used for radio and television transmissions except equipment and wiring for power supply, and the installations of towers and antennas.
3. The installation of any temporary system required for the testing or servicing of electrical equipment or apparatus.
4. Electrical wiring, devices, appliances, apparatus or equipment operating at less than twenty-five volts and not capable of supplying more than fifty watts of energy, unless specifically addressed in this code.
5. Process equipment and the associated wiring on the load side of the power disconnect to the equipment.
6. Electrical wiring equipment not connected to building services equipment in and adjacent to natural or artificially made bodies of water as defined in Article 682 of NFPA 70 as referenced in Chapter 35.

Gas:
1. Portable heating appliances;
2. Replacement of any part that does not alter approval of equipment or make such equipment unsafe.
3. Gas distribution piping owned and maintained by public or municipal utilities and located upstream of the point of delivery.
4. Process equipment, including the associated tanks, foundations, and process piping. For combination building services/process or power piping systems, the power or process piping located downstream of the control valve which separates the process from the building services piping is exempt from approval.

Mechanical:
1. Portable heating appliances;
2. Portable ventilation equipment;
3. Portable cooling units;
4. Replacement of any part which does not alter its approval or make it unsafe;
5. Portable evaporative cooler;
6. Process equipment including the associated tanks, foundations, and process piping. For combination building services/process or power piping systems, the power or process piping located downstream of the control valve which separates the process from the building services piping is exempt from approval.
7. Heating and cooling distribution piping installed and maintained by public or municipal utilities.

Plumbing:
1. The repair of leaks in drains, water, soil, waste or vent pipe; provided, however, that if any concealed trap, drain-pipe, water, soil, waste or vent pipe becomes defective and it becomes necessary to remove and replace the
same with new material, such work shall be considered as new work and an approval shall be obtained and inspection made as provided in this code.

2. The clearance of stoppages or the repair of leaks in pipes, valves or fixtures, and the removal and reinstallation of water closets, provided such repairs do not involve or require the replacement of more than one fixture or rearrangement of valves, pipes or fixtures.

3. Process equipment including the associated tanks, foundations, and process piping. For combination building services/process or power piping systems, the power or process piping located downstream of the control valve which separates the process from the building services piping is exempt from approval.

102.10.1 Emergency repairs. Where equipment replacements and repairs must be performed in an emergency situation, an application for approval shall be submitted within the next working business day to the building official.

102.10.2 Minor repairs. Minor repairs to structures may be made without application or notice to the building official. Such repairs shall not include the cutting away of any wall, partition or portion thereof, the removal or cutting of any structural beam or load bearing support, or the removal or change of any required means of egress, or rearrangement of parts of a structure affecting the egress requirements; nor shall minor repairs include addition to, alteration of, replacement or relocation of any standpipe, water supply, sewer, drainage, drain leader, gas, soil, waste, vent or similar piping, electric wiring or mechanical or other work affecting public health or general safety.

102.11 Building department jurisdictional limitations. A municipal, township, or county building department that has been certified by the board of building standards, pursuant to section 103.2 rule 4101:7-2-01 of the Administrative Code, shall enforce provisions of the rules of the board and of Chapters 3781. and 3791. of the Revised Code, relating to construction, arrangement, and the erection of buildings or parts thereof as defined in the rules of the board in accordance with the certification except as follows:

1. Fire. The state fire marshal or fire chief of municipal corporations or townships, having fire departments, shall enforce all provisions of the rules of the board relating to fire prevention.

2. Health. The department of health, or the boards of health of city or general health districts, the division of industrial compliance of the department of commerce, or the departments of building inspection of municipal corporations, townships, or counties shall enforce such provisions relating to sanitary construction.
3. **Sewerage and drainage system.** In accordance with Section 3781.03 of the Revised Code, the department of the city engineer, in cities having such departments, the boards of health of health districts, or the sewer purveyor, as appropriate, shall have complete supervision and regulation of the entire sewerage and drainage system of the jurisdiction, including the building sewer and all laterals draining into the street sewers. Such department or agency shall have control and supervision of the installation and construction of all drains and sewers that become a part of the sewerage system of the jurisdiction and shall issue all the necessary permits and licenses for the construction and installation of all building sewers and of all other lateral drains that empty into the main sewers. Such department or agency shall keep a permanent record of the installation and location of every drain and sewerage system of the city.

4. **Power Generation.** Structures on the premises of and directly related to the operation of a generating plant defined as a major utility facility regulated by the power siting board, including the structures associated with generation, transmission, and distribution. As a condition of the power siting board’s approval, the building department may be requested to review and inspect these structures for compliance with the rules of the board of building standards. However, the building department has no enforcement authority.

5. **State Projects.** Certification does not confer any jurisdiction to a certified building department to regulate:

5.1 The construction of buildings by the state of Ohio or on land owned by the state of Ohio including, but is not limited to, its agencies, authorities, boards, commissions, administrative departments, instrumentalities, community or technical college districts, but does not include other political subdivisions.

**Exception:** On other than land owned by the State of Ohio, local school district building projects funded by the Ohio school facilities commission in accordance with Chapter 3318. of the Revised Code when the local certified building department is authorized by the board to regulate construction of school facilities.

5.2 Park districts created pursuant to Chapter 1545. of the Revised Code. A certified municipal, township, or county building department may exercise enforcement authority, accept and approve plans and specifications, and make inspections for a park district created pursuant to Chapter 1545. of the Revised Code upon the approval, by resolution, of the board of park commissioners of the park district requesting the department to exercise that authority and conduct those activities.
5.3 The construction of buildings or structures within the scope of the building code on the premises of, and directly related to the operation of, natural gas liquids fractionation, natural gas cracking, or natural gas processing facilities.

Note: The lands owned by Miami university in the city of Oxford and Oxford township in Butler County and leased to private individuals or corporations under the land rent provisions of the Act of February 17, 1809, as set forth at 7 Ohio laws 184, are subject to local certified building department jurisdiction and are exempt from these provisions.

Section 103
Certified building departments, personnel, and appeals boards

Refer to division 4101:7 of the Administrative Code for existing relocated building department, building department personnel, and boards of building appeals certification requirements.

Section 104
Duties and responsibilities of building department personnel

104.1 General. Local boards of building appeals and personnel of building departments that have been certified by the board of building standards, pursuant to division 4101:7 of the Administrative Code, shall be responsible for performing the duties described in this section.

104.2 Building department personnel duties and responsibilities. Municipal, township, or county building departments certified by the board shall have personnel qualified to perform the enforcement duties and responsibilities described in this section.

104.2.1 Building official. The building official is responsible for the enforcement of the rules of the board and of Chapters 3781. and 3791. of the Revised Code relating to the construction, arrangement, and the erection of buildings or parts thereof. All building officials shall conduct themselves in a professional, courteous, impartial, responsive, and cooperative manner. The building official shall render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies, and procedures shall be in compliance with the intent and purpose of this code. Building officials shall be responsible to assure that a system is in place to track and audit all projects, to assure that all building
department personnel perform their duties in accordance with this section, and for the overall administration of a building department as follows:

104.2.1 Applications and plan approvals. The building official shall receive applications, require or cause the submitted construction documents to be examined, ascertain by such examinations whether the construction indicated and described is in accordance with the requirements of this code, and shall issue plan approvals for the construction, erection, alteration, demolition, and moving of buildings and structures. The building official shall require a master plans examiner or elective plans examiners to examine the construction documents to verify the construction indicated is in accordance with the requirements of this code and shall assure coordination of plan review.

104.2.1.1 Plan examination by the building official. When the building department does not have in its full-time employ a certified master plans examiner, the certified building official shall examine construction documents to determine compliance with the rules of the board if the registered design professional elects to submit construction documents that contain a written certification by the registered design professional indicating conformance with the requirements of the rules of the board and Chapters 3781. and 3791. of the Revised Code.

104.2.1.2 Orders. The building official shall issue all orders in accordance with section 109 to ensure compliance with this code.

104.2.1.3 Inspections. If the plans for the erection, construction, repair, alteration, relocating, or equipment of a building are subject to inspection by the building official, under section 108, the building official shall cause to be made such inspections, investigations, and determinations as are necessary to determine whether or not the work which has been performed and the installations which have been made are in conformity with the approved construction documents. The building official shall identify any special conditions that would affect the timing of inspections and schedule inspections times mutually agreed upon by the building official and the owner.

Exception: Special inspections required under section 1704.

104.2.1.4 Department records. The building official shall keep official records of applications received, certificates of plan approval issued, notices and orders issued, certificates of occupancy, certificates of
completion, and other such records required by the rules of the board of building standards. Such information shall be retained in the official permanent record for each project. One set of approved construction documents shall be retained by the building official for a period of not less than one hundred eighty days from date of completion of the permitted work, or as required by document retention regulations.

104.2.1.5 Department reports. The building official shall be responsible for the submission of reports and any requested special information to the board of building standards as required in paragraph (F) of rule 4101:7-2-01 of the Administrative Code. Failure to submit these reports as required by rule or by special request or inquiry of the board of building standards may be grounds for board action as described in paragraph (F)(7) of rule 4101:7-3-01 of the Administrative Code.

104.2.2 Plans Examiners. A plans examiner is responsible for the examination of construction documents in accordance with section 107, within the limits of their certification, to determine compliance with the rules of the board. All plan examiners shall effectively communicate the results of their plan review as designated by the building official. All plans examiners shall conduct themselves in a professional, courteous, impartial, responsive, and cooperative manner.

104.2.2.1 Master plans examiner. A master plans examiner is responsible for the examination of all types of construction documents to determine compliance with the rules of the board, except when the building official examines the construction documents pursuant to section 104.2.1.1.1. If elective plans examiners are utilized by the building department, the master plans examiner shall assure coordination of plan reviews.

104.2.2.1.1 Master plans examiner trainee. A master plans examiner trainee is responsible for the examination of all types of construction documents to determine compliance with the rules of the board under the direct supervision of the trainee supervisor as required in paragraph (F)(5)(b) of rule 4101:7-3-01 of the Administrative Code.

104.2.2.2 Elective plans examiners. Building departments may employ or have under contract elective plans examiners. The elective plans examiner(s) may be designated by the building official as responsible for examination of construction documents for which they are certified to determine compliance with the rules of the board. If the department does
not have in its employ or under contract persons holding any of the elective plans examiners certifications, then the examination of the construction documents for compliance with the specific provisions of the code shall be done by the master plans examiner.

104.2.2.1 Building plans examiner. A building plans examiner is responsible for the examination of construction documents related to all general building construction and associated structural work to determine compliance with the rules of the board.

104.2.2.2 Mechanical plans examiner. A mechanical plans examiner is responsible for the examination of construction documents related to heating, ventilating, and air conditioning ("HVAC") systems and the associated refrigeration, fuel gas, and heating piping to determine compliance with the rules of the board.

104.2.2.2.1 Mechanical plans examiner trainee. A mechanical plans examiner trainee is responsible for the examination of construction documents related to heating, ventilating, and air conditioning ("HVAC") systems and the associated refrigeration, fuel gas, and heating piping to determine compliance with the rules of the board under the direct supervision of the trainee supervisor as required in paragraph (F)(5)(b) of rule 4101:7-3-01 of the Administrative Code.

104.2.2.3 Electrical plans examiner. An electrical plans examiner is responsible for the examination of construction documents related to electrical systems to determine compliance with the rules of the board.

104.2.2.3.1 Electrical plans examiner trainee. An electrical plans examiner trainee is responsible for the examination of construction documents related to electrical systems to determine compliance with the rules of the board under the direct supervision of the trainee supervisor as required in paragraph (F)(5)(b) of rule 4101:7-3-01 of the Administrative Code.
supervisor as required in paragraph (F)(5)(b) of rule 4101:7-3-01 of the Administrative Code.

104.2.2.4 Plumbing plans examiner. A plumbing plans examiner is responsible for the examination of construction documents related to plumbing systems to determine compliance with the rules of the board.

104.2.2.4.1 Plumbing plans examiner trainee. A plumbing plans examiner trainee is responsible for the examination of construction documents related to plumbing systems to determine compliance with the rules of the board under the direct supervision of the trainee supervisor as required in paragraph (F)(5)(b) of rule 4101:7-3-01 of the Administrative Code.

104.2.2.5 Fire protection plans examiner. A fire protection plans examiner is responsible for the examination of construction documents related to fire protection systems (automatic sprinkler systems, alternative automatic fire-extinguishing systems, standpipe systems, fire alarm and detection systems, and fire pumps) to determine compliance with the rules of the board.

104.2.2.5.1 Fire protection plans examiner trainee. A fire protection plans examiner trainee is responsible for the examination of construction documents related to fire protection systems (automatic sprinkler systems, alternative automatic fire-extinguishing systems, standpipe systems, fire alarm and detection systems, and fire pumps) to determine compliance with the rules of the board under the trainee supervisor as required in paragraph (F)(5)(b) of rule 4101:7-3-01 of the Administrative Code.

104.2.3 Inspectors. An inspector is responsible for performing inspections and determining that work, for which they are certified to make inspections, is performed in compliance with the approved construction documents. All inspectors shall inspect the work to the extent of the approval given when construction documents were approved by the building official and for which the inspection was requested. All inspectors shall effectively communicate the results of their inspections as required by section 108, and shall conduct themselves in a professional, courteous, impartial, responsive, and cooperative manner.
104.2.3.1 Building inspector. A building inspector is responsible to determine compliance with the approved construction documents in accordance with section 108. A building inspector trainee is designated to determine compliance with approved construction documents, in accordance with section 108, under the direct supervision of an individual holding a building inspector certification.

104.2.3.2 Plumbing inspector. A plumbing inspector is responsible to determine plumbing system compliance with approved construction documents in accordance with section 108. A plumbing inspector trainee is designated to determine plumbing system compliance with approved construction documents, in accordance with section 108, under the direct supervision of an individual holding a plumbing inspector certification.

104.2.3.3 Electrical safety inspector. An electrical safety inspector is responsible to determine electrical systems compliance with approved construction documents in accordance with section 108. An electrical safety inspector trainee is designated to determine electrical systems compliance with approved construction documents, in accordance with section 108, under the direct supervision of an individual holding an electrical safety inspector certification.

104.2.3.4 Elective inspectors. Building departments may elect to employ inspectors designated as responsible for determining that work, for which they are certified to make inspections, is performed in compliance with approved construction documents.

104.2.3.4.1 Mechanical inspector. A mechanical inspector is responsible to determine compliance with the approved construction documents for heating, ventilating and air conditioning (HVAC) systems, and the associated refrigeration, fuel gas, and heating piping systems in accordance with section 108. If the department does not have in its employ or under contract persons holding the mechanical inspector certification, then the inspection of the mechanical systems shall be performed by persons holding the building inspector certification. A mechanical inspector trainee is designated to determine compliance with the approved construction documents for heating, ventilating and air conditioning (HVAC) systems, and the associated refrigeration, fuel
gas, and heating piping systems, in accordance with section 108, under the direct supervision of an individual holding a mechanical inspector certification.

104.2.3.4.2 Fire protection inspector. A fire protection inspector is responsible to determine compliance with approved construction documents for fire protection systems (automatic sprinkler systems, alternative automatic fire-extinguishing systems, standpipe systems, fire alarm and detection systems, and fire pump) in accordance with section 108.

If the department does not have in its employ or under contract persons holding the fire protection inspector certification, then the inspections of the fire protection systems shall be performed by persons holding the building inspector certification.

104.2.3.4.3 Medical gas piping inspector. A medical gas piping inspector is responsible to determine compliance with approved construction documents for non-flammable medical gas, medical oxygen, and medical vacuum systems in accordance with section 108.

If the department does not have in its employ or under contract persons holding a medical gas piping inspector certification, then all enforcement of medical gas piping systems shall be deferred to either of the following: the local health district when that district requests to enforce those piping systems and the district has employed or hired under contract a person holding the medical gas piping inspector certification; or the superintendent of the division of industrial compliance in the department of commerce.

104.2.4 Liability. Liability of certified building department personnel for any tortious act will be determined by Ohio courts to the applicable provisions of Chapter 2744. of the Revised Code.

104.3 Certified boards of building appeals duties and responsibilities. Before performing its duties, a jurisdiction wishing to establish a local board of building appeals shall receive certification by the board of building standards as required in section 3781.10 of the Revised Code and rule 4101:7-4-01 of the Administrative Code.

104.3.1 Powers, local boards of building appeals. Certified municipal and county boards of building appeals shall hear and decide the adjudication hearings referred to in section 109.1 within the jurisdiction of and arising from
orders of the local building official in the enforcement of Chapters 3781. and 3791. of the Revised Code and rules adopted thereunder. The orders may be reversed or modified by the board if it finds:

1. The order contrary to such laws or rules;
2. The order contrary to a fair interpretation or application thereof; or
3. That a variance from the provisions of such laws or rules, in a specific case, will not be contrary to the public interest where literal enforcement of such provisions will result in unnecessary hardship.

104.3.2 State board of building appeals. The Ohio board of building appeals shall conduct the adjudication hearings in political subdivisions without certified boards or without contracts with certified boards.

104.3.3 Materials. A certified board of building appeals may not prohibit the use of materials or assemblages authorized for statewide use by the board of building standards pursuant to section 3781.12 of the Revised Code.

104.4 Violation of duties. Any person affected by alleged improper actions of any building department, building official, plans examiner, inspector, fire protection system designer, or local board of building appeals certified by the board of building standards may file a written complaint with the board. Complaints will be processed by the board in accordance with the procedures outlined in the applicable certification rule found in division 4101:7 of the Administrative Code.

Section 105
Approvals

105.1 Approvals required. Any owner or owner’s representative who intends to construct, enlarge, alter, repair, move, or change the occupancy of a building or structure, or portion thereof, or to erect, install, enlarge, alter, repair, remove, convert or replace any electrical, gas, mechanical, plumbing system, other building service equipment, or piping system the installation of which is regulated by this code, or to cause any such work to be done, shall first make application to the building official and obtain the required approval.

105.1.1 Nonconformance approval. When construction documents are submitted which do not conform with the requirements of the rules of the board, such documents may be approved by the building official provided such nonconformance is not considered to result in a serious hazard and the owner or owner’s representative subsequently submits revised construction documents showing evidence of compliance with the applicable provisions of
the rules of the board. In the event such construction documents are not received within thirty days, the building official shall issue an adjudication order revoking the plan approval.

105.1.2 Conditional approval. When construction documents are submitted which cannot be approved under the other provisions of this rule, the building official, may at the request of the owner or owner’s representative, issue a conditional plan approval when an objection to any portion of the construction documents results from conflicting interpretations of the code, or compliance requires only minor modifications to the building design or construction. No conditional approval shall be issued where the objection is to the application of specific technical requirements of the code or correction of the objection would cause extensive changes in the building design or construction. A conditional approval is a conditional license to proceed with construction or materials up to the point where construction or materials objected to by the agency are to be incorporated into the building. The conditions objected to shall be in writing from the building official which shall be an adjudication order denying the issuance of a license and may be appealed in accordance with section 3781.19 of the Revised Code. In the absence of fraud or a serious safety or sanitation hazard, all items previously examined shall be conclusively presumed to comply with Chapters 3781. and 3791. of the Revised Code and the rules of the board. Reexamination of the construction documents shall be limited to those items in the adjudication order. A conditional plan approval is not a phased plan approval.

105.1.3 Previous approvals. This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful approval has previously been issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within one year of the approval of construction documents. One extension shall be granted for an additional year if requested by the owner at least ten days in advance of the expiration of the approval and upon payment of any fee not to exceed one hundred dollars. If, after the start of construction, work is delayed or suspended for more than six months, the approval is invalid. Two extensions shall be granted for six months if requested by the owner at least ten days in advance of the expiration of the approval and upon payment of any fee for each extension not to exceed one hundred dollars.

105.1.4 Phased approval. The building official shall issue an approval for the construction of foundations or any other part of a building, structure, or building service equipment before the construction documents for the whole
building, structure or building service equipment have been submitted, provided that adequate information and detailed statements have been filed complying with applicable requirements of this code. The holder of such approval, as required in section 105.1, for the foundation or other parts of a building or structure shall proceed at the holder's own risk with the building operation and without assurance that an approval for the entire structure will be granted. Such approvals shall be issued for various stages in the sequence of construction provided that all information and data required by the code for that portion of the building or structure has been submitted. The holder of a phased plan approval may proceed only to the point for which approval has been given.

105.1.5 Annual approval. In lieu of an individual approval for each alteration to an existing electrical, gas, mechanical, plumbing, or piping installation, the building official may issue an annual approval upon application to any person, firm or corporation regularly employing individuals holding the related board certification in the building, structure or on the premises owned or operated by the applicant for the approval.

105.1.5.1 Annual approval records. The person to whom an annual approval is issued shall keep a detailed record of alterations made under such annual approval. The building official shall have access to such records at all times or such records shall be filed with the building official as designated. These records shall include the applicable construction documents in accordance with section 106.1.

105.2 Validity of approval. The construction, erection, and alteration of a building, and any addition thereto, and the equipment and maintenance thereof, shall conform to required plans which have been approved by the building official, except for minor deviations which do not involve a violation of the rules of the board. In the absence of fraud or a serious safety or sanitation hazard, any structure built in accordance with approved plans shall be conclusively presumed to comply with Chapters 3781. and 3791. of the Revised Code and the rules of the board.

Exception: Industrialized units shall be constructed to conform to the plans approved by the board.

105.3 Expiration. The approval of plans or drawings and specifications or data by the building official is invalid if construction, erection, alteration, or other work upon the building has not commenced within twelve months of the approval of the plans or drawings and specifications.
One extension shall be granted for an additional twelve-month period if requested by the owner at least ten days in advance of the expiration of the approval and upon payment of a fee not to exceed one hundred dollars.

105.4 Extension. If, in the course of construction, work is delayed or suspended for more than six months, the approval of plans or drawings and specifications or data is invalid. Two extensions shall be granted for six months each if requested by the owner at least ten days in advance of the expiration of the approval and upon payment of a fee for each extension of not more than one hundred dollars.

105.5 Certificate of plan approval. After plans have been approved in accordance with section 107, the building official shall furnish the owner/applicant a certificate of plan approval.

105.5.1 Content. The form of the certificate shall be as prescribed by the building official and shall show the serial number of the certificate, the address at which the building or equipment under consideration is or is to be located, the name and address of the owner, the signature of the building official who issued the certificate, the date of issuance and such other information as is necessary to facilitate and ensure the proper enforcement of the rules of the board.

105.5.2 Duplicate issued upon request. Upon application by the owner, the building official shall issue a duplicate certificate of plan approval to replace a lost or destroyed original.

Section 106
Construction documents

106.1 Submittal documents. Construction documents, statement of special inspections required and other data shall be submitted in two or more sets with each application for an approval. Before beginning the construction of any building for which construction documents are required under section 105, the owner or the owner’s representative shall submit construction documents to the building official for approval. When construction documents have been found to be in compliance with the rules of the board of building standards in accordance with section 107 by a certified building department, that determination of compliance shall be deemed sufficient to obtain approval for construction pursuant to section 105.2 and the building official shall issue the certificate of plan approval. Construction documents for the installation of industrialized units shall be submitted to the
building official for approval in accordance with the provisions of section 106.1.2(1).

**Exception:** No construction documents need be filed with the division of industrial compliance for site installation of industrialized units used exclusively as one-, two-, or three-family dwellings.

**106.1.1 Information on construction documents.** Construction documents shall be dimensioned and drawn upon suitable material. Electronic media documents are permitted to be submitted when approved by the building official. Construction documents shall be coordinated and of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code. Construction documents, adequate for the scope of the project, shall include information necessary to determine compliance with the building, mechanical, plumbing, fire, electrical, energy, and fuel gas codes such as:

1. **Index.** An index of drawings located on the first sheet which shall also include all occupancy classification(s), type(s) of construction, the area in gross square feet for each level, the maximum design occupant load, the structural design loads, and the seismic design category and site class;

2. **Site plan.** A site plan showing a north orientation arrow, the size and location of new construction and all existing structures on the site, all property and interior lot line locations with setback and side yard dimensions and distances from buildings to lot lines, the locations of the nearest streets, the established street grades, the locations, types and sizes of all utility lines, the location of any fences, and the elevations of all proposed finished grades; and it shall be drawn in accordance with an accurate boundary line survey. In the case of demolition, the site plan shall show construction to be demolished and the location and size of existing structures and construction that are to remain on the site or plot. The building official is authorized to waive or modify the requirement for a site plan when the application for approval is for alteration or repair or when otherwise warranted.

2.1 **Buildings or structures located in flood hazard areas.** Construction documents submitted for buildings or structures located in communities with identified flood hazard areas, pursuant to section 1612, shall include the current FEMA “Flood Hazard Boundary Map” (FHBMM), “Flood Insurance Rate Map” (FIRM) or “Flood Boundary Floodway Map” (FBFM) for the project location. The required site plan shall include building elevations using the same datum as the related flood hazard map. The owner shall be
responsible for the compliance with local flood damage prevention regulations for additional critical elevation information for the project site.

2.2 Site Accessibility Plan. Information in plan view and details shall be submitted indicating compliance with the accessibility provisions of this code for the exterior of the building in addition to accessible features of the interior. When applicable, the plans shall include: the exterior accessible route between all facilities required to be connected; ramp locations and elevations along the exterior accessible route; number of and details for the required accessible van and car parking spaces and passenger loading areas; location and detail of required accessibility signage; grade/topographic elevations before and after proposed grading when site impracticality is intended to be applied.

3. **Floor plans.** Building configuration layout drawings with all walls and partitions shown including: plans of full or partial basements and full or partial attics and penthouses, grade elevations at the building perimeter, and references to other details and elevations. Floor plans must show all relevant information such as door swings, stairs and ramps, windows, shafts, all portions of the means of egress, plumbing fixtures, built-in fixtures, special equipment, vertical transportation, etc., and shall be sufficiently dimensioned to describe all relevant space sizes. Spaces shall be identified by appropriate code appellations (an "auditorium" may not be identified as a "meeting room" if its attributes indicate that it is an auditorium). The construction documents shall designate the number of occupants to be accommodated on every floor, and in all rooms and spaces;

4. **Demolition.** In the case of demolition, the floor plan shall identify construction to be demolished and the location, arrangement, and dimensions of existing construction that is to remain.

5. **Roof plan.** Roof outline, overall dimensions and dimensions of setbacks, slope of roof, drainage, reference to other details, roof materials, penetrations through roof, and roof-mounted equipment;

6. **Exterior elevations.** Vertical dimensions, floor-to-floor heights, opening heights, references to other details, floor lines, elevations of major elements, grade lines, foundation lines, material indications and notes, symbols for window schedule, gutters, signs and windows, doors, and all other openings.

7. **Building sections.** Vertical dimensions, elevations of the top of structural components and finish floor lines, materials, footings and
foundations, reference to other details, ceiling lines, and major mechanical services.

8. **Exterior building envelope.** The exterior envelope shall be described in sufficient detail to determine compliance with this code and the referenced standards. Details shall be provided which describe flashing, intersections with dissimilar materials, corners, end details, control joints, intersections at roof, eaves, or parapets, means of drainage, water-resistive membrane details around openings, location and type of vapor retarders, window and door “U”-values, and insulation location and “R”-values. The supporting documentation shall fully describe the exterior wall system, which was tested, where applicable, as well as the test procedure used.

9. **Wall Sections.** Face of wall dimensions to other components, vertical dimensions from foundations to parapet relating all elements to top of structural elements, all connection methods, wall, ceiling, floor, foundation, and roof materials and construction details.

10. **Interior elevations.** Vertical dimensions to critical elements, references to other details, openings in walls, wall finishes, built-in items, and locations of switches, thermostats, and other wall-mounted equipment.

11. **Schedules.** Information or tables that describe the room finishes, doors, windows, and door hardware and controls. Wall and floor materials shall be described by cross-hatching (with explanatory key), by notation, or by other clearly understandable method.

12. **Structure.** Complete structural description of the building including size and location of all structural elements and a table of live, wind, snow, and seismic loads used in the design of the building and other data as required to fully describe the structural system.

13. **Fire suppression system.** Areas of protection, fire suppression system occupancy hazard classification, and water supply data.

14. **Fire-resistance Ratings.** The fire-resistance ratings of all structural elements as required by this code, data substantiating all required fire-resistance ratings including details showing how penetrations will be made for electrical, mechanical, plumbing, and communication conduits, pipes, and systems, and the materials and methods for maintaining the required structural integrity, fire-resistance rating, and firestopping.

15. **System descriptions.** Complete description of the plumbing, mechanical and electrical systems, including: materials, insulation “R”-values, general routing and sizes of all piping; location and type of plumbing fixtures and equipment; plumbing schematics and isometrics; materials, insulation “R”-values, general routing and sizes of all ductwork, vents,
and louvers; location and type of heating, ventilation, air conditioning, and other mechanical equipment; location and type of all fire alarm, lighting and power equipment; type and size of all electrical conductors.

16. **Operations.** Information shall be provided regarding operations, the types, quantities, and arrangement of flammable, combustible, or hazardous materials proposed to be produced, used, dispensed, or stored in the facility; material safety data sheets for hazardous materials produced, used, or stored in the facility, the commodity and arrangement of high piled or rack storage, control areas, etc.

17. **Additional information.** Additional information required by the building official to determine compliance with this code.

106.1.1.1 **Fire protection system drawings.** Construction documents shall be approved prior to the start of system installation. Related product listing information shall be provided and drawings shall contain all information as required by the installation standards referenced in Chapter 9. In the event that the product listing information is not known at the time of plan examination, conditional plan approval shall be granted subject to subsequent submission of the listing information prior to installation of any part of the fire protection systems.

106.1.1.2 **Special inspections.** Where application is made for construction as described in this section, the owner or the registered design professional in responsible charge acting as the owner’s representative shall identify those special inspections needed during construction on the types of work listed under section 1704.

106.1.2 **Special provisions.** The following are special provisions:

1. When construction includes the use of industrialized units or alternative materials, designs and methods of construction or equipment approved by the board, documentation shall be provided to the building official describing how they are to be used. Before these items are installed or used, the following shall be submitted:

   1.1 A copy of the construction documents approved by the board; and
   1.2 Details pertaining to on-site interconnection of modules or assemblies.

   **Exception:** When construction includes the use of industrialized units for one-, two-, and three-family dwellings and their accessory structures, the documents shall be provided to the residential building official. If no residential department is certified in a jurisdiction, construction documents for one-, two-
, or three-family dwellings comprised of industrialized units are 
not required to be submitted for approval.

2. Construction documents submitted that include construction of public 
swimming pools shall include documentation indicating approval of the 
pool construction documents by the Ohio department of health in 
accordance with section 3109.1.1 of the “OBC”.

3. Construction documents submitted that include alterations or 
construction of, or additions to buildings where sales, display, storage 
or manufacture of consumer fireworks, 1.4g or display fireworks, 1.3g 
shall include documentation indicating that the applicant has received 
preliminary approval for construction issued by the state fire marshal 
pursuant to sections 3743.04 and 3743.17 of the Revised Code.

4. The elevation certification provided by a registered surveyor and dry 
floodproofing certification, when required in section 1612.5 for 
buildings or structures located in communities with identified flood 
 hazardous areas, shall be submitted to the building official.

5. When a certified building department receives an application for plan 
approval in a jurisdiction in which the local fire official has requested 
an opportunity to provide input to the certified building department on 
issues related to fire protection systems by submitting a completed 
“Request for Participation” form prescribed by the board and provided 
by the building official to the local fire official annually, the building 
official shall require that the applicant provide a set of relevant 
construction documents for the local fire official. The building official 
shall evaluate the local fire official’s comments related to fire protection 
system provisions of this code that are received within the timeframe 
established by the building official and section 3791.04 of the Revised 
Code prior to issuing the certificate of plan approval required in Section 
105.5. In the absence of timely input from the fire official during the 
plan review process, the building official shall proceed as outlined in 
Section 107.5.1

6. Construction documents submitted that include alterations or 
construction of, or additions to jails, workhouses, or municipal lockups 
shall include documentation indicating that the applicant has received 
preliminary approval for construction issued by the Ohio department of 
rehabilitation and corrections.

7. When, as a part of work subject to this code, construction includes or 
relates to the storage or use of hazardous, flammable or combustible 
liquids or gases connected to and utilized for the operation of building 
service equipment, such construction shall be in accordance with the 
provisions of this code. Notification of such storage or use shall be
provided to the fire official for emergency planning purposes. When construction includes or relates to the storage or use of hazardous, flammable or combustible liquids or gases not associated with the operation of building service equipment, the owner shall notify the building official in accordance with Sections 106.1.1(item #16) and 414.1.3 to ensure that the building has been adequately protected to address the hazard. However, approval of the storage and use shall be obtained from the fire official in accordance with the fire code.

106.2 Evidence of responsibility. Required construction documents, when submitted for review as required under section 107, shall bear the identification of the person primarily responsible for their preparation.

106.2.1 Seal requirements. Construction documents shall bear the seal of a registered design professional pursuant to section 3791.04 of the Revised Code. Exceptions: The seal of a registered design professional is not required on construction documents for:
1. Buildings or structures classified as one-, two-, or three-family dwellings and accessory structures;
2. Energy conservation design for buildings or structures classified as one-, two-, or three-family dwellings;
3. Fire protection system designs submitted under the signature of an individual certified in accordance with section 107.4.4;
4. Installation of replacement devices, equipment or systems that are equivalent in type and design to the replaced devices, equipment or systems; and
5. Alterations, construction or repairs to any buildings or structures subject to sections 3781.06 to 3781.18 and 3791.04 of the Revised Code where the building official determines that the proposed work does not involve the technical design analysis of work affecting public health or general safety in the following areas: means of egress, structural, mechanical, electrical, plumbing, or fire protection.
5.1 For the purpose of this exception, technical design analysis is defined as the development of integrated solutions using analytical methods in accordance with established scientific and engineering principles.

106.3 Amended construction documents. If substantive changes to the building and/or systems are contemplated after first document submission, or during construction, those changes must be submitted to the building official for review and approval prior to those changes being executed. The building official may
waive this requirement in the instance of an emergency repair, or similar instance.

106.4 Alternative materials and methods of construction and equipment. For approval of a device, material or assembly that does not conform to the performance requirements in this code, section 114 shall apply.

106.5 Alternative engineered design. The design, documentation, inspection, testing and approval of an alternative engineered system shall comply with sections 106.5.1 to 106.5.3 of this rule.

106.5.1 Design criteria. An alternative engineered design shall conform to the intent of the provisions of this code and shall provide an equivalent level of quality, strength, effectiveness, fire resistance, durability and safety. Materials, equipment or components shall be designed and installed in accordance with the manufacturer’s installation instructions.

106.5.2 Submittal. The registered design professional shall indicate on the application that the system is an alternative engineered design. The approval and permanent approval records shall indicate that an alternative engineered design was part of the approved installation. Where special conditions exist, the building official is authorized to require additional construction documents to be prepared by a registered design professional.

106.5.3 Technical data. The registered design professional shall submit sufficient technical data to substantiate the proposed alternative engineered design and to prove that the performance meets the intent of this code.

   Exception: Approval of alternative materials, products, assemblies and methods of construction in accordance with Section 114.3.2.

Section 107
Plan approval process

107.1 Plan review required. Where the rules of the board are applicable under section 101.2, before a building or addition to a building is constructed or erected, and before a building is altered or relocated, or building equipment is installed, or there is a change of occupancy, or a resubmission of construction documents is required or received, construction documents relating to the work and equipment under consideration shall be prepared in conformity with section 106 and be submitted to the building department for examination and approval.
107.2 Application for plan approval. To obtain a plan approval, the owner or the owner’s representative shall first file an application in writing on a form furnished by the building department for that purpose. Such application shall:

1. Identify and describe the work to be covered for which application is made for approval.
2. Describe the land on which the proposed work is to be done, street address or similar description that will readily identify and locate the proposed building or work.
3. Indicate the use and occupancy(ies) for which the proposed work is intended.
4. Be accompanied by construction documents and other information as required in section 106.1.
5. Be signed by the owner, or the owner’s representative.
6. Give such other data and information as required by the building official.
7. Identify and clearly indicate whether the project or portion of a project intends to utilize an industrialized unit, as defined in section 113.2.
8. Identify and clearly indicate whether the project or portion of a project intends to utilize an assembly of individually listed or labeled products.

107.2.1 Time limitation of application. The approval of plans under this section is a “license” and the failure to approve such plans as submitted within thirty days after filing or the disapproval of such plans is an “adjudication order denying the issuance of a license” requiring the opportunity for an “adjudication hearing” as provided by sections 119.07 to 119.13 of the Revised Code and as modified by sections 3781.031 and 3781.19 of the Revised Code. In accordance with section 109, an adjudication order denying the issuance of a license shall specify the reasons for such denial.

If construction documents have been reviewed for compliance with the rules of the board, an adjudication order has been issued to the owner and the owner’s representative, and the owner has neither exercised the right to appeal pursuant to section 110 nor resubmitted corrected documents, the application is invalid six months from the date of the issuance of the adjudication order.

107.3 Order of plan review. Construction documents submitted for approval shall be examined for compliance with the rules of the board in the order received, unless otherwise consented to by the building owners affected by deferred examination.
107.4 Review of plans. When construction documents have been submitted to the building department for review and approval, the building official shall cause the construction documents to be examined for compliance with the rules of the board by assigning the examination duty to an appropriately certified master plans examiner or certified elective plans examiners. The plans examiner(s) shall first determine whether the construction documents being reviewed are adequate as required in section 106. If so, the plans examiner(s) shall examine the construction documents to determine compliance with the rules of the board. When utilizing elective plans examiners, and when the scope of the work requires more than one elective plans examiner certification, the master plans examiner shall assure coordination of plan review.

107.4.1 Inadequate construction documents. If construction documents are determined to be incomplete or inadequate for examination, the plans examiner shall report the findings to the building official. The plans examiner shall examine the construction documents to the extent possible and identify what information from section 106 is missing and needed to complete the required examination. Upon receipt and review of the report, the building official shall proceed as required in section 107.6.

107.4.2 Resubmitted documents. If construction documents are resubmitted in response to an adjudication order, the review for compliance shall be limited to determining that the item of non-compliance, and any work affected, has been corrected and shall not be deemed to authorize another review of unmodified construction documents previously determined to comply.

107.4.3 Sealed construction documents. Construction documents which have been prepared by an Ohio registered design professional who prepared the same as conforming to the requirements of the rules of the board pertaining to design loads, stresses, strength, and stability, or other requirements involving technical analysis, need be examined only to the extent necessary to determine conformity of such construction documents with other requirements of the rules of the board.

107.4.4 Fire protection system construction documents. Construction documents for fire protection systems authorized to be submitted by individuals certified pursuant to Chapter 4101:7-5 of the Administrative Code shall:

1. When submitted under the signature of an individual certified under section 3781.105 of the Revised Code, be processed in the same manner as construction documents submitted under the signature of a registered design professional. Any statistical data, reports, explanations, plan
description, or information that would not also be required for a similar submission by a registered design professional need not be submitted by a certified designer.

2. If certified by a registered design professional or individual certified under section 3781.105 of the Revised Code as conforming to requirements of the rules of the board pertaining to design loads, stresses, strength, stability, or other requirements involving technical analysis, be examined by the building department official only to the extent necessary to determine conformity of such construction documents with other requirements adopted by the board under Chapters 3781. and 3791. of the Revised Code.

107.5 Plan review, compliance with rules of the board. If the construction documents are determined to comply with the rules of the board, the plans examiner shall communicate the findings and recommend the conditions and type of approval to the building official.

107.5.1 Building official approval. The building official shall evaluate the plans examiner’s recommendations and any communications received from the fire official as described in section 106.1.2. When the construction documents have been determined to conform to the applicable provisions of the rules of the board, the building official shall endorse or stamp such plans as approved and issue the certificate of plan approval in accordance with section 105.5.

107.5.2 Posting. The certificate of plan approval shall be posted in a conspicuous location on the site. The owner and the contractor shall preserve and keep the certificate posted until the final inspections have been completed.

107.6 Plan review, items of noncompliance. When the construction documents are examined and items of noncompliance with the rules of the board are found by the plans examiner, the building official shall proceed as required in either section 107.6.1 or section 107.6.2.

107.6.1 Communication process for items of non-compliance.
1. Item(s) of non-compliance shall be communicated to the owner or the owner’s representative and offer the following options:
   1.1 The owner will revise the drawings and resubmit to the department.
   1.2 The items of noncompliance will not be brought into compliance and will be referred to the building official as indicated in item 4 below.
2. The owner or the owner’s representative shall indicate which option (item 1 above) will be exercised.

3. Notations of the communication shall be made on a plan review record. The notations shall include the plans examiner’s name, the date of the communication with the owner or the owner’s representative, the observed items of noncompliance, the code citation related to the item(s) of noncompliance, the action necessary to correct the item(s) of noncompliance, the option chosen by the owner or the owner’s representative, the name of the person communicated with, and the estimated dates of compliance and resubmission, if applicable.

4. If the owner or the owner’s representative indicates that the work will not be brought into compliance with the rules of the board or requests an adjudication order, the plans examiner shall report to the building official in accordance with section 107.6.2.

**107.6.2 Building official determination of noncompliance.** The building official shall evaluate the plans examiner’s report and any reports received from the fire official as described in section 106.1.2 and render a final determination as to whether the items of non-compliance are to be communicated to the owner in the form of an adjudication order complying with section 109. The building official shall also determine whether any approvals are possible, and issue the appropriate approval as described in section 105.

**107.7 Approved construction document sets.** One set of approved construction documents shall be kept by the building official. The other set(s) shall be returned to the applicant, kept at the work site, along with manufacturers’ installation instructions and product information, and shall be available for use by the inspector.

**Section 108**

**Inspection process**

**108.1 General.** After construction documents have been approved, construction or work may proceed in accordance with the approved documents. Construction or work for which an approval is required shall be subject to inspection. It shall be the duty of the owner or the owner’s representative to notify the building department when work is ready for inspection. Access to and means for inspection of such work shall be provided for any inspections that are required by this code. It shall be the duty of the owner or the owner’s representative to cause the work to remain accessible and exposed for inspection purposes. Such construction or work
shall remain accessible and exposed for inspection purposes until the work has been inspected to verify compliance with the approved construction documents, but failure of the inspectors to inspect the work within four days, exclusive of Saturdays, Sundays, and legal holidays, after the work is ready for inspection, allows the work to proceed. Subsequent work is allowed to proceed only to the point of the next required inspection.

108.2 Required inspections. At the time that the certificate of plan approval is issued, the building official shall provide, to the owner or the owner’s representative, a list of all required inspections for each project. The required inspection list shall be created from the applicable inspections set forth in sections 108.2.1 to 108.2.14. The building official, upon notification from the owner or the owner’s representative that the work is ready for inspection, shall cause the inspections set forth in the required inspection list to be made by an appropriately certified inspector in accordance with the approved construction documents.

108.2.1 Lot line markers required. Before any work is started in the construction of a building or an addition to a building to which the rules of the board are applicable under section 101.2, all boundary lines shall be clearly marked at their intersections with permanent markers or with markers which are offset at a distance which is of record with the owner.

108.2.2 Footing or foundation inspection. Footing and foundation inspections shall be made after excavations for footings are complete and any required reinforcing steel is in place. For concrete foundations, any required forms shall be in place prior to inspection. Materials for the foundation shall be on the job, except where concrete is ready mixed in accordance with “ASTM C 94”, the concrete need not be on the job.

108.2.3 Concrete slab and under-floor inspection. Concrete slab and under-floor inspections shall be made after in-slab and under-floor reinforcing steel and building service equipment, conduit, insulation, vapor retarder, piping accessories and other ancillary equipment items are in place, but before any concrete is placed or floor sheathing installed, including the subfloor.

108.2.4 Lowest floor elevation. The elevation certification required in section 1612.5 shall be submitted to the building official.

108.2.5 Frame inspection. Framing inspections shall be made after the roof deck or sheathing, all framing, fire blocking and bracing are in place and pipes,
chimneys and vents to be concealed are complete and the rough electrical, plumbing, heating wires, pipes and ducts are approved.

108.2.6 **Lath or gypsum board inspection.** Lath and gypsum board inspections shall be made after lathing and gypsum board, interior and exterior, is in place, but before any plastering is applied or before gypsum board joints and fasteners are taped and finished.

   **Exception:** Gypsum board that is not part of a fire-resistive assembly or a shear assembly.

108.2.7 **Fire-resistant penetrations.** Protection of joints and penetrations in fire-resistance-rated assemblies shall not be concealed from view until inspected and approved.

108.2.8 **Energy efficiency inspections.** Inspections shall be made to determine compliance with Chapter 13 of the “OBC” and shall include, but not be limited to, inspections for: envelope insulation “R” and “U” values, fenestration “U” value, duct system “R” value, infiltration air barriers, caulking/sealing of openings in envelope and ductwork, and “HVAC” and water heating equipment efficiency.

108.2.9 **Building services equipment inspections.** Inspections shall be made of all building services equipment to ensure that it has been installed in accordance with the approved construction documents, the equipment listings, and the manufacturer’s installation instructions. Inspections shall include, but not be limited to, inspections for the following systems and their associated components: mechanical heating and ventilating systems, mechanical exhaust systems, plumbing systems, fire protection systems, and electrical systems.

   **108.2.9.1 Inspections of elevators.** Inspection of work related to elevators shall be coordinated with the division of industrial compliance and made in accordance with rules adopted pursuant to Chapter 4105 of the Revised Code and as required in Section 3006.1. A completed inspection form prescribed by the board shall be provided to the superintendent of the division of industrial compliance upon completion of the inspections.

   **108.2.9.2 Inspections of boilers.** Inspection of work related to boilers shall be made in accordance with rules adopted pursuant to Chapter 4104 of the Revised Code.
108.2.10 Other inspections. In addition to the inspections specified above, the building official is authorized to cause to be made or require other inspections of any construction work to be made to ascertain compliance with the provisions of this code. Where applications are submitted for projects of unusual magnitude of construction, the building official may require inspections or full-time project representation by a registered design professional or inspection agency. This inspector/project representative shall keep daily records and submit reports as required by the building official.

Exception: Where the building official requires full-time project inspection, the installation of a fire protection system may be inspected by a person certified under section 3781.105 of the Revised Code. The person shall be certified in the appropriate subfield of fire protection systems being inspected – water-based fire protection systems (formerly automatic sprinkler systems), fire alarm, or special hazards systems design.

108.2.11 Special inspections. For special inspections, see section 1704.

108.2.12 Inspections, completion. When all of the required successive inspections have been satisfactorily completed and the inspectors have verified compliance with the approved construction documents, the inspectors shall communicate their findings to the building official. The building official, after review of the findings, shall issue the certificate of occupancy or the certificate of completion as described in section 111.

108.2.12.1 Fire protection system final inspections. Fire protection system final inspections shall be coordinated with the fire official in accordance with Section 901.2.1.2.

108.2.13 Industrialized unit inspections. Approved industrialized units and the on-site construction to complete the installation of the industrialized units shall be inspected. Such inspections shall include:

1. Connection to on-site construction, interconnection of modules, connection to utilities. The inspections and conducting of required tests shall not require the destruction or disassembly of any factory-constructed component authorized by the board.

2. Inspection of the unit for damage resulting from transportation, improper protection of exposed parts from inclement weather or other causes. Damage shall be repaired as required by the building official to comply with the applicable provisions of the rules of the board;
3. Inspection of the unit to determine if it is marked by an insignia furnished by the board; and
4. Inspect the unit to determine if the floor plan, exterior elevations, and exposed details are in conformance with the plans approved by the board.

108.3 Inspection agencies. The building official is authorized to accept reports of approved inspection agencies, provided such agencies are approved in accordance with the rules of the board of building standards.

108.4 Right of entry. The building official, or the building official’s designee, is authorized to enter the structure or premises at reasonable times to inspect or to perform the duties imposed by this code, provided that credentials are presented to the occupant and that entry is requested and obtained. Where permission to enter has not been obtained, is denied, or the building official has probable cause to believe that there exists in a structure or upon a premises a condition which is a serious hazard the building official shall proceed as required in section 109 and shall also have recourse to the remedies provided by law to secure entry.

108.5 Inspections, compliance with construction documents. When an inspector from the department having jurisdiction finds that completed work is in accordance with the approved construction documents, the inspector shall communicate the findings to the owner or owner’s representative, shall make a note of the inspection on an on-site inspection record and in the inspector’s log, and communicate their findings to the building official. The building official, after review of the findings, shall issue the certificate of occupancy or certificate of completion in accordance with section 111.

108.6 Inspections, observation of violations, unsafe conditions, or serious hazards. When an inspector from the department having jurisdiction finds that any work in connection with the location, erection, construction, repair, alteration, moving, or equipment of a building is contrary to the approved construction documents for the same, the building inspector shall proceed as required in either section 108.6.1 or 108.7.

108.6.1 Communication process for work contrary to approved construction documents.

1. Communicate the nature of the differences to the owner or the owner’s on-site representative and offer the following options
   1.1 The owner will bring the item of noncompliance into compliance,
   1.2 The owner will revise the drawings and resubmit to the department,
1.3 The items of noncompliance will not be brought into compliance and will be referred to the building official as indicated in item 4 below.

2. The owner or the owner’s on-site representative shall indicate which option (item 1 above) will be exercised.

3. Notations on the on-site inspection record and in the inspector’s log shall be made. The notations shall include the inspector’s name, the date of the inspection, the type of inspection, the observed items of noncompliance, the option chosen by the owner or the owner’s on-site representative, the name of the person communicated with, and the estimated dates of compliance and follow-up inspections, if applicable.

4. If the owner or the owner’s on-site representative indicates that the work will not be brought into compliance with the approved construction documents, the inspector shall submit a report to the building official for the final determination of noncompliance in accordance with section 108.7.

108.6.2 Observation of violations not shown on plans. If an inspector, in the course of performing the assigned or requested inspections, observes a code violation that was either shown incorrectly or not adequately addressed or detailed in the approved construction documents, the inspector shall communicate the finding to the building official so that the building official can make a determination of whether the code violation is of such significance to warrant communicating the finding to the owner or the owner’s representative as a notice of recommended change.

108.6.3 Observation of unsafe conditions or serious hazards. If an inspector, in the course of performing the assigned or requested inspections, observes an unsafe condition or a serious hazard, the inspector shall communicate that condition to the owner or the owner’s on-site representative and shall report the findings immediately to the building official so that the building official can make a final determination of whether the violation constitutes a serious hazard which requires the issuance of an adjudication order as required in section 109.

108.6.4 Industrialized units, observations of noncompliance. When an inspector from the department having jurisdiction finds that an industrialized unit has been constructed contrary to the plans approved by the board, the inspector shall report the nonconformance to the building official. The building official shall notify the board of all violations of section 108.2.13. The board or its designee and the building official shall determine the corrective action to be taken before the building is approved.
to be occupied.

108.7 Building official determination of noncompliance. The building official shall evaluate the inspector’s report and render a final determination as to whether the items of non-compliance are to be communicated to the owner in the form of an adjudication order complying with section 109 or whether any additional approvals are necessary. The building official shall make the determination within four days of the inspector reporting as required in sections 108.6.2 and 108.6.3, exclusive of Saturdays, Sundays, and legal holidays.

108.8 Acceptance, performance, and operational testing. Acceptance, performance, and operational testing shall be conducted as required in the applicable code or referenced standard. Advanced notice of the test schedule shall be given to the building official. The building official may require that the tests be conducted in the presence of the building official or certified inspector. Testing and inspection records shall be made available to the building official or inspector, upon request, at all times during the fabrication of the systems and the erection of the building.

108.8.1 Fire protection system acceptance testing. Fire protection system acceptance tests shall be coordinated with the fire official in accordance with Sections 901.2.1.2 and 901.5.

108.8.2 New, altered, extended or repaired systems. New systems and parts of existing systems, which have been altered, extended, renovated or repaired, shall be tested as prescribed herein to disclose leaks and defects.

108.8.3 Apparatus, material and labor for tests. Apparatus, material and labor required for testing a system or part thereof shall be furnished by the owner or the owner’s representative. Required tests shall be conducted by and at the expense of the owner or the owner’s representative.

108.8.4 Reinspection and testing. Where any work or installation does not pass an initial test or inspection, the inspector shall proceed as outlined in section 108.6.

108.9 Posting of occupant and structural loads. Postings required by Section 1004.3 and 1602.2 shall be verified.

Section 109
Orders, Violations, and Unsafe Buildings
109.1 **Adjudication orders required.** When the building official denies any approval or takes action in response to findings of non-compliance with the rules of the board, such action shall be initiated by issuing an adjudication order, prior to seeking any remedy, civil or criminal. Every adjudication order shall:

1. Clearly identify the rules of the board violated;
   1.1 Clearly identify, in a contrasting and obviously marked manner, all violations related to accessibility.

2. Specifically indicate which detail, installation, site preparation, material, appliance, device, addition, alteration to structures, construction documents, assemblages or procedures are necessary to change to comply with the order;
   2.1 When issued to stop work, the order shall also clearly indicate the specific work that is required to cease, when the work must cease and the conditions under which the cited work will be permitted to resume.
   The order to stop work shall be given to the owner of the property involved, to the owner’s representative and the person doing the work.

3. Include notice of the procedure for appeal and right to a hearing if requested within thirty days of the mailing of the order. The order shall also indicate that, at the hearing, the owner may be represented by counsel, present arguments or contentions orally or in writing, and present evidence and examine witnesses appearing for or against the owner;
   3.1 Any hearing(s) scheduled for accessibility issues shall cause the building official or the appeals board to notify a local advocate organization for people with disabilities of the scheduled hearing. When a local advocate organization is not available, a state organization representing people with disabilities, such as the “Governor’s Council on People with Disabilities” shall be notified;

4. Specify a reasonable period of time in which to bring the item(s) on the order into compliance;

5. Include the signature of the building official;

6. The order shall be sent to the owner and owner’s representatives.

109.2 **Response to orders.** The person receiving an order shall exercise their right to appeal within 30 days of the mailing of the order, comply with the order, or otherwise be released from the order by the building official.

109.3 **Prosecution and penalties.** When an owner fails to comply with section 109.2, the owner may be prosecuted and is subject to a fine of not more than five hundred dollars as provided for in section 3791.04 of the Revised Code.
109.3.1 Unlawful continuance. Failure to cease work after receipt of an order to stop work is hereby declared a public nuisance.

109.4 Unsafe buildings. Structures or existing equipment that are unsafe or unsanitary due to inadequate means of egress facilities, inadequate light and ventilation, or which constitute a fire hazard, or are otherwise dangerous to human life, shall be deemed a serious hazard. Where a building is found to be a serious hazard, such hazard shall be eliminated or the building shall be vacated, and where such building, when vacated, remains a serious hazard, it shall be razed.

109.4.1 Orders, injunction proceedings. Where the building official finds that a building is a serious hazard and the owner of such building fails, in the time specified in an order from the building official, to eliminate such hazard, or to vacate or raze the building, the building official shall proceed under section 3781.15 of the Revised Code.

109.4.2 Restoration. Where the structure or equipment is determined to be unsafe by the building official, it is permitted to be restored to a safe condition. To the extent that repairs, alterations or additions are intended to be made or a change of occupancy occurs during the restoration of the structure, such repairs, alterations, additions or change of occupancy shall comply with Chapter 34 and this chapter.

Section 110
Appeals

110.1 Hearing and right of appeal, local board of building appeals. Adjudication hearings shall be in accordance with sections 119.09 to 119.13 of the Revised Code, as required by section 3781.031 of the Revised Code, and the following:

1. Requests for hearing shall be within thirty days of the mailing date of an adjudication order. The local board shall schedule a hearing and notify the party. If the hearing concerns section 3781.111 of the Revised Code or rules adopted thereunder, reasonable notice of time, date, place, and subject of the hearing shall be given to any local organization composed of or representing persons with disabilities, as defined in section 3781.111 of the Revised Code, or if there is no local organization, then to any statewide organization composed of or representing persons with disabilities.

1.1 For purposes of conducting adjudication hearings, the local board may require attendance of witnesses, production of records and papers, and may take depositions of witnesses in accordance with section 119.09 of the Revised Code.
1.2 Testimony shall be under oath and, as outlined in section 109.1, a stenographic or mechanical record of testimony and other evidence submitted shall be taken at the expense of the local board of building appeals.

1.3 The local board may postpone or continue any adjudication hearing on its own motion or upon the application of any party.

1.4 The board shall keep a full and complete record of all proceedings which shall be open to public inspection.

2. The Board shall render its decision within thirty days after the hearing.

3. Following the hearing, an order shall be entered on its journal, and the local board shall serve by certified mail, return receipt requested, upon the party affected thereby, a certified copy of the order and a statement of the time and method by which an appeal may be perfected. A copy of the order shall be mailed to the attorney or other representatives of record representing the party.

4. Any municipal or county officer, official municipal or county board, or person who was a party to the hearing before the municipal or county board of building appeals, may apply to the state board of building appeals for a de novo hearing, or may appeal to the court of common pleas of the county in which he is a resident or in which the premises affected by such order is located.

5. In addition, when the adjudication hearing concerns section 3781.111 of the Revised Code, or any rule made thereunder, any local organization composed of or representing persons with disabilities, or if no local organization exists, then any statewide organization representing persons with disabilities may file appeals as indicated in paragraph 4. of this section.

6. Application for a de novo hearing before the state board shall be made no later than thirty days after the municipal or county board renders its decision.

Section 111
Certificate of occupancy and certificate of completion

111.1 Approval required to occupy. No building or structure, in whole or in part, shall be used or occupied until the building official has issued an approval in the form of a certificate of occupancy or certificate of completion in compliance with this section.

111.1.1 Certificate of occupancy. The certificate of occupancy shall indicate the conditions under which the building shall be used. The building owner shall
only use the structure in compliance with the certificate of occupancy and any stated conditions. The structure and all approved building service equipment shall be maintained in accordance with the approval. When a building or structure is entitled thereto, the building official shall issue a certificate of occupancy provided there are not violations of the rules of the board or orders of the building official pending or as permitted in this section. A copy of the certificate of occupancy shall be forwarded to the local fire official.

111.1.1 New buildings and additions. A building or structure erected, enlarged or extended shall not be used or occupied, in whole or in part, until the certificate of occupancy has been issued by the building official. Occupancy of spaces within a building which are unaffected by the work shall be allowed to continue if the building official determines the existing spaces can be occupied safely.

111.1.2 Change of occupancy. Change of occupancy of an existing structure shall not be made except as specified in Chapter 34. A building or structure hereafter changed, in whole or in part, from one occupancy to another shall not be occupied for the new occupancy until the certificate of occupancy has been issued by the building official reflecting such changed portions. Existing occupancy of spaces within the building which are unaffected by the change of occupancy and any related alterations shall be allowed to continue if the building official determines the existing spaces can be occupied safely until the completion of the alterations.

111.1.3 Partial occupancy. Upon the request of the owner or owner’s representative, a building official shall issue a certificate of occupancy before the completion of the entire work, provided that the building official determines that the space can be safely occupied prior to full completion of the building, structure, or portion without endangering life or public welfare. The certificate shall indicate the extent of the areas approved for occupancy and any time limits for completion of the work.

111.1.4 Time-limited occupancy. A building or structure hereafter changed in part from one occupancy to another for a limited time may receive a certificate of occupancy reflecting that time-limited occupancy provided:

1. There are no violations of law or orders of the building official pending;
2. It is established after inspection and investigation that the proposed use is not deemed to endanger public safety and welfare;
3. The building official has approved the use for an alternative purpose on a temporary basis;
4. The building official has issued a certificate of occupancy indicating any special conditions under which the building or part of the building can be used for the alternative purpose within the time limit specified.

111.1.1.5 Temporary structures occupancy. A building intended to be erected, placed and used for a period of time not to exceed one hundred eighty days that has been determined by the building official to be in compliance with section 102.8 shall be issued a “Certificate of Occupancy for Temporary Structures.” The building official is authorized to grant extensions for demonstrated cause.

111.1.2 Certificate of completion for alterations and repairs. The certificate of completion for alterations and repairs shall indicate the conditions under which the building shall be used. The building owner shall only use the structure in accordance with the certificate of completion and any stated conditions. The structure and all approved building service equipment shall be maintained in accordance with the approval.

When the work in a building or structure is entitled thereto, the building official shall issue a certificate of completion for the work provided there are not violations of the rules of the board or orders of the building official pending or as permitted in this section. Occupancy of spaces within a building which are unaffected by the work shall be allowed to continue if the building official determines the existing spaces can be occupied safely.

111.2 Certificate issued. The certificate shall certify compliance with the provisions of this code, Chapters 3781. and 3791. of the Revised Code, and the purpose for which the building or structure may be used in its several parts. The certificate of occupancy or certificate of completion shall contain the following:
   1. The plan approval application number.
   2. The address.
   3. A description of that portion of the structure for which the certificate is issued.
   4. The signature of all building officials having jurisdiction. When more than one building official has jurisdiction for a building (when the certification of the building department is limited for such systems as plumbing or piping
systems) each shall sign the certificate with an indication of the scope of their individual approvals.

5. The edition of the code under which the plan approval was issued.
6. The use and occupancy, in accordance with the provisions of Chapter 3.
7. The type of construction as defined in Chapter 6.
8. The design occupant load.
9. If an automatic sprinkler systems is provided, whether the sprinkler system is required.
10. The hazard classification or storage configuration, including aisle widths, for which the automatic sprinkler system is designed.
11. The automatic sprinkler and standpipe system demand at the base of the riser.
12. Any special stipulations and conditions of the plan approval including any variances granted to the requirements of this code.

111.3 Validity of a certificate of occupancy or certificate of completion. The certificate represents an approval that is valid only when the building or structure is used as approved and certifies conformance with applicable provisions of the “Ohio Building Code” and Chapters 3781. and 3791. of the Revised Code. The approval is conditioned upon the building systems and equipment being maintained and tested in accordance with the approval, the “Ohio Building Code”, and applicable equipment and systems schedules.

111.4 Existing buildings. Upon written request from the owner of an existing building or structure, the building official shall issue a certificate of occupancy, provided there are not violations of law or orders of the building official pending, and it is established after inspection and investigation that the alleged occupancy of the building or structure has previously existed. This code shall not require the removal, alteration or abandonment of, or prevent the continuance of, the occupancy of a lawfully existing building or structure, unless such use is deemed to endanger public safety and welfare.

111.5 Connection of service utilities. No connections shall be made from a utility, source of energy, fuel or power to any building or system that is regulated by this code for which a plan approval and inspections are required, until approved by the building official.

111.6 Temporary connection. The building official shall approve the temporary connection of the building or system to the utility source of energy, fuel or power.

Section 112
Changes to the code

112.1 Code change petition process. In accordance with section 3781.10 of the Revised Code, the board may, on its own motion or upon receipt of a petition, adopt, amend, or rescind rules through the administrative rule process.

112.1.1. Changes, applications for. Any person may apply to the board to adopt, amend, or rescind rules of the board. The application for rule change shall be on forms and in format prescribed by the board. Twelve printed copies of the application shall be filed with the secretary of the board.

112.1.2. Processing applications for changes. When the secretary of the board receives a conforming application for an adoption, amendment, or annulment of a provision of the rules of the board, the secretary shall promptly deliver or mail a copy of the application to each member of the board.

After receiving an application for the adoption, amendment, or annulment of a provision of the rules of the board, the board shall proceed under sections 3781.101 and 3781.12 of the Revised Code.

112.2 Changes to the codes and code enforcement. The building department shall exercise enforcement authority to accept and approve plans and specifications and make inspections using the rules of the board that were in effect on the date of the first application for plan approval for that project. Such approvals shall be subject to the limitations of sections 105.3 and 105.4.

Section 113
Industrialized units

113.1 Industrialized units. Industrialized units shall be approved by the board in accordance with the provisions in this section.

Exceptions:
1. Alternative materials, design and methods of construction and equipment approved by the board in accordance with section 114.3.
2. Construction for which the provisions of section 1704 applies. Where panels or components are constructed to include elements not provided for or accounted for in section 1704, then this section shall apply. (For example, engineered gluelam beams, precast concrete panels or welded steel components that have been constructed offsite with electrical or mechanical components in them so that a detailed inspection of the
mechanical or electrical components cannot be done on the site of their intended use would be required to comply with this section.)

3. Foam plastic insulation conforming to the provisions of section 2603. (However, a foam plastic insulation panel that is constructed, listed and labeled in accordance with section 2603, is required to comply with this section if structural, electrical or other components not covered by section 2603 are enclosed within the panel).

4. Materials, devices, and products, in directories listed in Table 114.3 and assemblies used for building service equipment, systems in accordance certified and listed by a product certification body recognized by the board in accordance with Section 114.4, and proposed to be installed and used in a manner consistent with the listing and this code. For an assembly to meet this exception, the entire assembly, not individual components, must be listed by a product certification body recognized by the board.

113.2 Definitions.

Closed construction. An assembly of materials or products manufactured in such a manner that its structural, plumbing, electrical, environmental control, or fire protection elements or components are concealed and are not readily accessible for inspection at the site of its erection, without disassembly, damage, or destruction. Closed construction includes assemblies where only one of the components is not accessible for inspection. (For example, an equipment enclosure where all the electrical conductors and components are exposed for inspection and its roof and wall panels have exposed structural members but the floor panel structural members are not exposed, would be required to comply with this section.)

Industrialized units. Industrialized units are prefabricated components comprised of closed construction manufactured at a location remote from the site of intended use and transported to a building site for its subsequent use. Industrialized units are not restricted to housing for one-, two-, and three-family dwellings, but includes all prefabricated forms of building elements and assembled construction units, intended for both structural and service equipment purposes in all buildings of all groups. Prefabricated shop assemblies may be shipped in structurally complete units ready for installation in the building structure or in knock-down and packaged form for assembly at the site.

113.2.1 General terms. Such terms as heart modules or cores, modules, modulars, service cores, prefabs, sectional or sectionalized, panels or
panelized construction, and specific terms including "prefabricated-subassembly, -building, -unit, -unit service equipment" shall be considered industrialized units. They may be self-sufficient or interdependent as a unit or group of units and used together or incorporated with standard construction methods to form a completed structural entity.

113.3 Application. The application for approval, including revisions and renewals for existing approvals, shall be submitted to the board together with the fee required in section 113.8 of this chapter. The required information shall be provided as prescribed by the board on its website. Construction documents shall be included in conformity with the applicable provisions of section 106, and shall describe all essential elements of the structure or assembly and details of interconnection of: assemblies; service equipment; electrical wiring; plumbing; mechanical; and any other equipment whether installed at the site or in the manufacturing facility. The design and construction of the units shall be in conformance with the provisions of the Ohio building, mechanical and plumbing codes based on the intended use and/or occupancy type. Industrialized units intended to be used exclusively for one-, two-, or three-family dwellings shall comply with the applicable provisions of the “Residential Code of Ohio for One-, Two-, and Three- Family Dwellings” listed in section 3501.2 or shall meet the provisions of the board’s rules applicable to “Group R-3”. Only the person holding an approval may apply to the board for a revision or renewal of the approval.

113.3.1 Manufacturers with facilities outside Ohio. Each application for manufacturers with manufacturing facilities outside Ohio shall also identify the individual or agency that will be performing in-plant inspections of the units intended for placement in Ohio. The application shall also include a letter from the designated individual or agency indicating that they have a contractual relationship with the manufacturer to perform the inspections. This letter shall include the name(s) and board certification(s) of the individual(s) who will be assigned to perform the inspections.

113.3.2 Manufacturers with facilities in Ohio. Each application for manufacturers with manufacturing facilities in Ohio shall include the same information required in section 113.3.1 or, as an alternative, the manufacturer shall indicate their intention to have the inspections conducted by inspectors designated by the board.

113.4 Evaluation. After receipt of the application, the board or such agency designated by the board shall proceed with review of the industrialized unit
construction documents and cause such inspections of the manufacturer's quality control processes used to ensure compliance with the rules of the board.

113.4.1 Tests. The board shall have the authority to require tests as evidence of compliance. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the board shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the board for the period required for retention of public records.

113.4.2 Plant evaluations. An initial plant evaluation inspection shall be required at each plant of manufacture to observe and ensure that the manufacturer's facilities and quality control program maintains acceptable control of materials and processes used in the manufacture of industrialized units to ensure conformance with the approved construction documents. The plant evaluation inspection shall include all subassembly plants supplying the manufacturer, as the board may deem necessary.

113.5 Approval. The board, upon determination of compliance, shall issue an approval to the applicant. Industrialized units approved by the board may be used anywhere in Ohio subject to the conditions for their use and application as indicated in the approval.

113.5.1 Revisions. Any changes to board approved construction documents affecting the conditions listed in the approval shall require a revision of the approval.

113.5.2 Code changes. When any changes to the rules of the board are adopted which affect the use, safety or sanitation of any approved industrialized unit, the holder of the approval shall apply to the board for a revision of the approval. Failure to apply for revision of approvals within the time specified by the board, shall constitute failure to comply with the conditions of the approval.

113.5.3 Revocation of approval. Upon failure of the holder of an approval to comply with the conditions of the approval and this chapter, the board, on its own motion, shall order a hearing in accordance with section 119.03 of the Revised Code to revoke an existing approval.

113.5.4 Validity of the approval for the use of an industrialized unit. An industrialized unit manufactured under an approval by the board, not
transported to a building site for use but stored at a manufacturer’s or dealer’s facility, can be used in Ohio as an industrialized unit for a maximum of two years after the effective date upon which the board adopts building code rules using another edition of a model code as the basis of this code. After this two-year time period, the unit’s approval is no longer valid and the unit is no longer considered an industrialized unit but shall be regulated as a moved structure in accordance with Chapter 34.

113.6 Inspections, board insignias, and shipping reports. Each industrialized unit shall be inspected in-plant during each phase of the manufacturing process by inspectors certified by the board or such persons designated by the board until in-plant inspections demonstrate that the manufacturer’s quality control program is capable of assuring that the industrialized units produced are built in accordance with the construction documents approved by the board. When it has been determined that the manufacturer’s quality control program is capable of assuring compliance with the board approved construction documents, then at one overall inspection of “open” construction shall be performed in-plant for each unit by an inspector certified or designated by the board.

**Exception:** When a manufacturer with manufacturing facilities in Ohio has chosen to have inspections conducted by designees of the board, the inspection frequency shall be based upon the reliability or effectiveness of the manufacturer in maintaining sufficient control of the materials and processes to ensure that the units are constructed in accordance with the approved construction documents.

An insignia shall be obtained from the board for each industrialized unit module to be used within the state of Ohio. The insignia shall be affixed to each unit after a determination is made by the inspector that the unit is constructed in accordance with the construction documents approved by the Board, which shall constitute final approval of the unit. After an insignia has been affixed, the manufacturer shall record its use in shipping records, to be submitted monthly to the board, which shall record:

1. The shipping insignia number;
2. Ohio board of building standards industrialized unit group assigned project file number appearing on the board-approved construction documents;
3. The date the insignia was affixed to the individual unit;
4. Name and address of the construction inspector and inspection agency;
5. Manufacturer’s unit serial number;
6. Manufacturer’s model number;
7. Dealer name and address and;
8. Site installation destination address and owner name.
113.6.1 Increased inspection. When an inspection determines that the quality control program does not sufficiently ensure compliance with the construction documents approved by the board, the certified inspector or person designated by the board shall, by written notification, inform the manufacturer that the inspection frequency will be increased so that each assembly or component affected by the nonconforming item will be inspected. These inspections shall continue until an inspection determines that the manufacturer’s control of the materials and processes used is sufficient to ensure that the units are constructed in accordance with the approved construction documents.

113.7 Manufacturer responsibility. The manufacturer shall maintain responsibility over all work completed in the factory until the unit is approved for first occupancy and shall rectify any deviations from the approved construction documents, which are found either in the field or at the place of manufacture. The manufacturer shall submit to the board such periodic reports, notifications and information as required by board procedures.

113.7.1 Document submission to building departments. The manufacturer shall ensure that the construction documents approved by the board are presented to the building official in accordance with section 106.1.2(1) before placing the industrialized unit on site.

Exception: Industrialized units construction documents previously approved by the board and site related construction documents are not required to be submitted to the division of industrial compliance where industrialized units are used exclusively as one-, two, or three family dwellings.

113.7.2 Change in personnel. Whenever there are changes in company name, ownership, subsidiary status, address or change in the manufacturer’s management personnel who are responsible for making policy concerning quality control, the manufacturer shall immediately notify the board, in writing, and the manufacturing plant(s) affected by the change will be subject to a plant evaluation inspection.

113.8 Fees. All costs associated with industrialized unit approval applications, processing, construction document review, inspections and insignias shall be in accordance with sections 113.8.1 to 113.8.5.

113.8.1 Applications. Each initial application or revision submittal to the board shall be accompanied by nonrefundable fees, designated by the board to
include: application processing fee; one-hour minimum plan review fee; and other costs, when incurred, such as mailing and check processing.

113.8.2 Evaluation of construction documents. All costs of application processing, evaluation of construction documents or other documentation submitted to the board shall be paid by the applicant.

113.8.3 Plant evaluation and inspection costs. All costs of plant evaluations and inspections shall be paid by the manufacturer of the unit including travel, food, lodging, and administrative costs.

113.8.4 Insignias. The fee for insignia for all assembled modular units manufactured for use in the state of Ohio shall be fifty dollars per unit (any preassembled combination of walls to floor, ceilings, roof, and other such components).

The fee for insignia for all panelized units manufactured for use in the state of Ohio shall be one dollar for each twenty square feet of surface area of preassembled individual components (wall, floor, ceiling or roof sections, and other such components) intended to be shipped to the site and attached to other components at the site of intended use.

113.8.5 Tests. Tests required by the board to be performed to determine compliance pursuant to section 113.4.1, shall be conducted at no expense to the board. Costs associated with any required testing or research necessary to provide evidence of compliance shall be the responsibility of the applicant.

Section 114
Products and materials

114.1 General. Any material, product, assembly or method of construction used in a building or structure shall be approved by the building official. The provisions of this section describe the product approval process intended by the board of building standards in accordance with Section 3781.10 (C) of the Revised Code.

114.2 Definitions. The following words and terms shall, for the purposes of this section, have the meanings shown herein:
Accreditation. The formal recognition of a conformity assessment body's adherence and operation under a documented quality system whereby a third party (Accreditation Body) attests to technical competence and the specific scope of accreditation of the conformity assessment body.
Accreditation body. An authoritative body that is an established, independent, internationally recognized, third-party organization that performs accreditation to ascribe initial recognition and monitors, on a cyclical basis, the competency, integrity, and performance of conformity assessment bodies in accordance with established standards.

Assembly. A preassembled grouping of materials, products and/or components designed to act as a whole. This does not include industrialized units regulated by section 113.

Calibration laboratory. An established, independent, nationally recognized and accredited, third-party organization that regularly provides calibration services such as, but not limited to, tolerance testing to ensure the accuracy of measuring equipment used in construction.

Conformity assessment body. A body that performs conformity assessment services and can be an object of accreditation, such as a testing laboratory, inspection body, product certification body.

Evaluation service. An established, independent, nationally recognized and accredited, third-party conformity assessment body that is accredited as a product certification body and performs technical evaluations of building materials, products, and methods of construction where code requirements are not clear or the innovative products do not have national consensus standards. The evaluation of the product results in the issuance of a research report establishing the code compliance and conditions of its use based upon multiple sources of information including test reports, test data, performance data, or acceptance criteria, and can be approved for installation by the building official in accordance with the rules of the board.

Fabricator inspection agency. An established, independent, nationally recognized and accredited, third-party conformity assessment body regularly engaged in fabrication of construction materials and methods of construction.

Field evaluation body. An established, independent, nationally recognized and accredited, third-party conformity assessment body regularly engaged in furnishing field inspection, observation, testing, or reporting services for construction materials, products, and methods of construction.

Industry trade association certification program. A certification program operated by an established and nationally recognized organization, founded
and funded by businesses that operate in a specific industry, where the main focus is to monitor quality assurance among associated members.

**Insignia.** A mark or label prescribed in accordance with board procedures.

**Inspection body.** An established, independent, nationally recognized and accredited, third-party conformity assessment body regularly engaged in furnishing inspection, observation, testing, or reporting services for construction materials, products, and methods of construction. Such services include, but are not limited to geotechnical inspections, environmental inspections, mechanical and metallurgical analysis, non-destructive testing and evaluation, chemical analysis, and structural and product testing.

**Listing agency.** An established, independent, nationally recognized and accredited, third-party conformity assessment body that is accredited as a product certification body and conducts tests on materials, products, or methods of construction to certify products that meet the criteria for compliance with nationally recognized codes and standards. The product certification body allows its insignia of conformity to be placed on a material or product by the manufacturer, identifying that the material or product has been certified by the product certification body. The product certification body maintains a list or directory of all of the materials and products that they have certified and the conditions of their use.

**Material.** A manufactured form or substance designed to act as a whole.

**Method of construction.** A procedure or system intended to result in a finished building, structure or portion thereof.

**Product.** A material or device designed and manufactured to perform a predetermined function. Appliances, assemblies and equipment are also considered products.

**Product certification body.** An established, independent, nationally recognized and accredited, third-party conformity assessment body regularly engaged in conducting evaluation services, inspections and tests on materials and products to certify compliance with nationally recognized codes and standards. Product Certification Bodies are sub-classified as either Evaluation Services or Listing Agencies.
Recognition. An acceptance by the board of building standards of an accreditation body, a conformity assessment body, or an industry trade association certification program in accordance with the rules of the board of building standards.

Special inspection agency. An established, independent, nationally recognized and accredited, third-party conformity assessment body regularly engaged in performing special inspections as required by Chapter 17.

Testing laboratory. An established, independent, nationally recognized and accredited, third-party conformity assessment body regularly engaged in conducting tests of materials, products, or methods of construction to determine compliance with a specification or testing standard. The testing laboratory issues a report documenting the test results.
114.3 Building official approval process. The building official shall approve the use of products in accordance with Sections 114.3.1 through 114.3.3.

114.3.1 Materials, products, assemblies and methods of construction prescribed in the code.

114.3.1.1 Testing laboratories. When test reports are required to be submitted or when the rules of the Board require materials, products, assemblies and methods of construction to conform to specific referenced standards, the building official shall verify that the proposed material, product, assembly, and method of construction has been tested by a testing laboratory recognized by the board and published on the list titled “Recognized Conformity Assessment Bodies” found on the board’s website at http://www.com.ohio.gov/dico/bbs.

The building official shall verify that the testing laboratory is accredited to perform the specific tests prescribed in the code by verifying the testing laboratory’s “scope of accreditation” found on the testing laboratory’s website.

Exceptions:
1. Acceptance, performance, and operational testing reports submitted in accordance with Section 108.8 are permitted to be prepared and submitted by the individual performing the acceptance, performance, and operational tests. Board recognition is not required for persons conducting acceptance, performance, or operational tests.
2. Special inspection reports submitted in accordance with Section 1704.1.2 are permitted to be prepared and submitted by the special inspector defined in Section 1702.1 and qualified in accordance with Section 1704.1. Board recognition is not required for all special inspectors.

114.3.1.2 Listing agencies. When the rules of the Board require materials, products, assemblies and methods of construction to be marked or listed and labeled in accordance with a specific referenced standard, the building official shall verify that the proposed material, product, assembly, and method of construction has been listed and labeled by a listing agency recognized by the board and published on the list titled “Recognized Conformity Assessment Bodies” found on the board’s website at http://www.com.ohio.gov/dico/bbs.

Building officials are authorized to approve listed and labeled materials,
products, assemblies and methods of construction after verifying all of the following additional information:

1. The product is listed on the product certification body’s website directory.
2. The listing is current.
3. The product is proposed to be installed/used in accordance with the listing.
4. When used as an assembly, the assembly is proposed to be installed/used in compliance with this code.
5. The extent of the listing does not include in its scope, elements of design, construction or installation otherwise in conflict with the provisions of this code such as fire-resistance and structural design.

**114.3.2 Alternative materials, products, assemblies and methods of construction not prescribed in the code.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any material, product, assembly or method of construction not specifically prescribed by this code, provided that any such alternative shall have a valid evaluation service report, as described in section 114.3.2.1, or listing from a product certification body recognized by the board and published on a list titled “Recognized Conformity Assessment Bodies” found on the board’s website at http://www.com.ohio.gov/dico/bbs.

The alternative material, product, assembly, or method of construction shall be deemed to be approved provided it complies with the conditions listed in the evaluation service report or listing found on the product certification body’s website.

**Exceptions:**

1. Alternative materials, products, assemblies, or methods of construction submitted pursuant to section 106.5.
2. Industrialized units shall be approved and constructed in accordance with section 113.1 of this chapter.

**114.3.2.1 Evaluation Service Reports.** Building officials are authorized to accept evaluation service reports for materials, products, assemblies, and methods of construction from recognized evaluation service agencies after reviewing and verifying all of the following minimum information in the evaluation service report:

1. Identification and description of the product specifically addressed in the report and a description of how the product can be identified;
2. Identification of the specific code provisions to which the product was evaluated as a suitable alternative to the requirements of the code;
3. The product installation requirements;
4. The statement of the conditions and limitations of use of the product; and
5. List the test reports used in the evaluation.

114.3.3 Used materials and products. The use of used materials and products which meet the requirements of this code for new materials and products is permitted. Used products and materials shall not be reused unless approved by the building official.

114.4 Process for board-recognition of “Accreditation Bodies,” “Conformity Assessment Bodies,” and “Industry Trade Association Certification Programs.” All accreditation bodies, conformity assessment bodies, and industry trade association certification programs shall be recognized by the board in accordance with division 4101:7 of the Administrative Code.

Section 115
Board Organization

115.1 Meetings.
1. Meeting schedule. No later than December thirty-first of each year, the board shall establish a schedule of the dates, times, and locations of all regular board meetings and meetings of board committees for the following calendar year. Such schedule shall be posted on the board’s website: http://www.com.ohio.gov/dico/bbs.

2. Meeting location. All meetings of the board shall be held in offices of the Ohio department of commerce, training room #1, 6606 Tussing Rd., Reynoldsburg, Ohio, 43068, unless otherwise designated.

115.2 Notices. Prior to all regular or special meetings of the board, the executive secretary shall distribute the agenda, including meeting date, time, and location, by electronic mail to any person who has requested such information.

115.3 Rules. All rules of the board shall be adopted in accordance with Chapter 119. of the Revised Code.

115.4 Board committees and duties. The board shall have three standing
1. **Code committee.** The code committee provides general oversight of the board’s rule promulgation and code development activities. The committee reviews proposed rule changes and petitions for code changes and shall make recommendations to the board for action.

2. **Education committee.** The education committee provides general oversight to the board’s continuing education program. The committee reviews continuing education course applications submitted for approval pursuant to paragraph (G) of rule 4101:7-3-01 of the Administrative Code and shall make recommendations to the board for action on the applications.

3. **Certification committee.** The certification committee provides general oversight to the board’s personnel and building department certification program. The committee reviews personnel and building department certification applications submitted for approval pursuant to paragraph (G) of rule 4101:7-3-01 of the Administrative Code and shall make recommendations to the board for action on the applications.
4101:1-10-01 Means of egress.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:1-35-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 1001
ADMINISTRATION

1001.1 General. Buildings or portions thereof shall be provided with a means of egress system as required by this chapter. The provisions of this chapter shall control the design, construction and arrangement of means of egress components required to provide an approved means of egress from structures and portions thereof. Where Chapter 11 and this chapter have provisions relating to the same content, both chapters shall apply.

1001.2 Minimum requirements. It shall be unlawful to alter a building or structure in a manner that will reduce the number of exits or the minimum width or required capacity of the means of egress to less than required by this code.

1001.3 Maintenance. Means of egress shall be maintained in accordance with the Fire code.

1001.4 Fire safety and evacuation plans. Fire safety and evacuation plans shall be provided for all occupancies and buildings where required by the fire code. Such fire safety and evacuation plans shall comply with the applicable provisions of Sections 401.2 and 404 of the fire code.

SECTION 1002
DEFINITIONS

1002.1 Definitions. The following terms are defined in Chapter 2:
 ACCESSIBLE MEANS OF EGRESS.
 AISLE.
 AISLE ACCESSWAY.
 ALTERNATING TREAD DEVICE.
 AREA OF REFUGE.
BLEACHERS.
BREAKOUT.
COMMON PATH OF EGRESS TRAVEL.
CORRIDOR.
DOOR, BALANCED.
EGRESS COURT.
EMERGENCY ESCAPE AND RESCUE OPENING.
EXIT.
EXIT ACCESS.
EXIT ACCESS DOORWAY.
EXIT ACCESS RAMP.
EXIT ACCESS STAIRWAY.
EXIT DISCHARGE.
EXIT DISCHARGE, LEVEL OF.
EXIT, HORIZONTAL.
EXIT PASSAGEWAY.
EXTERIOR EXIT RAMP.
EXTERIOR EXIT STAIRWAY.
FIRE EXIT HARDWARE.
FIXED SEATING.
FLIGHT.
FLOOR AREA, GROSS.
FLOOR AREA, NET.
FOLDING AND TELESCOPIC SEATING.
GRANDSTAND.
GUARD.
HANDRAIL.
INTERIOR EXIT RAMP.
INTERIOR EXIT STAIRWAY.
LOW ENERGY POWER-OPERATED DOOR.
MEANS OF EGRESS.
MERCHANDISE PAD.
NOSING.
OCCUPANT LOAD.
OPEN-ENDED CORRIDOR.
PANIC HARDWARE.
PHOTOLUMINESCENT.
POWER-ASSISTED DOOR.
POWER-OPERATED DOOR.
PUBLIC WAY.
RAMP.
SCISSOR STAIRWAY.
SELF-LUMINOUS.
SMOKE-PROTECTED ASSEMBLY SEATING.
STAIR.
STAIRWAY.
STAIRWAY, SPIRAL.
WINDER.

SECTION 1003
GENERAL MEANS OF EGRESS

1003.1 Applicability. The general requirements specified in Sections 1003 through 1015 shall apply to all three elements of the means of egress system, in addition to those specific requirements for the exit access, the exit and the exit discharge detailed elsewhere in this chapter.

1003.2 Ceiling height. The means of egress shall have a ceiling height of not less than 7 feet 6 inches (2286 mm).

Exceptions:
1. Sloped ceilings in accordance with Section 1208.2.
2. Ceilings of dwelling units and sleeping units within residential occupancies in accordance with Section 1208.2.
3. Allowable projections in accordance with Section1003.3.
4. Stair headroom in accordance with Section 1011.3.
5. Door height in accordance with Section 1010.1.1.
6. Ramp headroom in accordance with Section 1012.5.2.
7. The clear height of floor levels in vehicular and pedestrian traffic areas of public and private parking garages in accordance with Section 406.4.1.
8. Areas above and below mezzanine floors in accordance with Section 505.2.
1003.3 Protruding objects. Protruding objects on circulation paths shall comply with the requirements of Sections 1003.3.1 through 1003.3.4.

1003.3.1 Headroom. Protruding objects are permitted to extend below the minimum ceiling height required by Section 1003.2 where a minimum headroom of 80 inches (2032 mm) is provided over any walking surface, including walks, corridors, aisles and passageways. Not more than 50 percent of the ceiling area of a means of egress shall be reduced in height by protruding objects.

Exception: Door closers and stops shall not reduce headroom to less than 78 inches (1981 mm). A barrier shall be provided where the vertical clearance is less than 80 inches (2032 mm) high. The leading edge of such a barrier shall be located 27 inches (686 mm) maximum above the floor.

1003.3.2 Post-mounted objects. A free-standing object mounted on a post or pylon shall not overhang that post or pylon more than 4 inches (102 mm) where the lowest point of the leading edge is more than 27 inches (686 mm) and less than 80 inches (2032 mm) above the walking surface. Where a sign or other obstruction is mounted between posts or pylons and the clear distance between the posts or pylons is greater than 12 inches (305 mm), the lowest edge of such sign or obstruction shall be 27 inches (686 mm) maximum or 80 inches (2032 mm) minimum above the finished floor or ground.

Exception: These requirements shall not apply to sloping portions of handrails between the top and bottom riser of stairs and above the ramp run.

1003.3.3 Horizontal projections. Objects with leading edges more than 27 inches (685 mm) and not more than 80 inches (2030 mm) above the floor shall not project horizontally more than 4 inches (102 mm) into the circulation path.

Exception: Handrails are permitted to protrude 4 1/2 inches (114 mm) from the wall.

1003.3.4 Clear width. Protruding objects shall not reduce the minimum clear width of accessible routes.

1003.4 Floor surface. Walking surfaces of the means of egress shall have a slip-resistant surface and be securely attached.

1003.5 Elevation change. Where changes in elevation of less than 12 inches (305
mm) exist in the means of egress, sloped surfaces shall be used. Where the slope is greater than one unit vertical in 20 units horizontal (5-percent slope), ramps complying with Section 1012 shall be used. Where the difference in elevation is 6 inches (152 mm) or less, the ramp shall be equipped with either handrails or floor finish materials that contrast with adjacent floor finish materials.

Exceptions:
1. A single step with a maximum riser height of 7 inches (178 mm) is permitted for buildings with occupancies in Groups F, H, R-2, R-3, S and U at exterior doors not required to be accessible by Chapter 11.
2. A stair with a single riser or with two risers and a tread is permitted at locations not required to be accessible by Chapter 11 where the risers and treads comply with Section 1011.5, the minimum depth of the tread is 13 inches (330 mm) and not less than one handrail complying with Section 1014 is provided within 30 inches (762 mm) of the centerline of the normal path of egress travel on the stair.
3. A step is permitted in aisles serving seating that has a difference in elevation less than 12 inches (305 mm) at locations not required to be accessible by Chapter 11, provided that the risers and treads comply with Section 1029.13 and the aisle is provided with a handrail complying with Section 1029.15.

Throughout a story in a Group I-2 occupancy, any change in elevation in portions of the means of egress that serve nonambulatory persons shall be by means of a ramp or sloped walkway.

1003.6 Means of egress continuity. The path of egress travel along a means of egress shall not be interrupted by a building element other than a means of egress component as specified in this chapter. Obstructions shall not be placed in the minimum width or required capacity of a means of egress component except projections permitted by this chapter. The minimum width or required capacity of a means of egress system shall not be diminished along the path of egress travel.

1003.7 Elevators, escalators and moving walks. Elevators, escalators and moving walks shall not be used as a component of a required means of egress from any other part of the building.

Exception: Elevators used as an accessible means of egress in accordance with Section 1009.4.

SECTION 1004
OCCUPANT LOAD
1004.1 Design occupant load. In determining means of egress requirements, the number of occupants for whom means of egress facilities are provided shall be determined in accordance with this section.

1004.1.1 Cumulative occupant loads. Where the path of egress travel includes intervening rooms, areas or spaces, cumulative occupant loads shall be determined in accordance with this section.

1004.1.1.1 Intervening spaces or accessory areas. Where occupants egress from one or more rooms, areas or spaces through others, the design occupant load shall be the combined occupant load of interconnected accessory or intervening spaces. Design of egress path capacity shall be based on the cumulative portion of occupant loads of all rooms, areas or spaces to that point along the path of egress travel.

1004.1.1.2 Adjacent levels for mezzanines. That portion of the occupant load of a mezzanine with required egress through a room, area or space on an adjacent level shall be added to the occupant load of that room, area or space.

1004.1.1.3 Adjacent stories. Other than for the egress components designed for convergence in accordance with Section 1005.6, the occupant load from separate stories shall not be added.

1004.1.2 Areas without fixed seating. The number of occupants shall be computed at the rate of one occupant per unit of area as prescribed in Table 1004.1.2. For areas without fixed seating, the occupant load shall be not less than that number determined by dividing the floor area under consideration by the occupant load factor assigned to the function of the space as set forth in Table 1004.1.2. Where an intended function is not listed in Table 1004.1.2, the building official shall establish a function based on a listed function that most nearly resembles the intended function.

Exception: Where approved by the building official, the actual number of occupants for whom each occupied space, floor or building is designed, although less than those determined by calculation, shall be permitted to be used in the determination of the design occupant load.

1004.2 Increased occupant load. The occupant load permitted in any building, or portion thereof, is permitted to be increased from that number established for the
occupancies in Table 1004.1.2, provided that all other requirements of the code are met based on such modified number and the occupant load does not exceed one occupant per 7 square feet (0.65 m²) of occupiable floor space. Where required by the building official, an approved aisle, seating or fixed equipment diagram substantiating any increase in occupant load shall be submitted. Where required by the building official, such diagram shall be posted.

**TABLE 1004.1.2**

**MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

<table>
<thead>
<tr>
<th>FUNCTION OF SPACE</th>
<th>OCCUPANT LOAD FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessory storage areas, mechanical equipment room</td>
<td>300 gross</td>
</tr>
<tr>
<td>Agricultural building</td>
<td>300 gross</td>
</tr>
<tr>
<td>Aircraft hangars</td>
<td>500 gross</td>
</tr>
<tr>
<td>Airport terminal</td>
<td></td>
</tr>
<tr>
<td>Baggage claim</td>
<td></td>
</tr>
<tr>
<td>Baggage handling</td>
<td></td>
</tr>
<tr>
<td>Concourse</td>
<td></td>
</tr>
<tr>
<td>Waiting areas</td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td></td>
</tr>
<tr>
<td>Gaming floors (keno, slots, etc.)</td>
<td>11 gross</td>
</tr>
<tr>
<td>Exhibit gallery and museum</td>
<td>30 net</td>
</tr>
<tr>
<td>Assembly with fixed seats</td>
<td>See Section 1004.4</td>
</tr>
<tr>
<td>Assembly without fixed seats</td>
<td></td>
</tr>
<tr>
<td>Concentrated (chairs only—not fixed)</td>
<td>7 net</td>
</tr>
<tr>
<td>Standing space</td>
<td>5 net</td>
</tr>
<tr>
<td>Unconcentrated (tables and chairs)</td>
<td>15 net</td>
</tr>
<tr>
<td>Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas</td>
<td>7 net</td>
</tr>
<tr>
<td>Business areas</td>
<td>400/50 gross</td>
</tr>
<tr>
<td>Concentrated business use areas</td>
<td>See Section 1004.7</td>
</tr>
<tr>
<td>Courtrooms—other than fixed seating areas</td>
<td>40 net</td>
</tr>
<tr>
<td>Day care</td>
<td>35 net</td>
</tr>
<tr>
<td>Dormitories</td>
<td>50 gross</td>
</tr>
<tr>
<td>Vocational Classroom area</td>
<td></td>
</tr>
<tr>
<td>Shops and other vocational room areas</td>
<td>20 net</td>
</tr>
<tr>
<td></td>
<td>50 net</td>
</tr>
<tr>
<td>Exercise rooms</td>
<td>50 gross</td>
</tr>
<tr>
<td>Group H-5 Fabrication and manufacturing areas</td>
<td>200 gross</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Industrial areas</td>
<td>100 gross</td>
</tr>
<tr>
<td>Institutional areas</td>
<td></td>
</tr>
<tr>
<td>Inpatient treatment areas</td>
<td></td>
</tr>
<tr>
<td>Outpatient areas</td>
<td></td>
</tr>
<tr>
<td>Sleeping areas</td>
<td></td>
</tr>
<tr>
<td>Sleeping areas</td>
<td>120 gross</td>
</tr>
<tr>
<td>Kitchens, commercial</td>
<td>200 gross</td>
</tr>
<tr>
<td>Library</td>
<td></td>
</tr>
<tr>
<td>Reading rooms</td>
<td></td>
</tr>
<tr>
<td>Stack area</td>
<td>50 net</td>
</tr>
<tr>
<td>Locker rooms</td>
<td>50 gross</td>
</tr>
<tr>
<td>Mall buildings—covered and open</td>
<td>See Section 402.8.2</td>
</tr>
<tr>
<td>Mercantile</td>
<td></td>
</tr>
<tr>
<td>Storage, stock, shipping areas</td>
<td>300 gross</td>
</tr>
<tr>
<td>Parking garages</td>
<td>200 gross</td>
</tr>
<tr>
<td>Residential</td>
<td>200 gross</td>
</tr>
<tr>
<td>Skating rinks, swimming pools</td>
<td></td>
</tr>
<tr>
<td>Rink and pool</td>
<td>50 gross</td>
</tr>
<tr>
<td>Decks</td>
<td>15 gross</td>
</tr>
<tr>
<td>Stages and platforms</td>
<td>15 net</td>
</tr>
<tr>
<td>Warehouses</td>
<td>500 gross</td>
</tr>
</tbody>
</table>

For SI: 1 square foot = 0.0929 m², 1 foot = 304.8 mm. a. Floor area in square feet per occupant.

**1004.3 Posting of occupant load.** Every room or space that is an assembly occupancy shall have the occupant load of the room or space posted in a conspicuous place, near the main exit or exit access doorway from the room or space. Posted signs shall be of an approved legible permanent design and shall be maintained by the owner or the owner’s representative.

**1004.4 Fixed seating.** For areas having fixed seats and aisles, the occupant load shall be determined by the number of fixed seats installed therein. The occupant load for areas in which fixed seating is not installed, such as waiting spaces, shall be determined in accordance with Section 1004.1.2 and added to the number of fixed seats.

The occupant load of wheelchair spaces and the associated companion seat shall be based on one occupant for each wheelchair space and one occupant for the associated companion seat provided in accordance with Section 1108.2.3.

For areas having fixed seating without dividing arms, the occupant load shall be not less than the number of seats based on one person for each 18 inches (457 mm) of seating length.
The occupant load of seating booths shall be based on one person for each 24 inches (610 mm) of booth seat length measured at the backrest of the seating booth.

1004.5 Outdoor areas. Yards, patios, courts and similar outdoor areas accessible to and usable by the building occupants shall be provided with means of egress as required by this chapter. The occupant load of such outdoor areas shall be assigned by the building official in accordance with the anticipated use. Where outdoor areas are to be used by persons in addition to the occupants of the building, and the path of egress travel from the outdoor areas passes through the building, means of egress requirements for the building shall be based on the sum of the occupant loads of the building plus the outdoor areas.

Exceptions:
1. Outdoor areas used exclusively for service of the building need only have one means of egress.
2. Both outdoor areas associated with Group R-3 and individual dwelling units of Group R-2.

1004.6 Multiple occupancies. Where a building contains two or more occupancies, the means of egress requirements shall apply to each portion of the building based on the occupancy of that space. Where two or more occupancies utilize portions of the same means of egress system, those egress components shall meet the more stringent requirements of all occupancies that are served.

1004.7 Concentrated business use areas. The occupant load factor for concentrated business use shall be applied to telephone call centers, trading floors, electronic data processing centers and similar business use areas with a higher density of occupants than would normally be expected in a typical business occupancy environment. Where approved by the building official, the occupant load for concentrated business use areas shall be the actual occupant load, but not less than one occupant per 50 square feet (4.65 m²) of gross occupiable floor space.

SECTION 1005
MEANS OF EGRESS SIZING

1005.1 General. All portions of the means of egress system shall be sized in accordance with this section.

Exception: Aisles and aisle access ways in rooms or spaces used for assembly
purposes complying with Section 1029.

1005.2 Minimum width based on component. The minimum width, in inches (mm), of any means of egress components shall be not less than that specified for such component, elsewhere in this code.

1005.3 Required capacity based on occupant load. The required capacity, in inches (mm), of the means of egress for any room, area, space or story shall be not less than that determined in accordance with Sections 1005.3.1 and 1005.3.2:

1005.3.1 Stairways. The capacity, in inches, of means of egress stairways shall be calculated by multiplying the occupant load served by such stairways by a means of egress capacity factor of 0.3 inch (7.6 mm) per occupant. Where stairways serve more than one story, only the occupant load of each story considered individually shall be used in calculating the required capacity of the stairways serving that story.

Exceptions:
1. For other than Group H and I-2 occupancies, the capacity, in inches, of means of egress stairways shall be calculated by multiplying the occupant load served by such stairways by a means of egress capacity factor of 0.2 inch (5.1 mm) per occupant in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 and an emergency voice/alarm communication system in accordance with Section 907.5.2.2.
2. Facilities with smoke-protected assembly seating shall be permitted to use the capacity factors in Table 1029.6.2 indicated for stepped aisles for exit access or exit stairways where the entire path for means of egress from the seating to the exit discharge is provided with a smoke control system complying with Section 909.
3. Facilities with outdoor smoke-protected assembly seating shall be permitted to the capacity factors in Section 1029.6.3 indicated for stepped aisles for exit access or exit stairways where the entire path for means of egress from the seating to the exit discharge is open to the outdoors.

1005.3.2 Other egress components. The capacity, in inches, of means of egress components other than stairways shall be calculated by multiplying the occupant load served by such component by a means of egress capacity factor of 0.2 inch (5.1 mm) per occupant.
Exceptions:

1. For other than Group H and I-2 occupancies, the capacity, in inches, of means of egress components other than stairways shall be calculated by multiplying the occupant load served by such component by a means of egress capacity factor of 0.15 inch (3.8 mm) per occupant in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 and an emergency voice/ alarm communication system in accordance with Section 907.5.2.2.

2. Facilities with smoke-protected assembly seating shall be permitted to use the capacity factors in Table 1029.6.2 indicated for level or ramped aisles for means of egress components other than stairways where the entire path for means of egress from the seating to the exit discharge is provided with a smoke control system complying with Section 909.

3. Facilities with outdoor smoke-protected assembly seating shall be permitted to the capacity factors in Section 1029.6.3 indicated for level or ramped aisles for means of egress components other than stairways where the entire path for means of egress from the seating to the exit discharge is open to the outdoors.

1005.4 Continuity. The minimum width or required capacity of the means of egress required from any story of a building shall not be reduced along the path of egress travel until arrival at the public way.

1005.5 Distribution of minimum width and required capacity. Where more than one exit, or access to more than one exit, is required, the means of egress shall be configured such that the loss of any one exit, or access to one exit, shall not reduce the available capacity or width to less than 50 percent of the required capacity or width.

1005.6 Egress convergence. Where the means of egress from stories above and below converge at an intermediate level, the capacity of the means of egress from the point of convergence shall be not less than the largest minimum width or the sum of the required capacities for the stairways or ramps serving the two adjacent stories, whichever is larger.
1005.7 **Encroachment.** Encroachments into the required means of egress width shall be in accordance with the provisions of this section.

1005.7.1 **Doors.** Doors, when fully opened, shall not reduce the required width by more than 7 inches (178 mm). Doors in any position shall not reduce the required width by more than one-half.

**Exceptions:**
1. Surface-mounted latch release hardware shall be exempt from inclusion in the 7-inch maximum (178 mm) encroachment where both of the following conditions exist:
   1.1. The hardware is mounted to the side of the door facing away from the adjacent wall where the door is in the open position.
   1.2. The hardware is mounted not less than 34 inches (865 mm) nor more than 48 inches (1219 mm) above the finished floor.
2. The restrictions on door swing shall not apply to doors within individual dwelling units and sleeping units of Group R-2 occupancies and dwelling units of Group R-3 occupancies.

1005.7.2 **Other projections.** Handrail projections shall be in accordance with the provisions of Section 1014.8. Other nonstructural projections such as trim and similar decorative features shall be permitted to project into the required width not more than $1\frac{1}{2}$ inches (38 mm) on each side.

**Exception:** Projections are permitted in corridors within Group I-2 Condition 1 in accordance with Section 407.4.3.

1005.7.3 **Protruding objects.** Protruding objects shall comply with the applicable requirements of Section 1003.3.

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**SECTION 1006**

**NUMBER OF EXITS AND EXIT ACCESS DOORWAYS**

1006.1 **General.** The number of exits or exit access doorways required within the means of egress system shall comply with the provisions of Section 1006.2 for spaces, including mezzanines, and Section 1006.3 for stories.

1006.2 **Egress from spaces.** Rooms, areas or spaces, including mezzanines, within a story or basement shall be provided with the number of exits or access to exits in accordance with this section.
1006.2.1 Egress based on occupant load and common path of egress travel distance. Two exits or exit access doorways from any space shall be provided where the design occupant load or the common path of egress travel distance exceeds the values listed in Table 1006.2.1.

Exceptions:
1. In Group R-2 and R-3 occupancies, one means of egress is permitted within and from individual dwelling units with a maximum occupant load of 20 where the dwelling unit is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and the common path of egress travel does not exceed 125 feet (38 100 mm).
2. Care suites in Group I-2 occupancies complying with Section 407.4.

1006.2.1.1 Three or more exits or exit access doorways. Three exits or exit access doorways shall be provided from any space with an occupant load of 501 to 1,000. Four exits or exit access doorways shall be provided from any space with an occupant load greater than 1,000.

1006.2.2 Egress based on use. The numbers of exits or access to exits shall be provided in the uses described in Sections 1006.2.2.1 through 1006.2.2.8.

1006.2.2.1 Boiler, incinerator and furnace rooms. Two exit access doorways are required in boiler, incinerator and furnace rooms where the area is over 500 square feet (46 m²) and any fuel-fired equipment exceeds 400,000 British thermal units (Btu) (422 000 KJ) input capacity. Where two exit access doorways are required, one is permitted to be a fixed ladder or an alternating tread device. Exit access doorways shall be separated by a horizontal distance equal to one-half the length of the maximum overall diagonal dimension of the room.

1006.2.2.2 Refrigeration machinery rooms. Machinery rooms larger than 1,000 square feet (93 m²) shall have not less than two exits or exit access doorways. Where two exit access doorways are required, one such doorway is permitted to be served by a fixed ladder or an alternating tread device. Exit access doorways shall be separated by a horizontal distance equal to one-half the maximum horizontal dimension of the room.

All portions of machinery rooms shall be within 150 feet (45 720 mm) of
an exit or exit access doorway. An increase in exit access travel distance is permitted in accordance with Section 1017.1.
Doors shall swing in the direction of egress travel, regardless of the occupant load served. Doors shall be tight fitting and self-closing.

1006.2.2.3 Refrigerated rooms or spaces. Rooms or spaces having a floor area larger than 1,000 square feet (93 m²), containing a refrigerant evaporator and maintained at a temperature below 68°F (20°C), shall have access to not less than two exits or exit access doorways.
Exit access travel distance shall be determined as specified in Section 1017.1, but all portions of a refrigerated room or space shall be within 150 feet (45 720 mm) of an exit or exit access doorway where such rooms are not protected by an approved automatic sprinkler system. Egress is allowed through adjoining refrigerated rooms or spaces.
Exception: Where using refrigerants in quantities limited to the amounts based on the volume set forth in the Mechanical code.

### TABLE 1006.2.1

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>MAXIMUM OCCUPANT LOAD OF SPACE</th>
<th>MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Without Sprinkler System</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(feet)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Occupant Load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OL &lt; 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(feet)</td>
</tr>
<tr>
<td>A', E, M</td>
<td>49</td>
<td>75</td>
</tr>
<tr>
<td>B</td>
<td>49</td>
<td>100</td>
</tr>
<tr>
<td>F</td>
<td>49</td>
<td>75</td>
</tr>
<tr>
<td>H-1, H-2, H-3</td>
<td>3</td>
<td>NP</td>
</tr>
<tr>
<td>H-4, H-5</td>
<td>10</td>
<td>NP</td>
</tr>
<tr>
<td>I-1, I-2&lt;sup&gt;e&lt;/sup&gt;, I-4</td>
<td>10</td>
<td>NP</td>
</tr>
<tr>
<td>I-3</td>
<td>10</td>
<td>NP</td>
</tr>
<tr>
<td>R-1</td>
<td>10</td>
<td>NP</td>
</tr>
<tr>
<td>R-2</td>
<td>10</td>
<td>NP</td>
</tr>
<tr>
<td>R-3&lt;sup&gt;e&lt;/sup&gt;</td>
<td>10</td>
<td>NP</td>
</tr>
<tr>
<td>Sf</td>
<td>29</td>
<td>100</td>
</tr>
<tr>
<td>U</td>
<td>49</td>
<td>100</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.
a. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.
b. Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.
c. For a room or space used for assembly purposes having fixed seating, see Section 1029.8.
d. For the travel distance limitations in Group I-2, see Section 407.4.
e. The length of common path of egress travel distance in a Group R-3 occupancy located in a mixed occupancy building or within a Group R-3 or R-4 congregate living facility.
f. The length of common path of egress travel distance in a Group S-2 open parking garage shall be not more than 250 feet.
g. For the travel distance limitations in Group R-3 and R-4 equipped throughout with an automatic sprinkler system, see Section 903.3.1.3, see Section 1006.2.2.6.
1006.2.4 Day care means of egress. Day care facilities, rooms or spaces where care is provided for more than 10 children that are 2 1/2 years of age or less, shall have access to not less than two exits or exit access doorways.

1006.2.5 Vehicular ramps. Vehicular ramps shall not be considered as an exit access ramp unless pedestrian facilities are provided.

1006.2.6 Group R-3 and R-4. Where Group R-3 occupancies are permitted by Section 903.2.8 to be protected by an automatic sprinkler system installed in accordance with Section 903.3.1.3, the exit access travel distance for Group R-3 shall not be more than 125 feet. Where Group R-4 occupancies are permitted by Section 903.2.8 to be protected by an automatic sprinkler system installed in accordance with Section 903.3.1.3, the exit access travel distance for Group R-4 shall not be more than 75 feet.

1006.2.7 Electrical equipment workspaces. Exit access shall be provided from electrical equipment workspaces as follows:

1. Electrical workspaces with equipment rated 1200 amperes or more. Electrical workspaces having electrical equipment rated 1200 amperes or more and over 6 ft (1.8 m) wide containing overcurrent devices, switching devices or control devices shall have exit access openings provided from the required working space at each end of the working space. The exit access openings shall be at least 24 inches (610 mm) wide and 6.5 ft (2 m) high. A single exit access opening from the required working space shall be permitted where access to the opening is continuous and unobstructed or where extra working space is provided in accordance with Article 110.26 (C)(2)(b) of NFPA 70. Where an exit access doorway is provided and the door is located less than 25 ft (7.6 m) from the nearest edge of the working space, the door(s) shall be equipped with panic hardware in accordance with Section 1010.1.10.

2. Electrical workspaces with equipment rated 800 amperes or more. Where an exit access doorway(s) is provided and is located less than 25 ft (7.6 m) from the nearest edge of the working space, the door shall be equipped with panic hardware in accordance with Section 1010.1.10.
1006.2.2.8 Elevator machine rooms and control rooms. Exit access doorways shall be provided from elevator machine rooms and control rooms when required by Section 2.7.3.4 of ASME A17.1 as referenced in rule 4101:5-3-01 of the Administrative Code.

1006.3 Egress from stories or occupied roofs. The means of egress system serving any story or occupied roof shall be provided with the number of exits or access to exits based on the aggregate occupant load served in accordance with this section. The path of egress travel to an exit shall not pass through more than one adjacent story.

1006.3.1 Egress based on occupant load. Each story and occupied roof shall have the minimum number of independent exits, or access to exits, as specified in Table 1006.3.1. A single exit or access to a single exit shall be permitted in accordance with Section 1006.3.2. The required number of exits, or exit access stairways or ramps providing access to exits, from any story or occupied roof shall be maintained until arrival at the exit discharge or a public way.

<table>
<thead>
<tr>
<th>OCCUPANT LOAD PER STORY</th>
<th>MINIMUM NUMBER OF EXITS OR ACCESS TO EXITS FROM STORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-500</td>
<td>2</td>
</tr>
<tr>
<td>501-1,000</td>
<td>3</td>
</tr>
<tr>
<td>More than 1,000</td>
<td>4</td>
</tr>
</tbody>
</table>

1006.3.2 Single exits. A single exit or access to a single exit shall be permitted from any story or occupied roof where one of the following conditions exists:

1. The occupant load, number of dwelling units and common path of egress travel distance does not exceed the values in Table 1006.3.2(1) or 1006.3.2(2).

2. Rooms, areas and spaces complying with Section1006.2.1 with exits that discharge directly to the exterior at the level of exit discharge, are permitted to have one exit or access to a single exit.

3. Parking garages where vehicles are mechanically parked shall be permitted to have one exit or access to a single exit.
4. Group R-3 and R-4 occupancies shall be permitted to have one exit or access to a single exit.

5. Individual single-story or multistory dwelling units shall be permitted to have a single exit or access to a single exit from the dwelling unit provided that both of the following criteria are met:

5.1. The dwelling unit complies with Section 1006.2.1 as a space with one means of egress.

5.2. Either the exit from the dwelling unit discharges directly to the exterior at the level of exit discharge, or the exit access outside the dwelling unit’s entrance door provides access to not less than two approved independent exits.

1006.3.2.1 Mixed occupancies. Where one exit, or exit access stairway or ramp providing access to exits at other stories, is permitted to serve individual stories, mixed occupancies shall be permitted to be served by single exits provided each individual occupancy complies with the applicable requirements of Table 1006.3.2(1) or 1006.3.2(2) for that occupancy. Where applicable, cumulative occupant loads from adjacent provisions of Section 1004.1. In each story of a mixed occupancy building, the maximum number of occupants served by a single exit shall be such that the sum of the ratios of the calculated number of occupants of the space divided by the allowable number of occupants indicated in Table 1006.3.2(2) for each occupancy does not exceed one. Where dwelling units are located on a story with other occupancies, the actual number of dwelling units divided by four plus the ratio from the other occupancy does not exceed one.

**TABLE 1006.3.2(1)**

**STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR R-2 OCCUPANCIES**

<table>
<thead>
<tr>
<th>STORY</th>
<th>OCCUPANCY</th>
<th>MAXIMUM NUMBER OF DWELLING UNITS</th>
<th>MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basement, first, second or third story above grade plane</td>
<td>R-2a, b</td>
<td>4 dwelling units</td>
<td>125 feet</td>
</tr>
<tr>
<td>Fourth story above grade plane and higher</td>
<td>NP</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 3048 mm.
NP = Not permitted. NA = Not Applicable.

a. Except as otherwise provided in Section 903.2.8, buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 1030.
b. This table is used for R-2 occupancies consisting of dwelling units. For R-2 occupancies consisting of sleeping units, use Table 1006.3.2(2).

**TABLE 1006.3.2(2)**

STORIES WITH ONE EXIT OR ACCESS TO ONE EXIT FOR OTHER OCCUPANCIES

<table>
<thead>
<tr>
<th>STORY</th>
<th>OCCUPANCY</th>
<th>MAXIMUM OCCUPANT LOAD PER STORY</th>
<th>MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First story above or below grade plane</td>
<td>A, B&lt;sup&gt;b&lt;/sup&gt;, E&lt;sup&gt;b&lt;/sup&gt;, M, U</td>
<td>49</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>H-2, H-3</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>H-4, H-5, I, R-1, R-2&lt;sup&gt;c&lt;/sup&gt;, R-4</td>
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<td>75</td>
</tr>
<tr>
<td></td>
<td>Sb, d</td>
<td>29</td>
<td>75</td>
</tr>
<tr>
<td>Second story above grade plane</td>
<td>B, F, M, S&lt;sup&gt;d&lt;/sup&gt;</td>
<td>29</td>
<td>75</td>
</tr>
<tr>
<td>Third story above grade plane and higher</td>
<td>NP</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.
NP = Not Permitted. NA = Not Applicable.

a. *Except as otherwise provided in Section 903.2.8, buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 1030.*

b. Group B, F and S occupancies in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 shall have a maximum exit access travel distance of 100 feet.

c. This table is used for R-2 occupancies consisting of sleeping units. For R-2 occupancies consisting of dwelling units, use Table 1006.3.2(1).

d. The length of exit access travel distance in a Group S-2 open parking garage shall be not more than 100 feet.

**SECTION 1007**

EXIT AND EXIT ACCESS DOORWAY CONFIGURATION

1007.1 General. Exits, exit access doorways, and exit access stairways and ramps serving spaces, including individual building stories, shall be separated in accordance with the provisions of this section.

1007.1.1 Two exits or exit access doorways. Where two exits, exit access doorways, exit access stairways or ramps, or any combination thereof, are required from any portion of the exit access, they shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served measured in a straight line between them. Interlocking or scissor stairways shall be counted as one exit stairway.

**Exceptions:**

1. Where interior exit stairways or ramps are interconnected by a 1-hour
fire-resistance-rated corridor conforming to the requirements of Section 1020, the required exit separation shall be measured along the shortest direct line of travel with the within the corridor.

2. Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2, the separation distance shall be not less than one-third of the length - of the maximum overall diagonal dimension of the area served.

1007.1.1.1 Measurement point. The separation distance required in Section 1007.1.1 shall be measured in accordance with the following:

1. The separation distance to exit or exit access doorways shall be measured to any point along the width of the doorway.
2. The separation distance to exit access stairways shall be measured to the closest riser.
3. The separation distance to exit access ramps shall be measured to the start of the ramp run.

1007.1.2 Three or more exits or exit access doorways. Where access to three or more exits is required, not less than two exit or exit access doorways shall be arranged in accordance with the provisions of Section 1007.1.1. Additional required exit or exit access doorways shall be arranged a reasonable distance apart so that if one becomes blocked, the others will be available.

1007.1.3 Remoteness of exit access stairways or ramps. Where two exit access stairways or ramps provide the required means of egress to exits at another story, the required separation distance shall be maintained for all portions of such exit access stairways or ramps.

1007.1.3.1 Three or more exit access stairways or ramps. Where more than two exit access stairways or ramps provide the required means of egress, not less than two shall be arranged in accordance with Section 1007.1.3.

SECTION 1008
MEANS OF EGRESS ILLUMINATION

1008.1 Means of egress illumination. Illumination shall be provided in the means of egress in accordance with Section 1008.2. Under emergency power, means of egress illumination shall comply with Section 1008.3.
1008.2 Illumination required. The means of egress serving a room or space shall be illuminated at all times that the room or space is occupied.

Exceptions:
1. Occupancies in Group U.
2. Aisle accessways in Group A.
3. Dwelling units and sleeping units in Groups R-1, R-2 and R-3.
4. Sleeping units of Group I occupancies.

1008.2.1 Illumination level under normal power. The means of egress illumination level shall be not less than 1 footcandle (11 lux) at the walking surface.

Exception: For auditoriums, theaters, concert or opera halls and similar assembly occupancies, the illumination at the walking surface is permitted to be reduced during performances by one of the following methods provided that the required illumination is automatically restored upon activation of a premises’ fire alarm system:
1. Externally illuminated walking surfaces shall be permitted to be illuminated to not less than 0.2 footcandle (2.15 lux).
2. Steps, landings and the sides of ramps shall be permitted to be marked with self-luminous materials in accordance with Sections 1025.2.1, 1025.2.2 and 1025.2.4 by systems listed in accordance with UL 1994.

1008.2.2 Exit discharge. In Group I-2 occupancies where two or more exits are required, on the exterior landings required by Section 1010.6.1, means of egress illumination levels for the exit discharge shall be provided such that failure of any single lighting unit shall not reduce the illumination level on that landing to less than 1 footcandle (11 lux).

1008.3 Emergency power for illumination. The power supply for means of egress illumination shall normally be provided by the premises’ electrical supply.

1008.3.1 General. In the event of power supply failure in rooms and spaces that require two or more means of egress, an emergency electrical system shall automatically illuminate all of the following areas:
1. Aisles.
2. Corridors.
3. Exit access stairways and ramps.

1008.3.2 Buildings. In the event of power supply failure in buildings that require two or more means of egress, an emergency electrical system shall automatically illuminate all of the following areas:

1. Interior exit access stairways and ramps.
2. Interior and exterior exit stairways and ramps.
3. Exit passageways.
4. Vestibules and areas on the level of discharge used for exit discharge in accordance with Section 1028.1.
5. Exterior landings as required by Section 1010.1.6 for exit doorways that lead directly to the exit discharge.

1008.3.3 Rooms and spaces. In the event of power supply failure, an emergency electrical system shall automatically illuminate all of the following areas:

1. Electrical equipment rooms.
2. Fire command centers.
3. Fire pump rooms.
4. Generator rooms.
5. Public restrooms with an area greater than 300 square feet (27.87 m²).

1008.3.4 Duration. The emergency power system shall provide power for a duration of not less than 90 minutes and shall consist of storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with Section 2702.

1008.3.5 Illumination level under emergency power. Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1 footcandle (11 lux) and a minimum at any point of 0.1 footcandle (1 lux) measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 0.6 footcandle (6 lux) average and a minimum at any point of 0.06 footcandle (0.6 lux) at the end of the emergency lighting time duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded. In Group I-2 occupancies, failure of any single lighting unit shall not reduce the illumination level to less than 0.2 foot-candle (2.2 lux).

SECTION 1009
ACCESSIBLE MEANS OF EGRESS

1009.1 Accessible means of egress required. Accessible means of egress shall comply with this section. Accessible spaces shall be provided with not less than one accessible means of egress. Where more than one means of egress are required by Section 1006.2 or 1006.3 from any accessible space, each accessible portion of the space shall be served by not less than two accessible means of egress.

Exceptions:

1. Accessible means of egress are not required to be provided in existing buildings.
2. One accessible means of egress is required from an accessible mezzanine level in accordance with Section 1009.3, 1009.4 or 1009.5.
3. In assembly areas with ramped aisles or stepped aisles, one accessible means of egress is permitted where the common path of egress travel is accessible and meets the requirements in Section 1029.8.

1009.2 Continuity and components. Each required accessible means of egress shall be continuous to a public way and shall consist of one or more of the following components:

1. Accessible routes complying with Section 1104.
2. Interior exit stairways complying with Sections 1009.3 and 1023.
3. Exit access stairways complying with Sections 1009.3 and 1019.3 or 1019.4.
4. Exterior exit stairways complying with Sections 1009.3 and 1027 and serving levels other than the level of exit discharge.
5. Elevators complying with Section 1009.4.
6. Platform lifts complying with Section 1009.5.
7. Horizontal exits complying with Section 1026.
8. Ramps complying with Section 1012.
9. Areas of refuge complying with Section 1009.6.
10. Exterior areas for assisted rescue complying with Section 1009.7 serving exits at the level of exit discharge.

1009.2.1 Elevators required. In buildings where a required accessible floor is four or more stories above or below a level of exit discharge, not less than one required accessible means of egress shall be an elevator complying with Section 1009.4.

Exceptions:
1. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the elevator shall not be required on floors provided with a horizontal exit and located at or above the levels of exit discharge.

2. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, the elevator shall not be required on floors provided with a ramp conforming to the provisions of Section 1012.

1009.3 Stairways. In order to be considered part of an accessible means of egress, a stairway between stories shall have a clear width of 48 inches (1219 mm) minimum between handrails and shall either incorporate an area of refuge within an enlarged floor-level landing or shall be accessed from an area of refuge complying with Section 1009.6. Exit access stairways that connect levels in the same story are not permitted as part of an accessible means of egress.

Exceptions:

1. Exit access stairways providing means of egress from mezzanines are permitted as part of an accessible means of egress.

2. The clear width of 48 inches (1219 mm) between handrails is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

3. The clear width of 48 inches (1219 mm) between handrails is not required for stairways accessed from a refuge area in conjunction with a horizontal exit.

4. Areas of refuge are not required at exit access stairways where two-way communication is provided at the elevator landing in accordance with Section 1009.8.

5. Areas of refuge are not required at stairways in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

6. Areas of refuge are not required at stairways serving open parking garages.

7. Areas of refuge are not required for smoke-protected assembly seating areas complying with Section 1029.6.2.

8. Areas of refuge are not required at stairways in Group R-2 occupancies.

9. Areas of refuge are not required for stairways accessed from a refuge area in conjunction with a horizontal exit.

1009.4 Elevators. In order to be considered part of an accessible means of egress,
an elevator shall comply with the emergency operation and signaling device requirements of Section 2.27 of ASME A17.1 as referenced in rule 4101:5-3-01 of the Administrative Code. Standby power shall be provided in accordance with Chapter 27 and Section 3003. The elevator shall be accessed from an area of refuge complying with Section 1009.6.

**Exceptions:**

1. Areas of refuge are not required at the elevator in open parking garages.
2. Areas of refuge are not required in buildings and facilities equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.
3. Areas of refuge are not required at elevators not required to be located in a shaft in accordance with Section 712.
4. Areas of refuge are not required at elevators serving smoke-protected assembly seating areas complying with Section 1029.6.2.
5. Areas of refuge are not required for elevators accessed from a refuge area in conjunction with a horizontal exit.

**1009.5 Platform lifts.** Platform lifts shall be permitted to serve as part of an accessible means of egress where allowed as part of a required accessible route in Section 1109.8 except for Item 10. Standby power for the platform lift shall be provided in accordance with Chapter 27.

**1009.6 Areas of refuge.** Every required area of refuge shall be accessible from the space it serves by an accessible means of egress.

**1009.6.1 Travel distance.** The maximum travel distance from any accessible space to an area of refuge shall not exceed the exit access travel distance permitted for the occupancy in accordance with Section 1017.1.

**1009.6.2 Stairway or elevator access.** Every required area of refuge shall have direct access to a stairway complying with Sections 1009.3 and 1023 or an elevator complying with Section 1009.4.

**1009.6.3 Size.** Each area of refuge shall be sized to accommodate one wheelchair space of 30 inches by 48 inches (762 mm by 1219 mm) for each 200 occupants or portion thereof, based on the occupant load of the area of refuge and areas served by the area of refuge. Such wheelchair spaces shall
not reduce the means of egress minimum width or required capacity. Access to any of the required wheelchair spaces in an area of refuge shall not be obstructed by more than one adjoining wheelchair space.

1009.6.4 Separation. Each area of refuge shall be separated from the remainder of the story by a smoke barrier complying with Section 709 or a horizontal exit complying with Section 1026. Each area of refuge shall be designed to minimize the intrusion of smoke.

Exceptions:
1. Areas of refuge located within an enclosure for interior exit stairways complying with Section 1023.
2. Areas of refuge in outdoor facilities where exit access is essentially open to the outside.

1009.6.5 Two-way communication. Areas of refuge shall be provided with a two-way communication system complying with Sections 1009.8.1 and 1009.8.2.

1009.7 Exterior areas for assisted rescue. Exterior areas for assisted rescue shall be accessed by an accessible route from the area served. Where the exit discharge does not include an accessible route from an exit located on the level of exit discharge to a public way, an exterior area of assisted rescue shall be provided on the exterior landing in accordance with Sections 1009.7.1 through 1009.7.4.

1009.7.1 Size. Each exterior area for assisted rescue shall be sized to accommodate wheelchair spaces in accordance with Section 1009.6.3.

1009.7.2 Separation. Exterior walls separating the exterior area of assisted rescue from the interior of the building shall have a minimum fire-resistance rating of 1 hour, rated for exposure to fire from the inside. The fire-resistance-rated exterior wall construction shall extend horizontally not less than 10 feet (3048 mm) beyond the landing on either side of the landing or equivalent fire-resistance-rated construction is permitted to extend out perpendicular to the exterior wall not less than 4 feet (1220 mm) minimum on the side of the landing. The fire-resistance-rated construction shall extend vertically from the ground to a point not less than 10 feet (3048 mm) above the floor level of the area for assisted rescue or to the roof line, whichever is lower. Openings within such fire-resistance-rated exterior walls shall be protected in accordance with Section 716.
**Exception:** The fire-resistance rating and opening protectives are not required in the exterior wall where the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

1009.7.3 **Openness.** The exterior area for assisted rescue shall be open to the outside air. The sides other than the separation walls shall be not less than 50 percent open, and the open area shall be distributed so as to minimize the accumulation of smoke or toxic gases.

1009.7.4 **Stairways.** Stairways that are part of the means of egress for the exterior area for assisted rescue shall provide a clear width of 48 inches (1220 mm) between handrails.

**Exception:** The clear width of 48 inches (1220 mm) between handrails is not required at stairways serving buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

1009.8 **Two-way communication.** A two-way communication system complying with Sections 1009.8.1 and 1009.8.2 shall be provided at the landing serving each elevator or bank of elevators on each accessible floor that is one or more stories above or below the level of exit discharge.

**Exceptions:**

1. Two-way communication systems are not required at the landing serving each elevator or bank of elevators where the two-way communication system is provided within areas of refuge in accordance with Section 1009.6.5.
2. Two-way communication systems are not required on floors provided with ramps conforming to the provisions of Section 1012.
3. Two-way communication systems are not required at the landings serving only service elevators that are not designated as part of the accessible means of egress or serve as part of the required accessible route into a facility.
4. Two-way communication systems are not required at the landings serving only freight elevators.
5. Two-way communication systems are not required at the landing serving a private residence elevator.
1009.8.1 System requirements. Two-way communication systems shall provide communication between each required location and the fire command center or a central control point location approved by the fire department. Where the central control point is not a constantly attended location, a two-way communication system shall have a timed automatic telephone dial-out capability to a monitoring location or 9-1-1. The two-way communication system shall include both audible and visible signals.

1009.8.2 Directions. Directions for the use of the two-way communication system, instructions for summoning assistance via the two-way communication system and written identification of the location shall be posted adjacent to the two-way communication system. Signage shall comply with the ICC A117.1 requirements for visual characters.

1009.9 Signage. Signage indicating special accessibility provisions shall be provided as shown:

1. Each door providing access to an area of refuge from an adjacent floor area shall be identified by a sign stating: AREA OF REFUGEE.
2. Each door providing access to an exterior area for assisted rescue shall be identified by a sign stating: EXTERIOR AREA FOR ASSISTED RESCUE.

Signage shall comply with the ICC A117.1 requirements for visual characters and include the International Symbol of Accessibility. Where exit sign illumination is required by Section 1013.3, the signs shall be illuminated. Additionally, visual characters, raised character and braille signage complying with ICC A117.1 shall be located at each door to an area of refuge and exterior area for assisted rescue in accordance with Section 1013.4.

1009.10 Directional signage. Directional signage indicating the location of all other means of egress and which of those are accessible means of egress shall be provided at the following:

1. At exits serving a required accessible space but not providing an approved accessible means of egress.
2. At elevator landings.
3. Within areas of refuge.

1009.11 Instructions. In areas of refuge and exterior areas for assisted rescue, instructions on the use of the area under emergency conditions shall be posted. Signage shall comply with the ICC A117.1 requirements for visual characters.
The instructions shall include all of the following:
1. Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
2. Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.
3. Directions for use of the two-way communication system where provided.

SECTION 1010
DOORS, GATES AND TURNSTILES

1010.1 Doors. Means of egress doors shall meet the requirements of this section. Doors serving a means of egress system shall meet the requirements of this section and Section 1022.2. Doors provided for egress purposes in numbers greater than required by this code shall meet the requirements of this section. Means of egress doors shall be readily distinguishable from the adjacent construction and finishes such that the doors are easily recognizable as doors. Mirrors or similar reflecting materials shall not be used on means of egress doors. Means of egress doors shall not be concealed by curtains, drapes, decorations or similar materials.

1010.1.1 Size of doors. The required capacity of each door opening shall be sufficient for the occupant load thereof and shall provide a minimum clear width of 32 inches (813 mm). Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees (1.57 rad). Where this section requires a minimum clear width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 32 inches (813 mm). The maximum width of a swinging door leaf shall be 48 inches (1219 mm) nominal. Means of egress doors in a Group I-2 occupancy used for the movement of beds shall provide a clear width not less than 41\(\frac{1}{2}\) inches (1054 mm). The height of door openings shall be not less than 80 inches (2032 mm).

Exceptions:
1. The minimum and maximum width shall not apply to door openings that are not part of the required means of egress in Group R-2 and R-3 occupancies.
2. Door openings to resident sleeping units not required to be accessible, in Group I-3 occupancies shall have a clear width of not less than 28 inches (711 mm).
3. Door openings to reach in storage closets less than 10 square feet (0.93 m\(^2\)) in area shall not be limited by the minimum width.
4. Width of door leaves in revolving doors that comply with Section 1010.1.4.1 shall not be limited.
5. Door openings within a dwelling unit or sleeping unit shall be not less than 78 inches (1981 mm) in height.
6. Exterior door openings in dwelling units and sleeping units, other than the required exit door, shall be not less than 76 inches (1930 mm) in height.
7. In other than Group R-1 occupancies, the minimum widths shall not apply to interior egress doors within a dwelling unit or sleeping unit that is not required to be an Accessible unit, Type A unit or Type B unit.
8. Door openings required to be accessible within Type B units shall have a minimum clear width of 31.75 inches (806 mm).
9. Doors to walk-in freezers and coolers less than 1,000 square feet (93 m²) in area shall have a maximum width of 60 inches (1524 mm).
10. In Group R-1 dwelling units or sleeping units not required to be Accessible units, the minimum width shall not apply to doors for showers or saunas.

**1010.1.1.1 Projections into clear width.** There shall not be projections into the required clear width lower than 34 inches (864 mm) above the floor or ground. Projections into the clear opening width between 34 inches (864 mm) and 80 inches (2032 mm) above the floor or ground shall not exceed 4 inches (102 mm).

   **Exception:** Door closers and door stops shall be permitted to be 78 inches (1980 mm) minimum above the floor.

**1010.1.2 Door swing.** Egress doors shall be of the pivoted or side-hinged swinging type.

   **Exceptions:**
   1. Private garages, office areas, factory and storage areas with an occupant load of 10 or less.
   2. Group I-3 occupancies used as a place of detention.
   3. Critical or intensive care patient rooms within suites of health care facilities.
   4. Doors within or serving a single dwelling unit in Groups R-2 and R-3.
   5. In other than Group H occupancies, revolving doors complying with Section 1010.1.4.1.
   6. In other than Group H occupancies, special purpose horizontal sliding, accordion or folding door assemblies complying with Section 1010.1.4.3.
7. Power-operated doors in accordance with Section 1010.1.4.2.
8. Doors serving a bathroom within an individual sleeping unit in Group R-1.
9. In other than Group H occupancies, manually operated horizontal sliding doors are permitted in a means of egress from spaces with an occupant load of 10 or less.

1010.1.2.1 Direction of swing. Pivot or side-hinged swinging doors shall swing in the direction of egress travel where serving a room or area containing an occupant load of 50 or more persons or a Group H occupancy.

1010.1.3 Door opening force. The force for pushing or pulling open interior swinging egress doors, other than fire doors, shall not exceed 5 pounds (22 N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. For other swinging doors, as well as sliding and folding doors, the door latch shall release when subjected to a 15-pound (67 N) force. The door shall be set in motion when subjected to a 30-pound (133 N) force. The door shall swing to a full-open position when subjected to a 15-pound (67 N) force.

1010.1.3.1 Location of applied forces. Forces shall be applied to the latch side of the door.

1010.1.4 Special doors. Special doors and security grilles shall comply with the requirements of Sections 1010.1.4.1 through 1010.1.4.4.

1010.1.4.1 Revolving doors. Revolving doors shall comply with the following:
   1. Revolving doors shall comply with BHMA A156.27 and shall be installed in accordance with the manufacturer’s instructions.
   2. Each revolving door shall be capable of breakout in accordance with BHMA A156.27 and shall provide an aggregate width of not less than 36 inches (914 mm).
   3. A revolving door shall not be located within 10 feet (3048 mm) of the foot or top of stairways or escalators. A dispersal area shall be provided between the stairways or escalators and the revolving doors.
   4. The revolutions per minute (rpm) for a revolving door shall not exceed the maximum rpm as specified in BHMA A156.27. Manual revolving doors shall comply with Table 1010.1.4.1(1). Automatic
or power-operated revolving doors shall comply with Table 1010.1.4.1(2).

5. An emergency stop switch shall be provided near each entry point of power or automatically operated revolving doors within 48 inches (1220 mm) of the door and between 24 inches (610 mm) and 48 inches (1220 mm) above the floor. The activation area of the emergency stop switch button shall be not less than 1 inch (25 mm) in diameter and shall be red.

6. Each revolving door shall have a side-hinged swinging door that complies with Section 1010.1 in the same wall and within 10 feet (3048 mm) of the revolving door.

7. Revolving doors shall not be part of an accessible route required by Section 1009 and Chapter 11.

### TABLE 1010.1.4.1(1)
MAXIMUM DOOR SPEED MANUAL REVOLVING DOORS

<table>
<thead>
<tr>
<th>REVOLVING DOOR MAXIMUM NOMINAL DIAMETER (FT-IN)</th>
<th>MAXIMUM ALLOWABLE REVOLVING DOOR SPEED (RPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-0</td>
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<tr>
<td>7-0</td>
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<td>8-0</td>
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<td>9-0</td>
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<td>8</td>
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For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

### TABLE 1010.1.4.1(2)
MAXIMUM DOOR SPEED AUTOMATIC OR POWER-OPERATED REVOLVING DOORS

<table>
<thead>
<tr>
<th>REVOLVING DOOR MAXIMUM NOMINAL DIAMETER (FT-IN)</th>
<th>MAXIMUM ALLOWABLE REVOLVING DOOR SPEED (RPM)</th>
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<tbody>
<tr>
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<tr>
<td>17-0</td>
<td>3.4</td>
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For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

1010.1.4.1.1 Egress component. A revolving door used as a component of a means of egress shall comply with Section 1010.1.4.1 and the following three conditions:

1. Revolving doors shall not be given credit for more than 50 percent of the minimum width or required capacity.
2. Each revolving door shall be credited with a capacity based on not more than a 50-person occupant load.
3. Each revolving door shall provide for egress in accordance with BHMA A156.27 with a breakout force of not more than 130 pounds (578 N).

1010.1.4.1.2 Other than egress component. A revolving door used as other than a component of a means of egress shall comply with Section 1010.1.4.1. The breakout force of a revolving door not used as a component of a means of egress shall not be more than 180 pounds (801 N).

Exception: A breakout force in excess of 180 pounds (801 N) is permitted if the collapsing force is reduced to not more than 130 pounds (578 N) when not less than one of the following conditions is satisfied:

1. There is a power failure or power is removed to the device holding the door wings in position.
2. There is an actuation of the automatic sprinkler system where such system is provided.
3. There is an actuation of a smoke detection system that is installed in accordance with Section 907 to provide coverage in areas within the building that are within 75 feet (22 860 mm) of the revolving doors.
4. There is an actuation of a manual control switch, in an approved location and clearly identified, that reduces the breakout force to not more than 130 pounds (578 N).

1010.1.4.2 Power-operated doors. Where means of egress doors are operated or assisted by power, the design shall be such that in the event of power failure, the door is capable of being opened manually to permit means of egress travel or closed where necessary to safeguard means of egress. The forces required to open these doors manually shall not exceed
those specified in Section 1010.1.3, except that the force to set the door in motion shall not exceed 50 pounds (220 N). The door shall be capable of swinging open from any position to the full width of the opening in which such door is installed when a force is applied to the door on the side from which egress is made. Power-operated swinging doors, power-operated sliding doors and power operated folding doors shall comply with BHMA A156.10. Power-assisted swinging doors and low energy power-operated swinging doors shall comply with BHMA A156.19.

**Exceptions:**

1. Occupancies in Group I-3.
2. Horizontal sliding doors complying with Section 1010.1.4.3.
3. For a biparting door in the emergency breakout mode, a door leaf located within a multiple-leaf opening shall be exempt from the minimum 32-inch (813 mm) single-leaf requirement of Section 1010.1.1, provided a minimum 32-inch (813 mm) clear opening is provided when the two biparting leaves meeting in the center are broken out.

1010.1.4.3 Special purpose horizontal sliding, accordion or folding doors. In other than Group H occupancies, special purpose horizontal sliding, accordion or folding door assemblies permitted to be a component of a means of egress in accordance with Exception 6 to Section 1010.1.2 shall comply with all of the following criteria:

1. The doors shall be power operated and shall be capable of being operated manually in the event of power failure.
2. The doors shall be openable by a simple method from both sides without special knowledge or effort.
3. The force required to operate the door shall not exceed 30 pounds (133 N) to set the door in motion and 15 pounds (67 N) to close the door or open it to the minimum required width.
4. The door shall be openable with a force not to exceed 15 pounds (67 N) when a force of 250 pounds (1100 N) is applied perpendicular to the door adjacent to the operating device.
5. The door assembly shall comply with the applicable fire protection rating and, where rated, shall be self-closing or automatic closing by smoke detection in accordance with Section 716.5.9.3, shall be installed in accordance with NFPA 80 and shall comply with Section 716.
6. The door assembly shall have an integrated standby power supply.
7. The door assembly power supply shall be electrically supervised.
8. The door shall open to the minimum required width within 10 seconds after activation of the operating device.

1010.1.4.4 Security grilles. In Groups B, F, M and S, horizontal sliding or vertical security grilles are permitted at the main exit and shall be openable from the inside without the use of a key or special knowledge or effort during periods that the space is occupied. The grilles shall remain secured in the full-open position during the period of occupancy by the general public. Where two or more means of egress are required, not more than one-half of the exits or exit access doorways shall be equipped with horizontal sliding or vertical security grilles.

1010.1.5 Floor elevation. There shall be a floor or landing on each side of a door. Such floor or landing shall be at the same elevation on each side of the door. Landings shall be level except for exterior landings, which are permitted to have a slope not to exceed 0.25 unit vertical in 12 units horizontal (2-percent slope).

Exceptions:
1. Doors serving individual dwelling units in Groups R-2 and R-3 where the following apply:
   1.1. A door is permitted to open at the top step of an interior flight of stairs, provided the door does not swing over the top step.
   1.2. Screen doors and storm doors are permitted to swing over stairs or landings.
2. Exterior doors as provided for in Section 1003.5, Exception 1, and Section 1022.2, which are not on an accessible route.
3. In Group R-3 occupancies not required to be Accessible units, Type A units or Type B units, the landing at an exterior doorway shall be not more than 7 3/4 inches (197 mm) below the top of the threshold, provided the door, other than an exterior storm or screen door, does not swing over the landing.
4. In units not required to be Accessible units, Type A units or Type B units, variations in elevation due to differences in finish materials, but not more than 1/2 inch (12.7 mm).
5. Exterior decks, patios or balconies that are part of Type B dwelling units, have impervious surfaces and that are not more than 4 inches (102 mm) below the finished floor level of the adjacent interior space of the dwelling unit.
6. Doors serving equipment spaces not required to be accessible in accordance with Section 1103.2.9 and serving an occupant load of five or less shall be permitted to have a landing on one side to be not more
than 7 inches (178 mm) above or below the landing on the egress side of the door.

1010.1.6 Landings at doors. Landings shall have a width not less than the width of the stairway or the door, whichever is greater. Doors in the fully open position shall not reduce a required dimension by more than 7 inches (178 mm). Where a landing serves an occupant load of 50 or more, doors in any position shall not reduce the landing to less than one-half its required width. Landings shall have a length measured in the direction of travel of not less than 44 inches (1118 mm).

Exception: Landing length in the direction of travel in Groups R-3 and U and within individual units of Group R-2 need not exceed 36 inches (914 mm) when the units are not required to be Accessible units or Type A units.

1010.1.7 Thresholds. Thresholds at doorways shall not exceed \(\frac{3}{4}\) inch (19.1 mm) in height above the finished floor or landing for sliding doors serving dwelling units or \(\frac{1}{2}\) inch (12.7 mm) above the finished floor or landing for other doors. Raised thresholds and floor level changes greater than \(\frac{1}{4}\) inch (6.4 mm) at doorways shall be beveled with a slope not greater than one unit vertical in two units horizontal (50-percent slope).

Exceptions:

1. In occupancy Group R-2 or R-3, threshold heights for sliding and side-hinged exterior doors shall be permitted to be up to \(7\frac{3}{4}\) inches (197 mm) in height if all of the following apply:
   1.1. The door is not part of the required means of egress.
   1.2. The door is not part of an accessible route as required by Chapter 11.
   1.3. The door is not part of an Accessible unit, Type A unit or Type B unit.

2. In Type B units, where Exception 5 to Section 1010.1.5 permits a 4-inch (102 mm) elevation change at the door, the threshold height on the exterior side of the door shall not exceed \(4\frac{3}{4}\) inches (120 mm) in height above the exterior deck, patio or balcony for sliding doors or \(4\frac{1}{2}\) inches (114 mm) above the exterior deck, patio or balcony for other doors.

1010.1.8 Door arrangement. Space between two doors in a series shall be 48 inches (1219 mm) minimum plus the width of a door swinging into the space. Doors in a series shall swing either in the same direction or away from the space between the doors.

Exceptions:
1. The minimum distance between horizontal sliding power-operated doors in a series shall be 48 inches (1219 mm).

2. Storm and screen doors serving individual dwelling units in Groups R-2 and R-3 need not be spaced 48 inches (1219 mm) from the other door.

3. Doors within individual dwelling units in Groups R-2 and R-3 other than within Type A dwelling units.

1010.1.9 Door operations. Except as specifically permitted by this section, egress doors shall be readily openable from the egress side without the use of a key or special knowledge or effort.

1010.1.9.1 Hardware. Door handles, pulls, latches, locks and other operating devices on doors required to be accessible by Chapter 11 shall not require tight grasping, tight pinching or twisting of the wrist to operate.

Exception: Non-fixed portions of door or gate hardware, including keys, access cards and temporary door locking devices.

1010.1.9.2 Hardware height. Door handles, pulls, latches, locks and other operating devices shall be installed 34 inches (864 mm) minimum and 48 inches (1219 mm) maximum above the finished floor. Locks used only for security purposes and not used for normal operation are permitted at any height.

Exception: Access doors or gates in barrier walls and fences protecting pools, spas and hot tubs shall be permitted to have operable parts of the release of latch on self-latching devices at 54 inches (1370 mm) maximum above the finished floor or ground, provided the self-latching devices are not also self locking devices operated by means of a key, electronic opener or integral combination lock.

1010.1.9.3 Locks and latches. Locks and latches shall be permitted to prevent operation of doors where any of the following exist:

1. Places of detention or restraint.
2. In buildings in occupancy Group A having an occupant load of 300 or less, Groups B, F, M and S, and in places of religious worship, the main door or doors are permitted to be equipped with key-operated locking devices from the egress side provided:
2.1. The locking device is readily distinguishable as locked.
2.2. A readily visible durable sign is posted on the egress side on or adjacent to the door stating: THIS DOOR TO REMAIN UNLOCKED WHEN THIS SPACE IS OCCUPIED. The sign shall be in letters 1 inch (25 mm) high on a contrasting background.

2.3. The use of the key-operated locking device is revocable by the building official for due cause.

3. Where egress doors are used in pairs, approved automatic flush bolts shall be permitted to be used, provided that the door leaf having the automatic flush bolts does not have a doorknob or surface-mounted hardware.

4. Doors from individual dwelling or sleeping units of Group R occupancies having an occupant load of 10 or less are permitted to be equipped with a night latch, dead bolt or security chain, provided such devices are openable from the inside without the use of a key or tool.

5. Fire doors after the minimum elevated temperature has disabled the unlatching mechanism in accordance with listed fire door test procedures.

6. Temporary door locking device used in accordance with section 1010.4.

1010.1.9.4 Bolt locks. Manually operated flush bolts or surface bolts are not permitted.

Exceptions:

1. On doors not required for egress in individual dwelling units or sleeping units.

2. Where a pair of doors serves a storage or equipment room, manually operated edge- or surface-mounted bolts are permitted on the inactive leaf.

3. Where a pair of doors serves an occupant load of less than 50 persons in a Group B, F or S occupancy, manually operated edge- or surface-mounted bolts are permitted on the inactive leaf. The inactive leaf shall not contain doorknobs, panic bars or similar operating hardware.

4. Where a pair of doors serves a Group B, F or S Occupancy, manually operated edge- or surface-mounted bolts are permitted on the inactive leaf provided such inactive leaf is not needed to meet egress capacity requirements and the building is equipped throughout with an automatic sprinkler system in accordance with
Section 903.3.1.1. The inactive leaf shall not contain doorknobs, panic bars or similar operating hardware.

5. Where a pair of doors serves patient care rooms in Group I-2 occupancies, self-latching edge- or surface-mounted bolts are permitted on the inactive leaf provided that the inactive leaf is not needed to meet egress capacity requirements and the inactive leaf shall not contain doorknobs, panic bars or similar operating hardware.

1010.1.9.5 Unlatching. The unlatching of any door or leaf shall not require more than one operation.

Exceptions:
1. Places of detention or restraint.
2. Where manually operated bolt locks are permitted by Section 1010.1.9.4.
3. Doors with automatic flush bolts as permitted by Section 1010.1.9.3, Item 3.
4. Doors from individual dwelling units and sleeping units of Group R occupancies as permitted by Section 1010.1.9.3, Item 4.
5. Temporary door locking device used in accordance with section 1010.4.

1010.1.9.5.1 Closet and bathroom doors in Group R-4 occupancies.
In Group R-4 occupancies, closet doors that latch in the closed position shall be openable from inside the closet, and bathroom doors that latch in the closed position shall be capable of being unlocked from the ingress side.

1010.1.9.6 Controlled egress doors in Groups I-1 and I-2. Electric locking systems, including electromechanical locking systems and electromagnetic locking systems, shall be permitted to be locked in the means of egress in Group I-1 or I-2 occupancies where the clinical needs of persons receiving care require their containment. Controlled egress doors shall be permitted in such occupancies where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or an approved automatic smoke or heat detection system installed throughout the locked space in accordance with Section 907, provided that the doors are installed and operate in accordance with all of the following:
1. The door locks shall unlock on actuation of the automatic sprinkler system or automatic fire detection system.
2. The door locks shall unlock on loss of power controlling the lock or lock mechanism.
3. The door locking system shall be installed to have the capability of being unlocked by a switch located at the fire command center, a nursing station or other approved location. The switch shall directly break power to the lock.
4. A building occupant shall not be required to pass through more than one door equipped with a controlled egress locking system before entering an exit.
5. The procedures for unlocking the doors shall be described and approved as part of the emergency planning and preparedness required by Chapter 4 of the Fire code.
6. All clinical staff shall have the keys, codes or other means necessary to operate the locking systems.
7. Emergency lighting shall be provided at the door.
8. The door locking system units shall be listed in accordance with UL 294.

**Exceptions:**

1. Items 1 through 4 shall not apply to doors to areas occupied by persons who, because of clinical needs, require restraint or containment as part of the function of a psychiatric treatment area.
2. Items 1 through 4 shall not apply to doors to areas where a listed egress control system is utilized to reduce the risk of child abduction from nursery and obstetric areas of a Group I2 hospital.

**1010.1.9.7 Delayed egress.** Delayed egress locking systems shall be permitted to be installed on doors serving any occupancy except Group A, E and H in buildings that are equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or an approved automatic smoke or heat detection system installed in accordance with Section 907. The locking system shall be installed and operated in accordance with all of the following:

1. The delay electronics of the delayed egress locking system shall deactivate upon actuation of the automatic sprinkler system or automatic fire detection system, allowing immediate, free egress.
2. The delay electronics of the delayed egress locking system shall deactivate upon loss of power controlling the lock or lock mechanism, allowing immediate free egress.
3. The delayed egress locking system shall have the capability of being deactivated at the fire command center and other approved locations.

4. An attempt to egress shall initiate an irreversible process that shall allow such egress in not more than 15 seconds when a physical effort to exit is applied to the egress side door hardware for not more than 3 seconds. Initiation of the irreversible process shall activate an audible signal in the vicinity of the door. Once the delay electronics have been deactivated, rearming the delay electronics shall be by manual means only.
   **Exception:** Where approved, a delay of not more than 30 seconds is permitted on a delayed egress door.

5. The egress path from any point shall not pass through more than one delayed egress locking system.
   **Exception:** In Group I-2 or I-3 occupancies, the egress path from any point in the building shall pass through not more than two delayed egress locking systems provided the combined delay does not exceed 30 seconds.

6. A sign shall be provided on the door and shall be located above and within 12 inches (305 mm) of the door exit hardware:
   6.1. For doors that swing in the direction of egress, the sign shall read: PUSH UNTIL ALARM SOUNDS. DOOR CAN BE OPENED IN 15 [30] SECONDS.
   6.2. For doors that swing in the opposite direction of egress, the sign shall read: PULL UNTIL ALARM SOUNDS. DOOR CAN BE OPENED IN 15 [30] SECONDS.
   6.3. The sign shall comply with the visual character requirements in ICC A117.1.
   **Exception:** Where approved, in Group I occupancies, the installation of a sign is not required where care recipients who because of clinical needs require restraint or containment as part of the function of the treatment area.

7. Emergency lighting shall be provided on the egress side of the door.

8. The delayed egress locking system units shall be listed in accordance with UL 294.

9. **The procedures for the operation(s) of the unlocking system shall be described and approved as part of the emergency planning and preparedness required by Chapter 4 of the fire code.**

10. **All clinical staff shall have the keys, codes or other means necessary to operate the locking devices.**
**Exception:** In Group I-2 occupancies, items 1 through 3 shall not apply to doors to areas where persons, because of clinical needs, require restraint or containment as part of the function of a mental hospital.

**1010.1.9.8 Sensor release of electrically locked egress doors.** The electric locks on sensor released doors located in a means of egress in buildings with an occupancy in Group A, B, E, I-1, I-2, I-4, M, R-1 or R2 and entrance doors to tenant spaces in occupancies in Group A, B, E, I-1, I-2, I-4, M, R-1 or R-2 are permitted where installed and operated in accordance with all of the following criteria:

1. The sensor shall be installed on the egress side, arranged to detect an occupant approaching the doors. The doors shall be arranged to unlock by a signal from or loss of power to the sensor.
2. Loss of power to the lock or locking system shall automatically unlock the doors.
3. The doors shall be arranged to unlock from a manual unlocking device located 40 inches to 48 inches (1016 mm to 1219 mm) vertically above the floor and within 5 feet (1524 mm) of the secured doors. Ready access shall be provided to the manual unlocking device and the device shall be clearly identified by a sign that reads “PUSH TO EXIT.” When operated, the manual unlocking device shall result in direct interruption of power to the lock— independent of other electronics—and the doors shall remain unlocked for not less than 30 seconds.
4. Activation of the building fire alarm system, where provided, shall automatically unlock the doors, and the doors shall remain unlocked until the fire alarm system has been reset.
5. Activation of the building automatic sprinkler system or fire detection system, where provided, shall automatically unlock the doors. The doors shall remain unlocked until the fire alarm system has been reset.
6. The door locking system units shall be listed in accordance with UL 294.

**1010.1.9.9 Electromagnetically locked egress doors.** Doors in the means of egress in buildings with an occupancy in Group A, B, E, I-1, I-2, I-4, M, R-1 or R-2 and doors to tenant spaces in Group A, B, E, I-1, I-2, I-4, M, R-1 or R-2 shall be permitted to be locked with an electromagnetic locking system where equipped with hardware that incorporates a built-in switch and where installed and operated in accordance with all of the
following:
1. The hardware that is affixed to the door leaf has an obvious method of operation that is readily operated under all lighting conditions.
2. The hardware is capable of being operated with one hand.
3. Operation of the hardware directly interrupts the power to the electromagnetic lock and unlocks the door immediately.
4. Loss of power to the locking system automatically unlocks the door.
5. Where panic or fire exit hardware is required by Section 1010.1.10, operation of the panic or fire exit hardware also releases the electromagnetic lock.
6. The locking system units shall be listed in accordance with UL 294.

1010.1.9.10 Locking arrangements in correctional facilities. In occupancies in Groups A-2, A-3, A-4, B, E, F, I-2, I-3, M and S within correctional and detention facilities, doors in means of egress serving rooms or spaces occupied by persons whose movements are controlled for security reasons shall be permitted to be locked where equipped with egress control devices that shall unlock manually and by not less than one of the following means:
1. Activation of an automatic sprinkler system installed in accordance with Section 903.3.1.1.
2. Activation of an approved manual fire alarm box.
3. A signal from a constantly attended location.

1010.1.9.11 Stairway doors. Interior stairway means of egress doors shall be openable from both sides without the use of a key or special knowledge or effort.

Exceptions:
1. Stairway discharge doors shall be openable from the egress side and shall only be locked from the opposite side.
2. This section shall not apply to doors arranged in accordance with Section 403.5.3.
3. In stairways serving not more than four stories, doors are permitted to be locked from the side opposite the egress side,
provided they are openable from the egress side and capable of being unlocked simultaneously without unlatching upon a signal from the fire command center, if present, or a signal by emergency personnel from a single location inside the main entrance to the building.

4. Stairway exit doors shall be openable from the egress side and shall only be locked from the opposite side in Group B, F, M and S occupancies where the only interior access to the tenant space is from a single exit stairway where permitted in Section 1006.3.2.

5. Stairway exit doors shall be openable from the egress side and shall only be locked from the opposite side in Group R-2 occupancies where the only interior access to the dwelling unit is from a single exit stairway where permitted in Section 1006.3.2.

1010.1.10 Panic and fire exit hardware. Doors serving a Group H occupancy and doors serving rooms or spaces with an occupant load of 50 or more in a Group A or E occupancy shall not be provided with a latch or lock other than panic hardware or fire exit hardware.

Exceptions:

1. A main exit of a Group A occupancy shall be permitted to be locking in accordance with Section 1010.1.9.3, Item 2.
2. Doors serving a Group A or E occupancy shall be permitted to be electromagnetically locked in accordance with Section 1010.1.9.9.

Where an exit access doorway is provided from an electrical equipment workspace, the door shall be equipped with panic hardware or fire exit hardware as required in Articles 110.26(C)(3), 110.31(A)(4), and 110.33(A)(3) of NFPA 70.

1010.1.10.1 Installation. Where panic or fire exit hardware is installed, it shall comply with the following:

1. Panic hardware shall be listed in accordance with UL 305.
2. Fire exit hardware shall be listed in accordance with UL 10C and UL 305.
3. The actuating portion of the releasing device shall extend not less than one-half of the door leaf width.
4. The maximum unlatching force shall not exceed 15 pounds (67 N).

1010.1.10.2 Balanced doors. If balanced doors are used and panic
hardware is required, the panic hardware shall be the push-pad type and the pad shall not extend more than one-half the width of the door measured from the latch side.

1010.2 Gates. Gates serving the means of egress system shall comply with the requirements of this section. Gates used as a component in a means of egress shall conform to the applicable requirements for doors.

Exception: Horizontal sliding or swinging gates exceeding the 4-foot (1219 mm) maximum leaf width limitation are permitted in fences and walls surrounding a stadium.

1010.2.1 Stadiums. Panic hardware is not required on gates surrounding stadiums where such gates are under constant immediate supervision while the public is present, and where safe dispersal areas based on 3 square feet (0.28 m²) per occupant are located between the fence and enclosed space. Such required safe dispersal areas shall not be located less than 50 feet (15 240 mm) from the enclosed space. See Section 1028.5 for means of egress from safe dispersal areas.

1010.3 Turnstiles. Turnstiles or similar devices that restrict travel to one direction shall not be placed so as to obstruct any required means of egress.

Exception: Each turnstile or similar device shall be credited with a capacity based on not more than a 50-person occupant load where all of the following provisions are met:
1. Each device shall turn free in the direction of egress travel when primary power is lost and on the manual release by an employee in the area.
2. Such devices are not given credit for more than 50 percent of the required egress capacity or width.
3. Each device is not more than 39 inches (991 mm) high.
4. Each device has not less than 16¹/₂ inches (419 mm) clear width at and below a height of 39 inches (991 mm) and not less than 22 inches (559 mm) clear width at heights above 39 inches (991 mm).

Where located as part of an accessible route, turnstiles shall have not less than 36 inches (914 mm) clear at and below a height of 34 inches (864 mm), not less than 32 inches (813 mm) clear width between 34 inches (864 mm) and 80 inches (2032 mm) and shall consist of a mechanism other than a revolving device.

1010.3.1 High turnstile. Turnstiles more than 39 inches (991 mm) high shall meet the requirements for revolving doors.
1010.3.2 Additional door. Where serving an occupant load greater than 300, each turnstile that is not portable shall have a side-hinged swinging door that conforms to Section 1010.1 within 50 feet (15 240 mm).

1010.3.3 Security access turnstiles. Security access turnstiles that inhibit travel in the direction of egress utilizing a physical barrier shall be permitted to be considered as a component of the means of egress, provided that all of the following criteria are met:

1. The building is protected throughout by an automatic sprinkler system in accordance with Section 903.3.1.1.

2. Each security access turnstile lane configuration has a minimum clear passage width of 22 inches (559 mm).

3. Any security access turnstile lane configuration providing a clear passage width of less than 32 inches (810 mm) shall be credited with a maximum egress capacity of 50 persons.

4. Any security access turnstile lane configuration providing a clear passage width of 32 inches (810 mm) or more shall be credited with a maximum egress capacity as calculated in accordance with Section 1005.

5. Each secured physical barrier shall automatically retract or swing to an unobstructed open position in the direction of egress, under each of the following conditions:

   5.1 Upon loss of power to the turnstile or any part of the access control system that secures the physical barrier.

   5.2 Upon actuation of a clearly identified manual release device with ready access that results in direct interruption of power to each secured physical barrier, after which such barriers remain in the open position for not less than 30 seconds. The manual release device shall be positioned at one of the following locations:

   5.2.1 On the egress side of each security access turnstile lane.

   5.2.2 At an approved location where it can be actuated by an employee assigned to the area at all times that the building is occupied.
5.3 Upon actuation of the building fire alarm system, if provided, after which the physical barrier remains in the open position until the fire alarm system is manually reset.

   Exception: Actuation of a manual fire alarm box.

5.4 Upon actuation of the building automatic sprinkler or fire detection system, after which the physical barrier remains in the open position until the fire alarm system is manually reset.

1010.4. Temporary door locking device in school buildings. A temporary door locking device shall be permitted when approved by the building official and noted on the certificate of occupancy only in school buildings where the requirements of sections 1010.4.1 and 1010.4.2 are met.

1010.4.1 Conditions of use. A temporary door locking device shall only be used on doors under the following conditions:

   1. Proof is provided by the administrative authority of a school building that a school safety plan has been adopted and filed pursuant to section 3313.536 of the Revised Code; and
   2. The temporary door locking device shall only be used in an emergency situation and during active shooter drills; and
   3. The temporary door locking device is engaged only by a staff member of the school building; and
   4. The temporary door locking device shall only be engaged for a finite period of time as determined by the administrative authority of a school building in accordance with the school safety plan adopted pursuant to section 3313.536 of the Revised Code; and
   5. Proof is provided by the administrative authority of a school building that police and fire officials having jurisdiction for the school building have been notified prior to the use of the temporary door locking device; and
   6. In-service training on the use of the temporary door locking device is provided for school staff members and records verifying this training shall be maintained on file and provided to the fire official upon request.

1010.4.2 Operational requirements. The temporary door locking device shall be permitted to be used in accordance with the following items:

   1. The temporary door locking device shall not be permanently mounted to the door.

   Exception: Individual parts of the temporary door locking device
assembly such as bolts, stops, brackets, pins, etc. that do not prevent normal ingress and egress through the door may be permanently mounted provided that when such parts are mounted on a labeled fire door assembly such installation does not affect the fire rating of the fire door assembly.

2. The removal of the temporary door locking device, after it is engaged, shall not require more than one operation. 

Exception: Two operations may be permitted to remove a temporary door locking device, after it is engaged, if the school building is equipped throughout with an automatic sprinkler system in accordance with section 903.3.1.1.

Provisions of the “Americans with Disabilities Act of 1990,” 104 Stat. 327, 42 U.S.C.A. 12101, as amended, may apply to the use of the temporary door locking device but are outside the scope of this code.

SECTION 1011
STAIRWAYS

1011.1 General. Stairways serving occupied portions of a building shall comply with the requirements of Sections 1011.2 through 1011.13. Alternating tread devices shall comply with Section 1011.14. Ships ladders shall comply with Section 1011.15. Ladders shall comply with Section 1011.16.

Exception: Within rooms or spaces used for assembly purposes, stepped aisles shall comply with Section 1029.

1011.2 Width and capacity. The required capacity of stairways shall be determined as specified in Section 1005.1, but the minimum width shall be not less than 44 inches (1118 mm). See Section 1009.3 for accessible means of egress stairways.

Exceptions:
1. Stairways serving an occupant load of less than 50 shall have a width of not less than 36 inches (914 mm).
2. Spiral stairways as provided for in Section 1011.10.
3. Where an incline platform lift or stairway chairlift is installed on stairways serving occupancies in Group R-3, or within dwelling units in occupancies in Group R-2, a clear passage width not less than 20 inches (508 mm) shall be provided. Where the seat and platform can be folded when not in use, the distance shall be measured from the folded position.

1011.3 Headroom. Stairways shall have a headroom clearance of not less than 80
inches (2032 mm) measured vertically from a line connecting the edge of the nosings. Such headroom shall be continuous above the stairway to the point where the line intersects the landing below, one tread depth beyond the bottom riser. The minimum clearance shall be maintained the full width of the stairway and landing.

**Exceptions:**
1. Spiral stairways complying with Section 1011.10 are permitted a 78-inch (1981 mm) headroom clearance.
2. In Group R-3 occupancies; within dwelling units in Group R-2 occupancies; and in Group U occupancies that are accessory to a Group R-3 occupancy or accessory to individual dwelling units in Group R-2 occupancies; where the nosings of treads at the side of a flight extend under the edge of a floor opening through which the stair passes, the floor opening shall be allowed to project horizontally into the required headroom not more than 4³/₄ inches (121 mm).

### 1011.4 Walkline.
The walkline across winder treads shall be concentric to the direction of travel through the turn and located 12 inches (305 mm) from the side where the winders are narrower. The 12-inch (305 mm) dimension shall be measured from the widest point of the clear stair width at the walking surface of the winder. Where winders are adjacent within the flight, the point of the widest clear stair width of the adjacent winders shall be used.

### 1011.5 Stair treads and risers.
Stair treads and risers shall comply with Sections 1011.5.1 through 1011.5.5.3.

#### 1011.5.1 Dimension reference surfaces.
For the purpose of this section, all dimensions are exclusive of carpets, rugs or runners.

#### 1011.5.2 Riser height and tread depth.
Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum. The riser height shall be measured vertically between the nosings of adjacent treads. Rectangular tread depths shall be 11 inches (279 mm) minimum measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread’s nosing. Winder treads shall have a minimum tread depth of 11 inches (279 mm) between the vertical planes of the foremost projection of adjacent treads at the intersections with the walkline and a minimum tread depth of 10 inches (254 mm) within the clear width of the stair.

**Exceptions:**
1. Spiral stairways in accordance with Section 1011.10.
2. Stairways connecting stepped aisles to cross aisles or concourses shall be permitted to use the riser/tread dimension in Section 1029.13.2.

3. In Group R-3 occupancies; within dwelling units in Group R-2 occupancies; and in Group U occupancies that are accessory to a Group R-3 occupancy or accessory to individual dwelling units in Group R-2 occupancies; the maximum riser height shall be 7 3/4 inches (197 mm); the minimum tread depth shall be 10 inches (254 mm); the minimum winder tread depth at the walkline shall be 10 inches (254 mm); and the minimum winder tread depth shall be 6 inches (152 mm). A nosing projection not less than 3/4 inch (19.1 mm) but not more than 1 1/4 inches (32 mm) shall be provided on stairways with solid risers where the tread depth is less than 11 inches (279 mm).

4. See Sections 3404 and 3411.6 for the replacement of existing stairways.

5. In Group I-3 facilities, stairways providing access to guard towers, observation stations and control rooms, not more than 250 square feet (23 m²) in area, shall be permitted to have a maximum riser height of 8 inches (203 mm) and a minimum tread depth of 9 inches (229 mm).

1011.5.3 Winder treads. Winder treads are not permitted in means of egress stairways except within a dwelling unit.

**Exceptions:**
1. Curved stairways in accordance with Section 1011.9.
2. Spiral stairways in accordance with Section 1011.10.

1011.5.4 Dimensional uniformity. Stair treads and risers shall be of uniform size and shape. The tolerance between the largest and smallest riser height or between the largest and smallest tread depth shall not exceed 3/8 inch (9.5 mm) in any flight of stairs. The greatest winder tread depth at the walkline within any flight of stairs shall not exceed the smallest by more than 3/8 inch (9.5 mm).

**Exceptions:**
1. Stairways connecting stepped aisles to cross aisles or concourses shall be permitted to comply with the dimensional no uniformity in Section 1029.13.2.
2. Consistently shaped winders, complying with Section 1011.5, differing from rectangular treads in the same flight of stairs.
3. Non uniform riser dimension complying with Section 1011.5.4.1.

1011.5.4.1 Non uniform height risers. Where the bottom or top riser adjoins a sloping public way, walkway or driveway having an established
grade and serving as a landing, the bottom or top riser is permitted to be reduced along the slope to less than 4 inches (102 mm) in height, with the variation in height of the bottom or top riser not to exceed one unit vertical in 12 units horizontal (8-percent slope) of stair width. The nosings or leading edges of treads at such nonuniform height risers shall have a distinctive marking stripe, different from any other nosing marking provided on the stair flight. The distinctive marking stripe shall be visible in descent of the stair and shall have a slip-resistant surface. Marking stripes shall have a width of not less than 1 inch (25 mm) but not more than 2 inches (51 mm).

1011.5.5 Nosing and riser profile. Nosings shall have a curvature or bevel of not less than \( \frac{1}{16} \) inch (1.6 mm) but not more than \( \frac{9}{16} \) inch (14.3 mm) from the foremost projection of the tread. Risers shall be solid and vertical or sloped under the tread above from the underside of the nosing above at an angle not more than 30 degrees (0.52 rad) from the vertical.

1011.5.5.1 Nosing projection size. The leading edge (nosings) of treads shall project not more than 1\( \frac{1}{4} \) inches (32 mm) beyond the tread below.

1011.5.5.2 Nosing projection uniformity. Nosing projections of the leading edges shall be of uniform size, including the projections of the nosing’s leading edge of the floor at the top of a flight.

1011.5.5.3 Solid risers. Risers shall be solid.

Exceptions:
1. Solid risers are not required for stairways that are not required to comply with Section 1009.3, provided that the opening between treads does not permit the passage of a sphere with a diameter of 4 inches (102 mm).
2. Solid risers are not required for occupancies in Group I-3 or in Group F, H and S occupancies other than areas accessible to the public. There are no restrictions on the size of the opening in the riser.
3. Solid risers are not required for spiral stairways constructed in accordance with Section 1011.10.

1011.6 Stairway landings. There shall be a floor or landing at the top and bottom of each stairway. The width of landings shall be not less than the width of stairways served. Every landing shall have a minimum width measured
perpendicular to the direction of travel equal to the width of the stairway. Where the stairway has a straight run the depth need not exceed 48 inches (1219 mm). Doors opening onto a landing shall not reduce the landing to less than one-half the required width. When fully open, the door shall not project more than 7 inches (178 mm) into a landing. Where wheelchair spaces are required on the stairway landing in accordance with Section 1009.6.3, the wheelchair space shall not be located in the required width of the landing and doors shall not swing over the wheelchair spaces.

**Exception:** Where stairways connect stepped aisles to cross aisles or concourses, stairway landings are not required at the transition between stairways and stepped aisles constructed in accordance with Section 1029.

**1011.7 Stairway construction.** Stairways shall be built of materials consistent with the types permitted for the type of construction of the building, except that wood handrails shall be permitted for all types of construction.

**1011.7.1 Stairway walking surface.** The walking surface of treads and landings of a stairway shall not be sloped steeper than one unit vertical in 48 units horizontal (2-percent slope) in any direction. Stairway treads and landings shall have a solid surface. Finish floor surfaces shall be securely attached.

**Exceptions:**
1. Openings in stair walking surfaces shall be a size that does not permit the passage of 1/2-inch-diameter (12.7 mm) sphere. Elongated openings shall be placed so that the long dimension is perpendicular to the direction of travel.
2. In Group F, H and S occupancies, other than areas of parking structures accessible to the public, openings in treads and landings shall not be prohibited provided a sphere with a diameter of 1 1/8 inches (29 mm) cannot pass through the opening.

**1011.7.2 Outdoor conditions.** Outdoor stairways and outdoor approaches to stairways shall be designed so that water will not accumulate on walking surfaces.

**1011.7.3 Enclosures under interior stairways.** The walls and soffits within enclosed usable spaces under enclosed and unenclosed stairways shall be protected by 1-hour fire-resistance-rated construction or the fire-resistance rating of the stairway enclosure, whichever is greater. Access to the enclosed space shall not be directly from within the stairway enclosure.

**Exception:** Spaces under stairways serving and contained within a single
residential dwelling unit in Group R-2 or R-3 shall be permitted to be protected on the enclosed side with \( \frac{1}{2} \)-inch (12.7 mm) gypsum board.

1011.7.4 Enclosures under exterior stairways. There shall not be enclosed usable space under exterior exit stairways unless the space is completely enclosed in 1-hour fire-resistance-rated construction. The open space under exterior stairways shall not be used for any purpose.

1011.8 Vertical rise. A flight of stairs shall not have a vertical rise greater than 12 feet (3658 mm) between floor levels or landings.

Exception: Spiral stairways used as a means of egress from technical production areas.

1011.9 Curved stairways. Curved stairways with winder treads shall have treads and risers in accordance with Section 1011.5 and the smallest radius shall be not less than twice the minimum width or required capacity of the stairway.

Exception: The radius restriction shall not apply to curved stairways in Group R-3 and within individual dwelling units in Group R-2.

1011.10 Spiral stairways. Spiral stairways are permitted to be used as a component in the means of egress only within dwelling units or from a space not more than 250 square feet (23 m²) in area and serving not more than five occupants, or from technical production areas in accordance with Section 410.6. A spiral stairway shall have a \( 7\frac{1}{2} \)-inch (191 mm) minimum clear tread depth at a point 12 inches (305 mm) from the narrow edge. The risers shall be sufficient to provide a headroom of 78 inches (1981 mm) minimum, but riser height shall not be more than \( 9\frac{1}{2} \) inches (241 mm). The minimum stairway clear width at and below the handrail shall be 26 inches (660 mm).

1011.11 Handrails. Stairways shall have handrails on each side and shall comply with Section 1014. Where glass is used to provide the handrail, the handrail shall comply with Section 2407.

Exceptions:

1. Stairways within dwelling units and spiral stairways are permitted to have a handrail on one side only.
2. Decks, patios and walkways that have a single change in elevation where the landing depth on each side of the change of elevation is greater than what is required for a landing do not require handrails.
3. In Group R-3 occupancies, a change in elevation consisting of a single riser at an entrance or egress door does not require handrails.
4. Changes in room elevations of three or fewer risers within dwelling units and sleeping units in Group R2 and R-3 do not require handrails.

1011.12 Stairway to roof. In buildings four or more stories above grade plane, one stairway shall extend to the roof surface unless the roof has a slope steeper than four units vertical in 12 units horizontal (33-percent slope).
   Exception: Other than where required by Section 1011.12.1, in buildings without an occupied roof access to the roof from the top story shall be permitted to be by an alternating tread device, a ships ladder or a permanent ladder.

1011.12.1 Stairway to elevator equipment. Deleted.

1011.12.2 Roof access. Where a stairway is provided to a roof, access to the roof shall be provided through a penthouse complying with Section 1510.2.
   Exception: In buildings without an occupied roof, access to the roof shall be permitted to be a roof hatch or trap door not less than 16 square feet (1.5 m²) in area and having a minimum dimension of 2 feet (610 mm).

1011.13 Guards. Guards shall be provided along stairways and landings where required by Section 1015 and shall be constructed in accordance with Section 1015. Where the roof hatch opening providing the required access is located within 10 feet (3049 mm) of the roof edge, such roof access or roof edge shall be protected by guards installed in accordance with Section 1015.

1011.14 Alternating tread devices. Alternating tread devices are limited to an element of a means of egress in buildings of Groups F, H and S from a mezzanine not more than 250 square feet (23 m²) in area and that serves not more than five occupants; in buildings of Group I-3 from a guard tower, observation station or control room not more than 250 square feet (23 m²) in area and for access to unoccupied roofs. Alternating tread devices used as a means of egress shall not have a rise greater than 20 feet (6096 mm) between floor levels or landings.

1011.14.1 Handrails of alternating tread devices. Handrails shall be provided on both sides of alternating tread devices and shall comply with Section 1014.

1011.14.2 Treads of alternating tread devices. Alternating tread devices shall have a minimum tread depth of 5 inches (127 mm), a minimum projected tread depth of 8 1/2 inches (216 mm), a minimum tread width of 7 inches (178
mm) and a maximum riser height of $9\frac{1}{2}$ inches (241 mm). The tread depth shall be measured horizontally between the vertical planes of the foremost projections of adjacent treads. The riser height shall be measured vertically between the leading edges of adjacent treads. The riser height and tread depth provided shall result in an angle of ascent from the horizontal of between 50 and 70 degrees (0.87 and 1.22 rad). The initial tread of the device shall begin at the same elevation as the platform, landing or floor surface.

**Exception:** Alternating tread devices used as an element of a means of egress in buildings from a mezzanine area not more than 250 square feet (23 m²) in area that serves not more than five occupants shall have a minimum tread depth of 3 inches (76 mm) with a minimum projected tread depth of $10\frac{1}{2}$ inches (267 mm). The rise to the next alternating tread surface shall not exceed 8 inches (203 mm).

### 1011.15 Ships ladders

Ships ladders are permitted to be used in Group I-3 as a component of a means of egress to and from control rooms or elevated facility observation stations not more than 250 square feet (23 m²) with not more than three occupants and for access to unoccupied roofs. The minimum clear width at and below the handrails shall be 20 inches (508 mm).

**1011.15.1 Handrails of ships ladders.** Handrails shall be provided on both sides of ships ladders.

**1011.15.2 Treads of ships ladders.** Ships ladders shall have a minimum tread depth of 5 inches (127 mm). The tread shall be projected such that the total of the tread depth plus the nosing projection is not less than $8\frac{1}{2}$ inches (216 mm). The maximum riser height shall be $9\frac{1}{2}$ inches (241 mm).

### 1011.16 Ladders

Permanent ladders shall not serve as a part of the means of egress from occupied spaces within a building. Permanent ladders shall be permitted to provide access to the following areas:

1. Spaces frequented only by personnel for maintenance, repair or monitoring of equipment.
2. Nonoccupiable spaces accessed only by catwalks, crawl spaces, freight elevators or very narrow passageways.
3. Raised areas used primarily for purposes of security, life safety or fire safety including, but not limited to, observation galleries, prison guard towers, fire towers or lifeguard stands.
4. Elevated levels in Group U not open to the general public.
5. Nonoccupied roofs that are not required to have stairway access in accordance with Section 1011.12.1.
1011.16.1 Ladders shall be constructed in accordance with Section 306.5 of the mechanical code.

SECTION 1012
RAMPS

1012.1 Scope. The provisions of this section shall apply to ramps used as a component of a means of egress.

Exceptions:
1. Ramped aisles within assembly rooms or spaces shall comply with the provisions in Section 1029.
2. Curb ramps shall comply with ICC A117.1.
3. Vehicle ramps in parking garages for pedestrian exit access shall not be required to comply with Sections 1012.3 through 1012.10 where they are not an accessible route serving accessible parking spaces, other required accessible elements or part of an accessible means of egress.

1012.2 Slope. Ramps used as part of a means of egress shall have a running slope not steeper than one unit vertical in 12 units horizontal (8-percent slope). The slope of other pedestrian ramps shall not be steeper than one unit vertical in eight units horizontal (12.5-percent slope).

1012.3 Cross slope. The slope measured perpendicular to the direction of travel of a ramp shall not be steeper than one unit vertical in 48 units horizontal (2-percent slope).

1012.4 Vertical rise. The rise for any ramp run shall be 30 inches (762 mm) maximum.

1012.5 Minimum dimensions. The minimum dimensions of means of egress ramps shall comply with Sections 1012.5.1 through 1012.5.3.

1012.5.1 Width and capacity. The minimum width and required capacity of a means of egress ramp shall be not less than that required for corridors by Section 1020.2. The clear width of a ramp between handrails, if provided, or other permissible projections shall be 36 inches (914 mm) minimum.

1012.5.2 Headroom. The minimum headroom in all parts of the means of egress ramp shall be not less than 80 inches (2032 mm).
1012.5.3 Restrictions. Means of egress ramps shall not reduce in width in the direction of egress travel. Projections into the required ramp and landing width are prohibited. Doors opening onto a landing shall not reduce the clear width to less than 42 inches (1067 mm).

1012.6 Landings. Ramps shall have landings at the bottom and top of each ramp, points of turning, entrance, exits and at doors. Landings shall comply with Sections 1012.6.1 through 1012.6.5.

1012.6.1 Slope. Landings shall have a slope not steeper than one unit vertical in 48 units horizontal (2-percent slope) in any direction. Changes in level are not permitted.

1012.6.2 Width. The landing width shall be not less than the width of the widest ramp run adjoining the landing.

1012.6.3 Length. The landing length shall be 60 inches (1525 mm) minimum.

Exceptions:
1. In Group R-2 and R-3 individual dwelling and sleeping units that are not required to be Accessible units, Type A units or Type B units in accordance with Section 1107, landings are permitted to be 36 inches (914 mm) minimum.
2. Where the ramp is not a part of an accessible route, the length of the landing shall not be required to be more than 48 inches (1220 mm) in the direction of travel.

1012.6.4 Change in direction. Where changes in direction of travel occur at landings provided between ramp runs, the landing shall be 60 inches by 60 inches (1524 mm by 1524 mm) minimum.

Exception: In Group R-2 and R-3 individual dwelling or sleeping units that are not required to be Accessible units, Type A units or Type B units in accordance with Section 1107, landings are permitted to be 36 inches by 36 inches (914 mm by 914 mm) minimum.

1012.6.5 Doorways. Where doorways are located adjacent to a ramp landing, maneuvering clearances required by ICC A117.1 are permitted to overlap the required landing area.

1012.7 Ramp construction. Ramps shall be built of materials consistent with the types permitted for the type of construction of the building, except that wood...
handrails shall be permitted for all types of construction.

1012.7.1 Ramp surface. The surface of ramps shall be of slip-resistant materials that are securely attached.

1012.7.2 Outdoor conditions. Outdoor ramps and outdoor approaches to ramps shall be designed so that water will not accumulate on walking surfaces.

1012.8 Handrails. Ramps with a rise greater than 6 inches (152 mm) shall have handrails on both sides. Handrails shall comply with Section 1014.

1012.9 Guards. Guards shall be provided where required by Section 1015 and shall be constructed in accordance with Section 1015.

1012.10 Edge protection. Edge protection complying with Section 1012.10.1 or 1012.10.2 shall be provided on each side of ramp runs and at each side of ramp landings.

Exceptions:
1. Edge protection is not required on ramps that are not required to have handrails, provided they have flared sides that comply with the ICC A117.1 curb ramp provisions.
2. Edge protection is not required on the sides of ramp landings serving an adjoining ramp run or stairway.
3. Edge protection is not required on the sides of ramp landings having a vertical dropoff of not more than ½ inch (12.7 mm) within 10 inches (254 mm) horizontally of the required landing area.

1012.10.1 Curb, rail, wall or barrier. A curb, rail, wall or barrier shall be provided to serve as edge protection. A curb shall be not less than 4 inches (102 mm) in height. Barriers shall be constructed so that the barrier prevents the passage of a 4-inch-diameter (102 mm) sphere, where any portion of the sphere is within 4 inches (102 mm) of the floor or ground surface.

1012.10.2 Extended floor or ground surface. The floor or ground surface of the ramp run or landing shall extend 12 inches (305 mm) minimum beyond the inside face of a handrail complying with Section 1014.
SECTION 1013
EXIT SIGNS

1013.1 Where required. Exits and exit access doors shall be marked by an approved exit sign readily visible from any direction of egress travel. The path of egress travel to exits and within exits shall be marked by readily visible exit signs to clearly indicate the direction of egress travel in cases where the exit or the path of egress travel is not immediately visible to the occupants. Intervening means of egress doors within exits shall be marked by exit signs. Exit sign placement shall be such that no point in an exit access corridor or exit passageway is more than 100 feet (30 480 mm) or the listed viewing distance for the sign, whichever is less, from the nearest visible exit sign.

Exceptions:
1. Exit signs are not required in rooms or areas that require only one exit or exit access.
2. Main exterior exit doors or gates that are obviously and clearly identifiable as exits need not have exit signs where approved by the building official.
3. Exit signs are not required in occupancies in Group U and individual sleeping units or dwelling units in Group R-1, R-2 or R-3.
4. Exit signs are not required in dayrooms, sleeping rooms or dormitories in occupancies in Group I.
5. In occupancies in Groups A-4 and A-5, exit signs are not required on the seating side of vomitories or openings into seating areas where exit signs are provided in the concourse that are readily apparent from the vomitories. Egress lighting is provided to identify each vomitory or opening within the seating area in an emergency.

1013.2 Floor-level exit signs in Group R-1. Where exit signs are required in Group R-1 occupancies by Section 1013.1, additional low-level exit signs shall be provided in all areas serving guest rooms in Group R-1 occupancies and shall comply with Section 1013.5. The bottom of the sign shall be not less than 10 inches (254 mm) nor more than 12 inches (305 mm) above the floor level. The sign shall be flush mounted to the door or wall. Where mounted on the wall, the edge of the sign shall be within 4 inches (102 mm) of the door frame on the latch side.

1013.3 Illumination. Exit signs shall be internally or externally illuminated.
    Exception: Tactile signs required by Section 1013.4 need not be provided with illumination.
1013.4 **Raised character and braille exit signs.** A sign stating EXIT in visual characters, raised characters and braille and complying with *Chapter 11* shall be provided adjacent to each door to an area of refuge, an exterior area for assisted rescue, an exit stairway or ramp, an exit passageway and the exit discharge.

1013.5 **Internally illuminated exit signs.** Electrically powered, self-luminous and photoluminescent exit signs shall be listed and labeled in accordance with UL 924 and shall be installed in accordance with the manufacturer’s instructions and Chapter 27. Exit signs shall be illuminated at all times.

1013.6 **Externally illuminated exit signs.** Externally illuminated exit signs shall comply with Sections 1013.6.1 through 1013.6.3.

1013.6.1 **Graphics.** Every exit sign and directional exit sign shall have plainly legible letters not less than 6 inches (152 mm) high with the principal strokes of the letters not less than \(\frac{3}{4}\) inch (19.1 mm) wide. The word “EXIT” shall have letters having a width not less than 2 inches (51 mm) wide, except the letter “I,” and the minimum spacing between letters shall be not less than \(\frac{3}{8}\) inch (9.5 mm). Signs larger than the minimum established in this section shall have letter widths, strokes and spacing in proportion to their height. The word “EXIT” shall be in high contrast with the background and shall be clearly discernible when the means of exit sign illumination is or is not energized. If a chevron directional indicator is provided as part of the exit sign, the construction shall be such that the direction of the chevron directional indicator cannot be readily changed.

1013.6.2 **Exit sign illumination.** The face of an exit sign illuminated from an external source shall have an intensity of not less than 5 footcandles (54 lux).

1013.6.3 **Power source.** Exit signs shall be illuminated at all times. To ensure continued illumination for a duration of not less than 90 minutes in case of primary power loss, the sign illumination means shall be connected to an emergency power system provided from storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with Chapter 27.

**Exceptions:**
1. Approved exit sign illumination means that provide continuous illumination independent of external power sources for a duration of not less than 90 minutes, in case of primary power loss, are not required to be connected to an emergency electrical system.
2. Group I-2 Condition 2 exit sign illumination shall not be provided by unit equipment battery only.

SECTION 1014
HANDRAILS

1014.1 Where required. Handrails serving stairways, ramps, stepped aisles and ramped aisles shall be adequate in strength and attachment in accordance with Section 1607.8. Handrails required for stairways by Section 1011.11 shall comply with Sections 1014.2 through 1014.9. Handrails required for ramps by Section 1012.8 shall comply with Sections 1014.2 through 1014.8. Handrails for stepped aisles and ramped aisles required by Section 1029.15 shall comply with Sections 1014.2 through 1014.8.

1014.2 Height. Handrail height, measured above stair tread nosings, or finish surface of ramp slope, shall be uniform, not less than 34 inches (864 mm) and not more than 38 inches (965 mm). Handrail height of alternating tread devices and ships ladders, measured above tread nosings, shall be uniform, not less than 30 inches (762 mm) and not more than 34 inches (864 mm).

Exceptions:
1. Where handrail fittings or bendings are used to provide continuous transition between flights, the fittings or bendings shall be permitted to exceed the maximum height.
2. In Group R-3 occupancies; within dwelling units in Group R-2 occupancies; and in Group U occupancies that are associated with a Group R-3 occupancy or associated with individual dwelling units in Group R-2 occupancies; where handrail fittings or bendings are used to provide continuous transition between flights, transition at winder treads, transition from handrail to guard, or where used at the start of a flight, the handrail height at the fittings or bendings shall be permitted to exceed the maximum height.
3. Handrails on top of a guard where permitted along stepped aisles and ramped aisles in accordance with Section 1029.15.

1014.3 Handrail graspability. Required handrails shall comply with Section 1014.3.1 or shall provide equivalent graspability.

Exception: In Group R-3 occupancies; within dwelling units not required to be Accessible units, Type A units or Type B units in Group R-2 occupancies; and in Group U occupancies that are accessory to a Group R-3 occupancy or accessory to individual dwelling units in Group R-2 occupancies; handrails shall be Type I in accordance with Section 1014.3.1, Type II in accordance
with Section 1014.3.2 or shall provide equivalent graspability.

1014.3.1 Type I. Handrails with a circular cross section shall have an outside diameter of not less than 1\(\frac{1}{4}\) inches (32 mm) and not greater than 2 inches (51 mm). Where the handrail is not circular, it shall have a perimeter dimension of not less than 4 inches (102 mm) and not greater than 6\(\frac{1}{4}\) inches (160 mm) with a maximum cross-sectional dimension of 2\(\frac{1}{4}\) inches (57 mm) and minimum cross-sectional dimension of 1 inch (25 mm). Edges shall have a minimum radius of 0.01 inch (0.25 mm).

1014.3.2 Type II. Handrails with a perimeter greater than 6\(\frac{1}{4}\) inches (160 mm) shall provide a graspable finger recess area on both sides of the profile. The finger recess shall begin within a distance of 3\(\frac{1}{8}\) inch (19 mm) measured vertically from the tallest portion of the profile and achieve a depth of not less than 5\(\frac{1}{16}\) inch (8 mm) within 7\(\frac{1}{8}\) inch (22 mm) below the widest portion of the profile. This required depth shall continue for not less than 3\(\frac{1}{8}\) inch (10 mm) to a level that is not less than 1\(\frac{3}{4}\) inches (45 mm) below the tallest portion of the profile. The width of the handrail above the recess shall be not less than 1\(\frac{1}{4}\) inches (32 mm) to not greater than 2\(\frac{3}{4}\) inches (70 mm). Edges shall have a minimum radius of 0.01 inch (0.25 mm).

1014.4 Continuity. Handrail gripping surfaces shall be continuous, without interruption by newel posts or other obstructions.

Exceptions:
1. Handrails within dwelling units are permitted to be interrupted by a newel post at a turn or landing.
2. Within a dwelling unit, the use of a volute, turnout, starting easing or starting newel is allowed over the lowest tread.
3. Handrail brackets or balusters attached to the bottom surface of the handrail that do not project horizontally beyond the sides of the handrail within 1\(\frac{1}{2}\) inches (38 mm) of the bottom of the handrail shall not be considered obstructions. For each \(\frac{1}{2}\) inch (12.7 mm) of additional handrail perimeter dimension above 4 inches (102 mm), the vertical clearance dimension of 1\(\frac{1}{2}\) inches (38 mm) shall be permitted to be reduced by \(\frac{1}{8}\) inch (3.2 mm).
4. Where handrails are provided along walking surfaces with slopes not steeper than 1:20, the bottoms of the handrail gripping surfaces shall be permitted to be obstructed along their entire length where they are integral to crash rails or bumper guards.
5. Handrails serving stepped aisles or ramped aisles are permitted to be discontinuous in accordance with Section 1029.15.1.
1014.5 **Fittings.** Handrails shall not rotate within their fittings.

1014.6 **Handrail extensions.** Handrails shall return to a wall, guard or the walking surface or shall be continuous to the handrail of an adjacent flight of stairs or ramp run. Where handrails are not continuous between flights, the handrails shall extend horizontally not less than 12 inches (305 mm) beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser. At ramps where handrails are not continuous between runs, the handrails shall extend horizontally above the landing 12 inches (305 mm) minimum beyond the top and bottom of ramp runs. The extensions of handrails shall be in the same direction of the flights of stairs at stairways and the ramp runs at ramps.

**Exceptions:**
1. Handrails within a dwelling unit that is not required to be accessible need extend only from the top riser to the bottom riser.
2. Handrails serving aisles in rooms or spaces used for assembly purposes are permitted to comply with the handrail extensions in accordance with Section 1029.15.
3. Handrails for alternating tread devices and ships ladders are permitted to terminate at a location vertically above the top and bottom risers. Handrails for alternating tread devices are not required to be continuous between flights or to extend beyond the top or bottom risers.

1014.7 **Clearance.** Clear space between a handrail and a wall or other surface shall be not less than 1 1/2 inches (38 mm). A handrail and a wall or other surface adjacent to the handrail shall be free of any sharp or abrasive elements.

1014.8 **Projections.** On ramps and on ramped aisles that are part of an accessible route, the clear width between handrails shall be 36 inches (914 mm) minimum. Projections into the required width of aisles, stairways and ramps at each side shall not exceed 4 1/2 inches (114 mm) at or below the handrail height. Projections into the required width shall not be limited above the minimum headroom height required in Section 1011.3. Projections due to intermediate handrails shall not constitute a reduction in the egress width. Where a pair of intermediate handrails are provided within the stairway width without a walking surface between the pair of intermediate handrails and the distance between the pair of intermediate handrails is greater than 6 inches (152 mm), the available egress width shall be reduced by the distance between the closest edges of each such intermediate pair of handrails that is greater than 6 inches (152 mm).
1014.9 Intermediate handrails. Stairways shall have intermediate handrails located in such a manner that all portions of the stairway minimum width or required capacity are within 30 inches (762 mm) of a handrail. On monumental stairs, handrails shall be located along the most direct path of egress travel.

SECTION 1015
GUARDS

1015.1 General. Guards shall comply with the provisions of Sections 1015.2 through 1015.7. Operable windows with sills located more than 72 inches (1829 mm) above finished grade or other surface below shall comply with Section 1015.8.

1015.2 Where required. Guards shall be located along open-sided walking surfaces, including mezzanines, equipment platforms, aisles, stairs, ramps and landings that are located more than 30 inches (762 mm) measured vertically to the floor or grade below at any point within 36 inches (914 mm) horizontally to the edge of the open side. Guards shall be adequate in strength and attachment in accordance with Section 1607.8.

   Exception: Guards are not required for the following locations:
   1. On the loading side of loading docks or piers.
   2. On the audience side of stages and raised platforms, including stairs leading up to the stage and raised platforms.
   3. On raised stage and platform floor areas, such as runways, ramps and side stages used for entertainment or presentations.
   4. At vertical openings in the performance area of stages and platforms.
   5. At elevated walking surfaces appurtenant to stages and platforms for access to and utilization of special lighting or equipment.
   6. Along vehicle service pits not accessible to the public.
   7. In assembly seating areas at cross aisles in accordance with Section 1029.16.2.

1015.2.1 Glazing. Where glass is used to provide a guard or as a portion of the guard system, the guard shall comply with Section 2407. Where the glazing provided does not meet the strength and attachment requirements of Section 1607.8, complying guards shall be located along glazed sides of open-sided walking surfaces.

1015.3 Height. Required guards shall be not less than 42 inches (1067 mm) high, measured vertically as follows:
   1. From the adjacent walking surfaces.
2. On stairways and stepped aisles, from the line connecting the leading edges of the tread nosings.
3. On ramps and ramped aisles, from the ramp surface at the guard.

Exceptions:
1. For occupancies in Group R-3 not more than three stories above grade in height and within individual dwelling units in occupancies in Group R-2 not more than three stories above grade in height with separate means of egress, required guards shall be not less than 36 inches (914 mm) in height measured vertically above the adjacent walking surfaces or adjacent fixed seating.
2. For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, guards on the open sides of stairs shall have a height not less than 34 inches (864 mm) measured vertically from a line connecting the leading edges of the treads.
3. For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, where the top of the guard also serves as a handrail on the open sides of stairs, the top of the guard shall be not less than 34 inches (864 mm) and not more than 38 inches (965 mm) measured vertically from a line connecting the leading edges of the treads.
4. The guard height in assembly seating areas shall comply with Section 1029.16 as applicable.
5. Along alternating tread devices and ships ladders, guards where the top rail also serves as a handrail shall have height not less than 30 inches (762 mm) and not more than 34 inches (864 mm), measured vertically from the leading edge of the device tread nosing.

1015.4 Opening limitations. Required guards shall not have openings that allow passage of a sphere 4 inches (102 mm) in diameter from the walking surface to the required guard height.

Exceptions:
1. From a height of 36 inches (914 mm) to 42 inches (1067 mm), guards shall not have openings that allow passage of a sphere 4\(\frac{3}{8}\) inches (111 mm) in diameter.
2. The triangular openings at the open sides of a stair, formed by the riser, tread and bottom rail shall not allow passage of a sphere 6 inches (152 mm) in diameter.
3. At elevated walking surfaces for access to and use of electrical, mechanical or plumbing systems or equipment, guards shall not have openings that allow passage of a sphere 21 inches (533 mm) in diameter.
4. In areas that are not open to the public within occupancies in Group I-3, F, H or S, and for alternating tread devices and ships ladders, guards shall not have openings that allow passage of a sphere 21 inches (533 mm) in diameter.

5. In assembly seating areas, guards required at the end of aisles in accordance with Section 1029.16.4 shall not have openings that allow passage of a sphere 4 inches (102 mm) in diameter up to a height of 26 inches (660 mm). From a height of 26 inches (660 mm) to 42 inches (1067 mm) above the adjacent walking surfaces, guards shall not have openings that allow passage of a sphere 8 inches (203 mm) in diameter.

6. Within individual dwelling units and sleeping units in Group R-2 and R-3 occupancies, guards on the open sides of stairs shall not have openings that allow passage of a sphere $4\frac{3}{16}$ (111 mm) inches in diameter.

1015.5 Screen porches. Porches and decks that are enclosed with insect screening shall be provided with guards where the walking surface is located more than 30 inches (762 mm) above the floor or grade below.

1015.6 Mechanical equipment, systems and devices. Guards shall be provided where various components that require service are located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof or grade below. The guard shall extend not less than 30 inches (762 mm) beyond each end of such components. The guard shall be constructed so as to prevent the passage of a sphere 21 inches (533 mm) in diameter.

**Exception:** Guards are not required where permanent fall arrest/restraint anchorage connector devices that comply with ANSI/ASSE Z 359.1 are affixed for use during the entire roof covering lifetime. The devices shall be reevaluated for possible replacement when the entire roof covering is replaced. The devices shall be placed not more than 10 feet (3048 mm) on center along hip and ridge lines and placed not less than 10 feet (3048 mm) from the roof edge or open side of the walking surface.

1015.7 Roof access. Guards shall be provided where the roof hatch opening is located within 10 feet (3048 mm) of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches (762 mm) above the floor, roof or grade below. The guard shall be constructed so as to prevent the passage of a sphere 21 inches (533 mm) in diameter.

**Exception:** Guards are not required where permanent fall arrest/restraint anchorage connector devices that comply with ANSI/ASSE Z 359.1 are affixed for use during the entire roof covering lifetime. The devices shall be
reevaluated for possible replacement when the entire roof covering is replaced. The devices shall be placed not more than 10 feet (3048 mm) on center along hip and ridge lines and placed not less than 10 feet (3048 mm) from the roof edge or open side of the walking surface.

**1015.8 Window openings.** Windows in Group R-2 and R-3 buildings including dwelling units, where the top of the sill of an operable window opening is located less than 36 inches above the finished floor and more than 72 inches (1829 mm) above the finished grade or other surface below on the exterior of the building, shall comply with one of the following:

1. Operable windows where the top of the sill of the opening is located more than 75 feet (22 860 mm) above the finished grade or other surface below and that are provided with window fall prevention devices that comply with ASTM F 2006.
2. Operable windows where the openings will not allow a 4-inch-diameter (102 mm) sphere to pass through the opening when the window is in its largest opened position.
3. Operable windows where the openings are provided with window fall prevention devices that comply with ASTM F 2090.
4. Operable windows that are provided with window opening control devices that comply with Section 1015.8.1.

**1015.8.1 Window opening control devices.** Window opening control devices shall comply with ASTM F 2090. The window opening control device, after operation to release the control device allowing the window to fully open, shall not reduce the minimum net clear opening area of the window unit to less than the area required by Section 1030.2.

**SECTION 1016**
**EXIT ACCESS**

**1016.1 General.** The exit access shall comply with the applicable provisions of Sections 1003 through 1015. Exit access arrangement shall comply with Sections 1016 through 1021.

**1016.2 Egress through intervening spaces.** Egress through intervening spaces shall comply with this section.

1. Exit access through an enclosed elevator lobby is permitted. Access to not less than one of the required exits shall be provided without travel through the enclosed elevator lobbies required by Section 3006. Where the path of exit access travel passes through an enclosed elevator lobby, the level of
protection required for the enclosed elevator lobby is not required to be extended to the exit unless direct access to an exit is required by other sections of this code.

2. Egress from a room or space shall not pass through adjoining or intervening rooms or areas, except where such adjoining rooms or areas and the area served are accessory to one or the other, are not a Group H occupancy and provide a discernible path of egress travel to an exit.

**Exception:** Means of egress are not prohibited through adjoining or intervening rooms or spaces in a Group H, S or F occupancy where the adjoining or intervening rooms or spaces are the same or a lesser hazard occupancy group.

3. An exit access shall not pass through a room that can be locked to prevent egress.

4. Means of egress from dwelling units or sleeping areas shall not lead through other sleeping areas, toilet rooms or bathrooms.

5. Egress shall not pass through kitchens, storage rooms, closets or spaces used for similar purposes.

**Exceptions:**

1. Means of egress are not prohibited through a kitchen area serving adjoining rooms constituting part of the same dwelling unit or sleeping unit.

2. Means of egress are not prohibited through stockrooms in Group M occupancies where all of the following are met:
   2.1. The stock is of the same hazard classification as that found in the main retail area.
   2.2. Not more than 50 percent of the exit access is through the stockroom.
   2.3. The stockroom is not subject to locking from the egress side.
   2.4. There is a demarcated, minimum 44inch-wide (1118 mm) aisle defined by full- or partial-height fixed walls or similar construction that will maintain the required width and lead directly from the retail area to the exit without obstructions.

**1016.2.1 Multiple tenants.** Where more than one tenant occupies any one floor of a building or structure, each tenant space, dwelling unit and sleeping unit shall be provided with access to the required exits without passing through adjacent tenant spaces, dwelling units and sleeping units.

**Exception:** The means of egress from a smaller tenant space shall not be prohibited from passing through a larger adjoining tenant space where such rooms or spaces of the smaller tenant occupy less than 10 percent of the area of the larger tenant space through which they pass; are the same
or similar occupancy group; a discernible path of egress travel to an exit is provided; and the means of egress into the adjoining space is not subject to locking from the egress side. A required means of egress serving the larger tenant space shall not pass through the smaller tenant space or spaces.

SECTION 1017
EXIT ACCESS TRAVEL DISTANCE

1017.1 General. Travel distance within the exit access portion of the means of egress system shall be in accordance with this section.

1017.2 Limitations. Exit access travel distance shall not exceed the values given in Table 1017.2.

1017.2.1 Exterior egress balcony increase. Exit access travel distances specified in Table 1017.2 shall be increased up to an additional 100 feet (30 480 mm) provided the last portion of the exit access leading to the exit occurs on an exterior egress balcony constructed in accordance with Section 1021. The length of such balcony shall be not less than the amount of the increase taken.

1017.2.2 Group F-1 and S-1 increase. The maximum exit access travel distance shall be 400 feet (122 m) in Group F-1 or S-1 occupancies where all of the following conditions are met:
1. The portion of the building classified as Group F-1 or S-1 is limited to one story in height.
2. The minimum height from the finished floor to the bottom of the ceiling or roof slab or deck is 24 feet (7315 mm).
3. The building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

1017.3 Measurement. Exit access travel distance shall be measured from the most remote point within a story along the natural and unobstructed path of horizontal and vertical egress travel to the entrance to an exit.

   Exception: In open parking garages, exit access travel distance is permitted to be measured to the closest riser of an exit access stairway or the closest slope of an exit access ramp.

1017.3.1 Exit access stairways and ramps. Travel distance on exit access stairways or ramps shall be included in the exit access travel distance measurement. The measurement along stairways shall be made on a plane
parallel and tangent to the stair tread nosings in the center of the stair and landings. The measurement along ramps shall be made on the walking surface in the center of the ramp and landings.

SECTION 1018
AISLES

1018.1 General. Aisles and aisle accessways serving as a portion of the exit access in the means of egress system shall comply with the requirements of this section. Aisles or aisle accessways shall be provided from all occupied portions of the exit access that contain seats, tables, furnishings, displays and similar fixtures or equipment. The minimum width or required capacity of aisles shall be unobstructed.

Exception: Encroachments complying with Section 1005.7.

1018.2 Aisles in assembly spaces. Aisles and aisle accessways serving a room or space used for assembly purposes shall comply with Section 1029.

1018.3 Aisles in Groups B and M. In Group B and M occupancies, the minimum clear aisle width shall be determined by Section 1005.1 for the occupant load served, but shall be not less than that required for corridors by Section 1020.2.

Exception: Nonpublic aisles serving less than 50 people and not required to be accessible by Chapter 11 need not exceed 28 inches (711 mm) in width.

TABLE 1017.2
EXIT ACCESS TRAVEL DISTANCEa

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>WITHOUT SPRINKLER SYSTEM (feet)</th>
<th>WITH SPRINKLER SYSTEM (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, E, F-1, M, R, S-1</td>
<td>200°</td>
<td>250°</td>
</tr>
<tr>
<td>I-1</td>
<td>Not Permitted</td>
<td>250°</td>
</tr>
<tr>
<td>B</td>
<td>200</td>
<td>300°</td>
</tr>
<tr>
<td>F-2, S-2, U</td>
<td>300</td>
<td>400°</td>
</tr>
<tr>
<td>H-1</td>
<td>Not Permitted</td>
<td>75°</td>
</tr>
<tr>
<td>H-2</td>
<td>Not Permitted</td>
<td>100°</td>
</tr>
<tr>
<td>H-3</td>
<td>Not Permitted</td>
<td>150°</td>
</tr>
<tr>
<td>H-4</td>
<td>Not Permitted</td>
<td>175°</td>
</tr>
<tr>
<td>H-5</td>
<td>Not Permitted</td>
<td>200°</td>
</tr>
<tr>
<td>I-2, I-3, I-4</td>
<td>Not Permitted</td>
<td>200°</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.
a. See the following sections for modifications to exit access travel distance requirements:
   Section 402.8: For the distance limitation in malls.
   Section 404.9: For the distance limitation through an atrium space.
   Section 407.4: For the distance limitation in Group I-2.
   Sections 408.6.1 and 408.8.1: For the distance limitations in Group I-3.
   Section 411.4: For the distance limitation in special amusement buildings.
   Section 412.7: For the distance limitations in aircraft manufacturing facilities.
   Section 1006.2.2.2: For the distance limitation in refrigeration machinery rooms.
   Section 1006.2.2.3: For the distance limitation in refrigerated rooms and spaces.
   Section 1006.3.2: For buildings with one exit.
   Section 1017.2.2: For increased distance limitation in Groups F-1 and S-1.
   Section 1029.7: For increased limitation in assembly seating.
   Section 3103.4: For temporary structures.
   Section 3104.9: For pedestrian walkways.

b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.

c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1.

d. Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.1.

e. Group R-3 and R-4 buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.3. See Section 903.2.8 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.3.

1018.4 Aisle accessways in Group M. An aisle accessway shall be provided on not less than one side of each element within the merchandise pad. The minimum clear width for an aisle accessway not required to be accessible shall be 30 inches (762 mm). The required clear width of the aisle accessway shall be measured perpendicular to the elements and merchandise within the merchandise pad. The 30-inch (762 mm) minimum clear width shall be maintained to provide a path to an adjacent aisle or aisle accessway. The common path of egress travel shall not exceed 30 feet (9144 mm) from any point in the merchandise pad.

   Exception: For areas serving not more than 50 occupants, the common path of egress travel shall not exceed 75 feet (22 860 mm).

1018.5 Aisles in other than assembly spaces and Groups Band M. In other than rooms or spaces used for assembly purposes and Group B and M occupancies, the minimum clear aisle capacity shall be determined by Section 1005.1 for the occupant load served, but the width shall be not less than that required for corridors by Section 1020.2.

   Exception: Nonpublic aisles serving less than 50 people and not required to be accessible by Chapter 11 need not exceed 28 inches (711 mm) in width.

SECTION 1019
EXIT ACCESS STAIRWAYS AND RAMPS
1019.1 **General.** Exit access stairways and ramps serving as an exit access component in a means of egress system shall comply with the requirements of this section. The number of stories connected by exit access stairways and ramps shall include basements, but not mezzanines.

1019.2 **All occupancies.** Exit access stairways and ramps that serve floor levels within a single story are not required to be enclosed.

1019.3 **Occupancies other than Groups I-2 and I-3.** In other than Group I-2 and I-3 occupancies, floor openings containing exit access stairways or ramps that do not comply with one of the conditions listed in this section shall be enclosed with a shaft enclosure constructed in accordance with Section 713.

1. Exit access stairways and ramps that serve or atmospherically communicate between only two stories. Such interconnected stories shall not be open to other stories.
2. In Group R-1, R-2 or R-3 occupancies, exit access stairways and ramps connecting four stories or less serving and contained within an individual dwelling unit or sleeping unit or live/work unit.
3. Exit access stairways serving and contained within a Group R-3 congregate residence or a Group R-4 facility are not required to be enclosed.
4. Exit access stairways and ramps in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, where the area of the vertical opening between stories does not exceed twice the horizontal projected area of the stairway or ramp and the opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. In other than Group B and M occupancies, this provision is limited to openings that do not connect more than four stories.
5. Exit access stairways and ramps within an atrium complying with the provisions of Section 404.
6. Exit access stairways and ramps in open parking garages that serve only the parking garage.
7. Exit access stairways and ramps serving open-air seating complying with the exit access travel distance requirements of Section 1029.7.
8. Exit access stairways and ramps serving the balcony, gallery or press box and the main assembly floor in occupancies such as theaters, places of religious worship, auditoriums and sports facilities.

1019.4 **Group I-2 and I-3 occupancies.** In Group I-2 and I-3 occupancies, floor openings between stories containing exit access stairways or ramps are required to be enclosed with a shaft enclosure constructed in accordance with Section 713.
Exception: In Group I-3 occupancies, exit access stairways or ramps constructed in accordance with Section 408 are not required to be enclosed.

SECTION 1020
CORRIDORS

1020.1 Construction. Corridors shall be fire-resistance rated in accordance with Table 1020.1. The corridor walls required to be fire-resistance rated shall comply with Section 708 for fire partitions.

Exceptions:
1. A fire-resistance rating is not required for corridors in an occupancy in Group E where each room that is used for instruction has not less than one door opening directly to the exterior and rooms for assembly purposes have not less than one-half of the required means of egress doors opening directly to the exterior. Exterior doors specified in this exception are required to be at ground level.
2. A fire-resistance rating is not required for corridors contained within a dwelling unit or sleeping unit in an occupancy in Groups I-1 and R.
3. A fire-resistance rating is not required for corridors in open parking garages.
4. A fire-resistance rating is not required for corridors in an occupancy in Group B that is a space requiring only a single means of egress complying with Section 1006.2.
5. Corridors adjacent to the exterior walls of buildings shall be permitted to have unprotected openings on unrated exterior walls where unrated walls are permitted by Table 602 and unprotected openings are permitted by Table 705.8.

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>OCCUPANT LOAD SERVED BY CORRIDOR</th>
<th>REQUIRED FIRE-RESISTANCE RATING (hours)</th>
<th>Without sprinkler system</th>
<th>With sprinkler system</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-1, H-2, H-3</td>
<td>All</td>
<td>Not Permitted</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>H-4, H-5</td>
<td>Greater than 30</td>
<td>Not Permitted</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A, B, E, F, M, S, U</td>
<td>Greater than 30</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>R</td>
<td>Greater than 10</td>
<td>Not Permitted</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I-2*, I-4</td>
<td>All</td>
<td>Not Permitted</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I-1, I-3</td>
<td>All</td>
<td>Not Permitted</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
a. For requirements for occupancies in Group I-2, see Sections 407.2 and 407.3.
b. For a reduction in the fire-resistance rating for occupancies in Group I-3, see Section 408.8.
c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 where allowed.
d. Group R-3 and R-4 buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.3. See Section 903.2.8 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.3.

### TABLE 1020.1
**CORRIDOR FIRE-RESISTANCE RATING**

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>OCCUPANT LOAD SERVED BY CORRIDOR</th>
<th>REQUIRED FIRE-RESISTANCE RATING (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Without sprinkler system or provided with a partial sprinkler system</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>13D</strong></td>
</tr>
<tr>
<td>H-1, H-2, H-3</td>
<td>All</td>
<td>NP</td>
</tr>
<tr>
<td>H-4, H-5</td>
<td>Greater than 30</td>
<td>NP</td>
</tr>
<tr>
<td>A, B, E, F, M, S, U</td>
<td>Greater than 30</td>
<td>1</td>
</tr>
<tr>
<td>R</td>
<td>Greater than 10</td>
<td>1</td>
</tr>
<tr>
<td>I-1</td>
<td>All</td>
<td>NP</td>
</tr>
<tr>
<td>I-2a</td>
<td>All</td>
<td>NP</td>
</tr>
<tr>
<td>I-3</td>
<td>All</td>
<td>NP</td>
</tr>
<tr>
<td>I-4</td>
<td>All</td>
<td>1</td>
</tr>
</tbody>
</table>

*NP = Not Permitted*

a. For requirements for occupancies in Group I-2, see Sections 407.2 and 407.3.
b. For a reduction in the fire-resistance rating for occupancies in Group I-3, see Section 408.8.

### 1020.2 Width and capacity

The required capacity of corridors shall be determined as specified in Section 1005.1, but the minimum width shall be not less than that specified in Table 1020.2.

**Exception:** In Group I-2 occupancies, corridors are not required to have a clear width of 96 inches (2438 mm) in areas where there will not be stretcher or bed movement for access to care or as part of the defend-in-place strategy.

### TABLE 1020.2
**MINIMUM CORRIDOR WIDTH**

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>MINIMUM WIDTH (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any facilities not listed below</td>
<td>44</td>
</tr>
</tbody>
</table>
Access to and utilization of mechanical, plumbing or electrical systems or equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>With an occupant load of less than 50</td>
<td>36</td>
</tr>
<tr>
<td>Within a dwelling unit</td>
<td>36</td>
</tr>
<tr>
<td>In Group E with a corridor having an occupant load of 100 or more</td>
<td>72</td>
</tr>
<tr>
<td>In corridors and areas serving stretcher traffic in occupancies where patients receive outpatient medical care, that causes the patient to be incapable of self-preservation</td>
<td>72</td>
</tr>
<tr>
<td>Group I-2 in areas where required for bed movement</td>
<td>96</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

1020.3 **Obstruction.** The minimum width or required capacity of corridors shall be unobstructed.

**Exception:** Encroachments complying with Section 1005.7.

1020.4 **Dead ends.** Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 20 feet (6096 mm) in length.

**Exceptions:**
1. In occupancies in Group I-3 of Condition 2, 3 or 4, the dead end in a corridor shall not exceed 50 feet (15 240 mm).
2. In occupancies in Groups B, E, F, I-1, M, R-1, R-2, R-4, S and U, where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the length of the dead-end corridors shall not exceed 50 feet (15 240 mm).
3. A dead-end corridor shall not be limited in length where the length of the dead-end corridor is less than 2.5 times the least width of the dead-end corridor.

1020.5 **Air movement in corridors.** Corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts.

**Exceptions:**
1. Use of a corridor as a source of makeup air for exhaust systems in rooms that open directly onto such corridors, including toilet rooms, bathrooms, dressing rooms, smoking lounges and janitor closets, shall be permitted, provided that each such corridor is directly supplied with outdoor air at a rate greater than the rate of makeup air taken from the corridor.
2. Where located within a dwelling unit, the use of corridors for conveying return air shall not be prohibited.
3. Where located within tenant spaces of 1,000 square feet (93 m²) or less in area, utilization of corridors for conveying return air is permitted.
4. Incidental air movement from pressurized rooms within health care facilities, provided that the corridor is not the primary source of supply or return to the room.

1020.5.1 Corridor ceiling. Use of the space between the corridor ceiling and the floor or roof structure above as a return air plenum is permitted for one or more of the following conditions:
1. The corridor is not required to be of fire-resistance rated construction.
2. The corridor is separated from the plenum by fire-resistance-rated construction.
3. The air-handling system serving the corridor is shut down upon activation of the air-handling unit smoke detectors required by the Mechanical code.
4. The air-handling system serving the corridor is shut down upon detection of sprinkler water flow where the building is equipped throughout with an automatic sprinkler system.
5. The space between the corridor ceiling and the floor or roof structure above the corridor is used as a component of an approved engineered smoke control system.

1020.6 Corridor continuity. Fire-resistance-rated corridors shall be continuous from the point of entry to an exit, and shall not be interrupted by intervening rooms. Where the path of egress travel within a fire-resistance-rated corridor to the exit includes travel along unenclosed exit access stairways or ramps, the fire-resistance rating shall be continuous for the length of the stairway or ramp and for the length of the connecting corridor on the adjacent floor leading to the exit.

Exceptions:
1. Foyers, lobbies or reception rooms constructed as required for corridors shall not be construed as intervening rooms.
2. Enclosed elevator lobbies as permitted by Item 1 of Section 1016.2 shall not be construed as intervening rooms.

SECTION 1021
EGRESS BALCONIES
1021.1 General. Balconies used for egress purposes shall conform to the same requirements as corridors for minimum width, required capacity, headroom, dead ends and projections.

1021.2 Wall separation. Exterior egress balconies shall be separated from the interior of the building by walls and opening protectives as required for corridors. Exception: Separation is not required where the exterior egress balcony is served by not less than two stairways and a dead-end travel condition does not require travel past an unprotected opening to reach a stairway.

1021.3 Openness. The long side of an egress balcony shall be at least 50 percent open, and the open area above the guards shall be so distributed as to minimize the accumulation of smoke or toxic gases.

1021.4 Location. Exterior egress balconies shall have a minimum fire separation distance of 10 feet (3048 mm) measured at right angles from the exterior edge of the egress balcony to the following:
   1. Adjacent lot lines.
   2. Other portions of the building.
   3. Other buildings on the same lot unless the adjacent building exterior walls and openings are protected in accordance with Section 705 based on fire separation distance.

   For the purposes of this section, other portions of the building shall be treated as separate buildings.

SECTION 1022
EXITS

1022.1 General. Exits shall comply with Sections 1022 through 1027 and the applicable requirements of Sections 1003 through 1015. An exit shall not be used for any purpose that interferes with its function as a means of egress. Once a given level of exit protection is achieved, such level of protection shall not be reduced until arrival at the exit discharge. Exits shall be continuous from the point of entry into the exit to the exit discharge.

1022.2 Exterior exit doors. Buildings or structures used for human occupancy shall have not less than one exterior door that meets the requirements of Section 1010.1.1.

   1022.2.1 Detailed requirements. Exterior exit doors shall comply with the applicable requirements of Section 1010.1.
1022.2.2 **Arrangement.** Exterior exit doors shall lead directly to the exit discharge or the public way.

**SECTION 1023**
**INTERIOR EXIT STAIRWAYS AND RAMPS**

1023.1 **General.** Interior exit stairways and ramps serving as an exit component in a means of egress system shall comply with the requirements of this section. Interior exit stairways and ramps shall be enclosed and lead directly to the exterior of the building or shall be extended to the exterior of the building with an exit passageway conforming to the requirements of Section 1024, except as permitted in Section 1028.1. An interior exit stairway or ramp shall not be used for any purpose other than as a means of egress and a circulation path.

1023.2 **Construction.** Enclosures for interior exit stairways and ramps shall be constructed as fire barriers in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both. Interior exit stairway and ramp enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more and not less than 1 hour where connecting less than four stories. The number of stories connected by the interior exit stairways or ramps shall include any basements, but not any mezzanines. Interior exit stairways and ramps shall have a fire-resistance rating not less than the floor assembly penetrated, but need not exceed 2 hours.

**Exceptions:**
1. Interior exit stairways and ramps in Group I-3 occupancies in accordance with the provisions of Section 408.3.8.
2. Interior exit stairways within an atrium enclosed in accordance with Section 404.6.

1023.3 **Termination.** Interior exit stairways and ramps shall terminate at an exit discharge or a public way.

**Exception:** A combination of interior exit stairways, interior exit ramps and exit passageways, constructed in accordance with Sections 1023.2, 1023.3.1 and 1024, respectively, and forming a continuous protected enclosure, shall be permitted to extend an interior exit stairway or ramp to the exit discharge or a public way.

1023.3.1 **Extension.** Where interior exit stairways and ramps are extended to an exit discharge or a public way by an exit passageway, the interior exit stairway and ramp shall be separated from the exit passageway by a fire
barrier constructed in accordance with Section 707 or a horizontal assembly constructed in accordance with Section 711, or both. The fire-resistance rating shall be not less than that required for the interior exit stairway and ramp. A fire door assembly complying with Section 716.5 shall be installed in the fire barrier to provide a means of egress from the interior exit stairway and ramp to the exit passageway. Openings in the fire barrier other than the fire door assembly are prohibited. Penetrations of the fire barrier are prohibited.

**Exceptions:**

1. Penetrations of the fire barrier in accordance with Section 1023.5 shall be permitted.
2. Separation between an interior exit stairway or ramp and the exit passageway extension shall not be required where there are no openings into the exit passageway extension.
3. Separation between an interior exit stairway or ramp and the exit passageway extension shall not be required where the interior exit stairway and the exit passageway extension are pressurized in accordance with Section 909.20.5.

**1023.4 Openings.** Interior exit stairway and ramp opening protectives shall be in accordance with the requirements of Section 716. Openings in interior exit stairways and ramps other than unprotected exterior openings shall be limited to those necessary for exit access to the enclosure from normally occupied spaces and for egress from the enclosure. Elevators shall not open into interior exit stairways and ramps.

**1023.5 Penetrations.** Penetrations into or through interior exit stairways and ramps are prohibited except for equipment and ductwork necessary for independent ventilation or pressurization, sprinkler piping, standpipes, electrical raceway for fire department communication systems and electrical raceway serving the interior exit stairway and ramp and terminating at a steel box not exceeding 16 square inches (0.010 m²). Such penetrations shall be protected in accordance with Section 714. There shall not be penetrations or communication openings, whether protected or not, between adjacent interior exit stairways and ramps.

**Exception:** Membrane penetrations shall be permitted on the outside of the interior exit stairway and ramp. Such penetrations shall be protected in accordance with Section 714.3.2.

**1023.6 Ventilation.** Equipment and ductwork for interior exit stairway and ramp ventilation as permitted by Section 1023.5 shall comply with one of the following items:
1. Such equipment and ductwork shall be located exterior to the building and shall be directly connected to the interior exit stairway and ramp by ductwork enclosed in construction as required for shafts.

2. Where such equipment and ductwork is located within the interior exit stairway and ramp, the intake air shall be taken directly from the outdoors and the exhaust air shall be discharged directly to the outdoors, or such air shall be conveyed through ducts enclosed in construction as required for shafts.

3. Where located within the building, such equipment and ductwork shall be separated from the remainder of the building, including other mechanical equipment, with construction as required for shafts.

In each case, openings into the fire-resistance-rated construction shall be limited to those needed for maintenance and operation and shall be protected by opening protectives in accordance with Section 716 for shaft enclosures.

The interior exit stairway and ramp ventilation systems shall be independent of other building ventilation systems.

1023.7 Interior exit stairway and ramp exterior walls. Exterior walls of the interior exit stairway or ramp shall comply with the requirements of Section 705 for exterior walls. Where nonrated walls or unprotected openings enclose the exterior of the stairway or ramps and the walls or openings are exposed by other parts of the building at an angle of less than 180 degrees (3.14 rad), the building exterior walls within 10 feet (3048 mm) horizontally of a nonrated wall or unprotected opening shall have a fire-resistance rating of not less than 1 hour. Openings within such exterior walls shall be protected by opening protectives having a fire protection rating of not less than \( \frac{3}{4} \) hour. This construction shall extend vertically from the ground to a point 10 feet (3048 mm) above the topmost landing of the stairway or ramp, or to the roof line, whichever is lower.

1023.8 Discharge identification. An interior exit stairway and ramp shall not continue below its level of exit discharge unless an approved barrier is provided at the level of exit discharge to prevent persons from unintentionally continuing into levels below. Directional exit signs shall be provided as specified in Section 1013.

1023.9 Stairway identification signs. A sign shall be provided at each floor landing in an interior exit stairway and ramp connecting more than three stories designating the floor level, the terminus of the top and bottom of the interior exit stairway and ramp and the identification of the stairway or ramp. The signage shall also state the story of, and the direction to, the exit discharge and the availability of roof access from the interior exit stairway and ramp for the fire
department. The sign shall be located 5 feet (1524 mm) above the floor landing in a position that is readily visible when the doors are in the open and closed positions. In addition to the stairway identification sign, a floor-level sign in visual characters, raised characters and braille complying with Chapter 11 shall be located at each floor-level landing adjacent to the door leading from the interior exit stairway and ramp into the corridor to identify the floor level.

1023.9.1 Signage requirements. Stairway identification signs shall comply with all of the following requirements:
1. The signs shall be a minimum size of 18 inches (457 mm) by 12 inches (305 mm).
2. The letters designating the identification of the interior exit stairway and ramp shall be not less than 1\(\frac{1}{2}\) inches (38 mm) in height.
3. The number designating the floor level shall be not less than 5 inches (127 mm) in height and located in the center of the sign.
4. Other lettering and numbers shall be not less than 1 inch (25 mm) in height.
5. Characters and their background shall have a nonglare finish. Characters shall contrast with their background, with either light characters on a dark background or dark characters on a light background.
6. Where signs required by Section 1023.9 are installed in the interior exit stairways and ramps of buildings subject to Section 1025, the signs shall be made of the same materials as required by Section 1025.4.

1023.10 Elevator lobby identification signs. At landings in interior exit stairways where two or more doors lead to the floor level, any door with direct access to an enclosed elevator lobby shall be identified by signage located on the door or directly adjacent to the door stating “Elevator Lobby.” Signage shall be in accordance with Section 1023.9.1, Items 4, 5 and 6.

1023.11 Smokeproof enclosures. Where required by Section 403.5.4 or 405.7.2, interior exit stairways and ramps shall be smokeproof enclosures in accordance with Section 909.20.

1023.11.1 Termination and extension. A smokeproof enclosure shall terminate at an exit discharge or a public way. The smokeproof enclosure shall be permitted to be extended by an exit passageway in accordance with Section 1023.3. The exit passageway shall be without openings other than the fire door assembly required by Section 1023.3.1 and those necessary for egress from the
exit passageway. The exit passageway shall be separated from the remainder of the building by 2-hour fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both.

Exceptions:
1. Openings in the exit passageway serving a smokeproof enclosure are permitted where the exit passageway is protected and pressurized in the same manner as the smokeproof enclosure, and openings are protected as required for access from other floors.
2. The fire barrier separating the smokeproof enclosure from the exit passageway is not required, provided the exit passageway is protected and pressurized in the same manner as the smokeproof enclosure.
3. A smokeproof enclosure shall be permitted to egress through areas on the level of exit discharge or vestibules as permitted by Section 1028.

1023.11.2 Enclosure access. Access to the stairway or ramp within a smokeproof enclosure shall be by way of a vestibule or an open exterior balcony.

Exception: Access is not required by way of a vestibule or exterior balcony for stairways and ramps using the pressurization alternative complying with Section 909.20.5.

SECTION 1024
EXIT PASSAGEWAYS

1024.1 Exit passageways. Exit passageways serving as an exit component in a means of egress system shall comply with the requirements of this section. An exit passageway shall not be used for any purpose other than as a means of egress and a circulation path.

1024.2 Width. The required capacity of exit passageways shall be determined as specified in Section 1005.1 but the minimum width shall be not less than 44 inches (1118 mm), except that exit passageways serving an occupant load of less than 50 shall be not less than 36 inches (914 mm) in width. The minimum width or required capacity of exit passageways shall be unobstructed.

Exception: Encroachments complying with Section 1005.7.

1024.3 Construction. Exit passageway enclosures shall have walls, floors and ceilings of not less than a 1-hour fire-resistance rating, and not less than that required for any connecting interior exit stairway or ramp. Exit passageways shall be constructed as fire barriers in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both.
1024.4 Termination. Exit passageways on the level of exit discharge shall terminate at an exit discharge. Exit passageways on other levels shall terminate at an exit.

1024.5 Openings. Exit passageway opening protectives shall be in accordance with the requirements of Section 716. Except as permitted in Section 402.8.7, openings in exit passageways other than unprotected exterior openings shall be limited to those necessary for exit access to the exit passageway from normally occupied spaces and for egress from the exit passageway.
Where an interior exit stairway or ramp is extended to an exit discharge or a public way by an exit passageway, the exit passageway shall comply with Section 1023.3.1.
Elevators shall not open into an exit passageway.

1024.6 Penetrations. Penetrations into or through an exit passageway are prohibited except for equipment and ductwork necessary for independent pressurization, sprinkler piping, standpipes, electrical raceway for fire department communication and electrical raceway serving the exit passageway and terminating at a steel box not exceeding 16 square inches (0.010 m²). Such penetrations shall be protected in accordance with Section 714. There shall not be penetrations or communicating openings, whether protected or not, between adjacent exit passageways.
Exception: Membrane penetrations shall be permitted on the outside of the exit passageway. Such penetrations shall be protected in accordance with Section 714.3.2.

1024.7 Ventilation. Equipment and ductwork for exit passageway ventilation as permitted by Section 1024.6 shall comply with one of the following:
1. The equipment and ductwork shall be located exterior to the building and shall be directly connected to the exit passageway by ductwork enclosed in construction as required for shafts.
2. Where the equipment and ductwork is located within the exit passageway, the intake air shall be taken directly from the outdoors and the exhaust air shall be discharged directly to the outdoors, or the air shall be conveyed through ducts enclosed in construction as required for shafts.
3. Where located within the building, the equipment and ductwork shall be separated from the remainder of the building, including other mechanical equipment, with construction as required for shafts.
In each case, openings into the fire-resistance-rated construction shall be
limited to those needed for maintenance and operation and shall be protected by opening protectives in accordance with Section 716 for shaft enclosures.

Exit passageway ventilation systems shall be independent of other building ventilation systems.

SECTION 1025
LUMINOUS EGRESS PATH MARKINGS

1025.1 General. Luminous egress path markings are not required to be installed in buildings regulated by this code. However, when non-required luminous egress path markings are installed, they shall be installed in accordance with this section to the extent of the installation.

Exception. Deleted.

1025.2 Markings within exit components. Egress path markings shall be provided in interior exit stairways, interior exit ramps and exit passageways, in accordance with Sections 1025.2.1 through 1025.2.6.

1025.2.1 Steps. A solid and continuous stripe shall be applied to the horizontal leading edge of each step and shall extend for the full length of the step. Outlining stripes shall have a minimum horizontal width of 1 inch (25 mm) and a maximum width of 2 inches (51 mm). The leading edge of the stripe shall be placed not more than \( \frac{1}{2} \) inch (12.7 mm) from the leading edge of the step and the stripe shall not overlap the leading edge of the step by not more than \( \frac{1}{2} \) inch (12.7 mm) down the vertical face of the step.

Exception: The minimum width of 1 inch (25 mm) shall not apply to outlining stripes listed in accordance with UL 1994.

1025.2.2 Landings. The leading edge of landings shall be marked with a stripe consistent with the dimensional requirements for steps.

1025.2.3 Handrails. Handrails and handrail extensions shall be marked with a solid and continuous stripe having a minimum width of 1 inch (25 mm). The stripe shall be placed on the top surface of the handrail for the entire length of the handrail, including extensions and newel post caps. Where handrails or handrail extensions bend or turn corners, the stripe shall not have a gap of more than 4 inches (102 mm).

Exception: The minimum width of 1 inch (25 mm) shall not apply to outlining stripes listed in accordance with UL 1994.

1025.2.4 Perimeter demarcation lines. Stair landings and other floor areas within interior exit stairways, interior exit ramps and exit passageways, with the exception of the sides of steps, shall be provided with solid and continuous demarcation lines on the floor or on the walls or a combination of both. The stripes
shall be 1 to 2 inches (25 mm to 51 mm) wide with interruptions not exceeding 4 inches (102 mm).

**Exception:** The minimum width of 1 inch (25 mm) shall not apply to outlining stripes listed in accordance with UL 1994.

**1025.2.4.1 Floor-mounted demarcation lines.** Perimeter demarcation lines shall be placed within 4 inches (102 mm) of the wall and shall extend to within 2 inches (51 mm) of the markings on the leading edge of landings. The demarcation lines shall continue across the floor in front of all doors.

**Exception:** Demarcation lines shall not extend in front of exit discharge doors that lead out of an exit and through which occupants must travel to complete the exit path.

**1025.2.4.2 Wall-mounted demarcation lines.** Perimeter demarcation lines shall be placed on the wall with the bottom edge of the stripe not more than 4 inches (102 mm) above the finished floor. At the top or bottom of the stairs, demarcation lines shall drop vertically to the floor within 2 inches (51 mm) of the step or landing edge. Demarcation lines on walls shall transition vertically to the floor and then extend across the floor where a line on the floor is the only practical method of outlining the path. Where the wall line is broken by a door, demarcation lines on walls shall continue across the face of the door or transition to the floor and extend across the floor in front of such door.

**Exception:** Demarcation lines shall not extend in front of exit discharge doors that lead out of an exit and through which occupants must travel to complete the exit path.

**1025.2.4.3 Transition.** Where a wall-mounted demarcation line transitions to a floor-mounted demarcation line, or vice versa, the wall-mounted demarcation line shall drop vertically to the floor to meet a complimentary extension of the floor-mounted demarcation line, thus forming a continuous marking.

**1025.2.5 Obstacles.** Obstacles at or below 6 feet 6 inches (1981 mm) in height and projecting more than 4 inches (102 mm) into the egress path shall be outlined with markings not less than 1 inch (25 mm) in width comprised of a pattern of alternating equal bands, of luminous material and black, with the alternating bands not more than 2 inches (51 mm) thick and angled at 45 degrees (0.79 rad). Obstacles shall include, but are not limited to, standpipes, hose cabinets, wall projections and restricted height areas. However, such markings shall not conceal any required information or indicators including but not limited to instructions to occupants for the use of standpipes.
1025.2.6 Doors within the exit path. Doors through which occupants must pass in order to complete the exit path shall be provided with markings complying with Sections 1025.2.6.1 through 1025.2.6.3.

1025.2.6.1 Emergency exit symbol. The doors shall be identified by a low-location luminous emergency exit symbol complying with NFPA 170. The exit symbol shall be not less than 4 inches (102 mm) in height and shall be mounted on the door, centered horizontally, with the top of the symbol not higher than 18 inches (457 mm) above the finished floor.

1025.2.6.2 Door hardware markings. Door hardware shall be marked with not less than 16 square inches (406 mm²) of luminous material. This marking shall be located behind, immediately adjacent to, or on the door handle or escutcheon. Where a panic bar is installed, such material shall not be less than 1 inch (25 mm) wide for the entire length of the actuating bar or touchpad.

1025.2.6.3 Door frame markings. The top and sides of the door frame shall be marked with a solid and continuous 1-inch- to 2-inch-wide (25 mm to 51 mm) stripe. Where the door molding does not provide sufficient flat surface on which to locate the stripe, the stripe shall be permitted to be located on the wall surrounding the frame.

1025.3 Uniformity. Placement and dimensions of markings shall be consistent and uniform throughout the same enclosure.

1025.4 Self-luminous and photoluminescent. Luminous egress path markings shall be permitted to be made of any material, including paint, provided that an electrical charge is not required to maintain the required luminance. Such materials shall include, but not be limited to, self-luminous materials and photoluminescent materials. Materials shall comply with either of the following standards:

1. UL 1994.
2. ASTM E 2072, except that the charging source shall be 1 footcandle (11 lux) of fluorescent illumination for 60 minutes, and the minimum luminance shall be 30 milicandelas per square meter at 10 minutes and 5 milicandelas per square meter after 90 minutes.

1025.5 Illumination. Where photoluminescent exit path markings are installed, they shall be provided with not less than 1 footcandle (11 lux) of illumination for not less than 60 minutes prior to periods when the building is occupied and continuously during occupancy.

SECTION 1026
HORIZONTAL EXITS

1026.1 Horizontal exits. Horizontal exits serving as an exit in a means of egress system shall comply with the requirements of this section. A horizontal exit shall
not serve as the only exit from a portion of a building, and where two or more exits are required, not more than one-half of the total number of exits or total exit minimum width or required capacity shall be horizontal exits.

**Exceptions:**
1. Horizontal exits are permitted to comprise two thirds of the required exits from any building or floor area for occupancies in Group I-2.
2. Horizontal exits are permitted to comprise 100 percent of the exits required for occupancies in Group I3. Not less than 6 square feet (0.6 m²) of accessible space per occupant shall be provided on each side of the horizontal exit for the total number of people in adjoining compartments.

**1026.2 Separation.** The separation between buildings or refuge areas connected by a horizontal exit shall be provided by a fire wall complying with Section 706; or by a fire barrier complying with Section 707 or a horizontal assembly complying with Section 711, or both. The minimum fire-resistance rating of the separation shall be 2 hours. Opening protectives in horizontal exits shall also comply with Section 716. Duct and air transfer openings in a fire wall or fire barrier that serves as a horizontal exit shall also comply with Section 717. The horizontal exit separation shall extend vertically through all levels of the building unless floor assemblies have a fire-resistance rating of not less than 2 hours with no unprotected openings.

**Exception:** A fire-resistance rating is not required at horizontal exits between a building area and an above-grade pedestrian walkway constructed in accordance with Section 3104, provided that the distance between connected buildings is more than 20 feet (6096 mm). Horizontal exits constructed as fire barriers shall be continuous from exterior wall to exterior wall so as to divide completely the floor served by the horizontal exit.

**1026.3 Opening protectives.** Fire doors in horizontal exits shall be self-closing or automatic-closing when activated by a smoke detector in accordance with Section 716.5.9.3. Doors, where located in a cross-corridor condition, shall be automatic-closing by activation of a smoke detector installed in accordance with Section 716.5.9.3.

**1026.4 Refuge area.** The refuge area of a horizontal exit shall be a space occupied by the same tenant or a public area and each such refuge area shall be adequate to accommodate the original occupant load of the refuge area plus the occupant load anticipated from the adjoining compartment. The anticipated occupant load from the adjoining compartment shall be based on the capacity of the horizontal exit doors entering the refuge area.
1026.4.1 Capacity. The capacity of the refuge area shall be computed based on a net floor area allowance of 3 square feet (0.2787 m²) for each occupant to be accommodated therein.

Exceptions: The net floor area allowable per occupant shall be as follows for the indicated occupancies:
1. Six square feet (0.6 m²) per occupant for occupancies in Group I-3.
2. Fifteen square feet (1.4 m²) per occupant for ambulatory occupancies in Group I-2.
3. Thirty square feet (2.8 m²) per occupant for nonambulatory occupancies in Group I-2.

1026.4.2 Number of exits. The refuge area into which a horizontal exit leads shall be provided with exits adequate to meet the occupant requirements of this chapter, but not including the added occupant load imposed by persons entering the refuge area through horizontal exits from other areas. Not less than one refuge area exit shall lead directly to the exterior or to an interior exit stairway or ramp.

Exception: The adjoining compartment shall not be required to have a stairway or door leading directly outside, provided the refuge area into which a horizontal exit leads has stairways or doors leading directly outside and are so arranged that egress shall not require the occupants to return through the compartment from which egress originates.

SECTION 1027
EXTERIOR EXIT STAIRWAYS AND RAMPS

1027.1 Exterior exit stairways and ramps. Exterior exit stairways and ramps serving as an element of a required means of egress shall comply with this section.

1027.2 Use in a means of egress. Exterior exit stairways shall not be used as an element of a required means of egress for Group I-2, I-4 and daycare facilities in Group E occupancies. For occupancies in other than Group I-2, I-4 and daycare facilities in Group E occupancies, exterior exit stairways and ramps shall be permitted as an element of a required means of egress for buildings not exceeding six stories above grade plane or that are not high-rise buildings.

1027.3 Open side. Exterior exit stairways and ramps serving as an element of a required means of egress shall be open on not less than one side, except for required structural columns, beams, handrails and guards. An open side shall have not less than 35 square feet (3.3 m²) of aggregate open area adjacent to each floor.
level and the level of each intermediate landing. The required open area shall be located not less than 42 inches (1067 mm) above the adjacent floor or landing level.

1027.4 Side yards. The open areas adjoining exterior exit stairways or ramps shall be either yards, courts or public ways; the remaining sides are permitted to be enclosed by the exterior walls of the building.

1027.5 Location. Exterior exit stairways and ramps shall have a minimum fire separation distance of 10 feet (3048 mm) measured at right angles from the exterior edge of the stairway or ramps, including landings, to:

1. Adjacent lot lines.
2. Other portions of the building.
3. Other buildings on the same lot unless the adjacent building exterior walls and openings are protected in accordance with Section 705 based on fire separation distance.
   For the purposes of this section, other portions of the building shall be treated as separate buildings.

1027.6 Exterior exit stairway and ramp protection. Exterior exit stairways and ramps shall be separated from the interior of the building as required in Section 1023.2. Openings shall be limited to those necessary for egress from normally occupied spaces. Where a vertical plane projecting from the edge of an exterior exit stairway or ramp and landings is exposed by other parts of the building at an angle of less than 180 degrees (3.14 rad), the exterior wall shall be rated in accordance with Section 1023.7.

Exceptions:

1. Separation from the interior of the building is not required for occupancies, other than those in Group R-1 or R-2, in buildings that are not more than two stories above grade plane where a level of exit discharge serving such occupancies is the first story above grade plane.
2. Separation from the interior of the building is not required where the exterior exit stairway or ramp is served by an exterior exit ramp or balcony that connects two remote exterior exit stairways or other approved exits with a perimeter that is not less than 50 percent open. To be considered open, the opening shall be not less than 50 percent of the height of the enclosing wall, with the top of the openings not less than 7 feet (2134 mm) above the top of the balcony.
3. Separation from the open-ended corridor of the building is not required for exterior exit stairways or ramps, provided that Items 3.1 through 3.5 are met:
3.1. The building, including open-ended corridors, and stairways and ramps, shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.

3.2. The open-ended corridors comply with Section 1020.

3.3. The open-ended corridors are connected on each end to an exterior exit stairway or ramp complying with Section 1027.

3.4. The exterior walls and openings adjacent to the exterior exit stairway or ramp comply with Section 1023.7.

3.5. At any location in an open-ended corridor where a change of direction exceeding 45 degrees (0.79 rad) occurs, a clear opening of not less than 35 square feet (3.3 m²) or an exterior stairway or ramp shall be provided. Where clear openings are provided, they shall be located so as to minimize the accumulation of smoke or toxic gases.

SECTION 1028
EXIT DISCHARGE

1028.1 General. Exits shall discharge directly to the exterior of the building. The exit discharge shall be at grade or shall provide a direct path of egress travel to grade. The exit discharge shall not reenter a building. The combined use of Exceptions 1 and 2 shall not exceed 50 percent of the number and minimum width or required capacity of the required exits.

Exceptions:
1. Not more than 50 percent of the number and minimum width or required capacity of interior exit stairways and ramps is permitted to egress through areas on the level of discharge provided all of the following conditions are met:
   1.1. Discharge of interior exit stairways and ramps shall be provided with a free and unobstructed path of travel to an exterior exit door and such exit is readily visible and identifiable from the point of termination of the enclosure.
   1.2. The entire area of the level of exit discharge is separated from areas below by construction conforming to the fire-resistance rating for the enclosure.
   1.3. The egress path from the interior exit stairway and ramp on the level of exit discharge is protected throughout by an approved automatic sprinkler system. Portions of the level of exit discharge with access to the egress path shall be either equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2, or separated from the egress path in accordance with the requirements for the enclosure of interior exit stairways or ramps.
1.4. Where a required interior exit stairway or ramp and an exit access stairway or ramp serve the same floor level and terminate at the same level of exit discharge, the termination of the exit access stairway or ramp and the exit discharge door of the interior exit stairway or ramp shall be separated by a distance of not less than 30 feet (9144 mm) or not less than one-fourth the length of the maximum overall diagonal dimension of the building, whichever is less. The distance shall be measured in a straight line between the exit discharge door from the interior exit stairway or ramp and the last tread of the exit access stairway or termination of slope of the exit access ramp.

2. Not more than 50 percent of the number and minimum width or required capacity of the interior exit stairways and ramps is permitted to egress through a vestibule provided all of the following conditions are met:

2.1. The entire area of the vestibule is separated from areas below by construction conforming to the fire-resistance rating of the interior exit stairway or ramp enclosure.

2.2. The depth from the exterior of the building is not greater than 10 feet (3048 mm) and the length is not greater than 30 feet (9144 mm).

2.3. The area is separated from the remainder of the level of exit discharge by a fire partition constructed in accordance with Section 708.

   **Exception:** The maximum transmitted temperature rise is not required.

2.4. The area is used only for means of egress and exits directly to the outside.

3. Horizontal exits complying with Section 1026 shall not be required to discharge directly to the exterior of the building.

### 1028.2 Exit discharge width or capacity
The minimum width or required capacity of the exit discharge shall be not less than the minimum width or required capacity of the exits being served.

### 1028.3 Exit discharge components
Exit discharge components shall be sufficiently open to the exterior so as to minimize the accumulation of smoke and toxic gases.

### 1028.4 Egress courts
Egress courts serving as a portion of the exit discharge in the means of egress system shall comply with the requirements of Sections 1028.4.1 and 1028.4.2.

#### 1028.4.1 Width or capacity
The required capacity of egress courts shall be determined as specified in Section 1005.1, but the minimum width shall be not
less than 44 inches (1118 mm), except as specified herein. Egress courts serving Group R-3 and U occupancies shall be not less than 36 inches (914 mm) in width. The required capacity and width of egress courts shall be unobstructed to a height of 7 feet (2134 mm).

**Exception:** Encroachments complying with Section 1005.7.

Where an egress court exceeds the minimum required width and the width of such egress court is then reduced along the path of exit travel, the reduction in width shall be gradual. The transition in width shall be affected by a guard not less than 36 inches (914 mm) in height and shall not create an angle of more than 30 degrees (0.52 rad) with respect to the axis of the egress court along the path of egress travel. The width of the egress court shall not be less than the required capacity.

**1028.4.2 Construction and openings.** Where an egress court serving a building or portion thereof is less than 10 feet (3048 mm) in width, the egress court walls shall have not less than 1-hour fire-resistance-rated construction for a distance of 10 feet (3048 mm) above the floor of the egress court. Openings within such walls shall be protected by opening protectives having a fire protection rating of not less than $3/4$ hour.

**Exceptions:**
1. Egress courts serving an occupant load of less than 10.
2. Egress courts serving Group R-3.

**1028.5 Access to a public way.** The exit discharge shall provide a direct and unobstructed access to a public way.

**Exception:** Where access to a public way cannot be provided, a safe dispersal area shall be provided where all of the following are met:
1. The area shall be of a size to accommodate not less than 5 square feet (0.46 m$^2$) for each person.
2. The area shall be located on the same lot not less than 50 feet (15240 mm) away from the building requiring egress.
3. The area shall be permanently maintained and identified as a safe dispersal area.
4. The area shall be provided with a safe and unobstructed path of travel from the building.

**SECTION 1029**
**ASSEMBLY**
1029.1 **General.** A room or space used for assembly purposes that contains seats, tables, displays, equipment or other material shall comply with this section.

1029.1.1 **Bleachers.** Bleachers, grandstands and folding and telescopic seating, that are not building elements, shall comply with *Chapters 1-4 of ICC 300.*

1029.1.1.1 **Spaces under grandstands and bleachers.** Where spaces under grandstands or bleachers are used for purposes other than ticket booths less than 100 square feet (9.29 m²) and toilet rooms, such spaces shall be separated by fire barriers complying with Section 707 and horizontal assemblies complying with Section 711 with not less than 1-hour fire-resistance-rated construction.

1029.2 **Assembly main exit.** A building, room or space used for assembly purposes that has an occupant load of greater than 300 and is provided with a main exit, that main exit shall be of sufficient capacity to accommodate not less than one half of the occupant load, but such capacity shall be not less than the total required capacity of all means of egress leading to the exit. Where the building is classified as a Group A occupancy, the main exit shall front on not less than one street or an unoccupied space of not less than 10 feet (3048 mm) in width that adjoins a street or public way. In a building, room or space used for assembly purposes where there is not a well-defined main exit or where multiple main exits are provided, exits shall be permitted to be distributed around the perimeter of the building provided that the total capacity of egress is not less than 100 percent of the required capacity.

1029.3 **Assembly other exits.** In addition to having access to a main exit, each level in a building used for assembly purposes having an occupant load greater than 300 and provided with a main exit, shall be provided with additional means of egress that shall provide an egress capacity for not less than one-half of the total occupant load served by that level and shall comply with Section 1007.1. In a building used for assembly purposes where there is not a well-defined main exit or where multiple main exits are provided, exits for each level shall be permitted to be distributed around the perimeter of the building, provided that the total width of egress is not less than 100 percent of the required width.

1029.4 **Foyers and lobbies.** In Group A-1 occupancies, where persons are admitted to the building at times when seats are not available, such persons shall be allowed to wait in a lobby or similar space, provided such lobby or similar space shall not encroach upon the minimum width or required capacity of the
means of egress. Such foyer, if not directly connected to a public street by all the main entrances or exits, shall have a straight and unobstructed corridor or path of travel to every such main entrance or exit.

**1029.5 Interior balcony and gallery means of egress.** For balconies, galleries or press boxes having a seating capacity of 50 or more located in a building, room or space used for assembly purposes, not less than two means of egress shall be provided, with one from each side of every balcony, gallery or press box.

**1029.6 Capacity of aisle for assembly.** The required capacity of aisles shall be not less than that determined in accordance with Section 1029.6.1 where smoke-protected assembly seating is not provided, and with Section 1029.6.2 or 1029.6.3 where smoke-protected assembly seating is provided and Section 1029.3 where open-air assembly seating is provided.

**1029.6.1 Without smoke protection.** The required capacity in inches (mm) of the aisles for assembly seating without smoke protection shall be not less than the occupant load served by the egress element in accordance with all of the following, as applicable:

1. Not less than 0.3 inch (7.6 mm) of aisle capacity for each occupant served shall be provided on stepped aisles having riser heights 7 inches (178 mm) or less and tread depths 11 inches (279 mm) or greater, measured horizontally between tread nosings.
2. Not less than 0.005 inch (0.127 mm) of additional aisle capacity for each occupant shall be provided for each 0.10 inch (2.5 mm) of riser height above 7 inches (178 mm).
3. Where egress requires stepped aisle descent, not less than 0.075 inch (1.9 mm) of additional aisle capacity for each occupant shall be provided on those portions of aisle capacity having no handrail within a horizontal distance of 30 inches (762 mm).
4. Ramped aisles, where slopes are steeper than one unit vertical in 12 units horizontal (8-percent slope), shall have not less than 0.22 inch (5.6 mm) of clear aisle capacity for each occupant served. Level or ramped aisles, where slopes are not steeper than one unit vertical in 12 units horizontal (8-percent slope), shall have not less than 0.20 inch (5.1 mm) of clear aisle capacity for each occupant served.

**1029.6.2 Smoke-protected assembly seating.** The required capacity in inches (mm) of the aisle for smokeprotected assembly seating shall be not less than the occupant load served by the egress element multiplied by the appropriate factor in Table 1029.6.2. The total number of seats specified shall be those
within the space exposed to the same smoke-protected environment. Interpolation is permitted between the specific values shown. A life safety evaluation, complying with Section 12.4.1 or Section 13.4.1 of NFPA 101 or other approved method, shall be done for a facility utilizing the reduced width requirements of Table 1029.6.2 for smoke-protected assembly seating.

**Exception:** For outdoor smoke-protected assembly seating with an occupant load not greater than 18,000, the required capacity in inches (mm) shall be determined using the factors in Section 1029.6.3.

1029.6.2.1 **Smoke control.** Aisles and aisle accessways serving a smoke-protected assembly seating area shall be provided with a smoke control system complying with Section 909 or natural ventilation designed to maintain the smoke level not less than 6 feet (1829 mm) above the floor of the means of egress.

1029.6.2.2 **Roof height.** A smoke-protected assembly seating area with a roof shall have the lowest portion of the roof deck not less than 15 feet (4572 mm) above the highest aisle or aisle accessway.

**Exception:** A roof canopy in an outdoor stadium shall be permitted to be less than 15 feet (4572 mm) above the highest aisle or aisle accessway provided that there are no objects less than 80 inches (2032 mm) above the highest aisle or aisle accessway.

1029.6.2.3 **Automatic sprinklers.** Enclosed areas with walls and ceilings in buildings or structures containing smoke-protected assembly seating shall be protected with an approved automatic sprinkler system in accordance with Section 903.3.1.1.

**Exceptions:**
1. The floor area used for contests, performances or entertainment provided the roof construction is more than 50 feet (15 240 mm) above the floor level and the use is restricted to low fire hazard uses.
2. Press boxes and storage facilities less than 1,000 square feet (93 m²) in area.
3. Outdoor seating facilities where seating and the means of egress in the seating area are essentially open to the outside.

1029.6.3 **Outdoor smoke-protected assembly seating.** The required capacity in inches (mm) of aisles shall be not less than the total occupant load served by the egress element multiplied by 0.08 (2.0 mm) where egress is by stepped aisle and multiplied by 0.06 (1.52 mm) where egress is by level aisles and
ramped aisles.

Exception: The required capacity in inches (mm) of aisles shall be permitted to comply with Section 1029.6.2 for the number of seats in the outdoor smoke protected assembly seating where Section 1029.6.2 permits less capacity.

1029.7 Travel distance. Exits and aisles shall be so located that the travel distance to an exit door shall be not greater than 200 feet (60 960 mm) measured along the line of travel in nonsprinklered buildings. Travel distance shall be not more than 250 feet (76 200 mm) in sprinklered buildings. Where aisles are provided for seating, the distance shall be measured along the aisles and aisle accessways without travel over or on the seats.

Exceptions:
1. Smoke-protected assembly seating: The travel distance from each seat to the nearest entrance to a vomitory or concourse shall not exceed 200 feet (60 960 mm). The travel distance from the entrance to the vomitory or concourse to a stairway, ramp or walk on the exterior of the building shall not exceed 200 feet (60 960 mm).
2. Open-air seating: The travel distance from each seat to the building exterior shall not exceed 400 feet (122 m). The travel distance shall not be limited in facilities of Type I or II construction.

### TABLE 1029.6.2
CAPACITY FOR AISLES FOR SMOKE-PROTECTED ASSEMBLY

<table>
<thead>
<tr>
<th>TOTAL NUMBER OF SEATS IN THE SMOKE-PROTECTED ASSEMBLY SEATING</th>
<th>Stepped aisles with handrails within 30 inches</th>
<th>Stepped aisles without handrails within 30 inches</th>
<th>Level aisles or ramped aisles not steeper than 1 in 10 in slope</th>
<th>Ramped aisles steeper than 1 in 10 in slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal to or less than 5,000</td>
<td>0.200</td>
<td>0.250</td>
<td>0.150</td>
<td>0.165</td>
</tr>
<tr>
<td>10,000</td>
<td>0.130</td>
<td>0.163</td>
<td>0.100</td>
<td>0.110</td>
</tr>
<tr>
<td>15,000</td>
<td>0.096</td>
<td>0.120</td>
<td>0.070</td>
<td>0.077</td>
</tr>
<tr>
<td>20,000</td>
<td>0.076</td>
<td>0.095</td>
<td>0.056</td>
<td>0.062</td>
</tr>
<tr>
<td>Equal to or greater than 25,000</td>
<td>0.060</td>
<td>0.075</td>
<td>0.044</td>
<td>0.048</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

1029.8 Common path of egress travel. The common path of egress travel shall not exceed 30 feet (9144 mm) from any seat to a point where an occupant has a choice of two paths of egress travel to two exits.

Exceptions:
1. For areas serving less than 50 occupants, the common path of egress travel shall not exceed 75 feet (22 860 mm).
2. For smoke-protected assembly seating, the common path of egress travel shall not exceed 50 feet (15 240 mm).
1029.8.1 Path through adjacent row. Where one of the two paths of travel is across the aisle through a row of seats to another aisle, there shall be not more than 24 seats between the two aisles, and the minimum clear width between rows for the row between the two aisles shall be 12 inches (305 mm) plus 0.6 inch (15.2 mm) for each additional seat above seven in the row between aisles.

Exception: For smoke-protected assembly seating there shall be not more than 40 seats between the two aisles and the minimum clear width shall be 12 inches (305 mm) plus 0.3 inch (7.6 mm) for each additional seat.

1029.9 Assembly aisles are required. Every occupied portion of any building, room or space used for assembly purposes that contains seats, tables, displays, similar fixtures or equipment shall be provided with aisles leading to exits or exit access doorways in accordance with this section.

1029.9.1 Minimum aisle width. The minimum clear width for aisles shall comply with one of the following:

1. Forty-eight inches (1219 mm) for stepped aisles having seating on each side.
   Exception: Thirty-six inches (914 mm) where the stepped aisles serve less than 50 seats.
2. Thirty-six inches (914 mm) for stepped aisles having seating on only one side.
   Exception: Twenty-three inches (584 mm) between a stepped aisle handrail and seating where a stepped aisle does not serve more than five rows on one side.
3. Twenty-three inches (584 mm) between a stepped aisle handrail or guard and seating where the stepped aisle is subdivided by a mid-aisle handrail.
4. Forty-two inches (1067 mm) for level or ramped aisles having seating on both sides.
   Exceptions:
   1. Thirty-six inches (914 mm) where the aisle serves less than 50 seats.
   2. Thirty inches (762 mm) where the aisle does not serve more than 14 seats.
5. Thirty-six inches (914 mm) for level or ramped aisles having seating on only one side.
   Exception: For other than ramped aisles that serve as part of an accessible route, 30 inches (762 mm) where the ramped aisle does not
serve more than 14 seats.

1029.9.2 Aisle catchment area. The aisle shall provide sufficient capacity for the number of persons accommodated by the catchment area served by the aisle. The catchment area served by an aisle is that portion of the total space served by that section of the aisle. In establishing catchment areas, the assumption shall be made that there is a balanced use of all means of egress, with the number of persons in proportion to egress capacity.

1029.9.3 Converging aisles. Where aisles converge to form a single path of egress travel, the required capacity of that path shall be not less than the combined required capacity of the converging aisles.

1029.9.4 Uniform width and capacity. Those portions of aisles, where egress is possible in either of two directions, shall be uniform in minimum width or required capacity.

1029.9.5 Dead end aisles. Each end of an aisle shall be continuous to a cross aisle, foyer, doorway, vomitory, concourse or stairway in accordance with Section 1029.9.7 having access to an exit.

Exceptions:
1. Dead-end aisles shall be not greater than 20 feet (6096 mm) in length.
2. Dead-end aisles longer than 16 rows are permitted where seats beyond the 16th row dead-end aisle are not more than 24 seats from another aisle, measured along a row of seats having a minimum clear width of 12 inches (305 mm) plus 0.6 inch (15.2 mm) for each additional seat above seven in the row where seats have backrests or beyond 10 where seats are without backrests in the row.
3. For smoke-protected assembly seating, the dead end aisle length of vertical aisles shall not exceed a distance of 21 rows.
4. For smoke-protected assembly seating, a longer dead-end aisle is permitted where seats beyond the 21-row dead-end aisle are not more than 40 seats from another aisle, measured along a row of seats having an aisle accessway with a minimum clear width of 12 inches (305 mm) plus 0.3 inch (7.6 mm) for each additional seat above seven in the row where seats have backrests or beyond 10 where seats are without backrests in the row.

1029.9.6 Aisle measurement. The clear width for aisles shall be measured to walls, edges of seating and tread edges except for permitted projections.

Exception: The clear width of aisles adjacent to seating at tables shall
be permitted to be measured in accordance with Section 1029.12.1.

1029.9.6.1 Assembly aisle obstructions. There shall not be obstructions in the minimum width or required capacity of aisles.

Exception: Handrails are permitted to project into the required width of stepped aisles and ramped aisles in accordance with Section 1014.8.

1029.9.7 Stairways connecting to stepped aisles. A stairway that connects a stepped aisle to a cross aisle or concourse shall be permitted to comply with the assembly aisle walking surface requirements of Section 1029.13. Transitions between stairways and stepped aisles shall comply with Section 1029.10.

1029.9.8 Stairways connecting to vomitories. A stairway that connects a vomitory to a cross aisle or concourse shall be permitted to comply with the assembly aisle walking surface requirements of Section 1029.13. Transitions between stairways and stepped aisles shall comply with Section 1029.10.

1029.10 Transitions. Transitions between stairways and stepped aisles shall comply with either Section 1029.10.1 or 1029.10.2.

1029.10.1 Transitions and stairways that maintain stepped aisle riser and tread dimensions. Stepped aisles, transitions and stairways that maintain riser and tread dimensions shall comply with Section 1029.13 as one exit access component.

1029.10.2 Transitions to stairways that do not maintain stepped aisle riser and tread dimensions. Transitions to stairways from stepped aisles with riser and tread dimensions that differ from the stairways shall comply with Sections 1029.10.2.1 through 1029.10.3.

1029.10.2.1 Stairways and stepped aisles in straight run. Transitions where the stairway is a straight run from the stepped aisle shall have a minimum depth of 22 inches (559 mm) where the treads on the descending side of the transition have greater depth and 30 inches (762 mm) where the treads on the descending side of the transition have lesser depth.

1029.10.2.2 Stairways and stepped aisles that change direction. Transitions where the stairway changes direction from the stepped aisle shall have a minimum depth of 11 inches (280 mm) or
the stepped aisle tread depth, whichever is greater, between the stepped aisle and stairway.

1029.10.3 Transition marking. A distinctive marking stripe shall be provided at each nosing or leading edge adjacent to the transition. Such stripe shall be not less than 1 inch (25 mm), and not more than 2 inches (51 mm), wide. The edge marking stripe shall be distinctively different from the stepped aisle contrasting marking stripe.

1029.11 Construction. Aisles, stepped aisles and ramped aisles shall be built of materials consistent with the types permitted for the type of construction of the building.

Exception: Wood handrails shall be permitted for all types of construction.

1029.11.1 Walking surface. The surface of aisles, stepped aisles and ramped aisles shall be of slip-resistant materials that are securely attached. The surface for stepped aisles shall comply with Section 1011.7.1.

1029.11.2 Outdoor conditions. Outdoor aisles, stepped aisles and ramped aisles and outdoor approaches to aisles, stepped aisles and ramped aisles shall be designed so that water will not accumulate on the walking surface.

1029.12 Aisle accessways. Aisle accessways for seating at tables shall comply with Section 1029.12.1. Aisle accessways for seating in rows shall comply with Section 1029.12.2.

1029.12.1 Seating at tables. Where seating is located at a table or counter and is adjacent to an aisle or aisle accessway, the measurement of required clear width of the aisle or aisle accessway shall be made to a line 19 inches (483 mm) away from and parallel to the edge of the table or counter. The 19-inch (483 mm) distance shall be measured perpendicular to the side of the table or counter. In the case of other side boundaries for aisles or aisle accessways, the clear width shall be measured to walls, edges of seating and tread edges.

Exception: Where tables or counters are served by fixed seats, the width of the aisle or aisle accessway shall be measured from the back of the seat.

1029.12.1.1 Aisle accessway capacity and width for seating at tables. Aisle accessways serving arrangements of seating at tables or counters shall comply with the capacity requirements of Section 1005.1 but shall
not have less than 12 inches (305 mm) of width plus \( \frac{1}{2} \) inch (12.7 mm) of width for each additional 1 foot (305 mm), or fraction thereof, beyond 12 feet (3658 mm) of aisle accessway length measured from the center of the seat farthest from an aisle.

**Exception:** Portions of an aisle accessway having a length not exceeding 6 feet (1829 mm) and used by a total of not more than four persons.

**1029.12.1.2 Seating at table aisle accessway length.** The length of travel along the aisle accessway shall not exceed 30 feet (9144 mm) from any seat to the point where a person has a choice of two or more paths of egress travel to separate exits.

**1029.12.2 Clear width of aisle accessways serving seating in rows.** Where seating rows have 14 or fewer seats, the minimum clear aisle accessway width shall be not less than 12 inches (305 mm) measured as the clear horizontal distance from the back of the row ahead and the nearest projection of the row behind. Where chairs have automatic or self-rising seats, the measurement shall be made with seats in the raised position. Where any chair in the row does not have an automatic or self-rising seat, the measurements shall be made with the seat in the down position. For seats with folding tablet arms, row spacing shall be determined with the tablet arm in the used position.

**Exception:** For seats with folding tablet arms, row spacing is permitted to be determined with the tablet arm in the stored position where the tablet arm when raised manually to vertical position in one motion automatically returns to the stored position by force of gravity.

**1029.12.2.1 Dual access.** For rows of seating served by aisles or doorways at both ends, there shall be not more than 100 seats per row. The minimum clear width of 12 inches (305 mm) between rows shall be increased by 0.3 inch (7.6 mm) for every additional seat beyond 14 seats where seats have backrests or beyond 21 where seats are without backrests. The minimum clear width is not required to exceed 22 inches (559 mm).

**Exception:** For smoke-protected assembly seating, the row length limits for a 12-inch-wide (305 mm) aisle accessway, beyond which the aisle accessway minimum clear width shall be increased, are in Table 1029.12.2.1.

**1029.12.2.2 Single access.** For rows of seating served by an aisle or doorway at only one end of the row, the minimum clear width of 12 inches
between rows shall be increased by 0.6 inch (15.2 mm) for every additional seat beyond seven seats where seats have backrests or beyond 10 where seats are without backrests. The minimum clear width is not required to exceed 22 inches (559 mm).

**Exception:** For smoke-protected assembly seating, the row length limits for a 12-inch-wide (305 mm) aisle accessway, beyond which the aisle accessway minimum clear width shall be increased, are in Table 1029.12.2.1.

**1029.13 Assembly aisle walking surfaces.** Ramped aisles shall comply with Sections 1029.13.1 through 1029.13.1.3. Stepped aisles shall comply with Sections 1029.13.2 through 1029.13.2.4.

**1029.13.1 Ramped aisles.** Aisles that are sloped more than one unit vertical in 20 units horizontal (5-percent slope) shall be considered a ramped aisle. Ramped aisles that serve as part of an accessible route in accordance with Sections 1009 and 1108.2 shall have a maximum slope of one unit vertical in 12 units horizontal (8-percent slope). The slope of other ramped aisles shall not exceed one unit vertical in 8 units horizontal (12.5-percent slope).

**1029.13.1.1 Cross slope.** The slope measured perpendicular to the direction of travel of a ramped aisle shall not be steeper than one unit vertical in 48 units horizontal (2-percent slope).

**1029.13.1.2 Landings.** Ramped aisles shall have landings in accordance with Sections 1012.6 through 1012.6.5. Landings for ramped aisles shall be permitted to overlap required aisles or cross aisles.

**1029.13.1.3 Edge protection.** Ramped aisles shall have edge protection in accordance with Sections 1012.10 and 1012.10.1. **Exception:** In assembly spaces with fixed seating, edge protection is not required on the sides of ramped aisles where the ramped aisles provide access to the adjacent seating and aisle accessways.

**1029.13.2 Stepped aisles.** Aisles with a slope exceeding one unit vertical in eight units horizontal (12.5-percent slope) shall consist of a series of risers and treads that extends across the full width of aisles and complies with Sections 1029.13.2.1 through 1029.13.2.4.

**1029.13.2.1 Treads.** Tread depths shall be not less than 11 inches (279 mm) and shall have dimensional uniformity.
Exception: The tolerance between adjacent treads shall not exceed $\frac{3}{16}$ inch (4.8 mm).

<table>
<thead>
<tr>
<th>TOTAL NUMBER OF SEATS IN SMOKE-PROTECTED ASSEMBLY SEATING</th>
<th>MAXIMUM NUMBER OF SEATS PER ROW PERMITTED TO HAVE A MINIMUM 12-INCH CLEAR WIDTH AISLE ACCESSWAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aisle or doorway at both ends of row</td>
</tr>
<tr>
<td></td>
<td>Seats with backrests</td>
</tr>
<tr>
<td>Less than 4,000</td>
<td>14</td>
</tr>
<tr>
<td>4,000</td>
<td>15</td>
</tr>
<tr>
<td>7,000</td>
<td>16</td>
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<tr>
<td>10,000</td>
<td>17</td>
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<tr>
<td>13,000</td>
<td>18</td>
</tr>
<tr>
<td>16,000</td>
<td>19</td>
</tr>
<tr>
<td>19,000</td>
<td>20</td>
</tr>
<tr>
<td>22,000 and greater</td>
<td>21</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

1029.13.2.2 Risers. Where the gradient of stepped aisles is to be the same as the gradient of adjoining seating areas, the riser height shall be not less than 4 inches (102 mm) nor more than 8 inches (203 mm) and shall be uniform within each flight.

Exceptions:
1. Riser height nonuniformity shall be limited to the extent necessitated by changes in the gradient of the adjoining seating area to maintain adequate sightlines. Where nonuniformities exceed $\frac{3}{16}$ inch (4.8 mm) between adjacent risers, the exact location of such nonuniformities shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the non-uniform risers. Such stripe shall be not less than 1 inch (25 mm), and not more than 2 inches (51 mm), wide. The edge marking stripe shall be distinctively different from the contrasting marking stripe.
2. Riser heights not exceeding 9 inches (229 mm) shall be permitted where they are necessitated by the slope of the adjacent seating areas to maintain sightlines.

1029.13.2.2.1 Construction tolerances. The tolerance between adjacent risers on a stepped aisle that were designed to be equal height shall not exceed $\frac{3}{16}$ inch (4.8 mm). Where the stepped aisle is
designed in accordance with Exception 1 of Section 1029.13.2.2, the stepped aisle shall be constructed so that each riser of unequal height, determined in the direction of descent, is not more than $\frac{3}{8}$ inch (9.5 mm) in height different from adjacent risers where stepped aisle treads are less than 22 inches (560 mm) in depth and $\frac{3}{4}$ inch (19.1 mm) in height different from adjacent risers where stepped aisle treads are 22 inches (560 mm) or greater in depth.

1029.13.2.3 **Tread contrasting marking stripe.** A contrasting marking stripe shall be provided on each tread at the nosing or leading edge such that the location of each tread is readily apparent when viewed in descent. Such stripe shall be not less than 1 inch (25 mm), and not more than 2 inches (51 mm), wide.

Exception: The contrasting marking stripe is permitted to be omitted where tread surfaces are such that the location of each tread is readily apparent when viewed in descent.

1029.13.2.4 **Nosing and profile.** Nosing and riser profile shall comply with Sections 1011.5.5 through 1011.5.5.3.

1029.14 **Seat stability.** In a building, room or space used for assembly purposes, the seats shall be securely fastened to the floor.

Exceptions:
1. In a building, room or space used for assembly purposes or portions thereof without ramped or tiered floors for seating and with 200 or fewer seats, the seats shall not be required to be fastened to the floor.
2. In a building, room or space used for assembly purposes or portions thereof with seating at tables and without ramped or tiered floors for seating, the seats shall not be required to be fastened to the floor.
3. In a building, room or space used for assembly purposes or portions thereof without ramped or tiered floors for seating and with greater than 200 seats, the seats shall be fastened together in groups of not less than three or the seats shall be securely fastened to the floor.
4. In a building, room or space used for assembly purposes where flexibility of the seating arrangement is an integral part of the design and function of the space and seating is on tiered levels, not more than 200 seats shall not be required to be fastened to the floor. Plans showing seating, tiers and aisles shall be submitted for approval.
5. Groups of seats within a building, room or space used for assembly purposes separated from other seating by railings, guards, partial height
walls or similar barriers with level floors and having not more than 14 seats per group shall not be required to be fastened to the floor.

6. Seats intended for musicians or other performers and separated by railings, guards, partial height walls or similar barriers shall not be required to be fastened to the floor.

1029.15 Handrails. Ramped aisles having a slope exceeding one unit vertical in 15 units horizontal (6.7-percent slope) and stepped aisles shall be provided with handrails in compliance with Section 1014 located either at one or both sides of the aisle or within the aisle width.

Exceptions:
1. Handrails are not required for ramped aisles with seating on both sides.
2. Handrails are not required where, at the side of the aisle, there is a guard with a top surface that complies with the graspability requirements of handrails in accordance with Section 1014.3.
3. Handrail extensions are not required at the top and bottom of stepped aisles and ramped aisles to permit crossovers within the aisles.

1029.15.1 Discontinuous handrails. Where there is seating on both sides of the aisle, the mid-aisle handrails shall be discontinuous with gaps or breaks at intervals not exceeding five rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of not less than 22 inches (559 mm) and not greater than 36 inches (914 mm), measured horizontally, and the mid-aisle handrail shall have rounded terminations or bends.

1029.15.2 Handrail termination. Handrails located on the side of stepped aisles shall return to a wall, guard or the walking surface or shall be continuous to the handrail of an adjacent stepped aisle flight.

1029.15.3 Mid-aisle termination. Mid-aisle handrails shall not extend beyond the lowest riser and shall terminate within 18 inches (381 mm), measured horizontally, from the lowest riser. Handrail extensions are not required.

Exception: Mid-aisle handrails shall be permitted to extend beyond the lowest riser where the handrail extensions do not obstruct the width of the cross aisle.

1029.15.4 Rails. Where mid-aisle handrails are provided in stepped aisles, there shall be an additional rail located approximately 12 inches (305 mm) below the handrail. The rail shall be adequate in strength and attachment in
1029.16 Assembly guards. Guards adjacent to seating in a building, room or space used for assembly purposes shall be provided where required by Section 1015 and shall be constructed in accordance with Section 1015 except where provided in accordance with Sections 1029.16.1 through 1029.16.4. At bleachers, grandstands and folding and telescopic seating, guards must be provided where required by ICC 300 and Section 1029.16.1.

1029.16.1 Perimeter guards. Perimeter guards shall be provided where the footboards or walking surface of seating facilities are more than 30 inches (762 mm) above the floor or grade below. Where the seatboards are adjacent to the perimeter, guard height shall be 42 inches (1067 mm) high minimum, measured from the seatboard. Where the seats are self-rising, guard height shall be 42 inches (1067 mm) high minimum, measured from the floor surface. Where there is an aisle between the seating and the perimeter, the guard height shall be measured in accordance with Section 1015.2.

Exceptions:
1. Guards that impact sightlines shall be permitted to comply with Section 1029.16.3.
2. Bleachers, grandstands and folding and telescopic seating shall not be required to have perimeter guards where the seating is located adjacent to a wall and the space between the wall and the seating is less than 4 inches (102 mm).

1029.16.2 Cross aisles. Cross aisles located more than 30 inches (762 mm) above the floor or grade below shall have guards in accordance with Section 1015.

Where an elevation change of 30 inches (762 mm) or less occurs between a cross aisle and the adjacent floor or grade below, guards not less than 26 inches (660 mm) above the aisle floor shall be provided.

Exception: Where the backs of seats on the front of the cross aisle project 24 inches (610 mm) or more above the adjacent floor of the aisle, a guard need not be provided.

1029.16.3 Sightline-constrained guard heights. Unless subject to the requirements of Section 1029.16.4, a fascia or railing system in accordance with the guard requirements of Section 1015 and having a minimum height of 26 inches (660 mm) shall be provided where the floor or footboard elevation is more than 30 inches (762 mm) above the floor or grade below and the
fascia or railing would otherwise interfere with the sightlines of immediately adjacent seating.

1029.16.4 Guards at the end of aisles. A fascia or railing system complying with the guard requirements of Section 1015 shall be provided for the full width of the aisle where the foot of the aisle is more than 30 inches (762 mm) above the floor or grade below. The fascia or railing shall be a minimum of 36 inches (914 mm) high and shall provide a minimum 42 inches (1067 mm) measured diagonally between the top of the rail and the nosing of the nearest tread.

SECTION 1030
EMERGENCY ESCAPE AND RESCUE

1030.1 General. In addition to the means of egress required by this chapter, provisions shall be made for emergency escape and rescue openings in Group R-2 occupancies in accordance with Tables 1006.3.2(1) and 1006.3.2(2) and Group R-3 occupancies. shall be provided in the following occupancies:

1. Group R-2 occupancies located in stories with only one exit or access to only one exit as permitted by Tables 1006.3.2(1) and 1006.3.2(2).

2. Group R-3 and R-4 occupancies.

Basements and sleeping rooms below the fourth story above grade plane shall have at least one exterior emergency escape and rescue opening in accordance with this section. Where basements contain one or more sleeping rooms, emergency escape and rescue openings shall be required in each sleeping room, but shall not be required in adjoining areas of the basement. Such openings shall open directly into a public way or to a yard or court that opens to a public way.

Exceptions:
1. Basements with a ceiling height of less than 80 inches (2032 mm) shall not be required to have emergency escape and rescue openings.
2. Emergency escape and rescue openings are not required from basements or sleeping rooms that have an exit door or exit access door that opens directly into a public way or to a yard, court or exterior exit balcony that opens to a public way.
3. Basements without habitable spaces and having not more than 200 square feet (18.6 m²) in floor area shall not be required to have emergency escape and rescue openings.
4. Within individual dwelling and sleeping units in Groups R-2 and R-3, where the building is equipped throughout with an automatic sprinkler
system installed in accordance with Section 903.3.1.1, 903.3.1.2 or 903.3.1.3, sleeping rooms in basements shall not be required to have emergency escape and rescue openings provided that the basement has one of the following:

4.1 One means of egress and one emergency escape and rescue opening.
4.2 Two means of egress.

1030.2 Minimum size. Emergency escape and rescue openings shall have a minimum net clear opening of 5.7 square feet (0.53 m²).

Exception: The minimum net clear opening for grade floor emergency escape and rescue openings shall be 5 square feet (0.46 m²).

1030.2.1 Minimum dimensions. The minimum net clear opening height dimension shall be 24 inches (610 mm). The minimum net clear opening width dimension shall be 20 inches (508 mm). The net clear opening dimensions shall be the result of normal operation of the opening.

1030.3 Maximum height from floor. Emergency escape and rescue openings shall have the bottom of the clear opening not greater than 44 inches (1118 mm) measured from the floor.

1030.4 Operational constraints. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools. Bars, grilles, grates or similar devices are permitted to be placed over emergency escape and rescue openings provided the minimum net clear opening size complies with Section 1030.2 and such devices shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the emergency escape and rescue opening. Where such bars, grilles, grates or similar devices are installed in existing buildings, smoke alarms shall be installed in accordance with Section 907.2.11 regardless of the valuation of the alteration.

1030.5 Window wells. An emergency escape and rescue opening with a finished sill height below the adjacent ground level shall be provided with a window well in accordance with Sections 1030.5.1 and 1030.5.2.

1030.5.1 Minimum size. The minimum horizontal area of the window well shall be 9 square feet (0.84 m²), with a minimum dimension of 36 inches (914 mm). The area of the window well shall allow the emergency escape and rescue opening to be fully opened.
1030.5.2 Ladders or steps. Window wells with a vertical depth of more than 44 inches (1118 mm) shall be equipped with an approved permanently affixed ladder or steps. Ladders or rungs shall have an inside width of at least 12 inches (305 mm), shall project at least 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center (o.c.) vertically for the full height of the window well. The ladder or steps shall not encroach into the required dimensions of the window well by more than 6 inches (152 mm). The ladder or steps shall not be obstructed by the emergency escape and rescue opening. Ladders or steps required by this section are exempt from the stairway requirements of Section 1011.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:1-35-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 1301
GENERAL

1301.1 Scope. This chapter governs the design and construction of buildings for energy efficiency.

1301.1.1 Criteria. Buildings shall be designed and constructed in accordance with the applicable provisions of the “International Energy Conservation Code” or the requirements of “ASHRAE 90.1” listed in Chapter 35 of this code except as modified in Sections 1301.2 and 1301.3.

EXCEPTION: Either the “International Energy Conservation Code” referenced in Chapter 44 of the “Residential Code of Ohio for One-, Two-, and Three-Family Dwellings” (RCO) or Sections 1101.2.2 through 1104 in Chapter 11 of the RCO are permitted to be used in place of the energy conservation requirements of this code for R-3 occupancies in buildings three stories or less, comprised exclusively of dwelling units, where each unit has independent means of egress. Except as provided by Section 1301.1.1.1, Chapter 11 of the “Residential Code of Ohio for One-, Two-, and Three-Family Dwellings” (RCO) is permitted to be used in place of the energy conservation requirements of this code for Group R-3 occupancies in buildings three stories or less, comprised exclusively of dwelling units, where each dwelling unit has an independent exit.

1301.1.1.1 Ohio Home Builder Association (OHBA) Alternative Energy Code Option. Group R-3 occupancy buildings are permitted to comply with Section 1112 of the RCO provided all the following are met:
1. The building is three stories or less, and
2. Comprised exclusively of dwelling units, and
3. Each dwelling unit has an independent exit, and
4. Minimum appliance efficiencies meet or exceed Table 1301.1.1.1.

<table>
<thead>
<tr>
<th>Type of appliance</th>
<th>Minimum Efficiency</th>
</tr>
</thead>
</table>

TABLE 1301.1.1.1 Appliance efficiency
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas furnace</td>
<td>96% AFUE</td>
</tr>
<tr>
<td>Electric heat pump (heating mode)</td>
<td>8.8 HSPF</td>
</tr>
<tr>
<td>Electric heat pump (cooling mode)</td>
<td>14 SEER</td>
</tr>
<tr>
<td>Electric air conditioner</td>
<td>14 SEER</td>
</tr>
<tr>
<td>Gas hot water tank</td>
<td>At least .57 EF, but not less than the federal minimum efficiency established in 10 C.F.R. 430</td>
</tr>
<tr>
<td>Electric hot water tank</td>
<td>.95 EF</td>
</tr>
</tbody>
</table>

1301.2 Modifications to the International Energy Conservation Code. The following changes shall be made to the International Energy Conservation Code:

**Residential**

1. Section R402.4.1.1 – Delete the last sentence.
2. Section R402.4.1.2, the first sentence shall be modified to read as follows: “The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding 4 air changes per hour at 50 Pascals.”
3. Section R402.4.2 shall read “Fireplaces. New wood-burning fireplaces shall have doors or tight-fitting flue dampers and outdoor combustion air. If using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace.”
4. Section R403.2.3 shall read “Building cavities (Mandatory). Building framing cavities shall not be used as supply ducts.”
5. Section R403.9 – Delete section and all subsections.

**Commercial**

1. Section C101.4.3
   a. Exception 5 shall read “Roof recover or roof repair.”
   b. Exception 6 shall read “Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.”
   c. Renumber exceptions 6, 7, and 8 as 7, 8, and 9.
2. Section C202 add the following definitions:
   **REROOFING.** The process of recovering or replacing an existing roof covering. See “Roof recover” and “Roof replacement.”
   **ROOF RECOVER.** The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.
   **ROOF REPAIR.** Reconstruction or renewal of any part of an existing roof for the purpose of its maintenance.
   **ROOF REPLACEMENT.** The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.
3. **Section C402.2.1.1:** Delete existing section and Table C402.2.1.1 and replace with new section which reads **“C402.2.1.1 Roof replacement.”** For roof replacements, where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above deck, roof replacement shall include compliance with the requirements of Table C402.1.2 or Table C402.2.”

**1301.3 Modifications to ASHRAE 90.1.** The following changes shall be made to the ASHRAE 90.1:

1. *Addenda ap, cj, and de included in the ASHRAE “Standard 90.1-2010 Addenda 2013 Supplement Package” as found on the ASHRAE website https://www.ashrae.org/standards-research--technology/standards-addenda are also adopted and intended to be applicable to computer rooms and data centers.*

2. *Addenda dd included in the ASHRAE “Standard 90.1-2010 Addenda 2013 Supplement Package” as found on the ASHRAE website https://www.ashrae.org/standards-research--technology/standards-addenda is also adopted and intended to be applicable to roofing projects.*

3. *Section 7.4.4.4 Circulating Pump Controls: Delete section.*

4. *Section 8.4.2 Automatic Receptacle Control; Delete section.*
4101:1-15-01 Roof assemblies and rooftop structures.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:1-35-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 1501
GENERAL

1501.1 Scope. The provisions of this chapter shall govern the design, materials, construction and quality of roof assemblies, and rooftop structures.

SECTION 1502
DEFINITIONS

1502.1 Definitions. The following terms are defined in Chapter 2:
AGGREGATE.
BALLAST.
BUILDING-INTEGRATED PHOTOVOLTAIC (BIPV) PRODUCT.
BUILT-UP ROOF COVERING.
INTERLAYMENT.
MECHANICAL EQUIPMENT SCREEN.
METAL ROOF PANEL.
METAL ROOF SHINGLE.
MODIFIED BITUMEN ROOF COVERING.
PENTHOUSE.
PHOTOVOLTAIC MODULE.
PHOTOVOLTAIC PANEL.
PHOTOVOLTAIC PANEL SYSTEM.
PHOTOVOLTAIC SHINGLES.
POSITIVE ROOF DRAINAGE.
RADIANT BARRIER.
REROOFING.
ROOF ASSEMBLY.
ROOF COVERING.
ROOF COVERING SYSTEM.
ROOF DECK.
ROOF RECOVER.
ROOF REPAIR.
SECTION 1503
WEATHER PROTECTION

1503.1 General. Roof decks shall be covered with approved roof coverings secured to the building or structure in accordance with the provisions of this chapter. Roof coverings shall be designed and installed in accordance with this code and the approved manufacturer’s instructions such that the roof covering shall serve to protect the building or structure.

1503.2 Flashing. Flashing shall be installed in such a manner so as to prevent moisture entering the wall and roof through joints in copings, through moisture-permeable materials and at intersections with parapet walls and other penetrations through the roof plane.

1503.2.1 Locations. Flashing shall be installed at wall and roof intersections, at gutters, wherever there is a change in roof slope or direction and around roof openings. Where flashing is of metal, the metal shall be corrosion resistant with a thickness of not less than 0.019 inch (0.483 mm) (No. 26 galvanized sheet).

1503.3 Coping. Parapet walls shall be properly coped with noncombustible, weatherproof materials of a width no less than the thickness of the parapet wall.

1503.4 Roof drainage. Design and installation of roof drainage systems shall comply with Section 1503 of this code and Sections 1106 and 1108, as applicable, of the plumbing code.

1503.4.1 Secondary (emergency overflow) drains or scuppers. Where roof drains are required, secondary (emergency overflow) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason. The installation and sizing of secondary emergency overflow drains, leaders and conductors shall comply with Sections 1106 and 1108, as applicable, of the plumbing code.
1503.4.2 Scuppers. When scuppers are used for secondary (emergency overflow) roof drainage, the quantity, size, location and inlet elevation of the scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1611.1. Scuppers shall not have an opening dimension of less than 4 inches (102 mm). The flow through the primary system shall not be considered when locating and sizing scuppers.

1503.4.3 Gutters. Gutters and leaders placed on the outside of buildings, other than Group R-3, private garages and buildings of Type V construction, shall be of noncombustible material or a minimum of Schedule 40 plastic pipe.

1503.5 Attic and rafter ventilation. Intake and exhaust vents shall be provided in accordance with Section 1203.2 and the vent product manufacturer’s installation instructions.

1503.6 Crickets and saddles. A cricket or saddle shall be installed on the ridge side of any chimney or penetration greater than 30 inches (762 mm) wide as measured perpendicular to the slope. Cricket or saddle coverings shall be sheet metal or of the same material as the roof covering.

Exception: Unit skylights installed in accordance with Section 2405.5 and flashed in accordance with the manufacturer’s instructions shall be permitted to be installed without a cricket or saddle.

SECTION 1504
PERFORMANCE REQUIREMENTS

1504.1 Wind resistance of roofs. Roof decks and roof coverings shall be designed for wind loads in accordance with Chapter 16 and Sections 1504.2, 1504.3 and 1504.4.

1504.1.1 Wind resistance of asphalt shingles. Asphalt shingles shall be tested in accordance with ASTM D 7158. Asphalt shingles shall meet the classification requirements of Table 1504.1.1 for the appropriate maximum basic wind speed. Asphalt shingle packaging shall bear a label to indicate compliance with ASTM D 7158 and the required classification in Table 1504.1.1.

Exception: Asphalt shingles that are not included in the scope of ASTM D 7158 shall be tested and labeled to indicate compliance with ASTM D
3161 and the required classification in Table 1504.1.1.

1504.2 Wind resistance of clay and concrete tile. Wind loads on clay and concrete tile roof coverings shall be in accordance with Section 1609.5.

1504.2.1 Testing. Testing of concrete and clay roof tiles shall be in accordance with Sections 1504.2.1.1 and 1504.2.1.2.

1504.2.1.1 Overturning resistance. Concrete and clay roof tiles shall be tested to determine their resistance to overturning due to wind in accordance with SBCCI SSTD 11 and Chapter 15.

1504.2.1.2 Wind tunnel testing. Where concrete and clay roof tiles do not satisfy the limitations in Chapter 16 for rigid tile, a wind tunnel test shall be used to determine the wind characteristics of the concrete or clay tile roof covering in accordance with SBCCI SSTD 11 and Chapter 15.

1504.3 Wind resistance of non-ballasted roofs. Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in accordance with Section 1609.

1504.3.1 Other roof systems. Built-up, modified bitumen, fully adhered or mechanically attached single-ply roof systems, metal panel roof systems applied to a solid or closely fitted deck and other types of membrane roof coverings shall be tested in accordance with FM 4474, UL 580 or UL 1897.

1504.3.2 Structural metal panel roof systems. Where the metal roof panel functions as the roof deck and roof covering and it provides both weather protection and support for loads, the structural metal panel roof system shall comply with this section. Structural standing-seam metal panel roof systems shall be tested in accordance with ASTM E 1592 or FM 4474. Structural through-fastened metal panel roof systems shall be tested in accordance with FM 4474, UL 580 or ASTM E 1592.
### Exceptions:

1. Metal roofs constructed of cold-formed steel shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2210.1.

2. Metal roofs constructed of aluminum shall be permitted to be designed and tested in accordance with the applicable referenced structural design standard in Section 2002.1.

#### 1504.4 Ballasted low-slope roof systems.

Ballasted low slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections 1507.12 and 1507.13 shall be designed in accordance with Section 1504.8 and ANSI/SPRI RP-4.

#### 1504.5 Edge securement for low-slope roofs.

Low-slope built-up, modified bitumen and single-ply roof system metal edge securement, except gutters, shall be designed and installed for wind loads in accordance with Chapter 16 and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI ES-1, except $V_{ult}$ wind speed shall be determined from Figure 1609A, 1609B, or 1609C-1609.3(1), 1609.3(2), or 1609.3(3) as applicable.

#### 1504.6 Physical properties.

Roof coverings installed on low-slope roofs (roof slope < 2:12) in accordance with Section 1507 shall demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to

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**TABLE 1504.1.1**

**CLASSIFICATION OF ASPHALT SHINGLES**

<table>
<thead>
<tr>
<th>MAXIMUM BASIC WIND SPEED, $V_{ult}$, FROM FIGURE 1609A, B, C, 1609.3(1), 1609.3(2), 1609.3(3) OR ASCE 7</th>
<th>MAXIMUM BASIC WIND SPEED, $V_{assd}$, FROM TABLE 1609.3.1</th>
<th>ASTM D 7158* CLASSIFICATION</th>
<th>ASTM D 3161 CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>85</td>
<td>D, G or H</td>
<td>A, D or F</td>
</tr>
<tr>
<td>116</td>
<td>90</td>
<td>D, G or H</td>
<td>A, D or F</td>
</tr>
<tr>
<td>129</td>
<td>100</td>
<td>G or H</td>
<td>A, D or F</td>
</tr>
<tr>
<td>142</td>
<td>110</td>
<td>G or H</td>
<td>F</td>
</tr>
<tr>
<td>155</td>
<td>120</td>
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<tr>
<td>168</td>
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<td>H</td>
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</tr>
<tr>
<td>194</td>
<td>150</td>
<td>H</td>
<td>F</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm; 1 mph = 0.447 m/s.

The standard calculations contained in ASTM D 7158 assume Exposure Category B or C and building height of 60 feet or less. Additional calculations are required for conditions outside of these assumptions.
accelerated weathering tests conducted in accordance with ASTM G 152, ASTM G 155 or ASTM G 154. Those roof coverings that are subject to cyclical flexural response due to wind loads shall not demonstrate any significant loss of tensile strength for unreinforced membranes or breaking strength for reinforced membranes when tested as herein required.

1504.7 Impact resistance. Roof coverings installed on low slope roofs (roof slope < 2:12) in accordance with Section 1507 shall resist impact damage based on the results of tests conducted in accordance with ASTM D 3746, ASTM D 4272, CGSB 37-GP-52M or the “Resistance to Foot Traffic Test” in Section 5.5 of FM 4470.

1504.8 Aggregate. Aggregate used as surfacing for roof coverings and aggregate, gravel or stone used as ballast shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 202, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site.

<table>
<thead>
<tr>
<th>NOMINAL DESIGN WIND SPEED, V_{asd} (mph)</th>
<th>MAXIMUM MEAN ROOF HEIGHT (ft)</th>
<th>Exposure category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>85</td>
<td>170</td>
<td>60</td>
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<tr>
<td>90</td>
<td>110</td>
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<td>100</td>
<td>55</td>
<td>15</td>
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<tr>
<td>105</td>
<td>40</td>
<td>NP</td>
</tr>
<tr>
<td>110</td>
<td>30</td>
<td>NP</td>
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<tr>
<td>115</td>
<td>20</td>
<td>NP</td>
</tr>
<tr>
<td>120</td>
<td>15</td>
<td>NP</td>
</tr>
<tr>
<td>Greater than 120</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

a. Mean roof height as defined in ASCE 7.

b. For intermediate values of V_{asd}, the height associated with the next higher value of V_{asd} shall be used, or direct interpolation is permitted.

c. NP = gravel and stone not permitted for any roof height.
SECTION 1505
FIRE CLASSIFICATION

1505.1 General. Roof assemblies shall be divided into the classes defined below. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E 108 or UL 790. In addition, fire-retardant-treated wood roof coverings shall be tested in accordance with ASTM D 2898. The minimum roof coverings installed on buildings shall comply with Table 1505.1 based on the type of construction of the building.

Exception: Skylights and sloped glazing that comply with Chapter 24 or Section 2610.

TABLE 1505.1a, b
MINIMUM ROOF COVERING CLASSIFICATION
FOR TYPES OF CONSTRUCTION

<table>
<thead>
<tr>
<th>IIA</th>
<th>IIB</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>VA</th>
<th>VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>B</td>
<td>B</td>
<td>Cc</td>
<td>B</td>
<td>Cc</td>
<td>B</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m².

a. Delete.
b. Non classified roof coverings shall be permitted on buildings of Group R-3 and Group U occupancies, where there is a minimum fire-separation distance of 6 feet measured from the leading edge of the roof.
c. Buildings that are not more than two stories above grade plane and having not more than 6,000 square feet of projected roof area and where there is a minimum 10-foot fire-separation distance from the leading edge of the roof to a lot line on all sides of the building, except for street fronts or public ways, shall be permitted to have roofs of No. 1 cedar or redwood shakes and No. 1 shingles constructed in accordance with Section 1505.7.

1505.2 Class A roof assemblies. Class A roof assemblies are those that are effective against severe fire test exposure. Class A roof assemblies and roof coverings shall be listed and identified as Class A by an approved testing agency. Class A roof assemblies shall be permitted for use in buildings or structures of all types of construction.

Exceptions:
1. Class A roof assemblies include those with coverings of brick, masonry or an exposed concrete roof deck.
2. Class A roof assemblies also include ferrous or copper shingles or sheets, metal sheets and shingles, clay or concrete roof tile or slate installed on noncombustible decks or ferrous, copper or metal sheets installed without a roof deck on noncombustible framing.
3. Class A roof assemblies include minimum 16 ounce per square foot (0.0416 kg/m²) copper sheets installed over combustible decks.
4. Class A roof assemblies include slate installed over ASTM D 226, Type II underlayment over combustible decks.

1505.3 Class B roof assemblies. Class B roof assemblies are those that are effective against moderate fire-test exposure. Class B roof assemblies and roof coverings shall be listed and identified as Class B by an approved testing agency.

1505.4 Class C roof assemblies. Class C roof assemblies are those that are effective against light fire-test exposure. Class C roof assemblies and roof coverings shall be listed and identified as Class C by an approved testing agency.

1505.5 Non classified roofing. Non classified roofing is approved material that is not listed as a Class A, B or C roof covering.

1505.6 Fire-retardant-treated wood shingles and shakes. Fire-retardant-treated wood shingles and shakes shall be treated by impregnation with chemicals by the full cell vacuum-pressure process, in accordance with AWPA C1. Each bundle shall be marked to identify the manufactured unit and the manufacturer, and shall also be labeled to identify the classification of the material in accordance with the testing required in Section 1505.1, the treating company and the quality control agency.

1505.7 Special purpose roofs. Special purpose wood shingle or wood shake roofing shall conform to the grading and application requirements of Section 1507.8 or 1507.9. In addition, an underlayment of 5/8-inch (15.9 mm) Type X water-resistant gypsum backing board or gypsum sheathing shall be placed under minimum nominal 1/2-inch-thick (12.7 mm) wood structural panel solid sheathing or 1-inch (25 mm) nominal spaced sheathing.

1505.8 Building-integrated photovoltaic products. Building-integrated photovoltaic products installed as the roof covering shall be tested, listed and labeled for fire classification in accordance with Section 1505.1.

1505.9 Photovoltaic panels and modules. Rooftop mounted photovoltaic panel systems shall be tested, listed and identified with a fire classification in accordance with UL 1703. The fire classification shall comply with Table 1505.1 based on the type of construction of the building.

1505.10 Roof gardens and landscaped roofs. Roof gardens and landscaped
roofs shall comply with Section 1507.16 and shall be installed in accordance with ANSI/SPRI VF-1.

SECTION 1506
MATERIALS

1506.1 Scope. The requirements set forth in this section shall apply to the application of roof-covering materials specified herein. Roof coverings shall be applied in accordance with this chapter and the manufacturer’s installation instructions. Installation of roof coverings shall comply with the applicable provisions of Section 1507.

1506.2 Material specifications and physical characteristics. Roof-covering materials shall conform to the applicable standards listed in this chapter.

1506.3 Product identification. Roof-covering materials shall be delivered in packages bearing the manufacturer’s identifying marks and approved testing agency labels required in accordance with Section 1505. Bulk shipments of materials shall be accompanied with the same information issued in the form of a certificate or on a bill of lading by the manufacturer.

SECTION 1507
REQUIREMENTS FOR ROOF COVERINGS

1507.1 Scope. Roof coverings shall be applied in accordance with the applicable provisions of this section and the manufacturer’s installation instructions.

1507.2 Asphalt shingles. The installation of asphalt shingles shall comply with the provisions of this section.

1507.2.1 Deck requirements. Asphalt shingles shall be fastened to solidly sheathed decks.

1507.2.2 Slope. Asphalt shingles shall only be used on roof slopes of two units vertical in 12 units horizontal (17-percent slope) or greater. For roof slopes from two units vertical in 12 units horizontal (17-percent slope) up to four units vertical in 12 units horizontal (33-percent slope), double underlayment application is required in accordance with Section 1507.2.8.

1507.2.3 Underlayment. Unless otherwise noted, required underlayment shall conform to ASTM D 226, Type I, ASTM D 4869, Type I, or ASTM D 6757.
1507.2.4 **Self-adhering polymer modified bitumen sheet.** Self-adhering polymer modified bitumen sheet shall comply with ASTM D 1970.

1507.2.5 **Asphalt shingles.** Asphalt shingles shall comply with ASTM D 225 or ASTM D 3462.

1507.2.6 **Fasteners.** Fasteners for asphalt shingles shall be galvanized, stainless steel, aluminum or copper roofing nails, minimum 12-gage [0.105 inch (2.67 mm)] shank with a minimum 3/8-inch-diameter (9.5 mm) head, of a length to penetrate through the roofing materials and a minimum of 3/4 inch (19.1 mm) into the roof sheathing. Where the roof sheathing is less than 3/4 inch (19.1 mm) thick, the nails shall penetrate through the sheathing. Fasteners shall comply with ASTM F 1667.

1507.2.7 **Attachment.** Asphalt shingles shall have the minimum number of fasteners required by the manufacturer, but not less than four fasteners per strip shingle or two fasteners per individual shingle. Where the roof slope exceeds 21 units vertical in 12 units horizontal (21:12), shingles shall be installed as required by the manufacturer.

1507.2.8 **Underlayment application.** For roof slopes from two units vertical in 12 units horizontal (17-percent slope) and up to four units vertical in 12 units horizontal (33-percent slope), underlayment shall be two layers applied in the following manner. Apply a minimum 19-inch-wide (483 mm) strip of underlayment felt parallel with and starting at the eaves, fastened sufficiently to hold in place. Starting at the eave, apply 36-inch-wide (914 mm) sheets of underlayment overlapping successive sheets 19 inches (483 mm) and fasten sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seal. For roof slopes of four units vertical in 12 units horizontal (33-percent slope) or greater, underlayment shall be one layer applied in the following manner. Underlayment shall be applied shingle fashion, parallel to and starting from the eave and lapped 2 inches (51 mm), fastened sufficiently to hold in place. Distortions in the underlayment shall not interfere with the ability of the shingles to seal.

1507.2.8.1 **High wind attachment.** Underlayment applied in areas subject to high winds [\(V_{asd}\) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm)
mm) on center. Underlayment installed where $V_{asd}$, in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section 1507.2.8 except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of 3/4 inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.2.8.2 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

1507.2.9 Flashings. Flashing for asphalt shingles shall comply with this section. Flashing shall be applied in accordance with this section and the asphalt shingle manufacturer’s printed instructions.

1507.2.9.1 Base and cap flashing. Base and cap flashing shall be installed in accordance with the manufacturer’s instructions. Base flashing shall be of either corrosion-resistant metal of minimum nominal 0.019-inch (0.483 mm) thickness or mineral-surfaced roll roofing weighing a minimum of 77 pounds per 100 square feet (3.76 kg/m²). Cap flashing shall be corrosion-resistant metal of minimum nominal 0.019-inch (0.483 mm) thickness.

1507.2.9.2 Valleys. Valley linings shall be installed in accordance with the manufacturer’s instructions before applying shingles. Valley linings of the following types shall be permitted:
1. For open valleys (valley lining exposed) lined with metal, the valley lining shall be at least 24 inches (610 mm) wide and of any of the corrosion-resistant metals in Table 1507.2.9.2.

2. For open valleys, valley lining of two plies of mineral-surfaced roll roofing complying with ASTM D 3909 or ASTM D 6380 shall be permitted. The bottom layer shall be 18 inches (457 mm) and the top layer a minimum of 36 inches (914 mm) wide.

3. For closed valleys (valleys covered with shingles), valley lining of one ply of smooth roll roofing complying with ASTM D 6380, and at least 36 inches (914 mm) wide or types as described in Item 1 or 2 above shall be permitted. Self-adhering polymer modified bitumen underlayment complying with ASTM D 1970 shall be permitted in lieu of the lining material.

1507.2.9.3 Drip edge. A drip edge shall be provided at eaves and rake edges of shingle roofs. Adjacent segments of the drip edge shall be lapped a minimum of 2 inches (51 mm). The vertical leg of drip edges shall be a minimum of 1 1/2 inches (38 mm) in width and shall extend a minimum of 1/4 inch (6.4 mm) below sheathing. The drip edge shall extend back on the roof a minimum of 2 inches (51 mm). Underlayment shall be installed over drip edges along eaves. Drip edges shall be installed over underlayment along rake edges. Drip edges shall be mechanically fastened a maximum of 12 inches (305 mm) on center.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>MINIMUM THICKNESS</th>
<th>GAGE</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>0.024 in.</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Cold-rolled copper</td>
<td>0.0216 in.</td>
<td>—</td>
<td>ASTM B 370, 16 oz. per square ft.</td>
</tr>
<tr>
<td>Copper</td>
<td>—</td>
<td>—</td>
<td>16 oz</td>
</tr>
<tr>
<td>Galvanized steel</td>
<td>0.0179 in.</td>
<td>26 (zinc-coated G90)</td>
<td>—</td>
</tr>
<tr>
<td>High-yield copper</td>
<td>0.0162 in.</td>
<td>—</td>
<td>ASTM B 370, 12 oz. per square ft.</td>
</tr>
<tr>
<td>Lead</td>
<td>—</td>
<td>—</td>
<td>2.5 pounds</td>
</tr>
<tr>
<td>Lead-coated copper</td>
<td>0.0216 in.</td>
<td>—</td>
<td>ASTM B 101, 16 oz. per square ft.</td>
</tr>
<tr>
<td>Lead-coated high-yield copper</td>
<td>0.0162 in.</td>
<td>—</td>
<td>ASTM B 101, 12 oz. per square ft.</td>
</tr>
<tr>
<td>Painted terne</td>
<td>—</td>
<td>—</td>
<td>20 pounds</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>—</td>
<td>28</td>
<td>—</td>
</tr>
<tr>
<td>Zinc alloy</td>
<td>0.027 in.</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 pound = 0.454 kg, 1 ounce = 28.35 g, 1 square foot = 0.0929 m².
1507.3 Clay and concrete tile. The installation of clay and concrete tile shall comply with the provisions of this section.

1507.3.1 Deck requirements. Concrete and clay tile shall be installed only over solid sheathing or spaced structural sheathing boards.

1507.3.2 Deck slope. Clay and concrete roof tile shall be installed on roof slopes of 2\(\frac{1}{2}\) units vertical in 12 units horizontal (21-percent slope) or greater. For roof slopes from 2\(\frac{1}{2}\) units vertical in 12 units horizontal (21-percent slope) to four units vertical in 12 units horizontal (33-percent slope), double underlayment application is required in accordance with Section 1507.3.3.

1507.3.3 Underlayment. Unless otherwise noted, required underlayment shall conform to: ASTM D 226, Type II; ASTM D 2626 or ASTM D 6380, Class M mineral-surfaced roll roofing.

1507.3.3.1 Low-slope roofs. For roof slopes from 2\(\frac{1}{2}\) units vertical in 12 units horizontal (21-percent slope), up to four units vertical in 12 units horizontal (33-percent slope), underlayment shall be a minimum of two layers applied as follows:

1. Starting at the eave, a 19-inch (483 mm) strip of underlayment shall be applied parallel with the eave and fastened sufficiently in place.
2. Starting at the eave, 36-inch-wide (914 mm) strips of underlayment felt shall be applied overlapping successive sheets 19 inches (483 mm) and fastened sufficiently in place.

1507.3.3.2 High-slope roofs. For roof slopes of four units vertical in 12 units horizontal (33-percent slope) or greater, underlayment shall be a minimum of one layer of underlayment felt applied shingle fashion, parallel to, and starting from the eaves and lapped 2 inches (51 mm), fastened only as necessary to hold in place.

1507.3.3.3 High wind attachment. Underlayment applied in areas subject to high wind \([V_{asd} \text{ greater than } 110 \text{ mph} (49 \text{ m/s})]\) as determined in accordance with Section 1609.3.1] shall be applied with corrosion-resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm) on center.

Underlayment installed where \(V_{asd}\), in accordance with Section 1609.3.1,
equals or exceeds 120 mph (54 m/s) shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Sections 1507.3.3.1 and 1507.3.3.2 except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of $\frac{3}{4}$ inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.3.4  **Clay tile.** Clay roof tile shall comply with ASTM C 1167.

1507.3.5  **Concrete tile.** Concrete roof tile shall comply with ASTM C 1492.

1507.3.6  **Fasteners.** Tile fasteners shall be corrosion resistant and not less than 11-gage, $\frac{5}{16}$-inch (8.0 mm) head, and of sufficient length to penetrate the deck a minimum of $\frac{3}{4}$ inch (19.1 mm) or through the thickness of the deck, whichever is less. Attaching wire for clay or concrete tile shall not be smaller than 0.083 inch (2.1 mm). Perimeter fastening areas include three tile courses but not less than 36 inches (914 mm) from either side of hips or ridges and edges of eaves and gable rakes.

1507.3.7  **Attachment.** Clay and concrete roof tiles shall be fastened in accordance with Table 1507.3.7.

### TABLE 1507.3.7
CLAY AND CONCRETE TILE ATTACHMENT\(^a, b, c\)

<table>
<thead>
<tr>
<th>Maximum Nominal Design Wind Speed, (V_{asd}) (mph)</th>
<th>Mean roof height (feet)</th>
<th>Roof slope &lt; 3:12</th>
<th>Roof slope 3:12 and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>0-60</td>
<td>One fastener per tile. Flat tile without vertical laps, two fasteners per tile.</td>
<td>Two fasteners per tile. Only one fastener on slopes of 7:12 and less for tiles with installed weight exceeding 7.5 lbs./sq. ft. having a width not more than 16 inches.</td>
</tr>
<tr>
<td>100</td>
<td>0-40</td>
<td>The head of all tiles shall be nailed. The nose of all eave tiles shall be fastened with approved clips. All rake tiles shall be nailed with two nails. The nose of all ridge, hip and rake tiles shall be set in a bead of roofer’s mastic.</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>&gt;40-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>0-60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(a\) See Table 1507.3.7.

\(b\) See Table 1507.3.7.

\(c\) See Table 1507.3.7.
The fastening system shall resist the wind forces in Section 1609.5.3.

### INTERLOCKING CLAY OR CONCRETE ROOF TILE WITH PROJECTING ANCHOR LUGS

(Installations on spaced/solid sheathing with battens or spaced sheathing)

<table>
<thead>
<tr>
<th>Maximum Nominal Design Wind Speed, $V_{ad}$ (mph)</th>
<th>Mean roof height (feet)</th>
<th>Roof slope $&lt; 5:12$</th>
<th>Roof slope $5:12 &lt; 12:12$</th>
<th>Roof slope $12:12$ and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>0-60</td>
<td>Fasteners are not required. Tiles with installed weight less than 9 lbs./sq. ft. require a minimum of one fastener per tile.</td>
<td>One fastener per tile every other row. All perimeter tiles require one fastener. Tiles with installed weight less than 9 lbs./sq. ft. require a minimum of one fastener per tile.</td>
<td>One fastener required for every tile. Tiles with installed weight less than 9 lbs./sq. ft. require a minimum of one fastener per tile.</td>
</tr>
<tr>
<td>100</td>
<td>0-40</td>
<td>The head of all tiles shall be nailed. The nose of all eave tiles shall be fastened with approved clips. All rake tiles shall be nailed with two nails. The nose of all ridge, hip and rake tiles shall be set in a bead of roofer’s mastic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>&gt;40-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>0-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>0-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>0-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>&gt;60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### INTERLOCKING CLAY OR CONCRETE ROOF TILE WITH PROJECTING ANCHOR LUGS

(Installations on solid sheathing without battens)

<table>
<thead>
<tr>
<th>Maximum Nominal Design Wind Speed, $V_{ad}$ (mph)</th>
<th>Mean roof height (feet)</th>
<th>All roof slopes</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>0-60</td>
<td>One fastener per tile.</td>
</tr>
<tr>
<td>100</td>
<td>0-40</td>
<td>One fastener per tile.</td>
</tr>
<tr>
<td>100</td>
<td>&gt; 40-60</td>
<td>The head of all tiles shall be nailed. The nose of all eave tiles shall be fastened with approved clips. All rake tiles shall be nailed with two nails. The nose of all ridge, hip and rake tiles shall be set in a bead of roofer’s mastic.</td>
</tr>
<tr>
<td>110</td>
<td>0-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
</tr>
<tr>
<td>120</td>
<td>0-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
</tr>
<tr>
<td>130</td>
<td>0-60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
</tr>
<tr>
<td>All</td>
<td>&gt;60</td>
<td>The fastening system shall resist the wind forces in Section 1609.5.3.</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s, 1 pound per square foot = 4.882 kg/m²

a. Minimum fastener size. Corrosion-resistant nails not less than No. 11 gage with $\frac{5}{16}$-inch head. Fasteners shall be long enough to penetrate into the sheathing $\frac{3}{4}$ inch or through the thickness of the sheathing, whichever is less. Attaching wire for clay and concrete tile shall not be smaller than 0.083 inch.

b. Snow areas. A minimum of two fasteners per tile are required or battens and one fastener.

c. Roof slopes greater than 24:12. The nose of all tiles shall be securely fastened.

d. Horizontal battens. Battens shall be not less than 1 inch by 2 inch nominal. Provisions shall be made for drainage by a minimum of $\frac{1}{8}$-inch riser at each nail or by 4-foot-long battens with at least a $\frac{1}{2}$-inch separation between battens. Horizontal battens are required for slopes over 7:12.

e. Perimeter fastening areas include three tile courses but not less than 36 inches from either side of hips or ridges and edges of eaves and gable rakes. $V_{ad}$ shall be determined in accordance with Section 1609.3.1.
1507.3.8 **Application.** Tile shall be applied according to the manufacturer’s installation instructions, based on the following:

1. Climatic conditions.
2. Roof slope.
3. Underlayment system.
4. Type of tile being installed.

1507.3.8 **Flashing.** At the juncture of the roof vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer’s installation instructions, and where of metal, shall not be less than 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend at least 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). For roof slopes of three units vertical in 12 units horizontal (25-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) underlayment of either one layer of Type I underlayment running the full length of the valley, or a self-adhering polymer-modified bitumen sheet complying with ASTM D 1970, in addition to other required underlayment. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing underlayment shall be solid cemented to the roofing underlayment for slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.4 **Metal roof panels.** The installation of metal roof panels shall comply with the provisions of this section.

1507.4.1 **Deck requirements.** Metal roof panel roof coverings shall be applied to a solid or closely fitted deck, except where the roof covering is specifically designed to be applied to spaced supports.

1507.4.2 **Deck slope.** Minimum slopes for metal roof panels shall comply with the following:

1. The minimum slope for lapped, non-soldered seam metal roof panels without applied lap sealant shall be three units vertical in 12 units horizontal (25-percent slope).
2. The minimum slope for lapped, non-soldered seam metal roof panels with applied lap sealant shall be one-half unit vertical in 12 units.
horizontal (4-percent slope). Lap sealants shall be applied in accordance with the approved manufacturer’s installation instructions.

3. The minimum slope for standing-seam metal roof panel systems shall be one-quarter unit vertical in 12 units horizontal (2-percent slope).

**1507.4.3 Material standards.** Metal-sheet roof covering systems that incorporate supporting structural members shall be designed in accordance with Chapter 22. Metal sheet roof coverings installed over structural decking shall comply with Table 1507.4.3(1). The materials used for metal-sheet roof coverings shall be naturally corrosion resistant or provided with corrosion resistance in accordance with the standards and minimum thicknesses shown in Table 1507.4.3(2).

<table>
<thead>
<tr>
<th>METAL ROOF COVERINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROOF COVERING TYPE</strong></td>
</tr>
<tr>
<td>Aluminum</td>
</tr>
<tr>
<td>Aluminum-zinc alloy coated steel</td>
</tr>
<tr>
<td>Cold-rolled copper</td>
</tr>
<tr>
<td>Copper</td>
</tr>
<tr>
<td>Galvanized steel</td>
</tr>
<tr>
<td>Hard lead</td>
</tr>
<tr>
<td>Lead-coated copper</td>
</tr>
<tr>
<td>Prepainted steel</td>
</tr>
<tr>
<td>Soft lead</td>
</tr>
<tr>
<td>Stainless steel</td>
</tr>
<tr>
<td>Steel</td>
</tr>
</tbody>
</table>
Terne and ternecoated stainless Terne coating of 40 lbs. per double base box, field painted where applicable in accordance with manufacturer’s installation instructions.

| Zinc | 0.027 inch minimum thickness; 99.995% electrolytic high grade zinc with alloy additives of copper (0.08% - 0.20%), titanium (0.07% - 0.12%) and aluminum (0.015%). |

For SI: 1 ounce per square foot = 0.305 kg/m², 1 pound per square foot = 4.882 kg/m², 1 inch = 25.4 mm, 1 pound = 0.454 kg.

a. For Group U buildings, the minimum coating thickness for ASTM A 653 galvanized steel roofing shall be G-60.

### TABLE 1507.4.3(2) MINIMUM CORROSION RESISTANCE

<table>
<thead>
<tr>
<th>Corrosion Resistant Roofing</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>55% Aluminum-zinc alloy coated steel</td>
<td>ASTM A 792 AZ 50</td>
</tr>
<tr>
<td>5% Aluminum alloy-coated steel</td>
<td>ASTM A 875 GF60</td>
</tr>
<tr>
<td>Aluminum-coated steel</td>
<td>ASTM A 463 T2 65</td>
</tr>
<tr>
<td>Galvanized steel</td>
<td>ASTM A 653 G-90</td>
</tr>
<tr>
<td>Prepainted steel</td>
<td>ASTM A 755</td>
</tr>
</tbody>
</table>

a. Paint systems in accordance with ASTM A 755 shall be applied over steel products with corrosion-resistant coatings complying with ASTM A 792, ASTM A 875, ASTM A 463 or ASTM A 653.

### 1507.4.4 Attachment.

Metal roof panels shall be secured to the supports in accordance with the approved manufacturer’s fasteners. In the absence of manufacturer recommendations, the following fasteners shall be used:

1. Galvanized fasteners shall be used for steel roofs.
2. Copper, brass, bronze, copper alloy or 300 series stainless-steel fasteners shall be used for copper roofs.
3. Stainless-steel fasteners are acceptable for all types of metal roofs.
4. Aluminum fasteners are acceptable for aluminum roofs attached to aluminum supports.

### 1507.4.5 Underlayment and high wind.

Underlayment applied in areas subject to high winds \( V_{\text{asd}} \) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1 shall be applied with corrosion-resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm) on center.

Underlayment installed where \( V_{\text{asd}} \), in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II, ASTM D 4869 Type IV, or ASTM D 1970. The underlayment shall be
attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with the manufacturer’s installation instructions except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of \( \frac{3}{4} \) inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

**1507.5 Metal roof shingles.** The installation of metal roof shingles shall comply with the provisions of this section.

**1507.5.1 Deck requirements.** Metal roof shingles shall be applied to a solid or closely fitted deck, except where the roof covering is specifically designed to be applied to spaced sheathing.

**1507.5.2 Deck slope.** Metal roof shingles shall not be installed on roof slopes below three units vertical in 12 units horizontal (25-percent slope).

**1507.5.3 Underlayment.** Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

**1507.5.3.1 Underlayment and high wind.** Underlayment applied in areas subject to high winds \([V_{asd}] \) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied with corrosion resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not farther apart than 36 inches (914 mm) on center. Underlayment installed where \( V_{asd} \), in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch spacing (152 mm) at the side laps. Underlayment shall be applied in accordance with the manufacturer’s installation instructions except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch
(2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of ¾ inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.5.4 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

1507.5.5 Material standards. Metal roof shingle roof coverings shall comply with Table 1507.4.3(1). The materials used for metal-roof shingle roof coverings shall be naturally corrosion resistant or provided with corrosion resistance in accordance with the standards and minimum thicknesses specified in the standards listed in Table 1507.4.3(2).

1507.5.6 Attachment. Metal roof shingles shall be secured to the roof in accordance with the approved manufacturer’s installation instructions.

1507.5.7 Flashing. Roof valley flashing shall be of corrosion-resistant metal of the same material as the roof covering or shall comply with the standards in Table 1507.4.3(1). The valley flashing shall extend at least 8 inches (203 mm) from the centerline each way and shall have a splash diverter rib not less than ¾ inch (19.1 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing shall have a 36-inch-wide (914 mm) underlayment directly under it consisting of either one layer of underlayment running the full length of the valley or a self-adhering polymer-modified bitumen sheet complying with ASTM D 1970, in addition to underlayment required for metal roof shingles. The metal valley flashing underlayment shall be solidly cemented to the roofing underlayment for roof slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.6 Mineral-surfaced roll roofing. The installation of mineral-surfaced roll
roofing shall comply with this section.

1507.6.1 Deck requirements. Mineral-surfaced roll roofing shall be fastened to solidly sheathed roofs.

1507.6.2 Deck slope. Mineral-surfaced roll roofing shall not be applied on roof slopes below one unit vertical in 12 units horizontal (8-percent slope).

1507.6.3 Underlayment. Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

1507.6.3.1 Underlayment and high wind. Underlayment applied in areas subject to high winds \(V_{asd}\) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied with corrosion resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm) on center.

Underlayment installed where \(V_{asd}\), in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226 Type II. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with the manufacturer’s installation instructions except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32gauge [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of \(\frac{3}{4}\) inch (19.1 mm) into the roof sheathing.

Exception: As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.6.4 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

Exception: Detached accessory structures that contain no conditioned floor area.
1507.6.5 Material standards. Mineral-surfaced roll roofing shall conform to ASTM D 3909 or ASTM D 6380.

1507.7 Slate shingles. The installation of slate shingles shall comply with the provisions of this section.

1507.7.1 Deck requirements. Slate shingles shall be fastened to solidly sheathed roofs.

1507.7.2 Deck slope. Slate shingles shall only be used on slopes of four units vertical in 12 units horizontal (4:12) or greater.

1507.7.3 Underlayment. Underlayment shall comply with ASTM D 226, Type II or ASTM D 4869, Type III or IV.

1507.7.3.1 Underlayment and high wind. Underlayment applied in areas subject to high winds [$V_{asd}$ greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied with corrosion resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm) on center.

Underlayment installed where $V_{asd}$, in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226, Type II or ASTM D 4869, Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with the manufacturer’s installation instructions except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of 3/4 inch (19.1 mm) into the roof sheathing.

Exception: As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.7.4 Ice barrier. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall extend from the lowest edges of all roof surfaces...
to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

**1507.7.5 Material standards.** Slate shingles shall comply with ASTM C 406.

**1507.7.6 Application.** Minimum headlap for slate shingles shall be in accordance with Table 1507.7.6. Slate shingles shall be secured to the roof with two fasteners per slate.

**TABLE 1507.7.6**

<table>
<thead>
<tr>
<th>SLOPE</th>
<th>HEADLAP (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:12 &lt; slope &lt; 8:12</td>
<td>4</td>
</tr>
<tr>
<td>8:12 &lt; slope &lt; 20:12</td>
<td>3</td>
</tr>
<tr>
<td>slope &gt; 20:12</td>
<td>2</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

**1507.7.7 Flashing.** Flashing and counterflashing shall be made with sheet metal. Valley flashing shall be a minimum of 15 inches (381 mm) wide. Valley and flashing metal shall be a minimum uncoated thickness of 0.0179inch (0.455 mm) zinc-coated G90. Chimneys, stucco or brick walls shall have a minimum of two plies of felt for a cap flashing consisting of a 4-inch-wide (102 mm) strip of felt set in plastic cement and extending 1 inch (25 mm) above the first felt and a top coating of plastic cement. The felt shall extend over the base flashing 2 inches (51 mm).

**1507.8 Wood shingles.** The installation of wood shingles shall comply with the provisions of this section and Table 1507.8.

**1507.8.1 Deck requirements.** Wood shingles shall be installed on solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1-inch by 4-inch (25 mm by 102 mm) nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners.

**1507.8.1.1 Solid sheathing required.** Solid sheathing is required in areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water.
1507.8.2 Deck slope. Wood shingles shall be installed on slopes of not less than three units vertical in 12 units horizontal (25-percent slope).

1507.8.3 Underlayment. Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

1507.8.3.1 Underlayment and high wind. Underlayment applied in areas subject to high winds \( V_{\text{asd}} \) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1 shall be applied with corrosion resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm) on center.

Underlayment installed where \( V_{\text{asd}} \), in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226, Type II or ASTM D 4869, Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with the manufacturer’s installation instructions except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage \( 0.0134 \) inch (0.34 mm) sheet metal. The cap nail shank shall be a minimum of 12 gage \( 0.105 \) inch (2.67 mm) with a length to penetrate through the roof sheathing or a minimum of \( \frac{3}{4} \) inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.8.4 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

1507.8.5 Material standards. Wood shingles shall be of naturally durable wood and comply with the requirements of Table 1507.8.5.

**TABLE 1507.8.5**
WOOD SHINGLE MATERIAL REQUIREMENTS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>APPLICABLE MINIMUM GRADES</th>
<th>GRADING RULES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood shingles of naturally durable wood</td>
<td>1, 2 or 3</td>
<td>CSSB</td>
</tr>
</tbody>
</table>

CSSB = Cedar Shake and Shingle Bureau

1507.8.6 Attachment. Fasteners for wood shingles shall be corrosion resistant with a minimum penetration of \( \frac{3}{4} \) inch (19.1 mm) into the sheathing. For sheathing less than \( \frac{1}{2} \) inch (12.7 mm) in thickness, the fasteners shall extend through the sheathing. Each shingle shall be attached with a minimum of two fasteners.

1507.8.7 Application. Wood shingles shall be laid with a side lap not less than \( 1\frac{1}{2} \) inches (38 mm) between joints in adjacent courses, and not be in direct alignment in alternate courses. Spacing between shingles shall be \( \frac{1}{4} \) to \( \frac{3}{8} \) inch (6.4 to 9.5 mm). Weather exposure for wood shingles shall not exceed that set in Table 1507.8.7.

TABLE 1507.8.7
WOOD SHINGLE WEATHER EXPOSURE AND ROOF SLOPE

<table>
<thead>
<tr>
<th>ROOFING MATERIAL</th>
<th>LENGTH (inches)</th>
<th>GRADE</th>
<th>3:12 pitch to &lt; 4:12</th>
<th>4:12 pitch or steeper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shingles of naturally durable wood</td>
<td>16</td>
<td>No. 1</td>
<td>3.75</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 2</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 3</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>No. 1</td>
<td>4.25</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 2</td>
<td>4</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 3</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>No. 1</td>
<td>5.75</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 2</td>
<td>5.5</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 3</td>
<td>5</td>
<td>5.5</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

1507.8.8 Flashing. At the juncture of the roof and vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer’s installation instructions, and where of metal, shall be not less than 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend at least 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an
end lap of not less than 4 inches (102 mm). For roof slopes of three units vertical in 12 units horizontal (25-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) underlayment of either one layer of Type I underlayment running the full length of the valley or a self-adhering polymer-modified bitumen sheet complying with ASTM D 1970, in addition to other required underlayment. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing underlayment shall be solidly cemented to the roofing underlayment for slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.9 Wood shakes. The installation of wood shakes shall comply with the provisions of this section and Table 1507.8.

1507.9.1 Deck requirements. Wood shakes shall only be used on solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1-inch by 4-inch (25 mm by 102 mm) nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners. Where 1-inch by 4-inch (25 mm by 102 mm) spaced sheathing is installed at 10 inches (254 mm) on center, additional 1-inch by 4-inch (25 mm by 102 mm) boards shall be installed between the sheathing boards.

1507.9.1.1 Solid sheathing required. Solid sheathing is required in areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water.

1507.9.2 Deck slope. Wood shakes shall only be used on slopes of not less than four units vertical in 12 units horizontal (33-percent slope).

1507.9.3 Underlayment. Underlayment shall comply with ASTM D 226, Type I or ASTM D 4869.

1507.9.3.1 Underlayment and high wind. Underlayment applied in areas subject to high winds \( V_{asd} \) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied with corrosion resistant fasteners in accordance with the manufacturer’s installation instructions. Fasteners are to be applied along the overlap not more than 36 inches (914 mm) on center.
Underlayment installed where $V_{asd}$, in accordance with Section 1609.3.1, equals or exceeds 120 mph (54 m/s) shall comply with ASTM D 226, Type II or ASTM D 4869 Type IV. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with the manufacturer’s installation instructions except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of at least 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of $\frac{3}{4}$ inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.
TABLE 1507.8
WOOD SHINGLE AND SHAKE INSTALLATION

<table>
<thead>
<tr>
<th>ROOF ITEM</th>
<th>WOOD SHINGLES</th>
<th>WOOD SHAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Roof slope</td>
<td>Wood shingles shall be installed on slopes of not less than three units vertical in 12 units horizontal (3:12).</td>
<td>Wood shakes shall be installed on slopes of not less than four units vertical in 12 units horizontal (4:12).</td>
</tr>
<tr>
<td>2. Deck requirement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperate climate</td>
<td>Shingles shall be applied to roofs with solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1” × 4” nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners.</td>
<td>Shakes shall be applied to roofs with solid or spaced sheathing. Where spaced sheathing is used, sheathing boards shall be not less than 1” × 4” nominal dimensions and shall be spaced on centers equal to the weather exposure to coincide with the placement of fasteners. When 1” × 4” spaced sheathing is installed at 10 inches, boards must be installed between the sheathing boards.</td>
</tr>
<tr>
<td></td>
<td>In areas where the average daily temperature in January is 25°F or less or where there is a possibility of ice forming along the eaves causing a backup of water.</td>
<td>Solid sheathing is required.</td>
</tr>
<tr>
<td>3. Interlayment</td>
<td>No requirements.</td>
<td>Interlayment shall comply with ASTM D 226, Type 1.</td>
</tr>
<tr>
<td>4. Underlayment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperate climate</td>
<td>Underlayment shall comply with ASTM D 226, Type 1.</td>
<td>Underlayment shall comply with ASTM D 226, Type 1.</td>
</tr>
<tr>
<td></td>
<td>In areas where there is a possibility of ice forming along the eaves causing a backup of water.</td>
<td>An ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall extend from the eave's edge to a point at least 24 inches inside the exterior wall line of the building.</td>
</tr>
<tr>
<td>5. Application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attachment</td>
<td>Fasteners for wood shingles shall be hot dipped galvanized or Type 304 (Type 316 for coastal areas) stainless steel with a minimum penetration of 0.75 inch into the sheathing. For sheathing less than 0.5 inch thick, the fasteners shall extend through the sheathing.</td>
<td>Fasteners for wood shakes shall be hot-dipped galvanized or Type 304 (Type 316 for coastal areas) with a minimum penetration of 0.75 inch into the sheathing. For sheathing less than 0.5 inch thick, the fasteners shall extend through the sheathing.</td>
</tr>
<tr>
<td>No. of fasteners</td>
<td>Two per shingle.</td>
<td>Two per shake.</td>
</tr>
<tr>
<td>Exposure</td>
<td>Weather exposures shall not exceed those set forth in Table 1507.8.7.</td>
<td>Weather exposures shall not exceed those set forth in Table 1507.9.8.</td>
</tr>
<tr>
<td>Method</td>
<td>Shingles shall be laid with a side lap of not less than 1.5 inches between joints in courses, and no two joints in any three adjacent courses shall be in direct alignment. Spacing between shingles shall be 0.25 to 0.375 inch.</td>
<td>Shakes shall be laid with a side lap of not less than 1.5 inches between joints in adjacent courses. Spacing between shakes shall not be less than 0.375 inch or more than 0.625 inch for shakes and taper sawn shakes of naturally durable wood and shall be 0.25 to 0.375 inch for preservative-treated taper sawn shakes.</td>
</tr>
<tr>
<td>Flashing</td>
<td>In accordance with Section 1507.8.8.</td>
<td>In accordance with Section 1507.9.9.</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.
1507.9.4 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall be used in lieu of normal underlayment and extend from the lowest edges of all roof surfaces to a point at least 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned floor area.

1507.9.5 Interlayment. Interlayment shall comply with ASTM D 226, Type I.

1507.9.6 Material standards. Wood shakes shall comply with the requirements of Table 1507.9.6.

### TABLE 1507.9.6

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>MINIMUM GRADES</th>
<th>APPLICABLE GRADING RULES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood shakes of naturally durable wood</td>
<td>1</td>
<td>CSSB</td>
</tr>
<tr>
<td>Taper sawn shakes of naturally durable wood</td>
<td>1 or 2</td>
<td>CSSB</td>
</tr>
<tr>
<td>Preservative-treated shakes and shingles of naturally durable wood</td>
<td>1</td>
<td>CSSB</td>
</tr>
<tr>
<td>Fire-retardant-treated shakes and shingles of naturally durable wood</td>
<td>1</td>
<td>CSSB</td>
</tr>
<tr>
<td>Preservative-treated taper sawn shakes of Southern pine treated in accordance with AWPA U1 (Commodity Specification A, Use Category 3B and Section 5.6)</td>
<td>1 or 2</td>
<td>TFS</td>
</tr>
</tbody>
</table>

CSSB = Cedar Shake and Shingle Bureau.
TFS = Forest Products Laboratory of the Texas Forest Services.

1507.9.7 Attachment. Fasteners for wood shakes shall be corrosion resistant with a minimum penetration of 3/4 inch (19.1 mm) into the sheathing. For sheathing less than 1/2 inch (12.7 mm) in thickness, the fasteners shall extend through the sheathing. Each shake shall be attached with a minimum of two fasteners.

1507.9.8 Application. Wood shakes shall be laid with a side lap not less than 1 1/2 inches (38 mm) between joints in adjacent courses. Spacing between
shakes in the same course shall be $\frac{3}{8}$ to $\frac{5}{8}$ inch (9.5 to 15.9 mm) for shakes and taper sawn shakes of naturally durable wood and shall be $\frac{1}{4}$ to $\frac{3}{8}$ inch (6.4 to 9.5 mm) for preservative taper sawn shakes. Weather exposure for wood shakes shall not exceed those set in Table 1507.9.8.

1507.9.9 **Flashing.** At the juncture of the roof and vertical surfaces, flashing and counterflashing shall be provided in accordance with the manufacturer’s installation instructions, and where of metal, shall be not less than 0.019-inch (0.48 mm) (No. 26 galvanized sheet gage) corrosion-resistant metal. The valley flashing shall extend at least 11 inches (279 mm) from the centerline each way and have a splash diverter rib not less than 1 inch (25 mm) high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than 4 inches (102 mm). For roof slopes of three units vertical in 12 units horizontal (25-percent slope) and over, the valley flashing shall have a 36-inch-wide (914 mm) underlayment of either one layer of Type I underlayment running the full length of the valley or a self-adhering polymer-modified bitumen sheet complying with ASTM D 1970, in addition to other required underlayment. In areas where the average daily temperature in January is 25°F (-4°C) or less or where there is a possibility of ice forming along the eaves causing a backup of water, the metal valley flashing underlayment shall be solidly cemented to the roofing underlayment for slopes under seven units vertical in 12 units horizontal (58-percent slope) or self-adhering polymer-modified bitumen sheet shall be installed.

1507.10 **Built-up roofs.** The installation of built-up roofs shall comply with the provisions of this section.

1507.10.1 **Slope.** Built-up roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage, except for coal-tar built-up roofs that shall have a design slope of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope).

1507.10.2 **Material standards.** Built-up roof covering materials shall comply with the standards in Table 1507.10.2 or UL 55A.

**TABLE 1507.9.8**

<table>
<thead>
<tr>
<th>ROOFING MATERIAL</th>
<th>LENGTH (inches)</th>
<th>GRADE</th>
<th>EXPOSURE (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shakes of naturally durable wood</td>
<td>18</td>
<td>No. 1</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>No. 1</td>
<td>10</td>
</tr>
<tr>
<td>Preservative-taper sawn shakes of Southern yellow pine</td>
<td>18</td>
<td>No. 1</td>
<td>7.5 10</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>No. 1</td>
<td></td>
</tr>
<tr>
<td>Taper sawn shakes of naturally durable wood</td>
<td>18</td>
<td>No. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>No. 2</td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.
a. For 24-inch by 0.375-inch hand split shakes, the maximum exposure is 7.5 inches.
1507.11 Modified bitumen roofing. The installation of modified bitumen roofing shall comply with the provisions of this section.

1507.11.1 Slope. Modified bitumen membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.


1507.12 Thermoset single-ply roofing. The installation of thermoset single-ply roofing shall comply with the provisions of this section.

1507.12.1 Slope. Thermoset single-ply membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.12.2 Material standards. Thermoset single-ply roof coverings shall comply with ASTM D 4637, ASTM D 5019 or CGSB 37-GP-52M.

1507.12.3 Ballasted thermoset low-slope roofs. Ballasted thermoset low-slope roofs (roof slope < 2:12) shall be installed in accordance with this section and Section 1504.4. Stone used as ballast shall comply with ASTM D 448 or ASTM D 7655.

1507.13 Thermoplastic single-ply roofing. The installation of thermoplastic single-ply roofing shall comply with the provisions of this section.

**TABLE 1507.10.2**

<table>
<thead>
<tr>
<th>MATERIAL STANDARD</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic coatings used in roofing</td>
<td>ASTM D 6083</td>
</tr>
<tr>
<td>Aggregate surfacing</td>
<td>ASTM D 1863</td>
</tr>
<tr>
<td>Asphalt adhesive used in roofing</td>
<td>ASTM D 3747</td>
</tr>
<tr>
<td>Asphalt cements used in roofing</td>
<td>ASTM D 3019; D 2822; D 4586</td>
</tr>
<tr>
<td>Asphalt-coated glass fiber base sheet</td>
<td>ASTM D 4601</td>
</tr>
</tbody>
</table>
1507.13.1 **Slope.** Thermoplastic single-ply membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope).

1507.13.2 **Material standards.** Thermoplastic single-ply roof coverings shall comply with ASTM D 4434, ASTM D 6754, ASTM D 6878 or CGSB CAN/CGSB 37-54.

1507.13.3 **Ballasted thermoplastic low-slope roofs.** Ballasted thermoplastic low-slope roofs (roof slope < 2:12) shall be installed in accordance with this section and Section 1504.4. Stone used as ballast shall comply with ASTM D 448 or ASTM D 7655.

1507.14 **Sprayed polyurethane foam roofing.** The installation of sprayed polyurethane foam roofing shall comply with the provisions of this section.

1507.14.1 **Slope.** Sprayed polyurethane foam roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.
1507.14.2 **Material standards.** Spray-applied polyurethane foam insulation shall comply with Type III or IV as defined in ASTM C 1029.

1507.14.3 **Application.** Foamed-in-place roof insulation shall be installed in accordance with the manufacturer’s instructions. A liquid-applied protective coating that complies with Table 1507.14.3 shall be applied no less than 2 hours nor more than 72 hours following the application of the foam.

<table>
<thead>
<tr>
<th>TABLE 1507.14.3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROTECTIVE COATING MATERIAL STANDARDS</strong></td>
</tr>
<tr>
<td>MATERIAL</td>
</tr>
<tr>
<td>Acrylic coating</td>
</tr>
<tr>
<td>Silicone coating</td>
</tr>
<tr>
<td>Moisture-cured polyurethane coating</td>
</tr>
</tbody>
</table>

1507.14.4 **Foam plastics.** Foam plastic materials and installation shall comply with Chapter 26.

1507.15 **Liquid-applied roofing.** The installation of liquid applied roofing shall comply with the provisions of this section.

1507.15.1 **Slope.** Liquid-applied roofing shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope).

1507.15.2 **Material standards.** Liquid-applied roofing shall comply with ASTM C 836, ASTM C 957, and ASTM D 1227 or ASTM D 3468, ASTM D 6083, ASTM D 6694 or ASTM D 6947.

1507.16 **Vegetative roofs, roof gardens and landscaped roofs.** Vegetative roofs, roof gardens and landscaped roofs shall comply with the requirements of this chapter, Sections 1607.12.3 and 1607.12.3.1 and the fire code.

1507.16.1 **Structural fire resistance.** The structural frame and roof construction supporting the load imposed upon the roof by the vegetative roof, roof gardens or landscaped roofs shall comply with the requirements of Table 601.

1507.17 **Photovoltaic shingles.** The installation of photovoltaic shingles shall comply with the provisions of this section.

1507.17.1 **Deck requirements.** Photovoltaic shingles shall be applied to a
solid or closely fitted deck, except where the shingles are specifically designed to be applied over spaced sheathing.

1507.17.2 Deck slope. Photovoltaic shingles shall not be installed on roof slopes less than three units vertical in 12 units horizontal (25-percent slope).

1507.17.3 Underlayment. Unless otherwise noted, required underlayment shall conform to ASTM D 226, ASTM D 4869 or ASTM D 6757.

1507.17.4 Underlayment application. Underlayment shall be applied shingle fashion, parallel to and starting from the eave, lapped 2 inches (51 mm) and fastened sufficiently to hold in place.

1507.17.4.1 High wind attachment. Underlayment applied in areas subject to high winds \( V_{asd} \) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1] shall be applied with corrosion-resistant fasteners in accordance with the manufacturer’s instructions. Fasteners shall be applied along the overlap at not more than 36 inches (914 mm) on center. Underlayment installed where \( V_{asd} \) is not less than 120 mph (54 m/s) shall comply with ASTM D 226, Type II, ASTM D 4869, Type IV or ASTM D 6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. Underlayment shall be applied in accordance with Section 1507.2.8 except all laps shall be a minimum of 4 inches (102 mm). Underlayment shall be attached using metal or plastic cap nails with a head diameter of not less than 1 inch (25 mm) with a thickness of not less than 32-gage [0.0134 inch (0.34 mm)] sheet metal. The cap nail shank shall be a minimum of 12 gage [0.105 inch (2.67 mm)] with a length to penetrate through the roof sheathing or a minimum of \( \frac{3}{4} \) inch (19.1 mm) into the roof sheathing.

**Exception:** As an alternative, adhered underlayment complying with ASTM D 1970 shall be permitted.

1507.17.4.2 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer modified bitumen sheet shall be used instead of normal underlayment and extend from the lowest edges of all roof surfaces to a point not less than 24 inches (610 mm) inside the exterior wall line of the building.

**Exception:** Detached accessory structures that contain no conditioned
1507.17.5 Fasteners. Fasteners for photovoltaic shingles shall be galvanized, stainless steel, aluminum or copper roofing nails, minimum 12-gage [0.105 inch (2.67 mm)] shank with a minimum 3/8-inch-diameter (9.5 mm) head, of a length to penetrate through the roofing materials and a minimum of 3/4 inch (19.1 mm) into the roof sheathing. Where the roof sheathing is less than 3/4 inch (19.1 mm) thick, the nails shall penetrate through the sheathing. Fasteners shall comply with ASTM F 1667.

1507.17.6 Material standards. Photovoltaic shingles shall be listed and labeled in accordance with UL 1703.

1507.17.7 Attachment. Photovoltaic shingles shall be attached in accordance with the manufacturer’s installation instructions.

1507.17.8 Wind resistance. Photovoltaic shingles shall be tested in accordance with procedures and acceptance criteria in ASTM D 3161. Photovoltaic shingles shall comply with the classification requirements of Table 1504.1.1 for the appropriate maximum nominal design wind speed. Photovoltaic shingle packaging shall bear a label to indicate compliance with the procedures in ASTM D 3161 and the required classification from Table 1504.1.1.

1507.18 Building-integrated photovoltaic roof panels. The installation of building-integrated photovoltaic (BIPV) roof panels shall comply with the provisions of this section.

1507.18.1 Deck requirements. BIPV roof panels shall be applied to a solid or closely fitted deck, except where the roof covering is specifically designed to be applied over spaced sheathing.

1507.18.2 Deck slope. BIPV roof panels shall be used only on roof slopes of two units vertical in 12 units horizontal (2:12) or greater.

1507.18.3 Underlayment. Underlayment shall comply with ASTM D226, ASTM D4869 or ASTM D6757.

1507.18.4 Underlayment application. Underlayment shall be applied shingle fashion, parallel to and starting from the eave, lapped 2 inches (51 mm) and fastened sufficiently to hold in place.
1507.18.4.1 High-wind attachment. Underlayment applied in areas subject to high winds \( V_{\text{asd}} \) greater than 110 mph (49 m/s) as determined in accordance with Section 1609.3.1 shall be applied in accordance with the manufacturer’s instructions. Fasteners shall be applied along the overlap at not more than 36 inches (914 mm) on center. Underlayment installed where \( V_{\text{asd}} \) is not less than 120 mph (54 m/s) shall comply with ASTM D226, Type III, ASTM D4869, Type IV or ASTM D6757. The underlayment shall be attached in a grid pattern of 12 inches (305 mm) between side laps with a 6-inch (152 mm) spacing at the side laps. The underlayment shall be applied in accordance with Section 1507.2.8 except all laps shall be not less than 4 inches (102 mm). Underlayment shall be attached using cap nails or cap staples. Caps shall be metal or plastic with a nominal head diameter of not less than 1 inch (25.4 mm). Metal caps shall have a thickness of not less than 0.010 inch (0.25 mm). Power-driven metal caps shall have a thickness of not less than 0.010 inch (0.25 mm). Thickness of the outside edge of plastic caps shall be not less than 0.035 inch (0.89 mm). The cap nail shank shall be not less than 0.083 inch (2.11 mm) for ring shank cap nails and 0.091 inch (2.31 mm) for smooth shank cap nails. Staple gage shall be not less than 21 gage [0.0.02 inch (0.81 mm)]. Cap nail shank and cap staple legs shall have a length sufficient to penetrate through-the-roof sheathing or not less than 3/4 inch (19.1 mm) into the roof sheathing.

Exception: As an alternative, adhered underlayment complying with ASTM D1970 shall be permitted.

1507.18.4.2 Ice barrier. In areas where there has been a history of ice forming along the eaves causing a back-up of water, an ice barrier consisting of not fewer than two layers of underlayment cemented together or of a self-adhering polymer/modified bitumen sheet shall be used instead of normal underlayment and extend from the lowest edges of all roof surfaces to a point not less than 24 inches (610 mm) inside the exterior wall line of the building.

Exception: Detached accessory structures that do not contain conditioned floor area.

1507.18.5 Material standards. BIPV roof panels shall be listed and labeled in accordance with UL 1703.

1507.18.6 Attachment. BIPV roof panels shall be attached in accordance with the manufacturer’s installation instructions.
1507.18.7 **Wind resistance.** BIPV roof panels shall be tested in accordance with UL 1897. BIPV roof panel packaging shall bear a label to indicate compliance with UL 1897.

SECTION 1508
ROOF INSULATION

1508.1 **General.** The use of above-deck thermal insulation shall be permitted provided such insulation is covered with an approved roof covering and passes the tests of NFPA 276 or UL 1256 when tested as an assembly.

**Exceptions:**
1. Foam plastic roof insulation shall conform to the material and installation requirements of Chapter 26.
2. Where a concrete roof deck is used and the above deck thermal insulation is covered with an approved roof covering.

1508.1.1 **Cellulosic fiberboard.** Cellulosic fiberboard roof insulation shall conform to the material and installation requirements of Chapter 23.

1508.2 **Material standards.** Above-deck thermal insulation board shall comply with the standards in Table 1508.2.

| TABLE 1508.2 |
| MATERIAL STANDARDS FOR ROOF INSULATION |
| Cellular glass board | ASTM C 552 |
| Composite boards | ASTM C 1289, Type III, IV, V or VI |
| Expanded polystyrene | ASTM C 578 |
| Extruded polystyrene | ASTM C 578 |
| Fiber-reinforced gypsum board | ASTM C 1278 |
| Glass-faced gypsum board | ASTM C 1177 |
| Mineral fiber insulation board | ASTM C 726 |
| Perlite board | ASTM C 728 |
| Polysiocyanurate board | ASTM C 1289, Type I or II |
| Wood fiberboard | ASTM C 208 |

SECTION 1509
RADIANT BARRIERS INSTALLED ABOVE DECK
1509.1 General. A radiant barrier installed above a deck shall comply with Sections 1509.2 through 1509.4.

1509.2 Fire testing. Radiant barriers shall be permitted for use above decks where the radiant barrier is covered with an approved roof covering and the system consisting of the radiant barrier and the roof covering complies with the requirements of either FM 4550 or UL 1256.

1509.3 Installation. The low emittance surface of the radiant barrier shall face the continuous airspace between the radiant barrier and the roof covering.

1509.4 Material standards. A radiant barrier installed above a deck shall comply with ASTM C 1313/1313M.

SECTION 1510
ROOFTOP STRUCTURES

1510.1 General. The provisions of this section shall govern the construction of rooftop structures. Section 3107.10 shall govern the construction of rooftop signs.

1510.2 Penthouses. Penthouses in compliance with Sections 1510.2.1 through 1510.2.5 shall be considered as a portion of the story directly below the roof deck on which such penthouses are located. All other penthouses shall be considered as an additional story of the building.

1510.2.1 Height above roof deck. Penthouses constructed on buildings of other than Type I construction shall not exceed 18 feet (5486 mm) in height above the roof deck as measured to the average height of the roof of the penthouse.

Exceptions:
1. Where used to enclose tanks or elevators that travel to the roof level, penthouses shall be permitted to have a maximum height of 28 feet (8534 mm) above the roof deck.
2. Penthouses located on the roof of buildings of Type I construction shall not be limited in height.

1510.2.2 Area limitation. The aggregate area of penthouses and other enclosed rooftop structures shall not exceed one-third the area of the supporting roof deck. Such penthouses and other enclosed rooftop structures shall not be required to be included in determining the building area or number of stories as regulated by Section 503.1. The area of such penthouses shall not be included in determining the fire area specified in Section 901.7.
1510.2.3 Use limitations. Penthouses shall not be used for purposes other than the shelter of mechanical or electrical equipment, tanks, or vertical shaft openings in the roof assembly.

1510.2.4 Weather protection. Provisions such as louvers, louver blades or flashing shall be made to protect the mechanical and electrical equipment and the building interior from the elements.

1510.2.5 Type of construction. Penthouses shall be constructed with walls, floors and roofs as required for the type of construction of the building on which such penthouses are built.

Exceptions:
1. On buildings of Type I construction, the exterior walls and roofs of penthouses with a fire separation distance greater than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be permitted to have not less than a 1-hour fire-resistance rating. The exterior walls and roofs of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall not be required to have a fire-resistance rating.
2. On buildings of Type I construction two stories or less in height above grade plane or of Type II construction, the exterior walls and roofs of penthouses with a fire separation distance greater than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be permitted to have not less than a 1-hour fire-resistance rating or a lesser fire-resistance rating as required by Table 602 and be constructed of fire-retardant-treated wood. The exterior walls and roofs of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall be permitted to be constructed of fire-retardant-treated wood and shall not be required to have a fire-resistance rating. Interior framing and walls shall be permitted to be constructed of fire-retardant-treated wood.
3. On buildings of Type III, IV or V construction, the exterior walls of penthouses with a fire separation distance greater than 5 feet (1524 mm) and less than 20 feet (6096 mm) shall be permitted to have not less than a 1-hour fire-resistance rating or a lesser fire-resistance rating as required by Table 602. On buildings of Type III, IV or VA construction, the exterior walls of penthouses with a fire separation distance of 20 feet (6096 mm) or greater shall be permitted to be of Type IV or noncombustible construction or fire-retardant-treated wood and shall not be required to have a fire-resistance rating.

1510.3 Tanks. Tanks having a capacity of more than 500 gallons (1893 L)
located on the roof deck of a building shall be supported on masonry, reinforced concrete, steel or Type IV construction provided that, where such supports are located in the building above the lowest story, the support shall be fire-resistance rated as required for Type IA construction.

1510.3.1 Valve and drain. In the bottom or on the side near the bottom of the tank, a pipe or outlet, fitted with a suitable quick-opening valve for discharging the contents into a drain in an emergency shall be provided.

1510.3.2 Location. Tanks shall not be placed over or near a stairway or an elevator shaft, unless there is a solid roof or floor underneath the tank.

1510.3.3 Tank cover. Unenclosed roof tanks shall have covers sloping toward the perimeter of the tanks.

1510.4 Cooling towers. Cooling towers located on the roof deck of a building and greater than 250 square feet (23.2 m²) in base area or greater than 15 feet (4572 mm) in height above the roof deck, as measured to the highest point on the cooling tower, where the roof is greater than 50 feet (15 240 mm) in height above grade plane shall be constructed of noncombustible materials. The base area of cooling towers shall not exceed one-third the area of the supporting roof deck.

Exception: Drip boards and the enclosing construction shall be permitted to be of wood not less than 1 inch (25 mm) nominal thickness, provided the wood is covered on the exterior of the tower with noncombustible material.

1510.5 Towers, spires, domes and cupolas. Towers, spires, domes and cupolas shall be of a type of construction having fire-resistance ratings not less than required for the building on top of which such tower, spire, dome or cupola is built. Towers, spires, domes and cupolas greater than 85 feet (25 908 mm) in height above grade plane as measured to the highest point on such structures, and either greater than 200 square feet (18.6 m²) in horizontal area or used for any purpose other than a belfry or an architectural embellishment, shall be constructed of and supported on Type I or II construction.

1510.5.1 Noncombustible construction required. Towers, spires, domes and cupolas greater than 60 feet (18 288 mm) in height above the highest point at which such structure contacts the roof as measured to the highest point on such structure, or that exceeds 200 square feet (18.6 m²) in area at any horizontal section, or which is intended to be used for any purpose other than a belfry or architectural embellishment, or is located on the top of a building greater than 50 feet (1524 mm) in building height shall be constructed of and
supported by noncombustible materials and shall be separated from the building below by construction having a fire-resistance rating of not less than 1.5 hours with openings protected in accordance with Section 742711. Such structures located on the top of a building greater than 50 feet (15240 mm) in building height shall be supported by noncombustible construction.

**1510.5.2 Towers and spires.** Enclosed towers and spires shall have exterior walls constructed as required for the building on top of which such towers and spires are built. The roof covering of spires shall be not less than the same class of roof covering required for the building on top of which the spire is located.

**1510.6 Mechanical equipment screens.** Mechanical equipment screens shall be constructed of the materials specified for the exterior walls in accordance with the type of construction of the building. Where the fire separation distance is greater than 5 feet (1524 mm), mechanical equipment screens shall not be required to comply with the fire-resistance rating requirements.

**1510.6.1 Height limitations.** Mechanical equipment screens shall not exceed 18 feet (5486 mm) in height above the roof deck, as measured to the highest point on the mechanical equipment screen.

**Exception:** Where located on buildings of Type IA construction, the height of mechanical equipment screens shall not be limited.

**1510.6.2 Type I, II, III and IV construction.** Regardless of the requirements in Section 1510.6, mechanical equipment screens that are located on the roof decks of buildings of Type I, II, III or IV construction shall be permitted to be constructed of combustible materials in accordance with any one of the following limitations:

1. The fire separation distance shall be not less than 20 feet (6096 mm) and the height of the mechanical equipment screen above the roof deck shall not exceed 4 feet (1219 mm) as measured to the highest point on the mechanical equipment screen.
2. The fire separation distance shall be not less than 20 feet (6096 mm) and the mechanical equipment screen shall be constructed of fire-retardant-treated wood complying with Section 2303.2 for exterior installation.
3. Where exterior wall covering panels are used, the panels shall have a flame spread index of 25 or less when tested in the minimum and maximum thicknesses intended for use, with each face tested independently in accordance with ASTM E 84 or UL 723. The panels shall be tested in the minimum and maximum thicknesses intended for use.
in accordance with, and shall comply with the acceptance criteria of, NFPA 285 and shall be installed as tested. Where the panels are tested as part of an exterior wall assembly in accordance with NFPA 285, the panels shall be installed on the face of the mechanical equipment screen supporting structure in the same manner as they were installed on the tested exterior wall assembly.

1510.6.3 Type V construction. The height of mechanical equipment screens located on the roof decks of buildings of Type V construction, as measured from grade plane to the highest point on the mechanical equipment screen, shall be permitted to exceed the maximum building height allowed for the building by other provisions of this code where complying with any one of the following limitations, provided the fire separation distance is greater than 5 feet (1524 mm):

1. Where the fire separation distance is not less than 20 feet (6096 mm), the height above grade plane of the mechanical equipment screen shall not exceed 4 feet (1219 mm) more than the maximum building height allowed;
2. The mechanical equipment screen shall be constructed of noncombustible materials;
3. The mechanical equipment screen shall be constructed of fire-retardant-treated wood complying with Section 2303.2 for exterior installation; or
4. Where the fire separation distance is not less than 20 feet (6096 mm), the mechanical equipment screen shall be constructed of materials having a flame spread index of 25 or less when tested in the minimum and maximum thicknesses intended for use with each face tested independently in accordance with ASTM E 84 or UL 723.

1510.7 Photovoltaic panels and modules. Rooftop mounted photovoltaic panels and modules shall be designed in accordance with this section.

1510.7.1 Wind resistance. Rooftop-mounted photovoltaic panels and modules shall be designed for component and cladding wind loads in accordance with Chapter 16 using an effective wind area based on the dimensions of a single unit frame.

1510.7.2 Fire classification. Rooftop-mounted photovoltaic panels and modules shall have the fire classification in accordance with Section 1505.9.

1510.7.3 Installation. Rooftop-mounted photovoltaic panels and modules shall be installed in accordance with the manufacturer’s instructions.
1510.7.4 Photovoltaic panels and modules. Rooftop-mounted photovoltaic panels and modules shall be listed and labeled in accordance with UL 1703 and shall be installed in accordance with the manufacturer’s instructions.

1510.8 Other rooftop structures. Rooftop structures not regulated by Sections 1510.2 through 1510.7 shall comply with Sections 1510.8.1 through 1510.8.5, as applicable.

1510.8.1 Aerial supports. Aerial supports shall be constructed of noncombustible materials.

   **Exception:** Aerial supports not greater than 12 feet (3658 mm) in height as measured from the roof deck to the highest point on the aerial supports shall be permitted to be constructed of combustible materials.

1510.8.2 Bulkheads. Bulkheads used for the shelter of mechanical or electrical equipment or vertical shaft openings in the roof assembly shall comply with Section 1510.2 as penthouses. Bulkheads used for any other purpose shall be considered as an additional story of the building.

1510.8.3 Dormers. Dormers shall be of the same type of construction as required for the roof in which such dormers are located or the exterior walls of the building.

1510.8.4 Fences. Fences and similar structures shall comply with Section 1510.6 as mechanical equipment screens.

1510.8.5 Flagpoles. Flagpoles and similar structures shall not be required to be constructed of noncombustible materials and shall not be limited in height or number.

1510.9 Structural fire resistance. The structural frame and roof construction supporting imposed loads upon the roof by any rooftop structure shall comply with the requirements of Table 601. The fire-resistance reduction permitted by Table 601, Note a, shall not apply to roofs containing rooftop structures.

SECTION 1511
REROOFING

1511.1 General. Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of Chapter
15. **Exceptions:**
   1. Roof replacement or roof recover of existing low slope roof coverings shall not be required to meet the minimum design slope requirement of one-quarter unit vertical in 12 units horizontal (2-percent slope) in Section 1507 for roofs that provide positive roof drainage.
   2. Recovering or replacing an existing roof covering shall not be required to meet the requirement for secondary (emergency overflow) drains or scuppers in Section 1503.4 for roofs that provide for positive roof drainage. For the purposes of this exception, existing secondary drainage or scupper systems required in accordance with this code shall not be removed unless they are replaced by secondary drains or scuppers designed and installed in accordance with Section 1503.4.

1511.2 **Structural and construction loads.** Structural roof components shall be capable of supporting the roof-covering system and the material and equipment loads that will be encountered during installation of the system.

1511.3 **Roof replacement.** Roof replacement shall include the removal of all existing layers of roof coverings down to the roof deck.

   **Exception:** Where the existing roof assembly includes an ice barrier membrane that is adhered to the roof deck, the existing ice barrier membrane shall be permitted to remain in place and covered with an additional layer of ice barrier membrane in accordance with Section 1507.

1511.3.1 **Roof recover.** The installation of a new roof covering over an existing roof covering shall be permitted where any of the following conditions occur:
   1. Where the new roof covering is installed in accordance with the roof covering manufacturer’s approved instructions.
   2. Complete and separate roofing systems, such as standing-seam metal roof panel systems, that are designed to transmit the roof loads directly to the building’s structural system and that do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.
   3. Metal panel, metal shingle and concrete and clay tile roof coverings shall be permitted to be installed over existing wood shake roofs when applied in accordance with Section 1511.4.
   4. The application of a new protective coating over an existing spray polyurethane foam roofing system shall be permitted without tear off of existing roof coverings.
1511.3.1.1 **Exceptions.** A roof recover shall not be permitted where any of the following conditions occur:
1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering.

1511.4 **Roof recovering.** Where the application of a new roof covering over wood shingle or shake roofs creates a combustible concealed space, the entire existing surface shall be covered with gypsum board, mineral fiber, glass fiber or other approved materials securely fastened in place.

1511.5 **Reinstallation of materials.** Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Existing vent flashing, metal edgings, drain outlets, collars and metal counter flashings shall not be reinstalled where rusted, damaged or deteriorated. Aggregate surfacing materials shall not be reinstalled.

1511.6 **Flashings.** Flashings shall be reconstructed in accordance with approved manufacturer’s installation instructions. Metal flashing to which bituminous materials are to be adhered shall be primed prior to installation.

**SECTION 1512**
**PHOTOVOLTAIC PANELS AND MODULES**

1512.1 **Photovoltaic panels and modules.** Photovoltaic panels and modules installed upon a roof or as an integral part of a roof assembly shall comply with the requirements of this code and the fire code.
4101:1-29-01 Plumbing systems.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:1-35-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 2901
GENERAL

2901.1 Scope. The provisions of this chapter and the plumbing code shall govern the erection, installation, alteration, repairs, relocation, replacement, addition to, use or maintenance of plumbing equipment and systems. Toilet and bathing rooms shall be constructed in accordance with Section 1210. Plumbing systems and equipment shall be constructed, installed and maintained in accordance with the plumbing code.

SECTION 2902
MINIMUM PLUMBING FACILITIES

2902.1 Minimum number of fixtures. Plumbing fixtures shall be provided in the minimum number as shown in Table 2902.1 based on the actual use of the building or space. Uses not shown in Table 2902.1 shall be considered individually by the code official. The number of occupants shall be determined by this code. When the actual occupant load will be significantly different than that determined by section 1004 of the building code, the building official may establish an alternate basis for determining the occupant load. This alternate basis shall be included in the special stipulations and conditions section of the certificate of occupancy issued for that structure pursuant to section 111. For accessibility requirements, see “Chapter 11, Accessibility” of this code.

Exception: Facilities are not required in buildings less than 100 square feet in area if fixtures are available within 500 feet of the building.

2902.1.1 Fixture calculations. To determine the occupant load of each sex, the total occupant load shall be divided in half. To determine the required number of fixtures, the fixture ratio or ratios for each fixture type shall be applied to the occupant load of each sex in accordance with Table 2902.1. Fractional numbers resulting from applying the fixture ratios of Table 2902.1
shall be rounded up to the next whole number. For calculations involving multiple occupancies, such fractional numbers for each occupancy shall first be summed and then rounded up to the next whole number.

**Exception**

1. The total occupant load shall not be required to be divided in half where approved statistical data indicate a distribution of the sexes of other than 50 percent of each sex.
2. Distribution of the sexes is not required where single-user water closets and bathing room fixtures are provided in accordance with Section 2902.1.2.

### 2902.1.2 Single-user toilet facility and bathing room fixtures

The plumbing fixtures located in single-user toilet facilities and bathing rooms, including family or assisted-use toilet and bathing rooms that are required by Section 1109.2.1 shall contribute towards the total number of required plumbing fixtures for a building or tenant space. Single-user toilet facilities and bathing rooms, and family or assisted-use toilet and bathing rooms shall be identified for use by either sex.

The total number of fixtures shall be permitted to be based on the required number of separate facilities or based on the aggregate of any combination of single-user or separate facilities.

#### TABLE 2902.1

**MINIMUM NUMBER OF REQUIRED PLUMBING FIXTURES**

(See Sections 2902.1.1 and 2902.2)

<table>
<thead>
<tr>
<th>No.</th>
<th>CLASSIFICATION</th>
<th>OCCUPANCY</th>
<th>DESCRIPTION</th>
<th>WATER CLOSETS (URINALS; See footnote g)</th>
<th>LAVATORIES</th>
<th>BATHTUBS/SHOWERs</th>
<th>DRINKING FOUNTAINS (See Section 410 of the plumbing code for exceptions)</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A-1d</td>
<td>Theaters and other buildings for the performing arts and motion pictures</td>
<td>1 per 125</td>
<td>1 per 65</td>
<td>1 per 200</td>
<td>—</td>
<td>1 per 500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-2d</td>
<td>Nightclubs, bars, taverns, dance halls and buildings for similar purposes</td>
<td>1 per 40</td>
<td>1 per 40</td>
<td>1 per 75</td>
<td>—</td>
<td>1 per 500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-2d</td>
<td>Casino gaming areas</td>
<td>1:1-100</td>
<td>3:1-50</td>
<td>1:1-200</td>
<td>—</td>
<td>1 per 500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-2d</td>
<td>Casino gaming areas</td>
<td>4:51-100</td>
<td>2:201-400</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-2d</td>
<td>Casino gaming areas</td>
<td>6:101-200</td>
<td>3:401-750</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-2d</td>
<td>Casino gaming areas</td>
<td>8:201-400</td>
<td>Over 750, add one</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>No.</td>
<td>CLASSIFICATION</td>
<td>OCCUPANCY</td>
<td>DESCRIPTION</td>
<td>WATER CLOSETS (URINALS: See footnote g)</td>
<td>LAVATORIES</td>
<td>BATHTUBS/SHOWERS</td>
<td>DRINKING FOUNTAINS (See Section 410 of the plumbing code for exceptions)</td>
<td>OTHER</td>
</tr>
<tr>
<td>-----</td>
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<td>----------------------------------------</td>
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<td>-----------------------------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MALE</td>
<td>FEMALE</td>
<td>MALE</td>
<td>FEMALE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 400, add one fixture each additional 250 males, and one for each 150 females</td>
<td>fixture for each additional 500 persons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Restaurants, banquet halls and food courts</td>
<td>1 per 75</td>
<td>1 per 75</td>
<td>1 per 200</td>
<td>—</td>
<td>1 per 500</td>
<td>1 service sink</td>
</tr>
<tr>
<td>2</td>
<td>Business</td>
<td>B</td>
<td>Buildings for the transaction of business, professional services, other services involving merchandise, office buildings,</td>
<td>1 per 50</td>
<td>1 per 80</td>
<td>—</td>
<td>1 per 100</td>
<td>1 service sink'</td>
</tr>
<tr>
<td>A-3³</td>
<td></td>
<td>Auditoriums without permanent seating, art galleries, exhibition halls, museums, lecture halls, libraries, arcades and gymnasiums</td>
<td>1 per 125</td>
<td>1 per 65</td>
<td>1 per 200</td>
<td>—</td>
<td>1 per 500</td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Passenger terminals and transportation facilities</td>
<td>1 per 500</td>
<td>1 per 500</td>
<td>1 per 750</td>
<td>—</td>
<td>1 per 1,000</td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td>Places of worship and other religious services</td>
<td>1 per 150</td>
<td>1 per 75</td>
<td>1 per 200</td>
<td>—</td>
<td>1 per 1,000</td>
<td>1 service sink</td>
<td></td>
</tr>
<tr>
<td>A-4</td>
<td></td>
<td>Coliseums, arenas, skating rinks, pools and tennis courts for indoor sporting events and activities</td>
<td>1 per 75 for the first 1,500 and 1 per 120 for the remainder exceeding 1,500</td>
<td>1 per 40 for the first 1,520 and 1 per 60 for the remainder exceeding 1,520</td>
<td>1 per 200</td>
<td>1 per 150</td>
<td>—</td>
<td>1 per 1,000</td>
</tr>
<tr>
<td>A-5</td>
<td></td>
<td>Stadiums, amusement parks, bleachers and grandstands for outdoor sporting events and activities</td>
<td>1 per 75 for the first 1,500 and 1 per 120 for the remainder exceeding 1,500</td>
<td>1 per 40 for the first 1,520 and 1 per 60 for the remainder exceeding 1,520</td>
<td>1 per 200</td>
<td>1 per 150</td>
<td>—</td>
<td>1 per 1,000</td>
</tr>
</tbody>
</table>

*Note: Footnote g is not provided in the image.*
### TABLE 2902.1
MINIMUM NUMBER OF REQUIRED PLUMBING FIXTURES\(^a\)
(See Sections 2902.1.1 and 2902.2)

<table>
<thead>
<tr>
<th>No.</th>
<th>CLASSIFICATION</th>
<th>OCCUPANCY</th>
<th>DESCRIPTION</th>
<th>WATER CLOSETS (URINALS: See footnote g)</th>
<th>LAVATORIES</th>
<th>BATHTUBS/SHOWERS</th>
<th>DRINKING FOUNTAINS (See Section 410 of the plumbing code for exceptions)</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>banks, ambulatory care, light industrial and similar uses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Education</td>
<td>E</td>
<td>Educational facilities</td>
<td>1 per 50</td>
<td>1 per 50</td>
<td>—</td>
<td>1 per 100</td>
<td>1 service sink</td>
</tr>
<tr>
<td>4</td>
<td>Factory and industrial</td>
<td>F-1 and F-2</td>
<td>Structures in which occupants are engaged in work fabricating, assembly or processing of products or materials</td>
<td>1 per 100</td>
<td>1 per 100</td>
<td>See Section 411 of the plumbing code</td>
<td>1 per 400</td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Institutional</td>
<td>I-1</td>
<td>Residential care</td>
<td>1 per 10</td>
<td>1 per 10</td>
<td>1 per 8</td>
<td>1 per 100</td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hospitals, ambulatory nursing home care recipient(^b)</td>
<td>1 per room(^c)</td>
<td>1 per room(^c)</td>
<td>1 per 15</td>
<td>1 per 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I-2</td>
<td>Employess, other than residential care(^b)</td>
<td>1 per 25</td>
<td>1 per 35</td>
<td></td>
<td>1 per 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visitors, other than residential care</td>
<td>1 per 75</td>
<td>1 per 100</td>
<td></td>
<td>1 per 500</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Exception for Exceptional Uses—See Exceptional Uses Section 410 of this plumbing code for exceptions.
### TABLE 2902.1
MINIMUM NUMBER OF REQUIRED PLUMBING FIXTURES\(^a\)
(See Sections 2902.1.1 and 2902.2)

<table>
<thead>
<tr>
<th>No.</th>
<th>CLASSIFICATION</th>
<th>OCCUPANCY</th>
<th>DESCRIPTION</th>
<th>WATER CLOSETS</th>
<th>LAVATORIES</th>
<th>BATHTUBS/SHOWERS</th>
<th>DRINKING FOUNTAINS</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MALE</td>
<td>FEMALE</td>
<td>MALE</td>
<td>FEMALE</td>
<td>(URINALS: See footnote g)</td>
</tr>
<tr>
<td>1-3</td>
<td>Prisons(^b)</td>
<td>I-3</td>
<td>1 per cell</td>
<td>1 per cell</td>
<td>1 per 15</td>
<td>1 per 100</td>
<td></td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td>Reformatories, detention centers and correctional centers(^b)</td>
<td></td>
<td>1 per 15</td>
<td>1 per 15</td>
<td>1 per 15</td>
<td>1 per 100</td>
<td></td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td>Employees(^b)</td>
<td></td>
<td>1 per 25</td>
<td>1 per 35</td>
<td>—</td>
<td>1 per 100</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>I-4</td>
<td>Adult day care and child care</td>
<td>I-4</td>
<td>1 per 15</td>
<td>1 per 15</td>
<td>1</td>
<td>1 per 100</td>
<td></td>
<td>1 service sink</td>
</tr>
<tr>
<td>6</td>
<td>Mercantile(^f)</td>
<td>M</td>
<td>Retail stores, service stations, shops, salesrooms, markets and shopping centers</td>
<td>1 per 500</td>
<td>1 per 750</td>
<td>—</td>
<td>1 per 1,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Residential</td>
<td>R-1</td>
<td>Hotels, motels, boarding houses (transient)</td>
<td>1 per sleeping unit</td>
<td>1 per sleeping unit</td>
<td>1 per sleeping unit</td>
<td>—</td>
<td>1 service sink</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R-2</td>
<td>Dormitories, fraternities, sororities and boarding houses (not transient)</td>
<td>1 per 10</td>
<td>1 per 10</td>
<td>1 per 8</td>
<td>1 per 100</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>CLASSIFICATION</td>
<td>OCCUPANCY</td>
<td>DESCRIPTION</td>
<td>WATER CLOSETS (URINALS: See footnote g)</td>
<td>LAVATORIES</td>
<td>BATHTUBS/SHOWERS</td>
<td>DRINKING FOUNTAINS (See Section 410 of the plumbing code for exceptions)</td>
<td>OTHER</td>
</tr>
<tr>
<td>-----</td>
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<td>---------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MALE</td>
<td>FEMALE</td>
<td>MALE</td>
<td>FEMALE</td>
<td>1 per dwelling unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MALE</td>
<td>FEMALE</td>
<td>MALE</td>
<td>FEMALE</td>
<td>1 per dwelling unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 per 10</td>
<td>1 per 10</td>
<td>1 per 8</td>
<td>1 per 100</td>
<td>1 per 8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 per 10</td>
<td>1 per 10</td>
<td>1 per 8</td>
<td>1 per 100</td>
<td>1 per 8</td>
</tr>
<tr>
<td>8</td>
<td>Storage</td>
<td>S-1 S-2</td>
<td>Structures for the storage of goods, warehouses, storehouses and freight depots, low and moderate hazard</td>
<td>1 per 100</td>
<td>1 per 100</td>
<td>See Section 411 of the plumbing code</td>
<td>See Section 411 of the plumbing code for exceptions</td>
<td>1 per 1,000</td>
</tr>
</tbody>
</table>

a. The fixtures shown are based on one fixture being the minimum required for the number of persons indicated or any fraction of the number of persons indicated. The number of occupants shall be determined by this code.
b. Toilet facilities for employees shall be separate from facilities for inmates or care recipients.
c. A single-occupant toilet room with one water closet and one lavatory serving not more than two adjacent patient sleeping units shall be permitted, provided that each patient sleeping unit has direct access to the toilet room and provisions for privacy for the toilet room user are provided.
d. The occupant load for seasonal outdoor seating and entertainment areas shall be included when determining the minimum number of facilities required.
e. For business and mercantile occupancies with an occupant load of 15 or fewer, service sinks shall not be required.
f. Mercantile occupancies are not required to provide customer facilities when the occupant load is 50 or less.
g. In each bathroom or toilet room, urinals shall not be substituted for more than 67 percent of the required water closets in assembly and educational occupancies. Urinals shall not be substituted for more than 50 percent of the required water closets in all other occupancies.

2902.2 Separate facilities. Where plumbing fixtures are required, separate facilities shall be provided for each sex.

Exceptions:
1. Separate facilities shall not be required for dwelling units and sleeping units.
2. Separate facilities shall not be required in structures or tenant spaces with a total occupant load, including both employees and customers, of 15 or fewer.
3. Separate facilities shall not be required in mercantile occupancies in which the maximum occupant load is 100 or fewer.
4. Separate facilities shall not be required in business occupancies in which the maximum occupant load is 25 or fewer.
5. Separate facilities shall not be required to be designated by sex where single-user toilets rooms are provided in accordance with Section 2902.1.2.
6. Separate facilities shall not be required where rooms having both water closets and lavatory fixtures are designed for use by both sexes and privacy for water closets are installed in accordance with Section 405.3.4 of the plumbing code. Urinals shall be located in an area visually separated from the remainder of the facility or each urinal that is provided shall be located in a stall.

2902.2.1 Family or assisted-use toilet facilities serving as separate facilities. Where a building or tenant space requires a separate toilet facility for each sex and each toilet facility is required to have only one water closet, two family or assisted-use toilet facilities shall be permitted to serve as the required separate facilities. Family or assisted-use toilet facilities shall not be required to be identified for exclusive use by either sex as required by Section 2902.4.

2902.3 Employee and public toilet facilities. Customers, patrons and visitors
shall be provided with public toilet facilities in structures and tenant spaces intended for public utilization. The number of plumbing fixtures located within the required toilet facilities shall be provided in accordance with Section 2902.1 for all users. Employees shall be provided with toilet facilities in all occupancies. Employee toilet facilities shall be either separate or combined employee and public toilet facilities.

**Exception:** Public toilet facilities shall not be required in:

1. Open or enclosed parking garages.
2. Structures and tenant spaces intended for quick transactions, including takeout, pickup and drop-off, having a public access area less than or equal to 300 square feet (28 m²).

### 2902.3.1 Access.

The route to the public toilet facilities required by Section 2902.3 shall not pass through kitchens, storage rooms, closets, or similar spaces not available to the public. Access to the required facilities shall be from within the building or from the exterior of the building. Routes shall comply with the accessibility requirements of this code. The public shall have access to the required toilet facilities at all times that the building is occupied. The building owner is permitted to control access to the toilet facilities. Where such access is controlled, a sign shall be posted indicating how access is to be obtained.

### 2902.3.2 Location of toilet facilities in occupancies other than malls.

In occupancies other than covered and open mall buildings, the required public and employee toilet facilities shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 500 feet (152 m).

**Exception:** The location and maximum distances of travel to required employee facilities in factory and industrial occupancies are permitted to exceed that required by this section, provided that the location and maximum distance of travel are approved.

### 2902.3.3 Location of toilet facilities in malls.

In covered and open mall buildings, the required public and employee toilet facilities shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 300 feet (91 mm). In mall buildings, the required facilities shall be based on total square footage (m²) within a covered mall building or within the perimeter line of an open mall building, and facilities shall be installed in each individual store or in a central toilet area located in accordance with this section. The maximum distance of travel to central toilet facilities in mall
buildings shall be measured from the main entrance of any store or tenant space. In mall buildings, where employees’ toilet facilities are not provided in the individual store, the maximum distance of travel shall be measured from the employees’ work area of the store or tenant space.

2902.3.4 Pay facilities. Where pay facilities are installed, such facilities shall be in excess of the required minimum facilities. Required facilities shall be free of charge.

2902.3.5 Door locking. Where a toilet room is provided for the use of multiple occupants, the egress door for the room shall not be lockable from the inside of the room. This section does not apply to family or assisted-use toilet rooms.

2902.3.6 Prohibited toilet room location. Toilet rooms shall not open directly into a room used for the preparation of food for service to the public.

2902.4 Signage. Required public facilities shall be provided with signs that designate the sex as required by Section 2902.2. Signs shall be readily visible and located near the entrance to each toilet facility. Signs for accessible toilet facilities shall comply with Section 1111.

2902.4.1 Directional signage. Deleted.

2902.5 Drinking fountain location. Drinking fountains shall not be required to be located in individual tenant spaces provided that public drinking fountains are located within a distance of travel of 500 feet (152 m) of the most remote location in the tenant space and not more than one story above or below the tenant space. Where the tenant space is in a covered or open mall, such distance shall not exceed 300 feet (91 440 mm). Drinking fountains shall be located on an accessible route.

2902.6 Small occupancies. Drinking fountains shall not be required for an occupant load of 15 or fewer.
4101:1-35-01 Referenced standards.

3501.1 General. This chapter lists the standards that are referenced in various sections of the building code. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title. The application of the referenced standards shall be as specified in Section 102.5.

3501.2 Referenced codes. When indicated in this code, the following codes refer to provisions in the listed chapters of the administrative code:

<table>
<thead>
<tr>
<th>Referenced Code</th>
<th>Ohio Administrative Code Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Code</td>
<td>4101:1-1 to 4101:1-35</td>
</tr>
<tr>
<td>Energy Code</td>
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<td>Ohio Boiler and Pressure Vessel Rules</td>
<td>4101:4-1 to 4101:4-10</td>
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<td>Ohio Elevator Code</td>
<td>4101:5-1 to 4101:5-3</td>
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<td>Residential Code of Ohio for One, Two and Three Family Dwellings</td>
<td>4101:8-1 to 4101:8-44</td>
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<td>Plumbing Code</td>
<td>4101:3-1 to 4101:3-15</td>
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3501.3 Building Code Referenced Standards.

AA Aluminum Association
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209

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Public Hearing Draft
Amendments Group XCIX (99)
PART A - OBC Rules
Page A-225
ASM 35—00  Aluminum Sheet Metal Work in Building Construction (Fourth Edition)

AAMA  American Architectural Manufacturers Association
1827 Waldon Office Square, Suite 550
Schaumburg, IL 60173

<table>
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<tr>
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<tr>
<td>1402—09</td>
<td>Standard Specifications for Aluminum Siding, Soffit and Fascia</td>
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ACI  American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331

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<td>216.1—14</td>
<td>Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies</td>
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<td>Specifications for Masonry Structures</td>
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<td>562 - 16</td>
<td>Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures</td>
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AISC  American Institute of Steel
Construction One East Wacker Drive, Suite 700
Chicago, IL 60601-18021

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<td>Specification for Structural Steel Buildings</td>
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**AISI** American Iron and Steel Institute  
25 Massachusetts Avenue, NW Suite 800  
Washington, DC 20001

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<td>North American Specification for the Design of Cold-formed Steel Structural Members, 2012</td>
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<td>AISI S200—12</td>
<td>North American Standard for Cold-Formed Steel Framing-General Provisions</td>
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<td>AISI S210—07(2012)</td>
<td>North American Standard for Cold-Formed Steel Framing-Floor and Roof System Design (Reaffirmed 2012)</td>
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<td>S214—12</td>
<td>North American Standard for Cold-formed</td>
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Steel Framing-Truss Design, 2012
North American Standard for Cold-formed Steel Framing-Nonstructural Members

Standard for Cold-formed Steel Framing-Prescriptive Method for One- and Two-family Dwellings

ALI Automotive Lift Institute
P.O. Box 85
Courtland, NY 13045

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<td>Standard for Automotive Lifts—Safety Requirements for Construction, Testing and Validation (ANSI)</td>
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AMCA Air Movement and Control Association International
30 West University Drive
Arlington Heights, IL 60004

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<tr>
<td>540—13</td>
<td>Test Method for Louvers Impacted by Wind Borne Debris</td>
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ANSI American National Standards Institute
25 West 43rd Street, Fourth Floor
New York, NY 10036

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<td>Installation of Ceramic Tile in the Wet-set</td>
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A108.1B—14 Method, with Portland Cement Mortar
Installation of Ceramic Tile, quarry Tile on a
Cured Portland Cement Mortar Setting Bed
with Dry-set or Latex-Portland Mortar

A108.4—14 Installation of Ceramic Tile with Organic
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Epoxy Adhesive

A108.5—14 Installation of Ceramic Tile with Dry-set
Portland Cement Mortar or Latex-Portland
Cement Mortar

A108.6—14 Installation of Ceramic Tile with Chemical-
resistant, Water
Cleanable Tile-setting and -grouting Epoxy

A108.8—14 Installation of Ceramic Tile with Chemical-
resistant Furan Resin Mortar and Grout

A108.9—14 Installation of Ceramic Tile with Modified
Epoxy Emulsion Mortar/Grout

A108.10—14 Installation of Grout in Tilework

A118.1—14 American National Standard Specifications
for Dry-set Portland Cement Mortar

A118.3—14 American National Standard Specifications
for Chemical-resistant, Water-cleanable Tile-
setting and -grouting Epoxy and Water
Cleanable Tile-setting Epoxy Adhesive

A118.4—14 American National Standard Specifications
for Latex-Portland Cement Mortar

A118.5—14 American National Standard Specifications
for Chemical Resistant Furan Mortar and
Grouts for Tile Installation

A118.6—14 American National Standard Specifications
for Cement Grouts for Tile Installation

A118.8—14 American National Standard Specifications
for Modified Epoxy Emulsion Mortar/Grout

A136.1—14 American National Standard Specifications
for Organic Adhesives for Installation of
Ceramic Tile

A137.1—12 American National Standard Specifications
for Ceramic Tile

ANSI/A 190.1—12 Structural Glued Laminated Timber

Z 97.1—15 Safety Glazing Materials Used in
Buildings—Safety Performance
### Specifications and Methods of Test

**APA**  APA - Engineered Wood Association  
7011 South 19th  
Tacoma, WA 98466

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<td>Standard for Performance-Rated Engineered Wood Rim Boards</td>
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<td>Builders Tips: Proper Storage and Handling of Glulam Beams</td>
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<td>Glued Laminated Beam Design Tables</td>
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<td>Field Notching and Drilling of Glued Laminated Timber Beams</td>
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<td>EWS X450—01</td>
<td>Glulam in Residential Construction-Western Edition</td>
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**APSP**  The Association of Pool & Spa Professionals  
2111 Eisenhower Avenue
Alexandria, VA 22314

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**ASABE** American Society of Agricultural and Biological Engineers
2950 Niles Road
St. Joseph, MI 49085

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**ASCE/SEI** American Society of Civil Engineers
Structural Engineering Institute
1801 Alexander Bell Drive
Reston, VA 20191-4400

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<td>Design and Construction of Frost Protected Shallow Foundations</td>
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<td><em>Seismic Evaluation and Retrofit of Existing Buildings</em></td>
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<td>Wind Tunnel Testing for Buildings and Other Structures</td>
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<td>Tensile Membrane Structures</td>
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**ASHRAE** American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329-2305

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<td>Energy Standard for Buildings Except Low-Rise Residential Buildings (as modified in chapter 13 of this code including Addenda ap, cj, and de applicable to computer rooms and data centers and Addenda dd)</td>
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**ASME** American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990

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<td>Performance-Based Safety Code for Elevators and Escalators</td>
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A18.1—the edition referenced in rule 4101:5-3-01 of the Administrative Code

A90.1—the edition referenced in rule 4101:5-3-01 of the Administrative Code

B16.18—2012

B16.22—2013

B20.1—2015

B31.3—2016

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<td>Specification for Carbon Structural Steel</td>
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Chromium-nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications

A 252—10 Specification for Welded and Seamless Steel Pipe Piles

A 283/A 283M—13 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

A 416/A 416M—16 Specification for Steel Strand, Uncoated Seven-wire for Prestressed Concrete

A 463/A 463M—15 Standard Specification for Steel Sheet, Aluminum-coated, by the Hot-dip Process

A 572/A 572M—15 Specification for High-strength Low-alloy Columbium-Vanadium Structural Steel

A 588/A 588M—15 Specification for High-strength Low-alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point with Atmospheric Corrosion Resistance

A 615/A 615M—16 Specification for Deformed and Plain Billet-steel Bars for Concrete Reinforcement

A 653/A 653M—2015e1 Specification for Steel Sheet, Zinc-coated Galvanized or Zinc-iron Alloy-coated Galvannealed by the Hot-dip Process

A 690/A 690M—2013a Standard Specification for High-strength Low-alloy Nickel, Copper, Phosphorus Steel H-piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments

A 706/A 706M—16 Specification for Low-alloy Steel Deformed and Plain Bars for Concrete Reinforcement

A 722/A 722M—15 Specification for Uncoated High-strength Steel Bar for Prestressing Concrete

A 755/A 755M—2016e1 Specification for Steel Sheet, Metallic-coated by the Hot-dip Process and Prepainted by the Coil-coating Process for Exterior Exposed Building Products


A 875/A 875M—13 Standard Specification for Steel Sheet Zinc-5 percent, Aluminum Alloy-coated by the Hot-dip Process
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<td>Specification for Seamless Copper Tube, Bright Annealed (Metric)</td>
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<td>Practice for Making and Curing Concrete Test Specimens in the Field</td>
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C 62—2013a  Standard Specification for Building Brick  
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C 67—14  Test Methods of Sampling and Testing Brick and Structural Clay Tile
C 73—14  Specification for Calcium Silicate Brick  
(Sand-lime Brick)
C 90—16  Specification for Loadbearing Concrete Masonry Units
C 91/91M—12  Specification for Masonry Cement
C 94/C 94M—2016a  Specification for Ready-Mixed Concrete
C 140/C140M—2016  Test Method Sampling and Testing Concrete Masonry Units and Related Units
C 150/C150M-2016  Specification for Portland Cement
C 172/C 172M—2014a  Practice for Sampling Freshly Mixed Concrete
C 199—84 (2016)  Test Method for Pier Test for Refractory Mortars
C 206—14  Specification for Finishing Hydrated Lime
C 208—12  Specification for Cellulosic Fiber Insulating Board
C 216—16  Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
C 270—14a  Specification for Mortar for Unit Masonry
C 317/C 317M—00(2015)  Specification for Gypsum Concrete
C 330/C 330M—2014  Specification for Lightweight Aggregates for Structural Concrete
C 331/C 331M—2014  Specification for Lightweight Aggregates for Concrete Masonry Units
C 406/C 406M—2015  Specification for Roofing Slate
C 473—15  Test Method for Physical Testing of Gypsum Panel Products
C 474—13  Test Methods for Joint Treatment Materials for Gypsum Board Construction
C 475/C 475M—15  Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
C 516—08 (2013)e1 Specifications for Vermiculite Loose Fill Thermal Insulation
C 547—15 Specification for Mineral Fiber Pipe Insulation
C 549—06(2012) Specification for Perlite Loose Fill Insulation
C 552—16a Standard Specification for Cellular Glass Thermal Insulation
C 557—03(2009)e01 Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
C 578—15b Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
C 595/C 595M-16 Specification for Blended Hydraulic Cements
C 635/C 635M—13 Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
C 636/C 636M—13 Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
C 645—14e1 Specification for Nonstructural Steel Framing Members
C 652—15 Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
C 744—16 Specification for Prefaced Concrete and Calcium Silicate Masonry Units
C 754—15 Specification for Installation of Steel Framing Members to Receive Screw-attached Gypsum Panel Products
C 836/C 836M—15 Specification for High-solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane for Use with Separate Wearing
Course

C 840—13  Specification for Application and Finishing of Gypsum Board
C 841—03(2013) Specification for Installation of Interior Lathing and Furring
C 847—14a Specification for Metal Lath
C 887—13 Specification for Packaged, Dry Combined Materials for Surface Bonding Mortar
C 897—15 Specification for Aggregate for Job-Mixed Portland Cement-based Plaster
C 920—14a Standard for Specification for Elastomeric Joint Sealants
C 926—16a Specification for Application of Portland Cement-based Plaster
C 933—14 Specification for Welded Wire Lath
C 946—10 Specification for Construction of Dry-stacked, Surface-bonded Walls
C 954—15 Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch (0.84 mm) to 0.112 inch (2.84 mm) in Thickness
C 955—15e1 Standard Specification for Load-bearing Transverse and Axial Steel Studs, Runners Tracks, and Bracing or Bridging, for Screw Application of Gypsum Panel Products and Metal Plaster Bases
C 957/C 957M—15 Specification for High-solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane with Integral Wearing Surface
C 1002—14 Specification for Steel Self-piercing Tapping
Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

C 1007—11a(2015) Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories

C 1029—15 Specification for Spray-applied Rigid Cellular Polyurethane Thermal Insulation

C 1032—14 Specification for Woven Wire Plaster Base

C 1047—14a Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base

C 1063—16a Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-based Plaster

C 1088—14 Specification for Thin Veneer Brick Units Made from Clay or Shale


C 1167—11 Specification for Clay Roof Tiles

C 1177/C 1177M—13 Specification for Glass Mat Gypsum Substrate for Use as Sheathing

C 1178/C 1178M—13 Specification for Coated Mat Water-resistant Gypsum Backing Panel


C 1261—13 Specification for Firebox Brick for Residential Fireplaces


C 1280—13 Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing

C 1283—15 Practice for Installing Clay Flue Lining


C 1289—16 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

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<td>Standard Specification for Architectural Cast Stone</td>
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<td>Specification for Precast Autoclaved Aerated Concrete (AAC) Wall Construction Units</td>
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<td>Standard Specification for Rapid Hardening Hydraulic Cement</td>
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<td>Standard Classification for Abuse-resistant Nondecorated Interior Gypsum Panel Products and Fiber-reinforced Cement Panels</td>
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<td>Standard Specification for Glass Mat Gypsum Panels</td>
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<td>Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position</td>
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<td>Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [56,000 ft-lb/ft³ (2,700 KN m/m³)]</td>
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<td>Specification for Asphalt Roof Coatings, Asbestos Containing</td>
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D 3019—08 Fire-retardant-treated Wood for Fire Testing
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D 3161/D 3161M—16 Test Method for a Wind Resistance of Asphalt Shingles (Fan Induced Method)


D 3462/D 3462M—16 Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules

D 3468—13 Specification for Liquid-applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing

D 3679—13 Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding


D 3737—2012 Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)

D 3746—15 Test Method for Impact Resistance of Bituminous Roofing Systems


D 3909/D 3909M—14 Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules

D 3957—15 Standard Practices for Establishing Stress Grades for Structural Members Used in Log Buildings


D 4272—15 Test Method for Total Energy Impact of Plastic Films by Dart Drop

D 4318—10e1 Test Methods for Liquid Limit, Plastic Limit
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<td>Test Method of Evaluating the Flexural Properties of Fire-retardant-treated Softwood Plywood Exposed to the Elevated Temperatures</td>
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D 6083—05e01 Specification for Liquid Applied Acrylic Coating Used in Roofing

D 6162—15 Specification for Styrene-butadiene-styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements


D 6223/D 6223M—02(2011)E1 Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements

D 6298—13 Specification for Fiberglass Reinforced Styrene-butadiene-styrene (SBS) Modified Bituminous Sheets with a Factory Applied Metal Surface

D 6305—15 Practice for Calculating Bending Strength Design Adjustment Factors for Fire-retardant-treated Plywood Roof Sheathing

D 6380—13 Standard Specification for Asphalt Roll Roofing (Organic) Felt


D 6694—15 Standard Specification for Liquid-applied Silicone Coating Used in Spray Polyurethane Foam Roofing Systems

D 6754/D 6745M—15 Standard Specification for Ketone Ester Based Sheet Roofing

D 6757—16 Standard Specification for Underlayment for Use with Steep Slope Roofing
D 6841—16 Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire-retardant-treated Lumber
D 6878/D 6878M—13 Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing
D 7254—15 Standard Specification for polypropylene (PP) siding
D 7655—12 Standard Classification for Size of Aggregate Used as Ballast for Roof Membrane Systems
D 7672—14 Standard Specification for Evaluating Structural Capacities of Rim Board Products and Assemblies
E 84—16 Test Methods for Surface Burning Characteristics of Building Materials
E 90—09 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E 96/E 96M—16 Test Method for Water Vapor Transmission of Materials
E 136—2012 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
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<td>Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials</td>
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</table>
Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

E 2072—14
Standard Specification for Photoluminescent (Phosphorescent) Safety Markings

E 2174—14
Standard Practice for On-Site Inspection of Installed Fire Stops

E 2178—13
Standard Test Method for Air Permeance of Building Materials

E 2273—03(2011)

E 2307—15
Standard Test Method for Determining Fire Resistance of a Perimeter Joint System Between an Exterior Wall Assembly and Floor Assembly Using the Intermediate-scale, Multistory Test Apparatus

E 2393—15
Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barrier

E 2397—15
Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems

E 2404—15
Standard Practice for Specimen Preparation and Mounting of Textile, Paper or Vinyl Wall or Ceiling Coverings to Assess Surface Burning Characteristics

E 2556—10
Standard Specification for Vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment

E 2568—09e1

E 2570—14

E 2573—12
Standard Practice for Specimen Preparation and Mounting of Site-fabricated Stretch Systems to Assess Surface Burning Characteristics
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<td>F 547—(2012)</td>
<td>Terminology of Nails for Use with Wood and Wood-based Materials</td>
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<td>Specification for Driven Fasteners: Nails, Spikes and Staples</td>
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<td>F 2006—10</td>
<td>Standard/Safety Specification for Window Fall Prevention Devices for Nonemergency Escape (Egress) and Rescue (Ingress) Windows</td>
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<td>Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms</td>
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<td>Standard Specification for Automated Vehicular Gate Construction</td>
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**AWC** American Wood Council  
222 Catoctin Cir SE, Suite 201  
Leesburg, VA 20175
<table>
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<tr>
<td>AWC WCD No. 4—2003</td>
<td>Wood Construction Data—Plank and Beam Framing for Residential Buildings</td>
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<td>AWC WFCM—2015</td>
<td>Wood Frame Construction Manual for One- and Two-Family Dwellings</td>
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<td>AWC STJR—2015</td>
<td>Span Tables for Joists and Rafters</td>
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<td>ANSI/AWC PWF—2015</td>
<td>Permanent Wood Foundation Design Specification</td>
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<td>AWC SDPWS—2015</td>
<td>Special Design Provisions for Wind and Seismic</td>
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**AWCI**  
Association of the Wall and Ceiling Industry  
513 West Broad Street, Suite 210  
Falls Church, VA 22046

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**AWPA**  
American Wood Protection Association  
P.O. Box 361784  
Birmingham, AL 35236-1784

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<td>C1—03</td>
<td>All Timber Products-Preservative Treatment by Pressure Processes</td>
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<td>M4—15</td>
<td>Standard for the Care of Preservative-treated</td>
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Wood Products
USE CATEGORY SYSTEM: User
Specification for Treated Wood Except
Section 6, Commodity Specification H

AWS American Welding Society
8669 NW 36 Street, #130
Doral, FL 33166

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<td>Structural Welding Code-Reinforcing Steel Including Metal Inserts and Connections In Reinforced Concrete Construction</td>
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BHMA Builders Hardware Manufacturers’ Association
355 Lexington Avenue, 17th Floor
New York, NY 10017-6603

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<td>Power Operated Pedestrian Doors</td>
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<td>Standard for Power Assist and Low Energy Operated Doors</td>
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<td>Power and Manual Operated Revolving Pedestrian Doors</td>
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CEN European Committee for Standardization (CEN)
Central Secretariat
Rue de Stassart 36
B-10 50 Brussels

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<td>EN 1081—98</td>
<td>Resilient Floor Coverings—Determination of</td>
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the Electrical Resistance
BS EN 15250—2007 Slow Heat Release Appliances Fired By
Solid Fuel Requirements and Test Methods

CGSB Canadian General Standards Board
Place du Portage 111, 6B1
11 Laurier Street
Gatineau, Quebec, Canada KIA 1G6

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<td>CAN/CGSB 37.54—95</td>
<td>Polyvinyl Chloride Roofing and Waterproofing Membrane</td>
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CPA Composite Panel Association
19465 Deerfield Avenue, Suite 306
Leesburg, VA 20176

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CPSC Consumer Product Safety Commission
4330 East West Highway
Bethesda, MD 20814-4408

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<td>Specifications for Windows, Doors and Unit Skylights</td>
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<td>CSSB—97</td>
<td>Grading and Packing Rules for Western Red Cedar Shakes and Western Red Shingles of the Cedar Shake and Shingle Bureau</td>
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**CSA** Canadian Standards Association  
8501 East Pleasant Valley  
Cleveland, OH 44131-5516

**CSSB** Cedar Shake and Shingle Bureau  
P. O. Box 1178  
Sumas, WA 98295-1178

**DASMA** Door and Access Systems Manufacturers Association International  
1300 Summer Avenue
Cleveland, OH 44115-2851

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**DOC** U.S. Department of Commerce
National Institute of Standards and Technology
1401 Constitution Avenue NW
Washington, DC 20230

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<td>Performance Standard for Wood-based Structural-use Panels</td>
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<td>PS 20—15</td>
<td>American Softwood Lumber Standard</td>
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**DOL** U.S. Department of Labor
Frances Perkins Building
200 Constitution Avenue NW
Washington, DC 20210
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<td>Washington, DC 20590</td>
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<td>Hazardous Materials Regulations</td>
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<td>49 CFR—1998</td>
<td>Specification of Transportation of Explosive and Other Dangerous Articles, UN 0335, UN 0336 Shipping Containers</td>
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<td>FEMA Federal Emergency Management Agency</td>
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<td>Federal Center Plaza 500 C Street S.W.</td>
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<td>Crawlspace Construction for Buildings Located in Special Flood Hazard Areas.</td>
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<td>FM Factory Mutual Global Research</td>
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<td>1301 Atwood Avenue, P.O. Box 7500</td>
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<td>4430 (2012)</td>
<td>Approval Standard for Heat and Smoke</td>
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4880-2010 Approval Standard for Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems

**GA** Gypsum Association
6525 Belcrest Road, Suite 480
Hyattsville, MD 20782

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<tr>
<td>GA 216—16</td>
<td>Application and Finishing of Gypsum Panel Products</td>
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**HPVA** Hardwood Plywood Veneer Association
1825 Michael Faraday Drive
Reston, VA 20190

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<td>Standard for Hardwood and Decorative Plywood</td>
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**HUD** U.S. Department of Housing and Urban Development
451 7th Street, SW
Washington, DC 20410
**Standard Referenced** | **Title**
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*HUD 24 CFR Part 3280 (1994)* | *Manufactured Home Construction and Safety Standards*

**ICC** International Code Council, Inc.
500 New Jersey Ave, NW
6th Floor
Washington, DC 20001

**Standard Referenced** | **Title**
--- | ---
ICC A117.1—09 | Accessible and Usable Buildings and Facilities
ICC 300—12 | ICC Standard on Bleachers, Folding and Telescopic Seating and Grandstands
ICC 400—12 | Standard on Design and Construction of Log Structures
ICC 500—14 | ICC/NSSA Standard on the Design and Construction of Storm Shelters
ICC 600—14 | Standard for Residential Construction in High-wind Regions
IEBC—15 | International Existing Building Code®
IECC—12 | International Energy Conservation Code® *(adoption includes chapters 2 through 5 of both the commercial provisions and the residential provisions, but only section 101 of chapters 1 and as further modified in chapter 13 of this code)*
SBCCI SSTD 11—13 | Test Standard for Determining Wind Resistance of Concrete or Clay Roof Tiles

**ISO** International Organization for Standardization
ISO Central Secretariat  
1 ch, de la Voie-Creuse, Case Postale 56  
CH-1211 Geneva 20, Switzerland

**Standard Referenced** | **Title**
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ISO 8115—86 | Cotton Bales—Dimensions and Density  
ISO 8336—09 | Fiber-Cement Flat Sheets - Product Specification and Test Methods

**MHI** Material Handling Institute  
8720 Red Oak Blvd. Suite 201  
Charlotte, NC 28217

**Standard Referenced** | **Title**
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ANSI MH29.1—08 | Safety Requirements for Industrial Scissors Lifts

**NAAMM** National Association of Architectural Metal Manufacturers  
800 Roosevelt Road, Bldg. C, Suite 312  
Glen Ellyn, IL 60137

**Standard Referenced** | **Title**
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FP 1001—07 | Guide Specifications for Design of Metal Flag Poles

**NCMA** National Concrete Masonry Association  
13750 Sunrise Valley  
Herndon, VA 22071-4662

**Standard Referenced** | **Title**
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TEK 5—84 (1996) Details for Concrete Masonry Fire Walls

**NFPA** National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471

<table>
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<th>Standard Referenced</th>
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<td>10—13</td>
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<td>Standard on Halon 1301 Fire Extinguishing Systems</td>
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<td>13R—16</td>
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<td>20—16</td>
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<td>85—the edition referenced in rule 4101:4-3-01 of the Administrative Code</td>
<td>Standard on Incinerators and Waste and Linen Handling Systems and Equipment</td>
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<td>92—15</td>
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Building Materials
265—15 Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings on Full Height Panels and Walls
275—13 Standard Method of Fire Tests for the Evaluation of Thermal Barriers
276—15 Standard Method of Fire Tests for Determining the Heat Release Rate of Roofing Assemblies With Combustible Above-Deck Roofing Components
286—15 Standard Methods of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
288—12 Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal in Fire-resistance-rated Floor Systems
289—13 Standard Method of Fire Test for Individual Fuel Packages
409—16 Standard for Aircraft Hangars
418—16 Standard for Heliports
484—15 Standard for Combustible Metals
654—17 Standard for the Prevention of Fire & Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate Solids
655—12 Standard for the Prevention of Sulfur Fires and Explosions
664—17 Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities
701—15 Standard Method of Fire Tests for Flame-Propagation of Textiles and Films
704—17 Standard System for the Identification of the
Hazards of Materials for Emergency Response

720—15 Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment

750—15 Standard on Water Mist Fire Protection Systems

2001—15 Standard on Clean Agent Fire Extinguishing Systems

2010-15 Standard for Fixed Aerosol Fire Extinguishing Systems

**PCI** Precast Prestressed Concrete Institute
200 West Adams Street, Suite 2100
Chicago, IL 60606-6938

<table>
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<th>Standard Referred</th>
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<tr>
<td>MNL 124—11</td>
<td>Design for Fire Resistance of Precast Prestressed Concrete</td>
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<td>MNL 128—01</td>
<td>Recommended Practice for Glass Fiber Reinforced Concrete Panels.</td>
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**PTI** Post-Tensioning Institute
38800 Country Club Drive
Farmington Hills, MI 48331

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<td>PTI DC—10.5-12</td>
<td>Standard Requirements for Design and Analysis of Shallow Concrete Foundations on Expansive Soils</td>
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**RMI** Rack Manufacturers Institute
8720 Red Oak Boulevard, Suite 201
Charlotte, NC 28217
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<th>Standard Referenced</th>
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<td>ANSI/MH16.1—12</td>
<td>Specification for Design, Testing and Utilization of Industrial Steel Storage Racks</td>
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**SBCA** Structural Building Components Association  
6300 Enterprise Lane  
Madison, WI 53719

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<td>ANSI/FS 100-12</td>
<td>Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies</td>
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**SDI** Steel Deck Institute  
P. O. Box 426  
Glenshaw, PA 15116

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<tr>
<td>ANSI/NC1.0—10</td>
<td>Standard for Noncomposite Steel Floor Deck</td>
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<td>ANSI/RD1.0—10</td>
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<td>SDI-C—2011</td>
<td>Standard for Composite Steel Floor Deck Slabs</td>
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<tr>
<td>SDI-QA/QC—2011</td>
<td>Standard for Quality Control and Quality Assurance for Installation of Steel Deck</td>
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**SJI** Steel Joist Institute  
1173B London Links Drive  
Forest, VA 24551

<table>
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</table>
CJ—10  Standard Specification for Composite Steel Joists, CJ-series
JG—10  Standard Specification for Joist Girders
K—10  Standard Specification for Open Web Steel Joists, K-series

**SPRI** Single-Ply Roofing Institute
411 Waverly Oaks Road, Suite 331B
Waltham, MA 02452

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<td>Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems</td>
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<td>ANSI/SPRI VF1—10</td>
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**TIA** Telecommunications Industry Association
1320 N. Courthouse Road
Arlington, VA 22201-3834

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<thead>
<tr>
<th>Standard Referenced</th>
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| 222-G—05 | Structural Standards for Antenna Supporting Structures and Antennas, including—
Addendum 1, 222-G-1, Dated 2007,
Addendum 2, 222-G-2 Dated 2009
Addendum 3, 222-3 dated 2013 and
Addendum 4, 222-G-4 dated 2014 |

**TMS** The Masonry Society
**Standard Referenced** | **Title**
--- | ---
302—2012 | Standard Method for Determining the Sound Transmission Class Rating for Masonry Walls
402—2013 | Building Code for Masonry Structures
403-2013 | Direct Design Handbook for Masonry Structures
602—2013 | Specification for Masonry Structures

**TPI** Truss Plate Institute  
218 N. Lee Street, Suite 312  
Alexandria, VA 22314

**Standard Referenced** | **Title**
--- | ---
TPI 1—2014 | National Design Standard for Metal-plate-connected Wood Truss Construction

**UL** Underwriters Laboratories, LLC  
333 Pfingsten Road  
Northbrook, IL 60062-2096

**Standard Referenced** | **Title**
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9—2009 | Fire Tests of Window Assemblies
10A—2009 | Tin Clad Fire Doors
10B—2008 | Fire Tests of Door Assemblies—with Revisions through April 2009
10C—2016 | Positive Pressure Fire Tests of Door
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<td>Factory-built Chimneys, for Residential Type and Building Heating Appliances—with Revisions through July 2012</td>
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<td>300A—06</td>
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<td>Test for Uplift Resistance of Roof Assemblies—with Revisions through July 2012</td>
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641—2010  Type L Low-temperature Venting Systems—
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710B—2011  Recirculating Systems
723—2008  Standard for Test for Surface Burning
Characteristics of Building Materials—with
Revisions through September 2010
790—04   Standard Test Methods for Fire Tests of
Roof Coverings—with Revisions through
October 2008
793—08   Standards for Automatically Operated Roof
Vents for Smoke and Heat—with Revisions
through September 2011
864—14   Standards for Control Units and Accessories
for Fire Alarm Systems—with Revisions
through August 2012
924—16   Standard for Safety Emergency Lighting and
Power Equipment—with Revisions through
February 2011
1040—96  Fire Test of Insulated Wall Construction—
with Revisions through October 2012
1256—02  Fire Test of Roof Deck Construction—with
Revisions through January 2007
1479—15  Fire Tests of Through-penetration
Firestopping Firestoppers—with Revisions through October
2012
1482—2011 Solid-Fuel-type Room Heaters
1703—02  Flat-Plate Photovoltaic Modules and
Panels—with Revisions through November
2014
1715—97  Fire Test of Interior Finish Material—with
Revisions through January 2013
1777—2015 Chimney Liners—with Revisions through
July 2009
1784—15  Air Leakage Tests of Door Assemblies—with
Revisions through July 2009
1897—15  Uplift Tests for Roof Covering Systems
1975—06  Fire Test of Foamed Plastics Used for
Decorative Purposes
1994—15  Luminous Egress Path Marking Systems—with
Revisions through November 2010

2034—2008 Standard for Single- and Multiple-Station Carbon Monoxide Alarm—with Revisions through February 2009

2075—2013 Standard for Gas and Vapor Detectors and Sensors


2196—2001 Tests for Fire Resistive Cables—with Revisions through March 2012

2200—2012 Stationary Engine Generator Assemblies—with Revisions through June 2013

**ULC** Underwriters Laboratories of Canada
7 Underwriters Road
Toronto, Ontario, Canada M1R3B4

**Standard Referenced**  **Title**

CAN/ULC S 102.2—2010 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies—with 2000 Revisions

**USC** United States Code c/o Superintendent of Documents
U.S. Government Printing Office
732 North Capitol Street NW
Washington, DC 20401

**Standard Referenced**  **Title**

18 USC Part 1, Ch.40 Importation, Manufacture, Distribution and Storage of Explosive Materials
### WCLIB West Coast Lumber Inspection Bureau

P. O. Box 23145  
Portland, OR 97281

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<td>AITC Technical Note 7—96</td>
<td>Calculation of Fire Resistance of Glued Laminated Timbers</td>
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<td>AITC 110—01</td>
<td>Standard Appearance Grades for Structural Glued Laminated Timber</td>
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<td>AITC 113—10</td>
<td>Standard for Dimensions of Structural Glued Laminated Timber</td>
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<td>AITC 117—10</td>
<td>Standard Specifications for Structural Glued Laminated Timber of Softwood Species</td>
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<tr>
<td>AITC 200—09</td>
<td>Manufacturing Quality Control Systems Manual for Structural Glued Laminated Timber</td>
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### WDMA Window and Door Manufacturers Association

2025 M Street, NW Suite 800  
Washington, DC 20036-3309

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<td>AAMA/WDMA/CSA 101/I.S.2/A440—11</td>
<td>Specifications for Windows, Doors and Unit Skylights</td>
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### WRI Wire Reinforcement Institute, Inc.

942 Main Street, Suite 300  
Hartford, CT 06103

<table>
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<tr>
<th>Standard Referred</th>
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PART B - OHIO MECHANICAL CODE RULES

4101:2-5-01 Exhaust systems.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:2-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 501
GENERAL

501.1 Scope. This chapter shall govern the design, construction and installation of mechanical exhaust systems, including exhaust systems serving clothes dryers and cooking appliances; hazardous exhaust systems; dust, stock and refuse conveyor systems; subslab soil exhaust systems; smoke control systems; energy recovery ventilation systems and other systems specified in Section 502.

501.2 Independent system required. Single or combined mechanical exhaust systems for environmental air shall be independent of all other exhaust systems. Dryer exhaust shall be independent of all other systems. Type I exhaust systems shall be independent of all other exhaust systems except as provided in Section 506.3.5. Single or combined Type II exhaust systems for food-processing operations shall be independent of all other exhaust systems. Kitchen exhaust systems shall be constructed in accordance with Section 505 for domestic equipment and Sections 506 through 509 for commercial equipment.

501.3 Exhaust discharge. The air removed by every mechanical exhaust system shall be discharged outdoors at a point where it will not cause a public nuisance and not less than the distances specified in Section 501.3.1. The air shall be discharged to a location from which it cannot again be readily drawn in by a ventilating system. Air shall not be exhausted into an attic, crawl space, or be directed onto walkways.

Exceptions:
1. Whole-house ventilation-type attic fans shall be permitted to discharge into the attic space of dwelling units having private attics.
2. Commercial cooking recirculating systems.
3. Where installed in accordance with the manufacturer’s instructions and where mechanical or natural ventilation is otherwise provided in
accordance with Chapter 4, listed and labeled domestic ductless range hoods shall not be required to discharge to the outdoors.

501.3.1 Location of exhaust outlets. The termination point of exhaust outlets and ducts discharging to the outdoors shall be located with the following minimum distances:

1. For ducts conveying explosive or flammable vapors, fumes or dusts: 30 feet (9144 mm) from property lines; 10 feet (3048 mm) from operable openings into buildings; 6 feet (1829 mm) from exterior walls and roofs; 30 feet (9144 mm) from combustible walls and operable openings into buildings which are in the direction of the exhaust discharge; 10 feet (3048 mm) above adjoining grade.
2. For other product-conveying outlets: 10 feet (3048 mm) from the property lines; 3 feet (914 mm) from exterior walls and roofs; 10 feet (3048 mm) from operable openings into buildings; 10 feet (3048 mm) above adjoining grade.
3. For all environmental air exhaust: 3 feet (914 mm) from property lines; 3 feet (914 mm) from operable openings into buildings for all occupancies other than Group U, and 10 feet (3048 mm) from mechanical air intakes. Such exhaust shall not be considered hazardous or noxious.
4. Exhaust outlets serving structures in flood hazard areas shall be installed at or above the elevation required by Section 1612 of the building code for utilities and attendant equipment.
5. For specific systems see the following sections:
   5.1. Clothes dryer exhaust, Section 504.4.
   5.2. Kitchen hoods and other kitchen exhaust equipment, Sections 506.3.13, 506.4 and 506.5.
   5.3. Dust stock and refuse conveying systems, Section 511.2.
   5.4. Subslab soil exhaust systems, Section 512.4.
   5.5. Smoke control systems, Section 513.10.3.
   5.6. Refrigerant discharge, Section 1105.7.
   5.7. Machinery room discharge, Section 1105.6.1.

501.3.2 Exhaust opening protection. Exhaust openings that terminate outdoors shall be protected with corrosion resistant screens, louvers or grilles. Openings in screens, louvers and grilles shall be sized not less than 1/4 inch (6.4 mm) and not larger than 1/2 inch (12.7 mm). Openings shall be protected against local weather conditions. Louvers that protect exhaust openings in structures located in hurricane-prone regions, as defined in the building code, shall comply with AMCA Standard 550. Outdoor openings located in exterior
walls shall meet the provisions for exterior wall opening protectives in accordance with the building code.

501.4 Pressure equalization. Mechanical exhaust systems shall be sized to remove the quantity of air required by this chapter to be exhausted. The system shall operate when air is required to be exhausted. Where mechanical exhaust is required in a room or space in other than occupancies in R-3 and dwelling units in R-2, such space shall be maintained with a neutral or negative pressure. If a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical exhaust for a room, adequate means shall be provided for the natural or mechanical exhaust of the excess air supplied. If only a mechanical exhaust system is installed for a room or if a greater quantity of air is removed by a mechanical exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate makeup air shall be provided to satisfy the deficiency.

501.5 Ducts. Where exhaust duct construction is not specified in this chapter, such construction shall comply with Chapter 6.

SECTION 502
REQUIRED SYSTEMS

502.1 General. An exhaust system shall be provided, maintained and operated as specifically required by this section and for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders and other appliances, equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas or smoke, in such quantities so as to be irritating or injurious to health or safety.

502.1.1 Exhaust location. The inlet to an exhaust system shall be located in the area of heaviest concentration of contaminants.

502.1.2 Fuel-dispensing areas. The bottom of an air inlet or exhaust opening in fuel-dispensing areas shall be located not more than 18 inches (457 mm) above the floor.

502.1.3 Equipment, appliance and service rooms. Equipment, appliance and system service rooms that house sources of odors, fumes, noxious gases, smoke, steam, dust, spray or other contaminants shall be designed and constructed so as to prevent spreading of such contaminants to other occupied parts of the building.
502.1.4 **Hazardous exhaust.** The mechanical exhaust of high concentrations of dust or hazardous vapors shall conform to the requirements of Section 510.

502.2 **Aircraft fueling and defueling.** Compartments housing piping, pumps, air eliminators, water separators, hose reels and similar equipment used in aircraft fueling and defueling operations shall be adequately ventilated at floor level or within the floor itself.

502.3 **Battery-charging areas for powered industrial trucks and equipment.** Ventilation shall be provided in an approved manner in battery-charging areas for powered industrial trucks and equipment to prevent a dangerous accumulation of flammable gases.

502.4 **Stationary storage battery systems.** Stationary storage battery systems, as regulated by Section 608 of the fire code, shall be provided with ventilation in accordance with this chapter and Section 502.4.1 or 502.4.2.

**Exception:** Lithium-ion and lithium metal polymer batteries shall not require additional ventilation beyond that which would normally be required for human occupancy of the space.

502.4.1 **Hydrogen limit in rooms.** For flooded lead acid, flooded nickel cadmium and VRLA batteries, the ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room.

502.4.2 **Ventilation rate in rooms.** Continuous ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot (cfm/ft²) [0.00508 m³/(s ⋅ m²)] of floor area of the room.

502.4.3 **Supervision.** Mechanical ventilation systems required by Section 502.4 shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

502.5 **Valve-regulated lead-acid batteries in cabinets.** Valve-regulated lead-acid (VRLA) batteries installed in cabinets, as regulated by Section 608.6.2 of the fire code, shall be provided with ventilation in accordance with Section 502.5.1 or 502.5.2.

502.5.1 **Hydrogen limit in cabinets.** The cabinet ventilation system shall be
designed to limit the maximum concentration of hydrogen to 1.0 percent of
the total volume of the cabinet during the worst-case event of simultaneous
boost charging of all batteries in the cabinet.

502.5.2 Ventilation rate in cabinets. Continuous cabinet ventilation shall be
provided at a rate of not less than 1 cubic foot per minute per square foot
(cf m/ft²) [0.00508 m³/(s ∙ m²)] of the floor area covered by the cabinet. The
room in which the cabinet is installed shall be ventilated as required by
Section 502.4.1 or 502.4.2.

502.5.3 Supervision. Mechanical ventilation systems required by Section
502.5 shall be supervised by an approved central, proprietary or remote station
service or shall initiate an audible and visual signal at a constantly attended
on-site location.

502.6 Dry cleaning plants. Ventilation in dry cleaning plants shall be adequate to
protect employees and the public in accordance with this section and DOL 29
CFR Part 1910.1000, where applicable.

502.6.1 Type II systems. Type II dry cleaning systems shall be provided with
a mechanical ventilation system that is designed to exhaust 1 cubic foot of air
per minute for each square foot of floor area (1 cf m/ft²) [0.00508 m³/(s ∙ m²)]
in dry cleaning rooms and in drying rooms. The ventilation system shall
operate automatically when the dry cleaning equipment is in operation and
shall have manual controls at an approved location.

502.6.2 Type IV and V systems. Type IV and V dry cleaning systems shall
be provided with an automatically activated exhaust ventilation system to
maintain an air velocity of not less than 100 feet per minute (0.51 m/s)
through the loading door when the door is opened.

Exception: Dry cleaning units are not required to be provided with exhaust
ventilation where an exhaust hood is installed immediately outside of and
above the loading door which operates at an airflow rate as follows:

\[ Q = 100 \times A_{LD} \]  \hspace{1cm} \text{(Equation 5-1)}

where:

\[ Q \] = Flow rate exhausted through the hood, cubic feet per minute.
\[ A_{LD} \] = Area of the loading door, square feet.

502.6.3 Spotting and pretreating. Scrubbing tubs, scouring, brushing or
spotting operations shall be located such that solvent vapors are captured and exhausted by the ventilating system.

502.7 Application of flammable finishes. Mechanical exhaust as required by this section and the fire code shall be provided for operations involving the application of flammable finishes.

502.7.1 During construction. Ventilation shall be provided for operations involving the application of materials containing flammable solvents in the course of construction, alteration or demolition of a structure.

502.7.2 Limited spraying spaces. Positive mechanical ventilation that provides not less than six complete air changes per hour shall be installed in limited spraying spaces. Such system shall meet the requirements of the fire code for handling flammable vapors. Explosion venting is not required.

502.7.3 Flammable vapor areas. Mechanical ventilation of flammable vapor areas shall be provided in accordance with Sections 502.7.3.1 through 502.7.3.6.

502.7.3.1 Operation. Mechanical ventilation shall be kept in operation at all times while spraying operations are being conducted and for a sufficient time thereafter to allow vapors from drying coated articles and finishing material residue to be exhausted. Spraying equipment shall be interlocked with the ventilation of the flammable vapor area such that spraying operations cannot be conducted unless the ventilation system is in operation.

502.7.3.2 Recirculation. Air exhausted from spraying operations shall not be recirculated.

Exceptions:
1. Air exhausted from spraying operations shall be permitted to be recirculated as makeup air for unmanned spray operations provided that:
   1.1. The solid particulate has been removed.
   1.2. The vapor concentration is less than 25 percent of the lower flammable limit (LFL).
   1.3. Approved equipment is used to monitor the vapor concentration.
   1.4. An alarm is sounded and spray operations are automatically shut down if the vapor concentration exceeds 25 percent of the
1.5. In the event of shutdown of the vapor concentration monitor, 100 percent of the air volume specified in Section 510 is automatically exhausted.

2. Air exhausted from spraying operations is allowed to be recirculated as makeup air to manned spraying operations where all of the conditions provided in Exception 1 are included in the installation and documents have been prepared to show that the installation does not pose a life safety hazard to personnel inside the spray booth, spraying space or spray room.

**502.7.3.3 Air velocity.** The ventilation system shall be designed, installed and maintained so that the flammable contaminants are diluted in noncontaminated air to maintain concentrations in the exhaust air flow below 25 percent of the contaminant’s lower flammable limit (LFL). In addition, the spray booth shall be provided with mechanical ventilation so that the average air velocity through openings is in accordance with Sections 502.7.3.3.1 and 502.7.3.3.2.

**502.7.3.3.1 Open face or open front spray booth.** For spray application operations conducted in an open face or open front spray booth, the ventilation system shall be designed, installed and maintained so that the average air velocity into the spray booth through all openings is not less than 100 feet per minute (0.51 m/s).

**Exception:** For fixed or automated electrostatic spray application equipment, the average air velocity into the spray booth through all openings shall be not less than 50 feet per minute (0.25 m/s).

**502.7.3.3.2 Enclosed spray booth or spray room with openings for product conveyance.** For spray application operations conducted in an enclosed spray booth or spray room with openings for product conveyance, the ventilation system shall be designed, installed and maintained so that the average air velocity into the spray booth through openings is not less than 100 feet per minute (0.51 m/s).

**Exceptions:**

1. For fixed or automated electrostatic spray application equipment, the average air velocity into the spray booth through all openings shall be not less than 50 feet per minute (0.25 m/s).

2. Where methods are used to reduce cross drafts that can draw vapors and overspray through openings from the spray booth or...
spray room, the average air velocity into the spray booth or spray room shall be that necessary to capture and confine vapors and overspray to the spray booth or spray room.

502.7.3.4 Ventilation obstruction. Articles being sprayed shall be positioned in a manner that does not obstruct collection of overspray.

502.7.3.5 Independent ducts. Each spray booth and spray room shall have an independent exhaust duct system discharging to the outdoors.

Exceptions:
1. Multiple spray booths having a combined frontal area of 18 square feet (1.67 m²) or less are allowed to have a common exhaust where identical spray-finishing material is used in each booth. If more than one fan serves one booth, such fans shall be interconnected so that all fans operate simultaneously.
2. Where treatment of exhaust is necessary for air pollution control or energy conservation, ducts shall be allowed to be manifolded if all of the following conditions are met:
   2.1. The sprayed materials used are compatible and will not react or cause ignition of the residue in the ducts.
   2.2. Nitrocellulose-based finishing material shall not be used.
   2.3. A filtering system shall be provided to reduce the amount of overspray carried into the duct manifold.
   2.4. Automatic sprinkler protection shall be provided at the junction of each booth exhaust with the manifold, in addition to the protection required by this chapter.

502.7.3.6 Fan motors and belts. Electric motors driving exhaust fans shall not be placed inside booths or ducts. Fan rotating elements shall be nonferrous or nonsparking or the casing shall consist of, or be lined with, such material. Belts shall not enter the duct or booth unless the belt and pulley within the duct are tightly enclosed.

502.7.4 Dipping operations. Flammable vapor areas of dip tank operations shall be provided with mechanical ventilation adequate to prevent the dangerous accumulation of vapors. Required ventilation systems shall be so arranged that the failure of any ventilating fan will automatically stop the dipping conveyor system.

502.7.5 Electrostatic apparatus. The flammable vapor area in spray-finishing operations involving electrostatic apparatus and devices shall be
ventilated in accordance with Section 502.7.3.

502.7.6 Powder coating. Exhaust ventilation for powder-coating operations shall be sufficient to maintain the atmosphere below one-half of the minimum explosive concentration for the material being applied. Nondeposited, air-suspended powders shall be removed through exhaust ducts to the powder recovery system.

502.7.7 Floor resurfacing operations. To prevent the accumulation of flammable vapors during floor resurfacing operations, mechanical ventilation at a minimum rate of 1 cfm/ft² [0.00508 m³/(s • m²)] of area being finished shall be provided. Such exhaust shall be by approved temporary or portable means. Vapors shall be exhausted to the exterior of the building.

502.8 Hazardous materials—general requirements. Exhaust ventilation systems for structures containing hazardous materials shall be provided as required in Sections 502.8.1 through 502.8.5.

502.8.1 Storage in excess of the maximum allowable quantities. Indoor storage areas and storage buildings for hazardous materials in amounts exceeding the maximum allowable quantity per control area shall be provided with mechanical exhaust ventilation or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored.

Exceptions:
1. Storage areas for flammable solids complying with Section 5904 of the fire code.
2. Storage areas and storage buildings for fireworks and explosives complying with Chapter 56 of the fire code.

502.8.1.1 System requirements. Exhaust ventilation systems shall comply with all of the following:
1. The installation shall be in accordance with this code.
2. Mechanical ventilation shall be provided at a rate of not less than 1 cfm per square foot [0.00508 m³/(s • m²)] of floor area over the storage area.
3. The systems shall operate continuously unless alternate designs are approved.
4. A manual shutoff control shall be provided outside of the room in a position adjacent to the access door to the room or in another approved location. The switch shall be a break-glass or other
approved type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.

5. The exhaust ventilation shall be designed to consider the density of the potential fumes or vapors released. For fumes or vapors that are heavier than air, exhaust shall be taken from a point within 12 inches (305 mm) of the floor. For fumes or vapors that are lighter than air, exhaust shall be taken from a point within 12 inches (305 mm) of the highest point of the room.

6. The location of both the exhaust and inlet air openings shall be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.

7. The exhaust air shall not be recirculated to occupied areas if the materials stored are capable of emitting hazardous vapors and contaminants have not been removed. Air contaminated with explosive or flammable vapors, fumes or dusts; flammable, highly toxic or toxic gases; or radioactive materials shall not be recirculated.

502.8.2 Gas rooms, exhausted enclosures and gas cabinets. The ventilation system for gas rooms, exhausted enclosures and gas cabinets for any quantity of hazardous material shall be designed to operate at a negative pressure in relation to the surrounding area. Highly toxic and toxic gases shall comply with Sections 502.9.7.1, 502.9.7.2 and 502.9.8.4.

502.8.3 Indoor dispensing and use. Indoor dispensing and use areas for hazardous materials in amounts exceeding the maximum allowable quantity per control area shall be provided with exhaust ventilation in accordance with Section 502.8.1.

Exception: Ventilation is not required for dispensing and use of flammable solids other than finely divided particles.

502.8.4 Indoor dispensing and use—point sources. Where gases, liquids or solids in amounts exceeding the maximum allowable quantity per control area and having a hazard ranking of 3 or 4 in accordance with NFPA 704 are dispensed or used, mechanical exhaust ventilation shall be provided to capture gases, fumes, mists or vapors at the point of generation.

Exception: Where it can be demonstrated that the gases, liquids or solids do not create harmful gases, fumes, mists or vapors.

502.8.5 Closed systems. Where closed systems for the use of hazardous materials in amounts exceeding the maximum allowable quantity per control
area are designed to be opened as part of normal operations, ventilation shall
be provided in accordance with Section 502.8.4.

502.9 Hazardous materials—requirements for specific materials. Exhaust
ventilation systems for specific hazardous materials shall be provided as required
in Section 502.8 and Sections 502.9.1 through 502.9.11.

502.9.1 Compressed gases—medical gas systems. Rooms for the storage of
compressed medical gases in amounts exceeding the permit amounts for
compressed gases in the fire code, and that do not have an exterior wall, shall
be exhausted through a duct to the exterior of the building. Both separate
airstreams shall be enclosed in a 1-hour-rated shaft enclosure from the room to
the exterior. Approved mechanical ventilation shall be provided at a minimum
rate of 1 cfm/ft² [0.00508 m³/(s · m²)] of the area of the room.
Gas cabinets for the storage of compressed medical gases in amounts
exceeding the permit amounts for compressed gases in the fire code shall be
connected to an exhaust system. The average velocity of ventilation at the face
of access ports or windows shall be not less than 200 feet per minute (1.02
m/s) with a minimum velocity of 150 feet per minute (0.76 m/s) at any point
at the access port or window.

502.9.2 Corrosives. Where corrosive materials in amounts exceeding the
maximum allowable quantity per control area are dispensed or used,
mechanical exhaust ventilation in accordance with Section 502.8.4 shall be
provided.

502.9.3 Cryogenics. Storage areas for stationary or portable containers of
cryogenic fluids in any quantity shall be ventilated in accordance with Section
502.8. Indoor areas where cryogenic fluids in any quantity are dispensed shall
be ventilated in accordance with the requirements of Section 502.8.4 in a
manner that captures any vapor at the point of generation.
Exception: Ventilation for indoor dispensing areas is not required where it
can be demonstrated that the cryogenic fluids do not create harmful
vapors.

502.9.4 Explosives. Squirrel cage blowers shall not be used for exhausting
hazardous fumes, vapors or gases in operating buildings and rooms for the
manufacture, assembly or testing of explosives. Only nonferrous fan blades
shall be used for fans located within the ductwork and through which
hazardous materials are exhausted. Motors shall be located outside the duct.
502.9.5 Flammable and combustible liquids. Exhaust ventilation systems shall be provided as required by Sections 502.9.5.1 through 502.9.5.5 for the storage, use, dispensing, mixing and handling of flammable and combustible liquids. Unless otherwise specified, this section shall apply to any quantity of flammable and combustible liquids.

Exception: This section shall not apply to the following:

1. Specific provisions for flammable liquids in motor fuel-dispensing facilities, airports and marinas as identified in Chapter 23 of the fire code.
2. Medicines, foodstuffs, cosmetics and commercial or institutional products containing not more than fifty percent by volume of water-miscible liquids and with the remainder of the solution not being flammable, provided that such materials are packaged in individual containers not exceeding 1.3 gallons (5 L).
3. Quantities of alcoholic beverages in retail or wholesale sales or storage occupancies, provided that the liquids are packaged in individual containers not exceeding 1.3 gallons (5 L).
4. Fuel oil and diesel oil tanks and containers connected to oil-burning or fuel-burning equipment. Such storage and use shall be in accordance with chapter 13.
5. Refrigerant liquids and oils in refrigeration systems (see chapter 11 of this code).
6. Storage and display of aerosol products complying with chapter 51 of the fire code.
7. Storage and use of liquids that have no fire point when tested in accordance with ASTM D 92.
8. Liquids with a flash point greater than ninety-five degrees Fahrenheit (thirty-five degrees Centigrade) in a water-miscible solution or dispersion with a water and inert (noncombustible) solids content of more than eighty per cent by weight, which do not sustain combustion.
9. Liquids without flash points that can be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons.
10. The storage of distilled spirits and wines in wooden barrels and casks.
11. Commercial cooking oil storage tank systems located within a building and designed and installed in accordance with Section 610 of the fire code and NFPA 30.
12. Underground storage tanks installed in accordance with the fire code and rules adopted by the state fire marshal and enforced by the fire official, in accordance with Sections 3737.87 to 3737.89 of the Revised Code.

502.9.5.1 Vaults. Vaults that contain tanks of Class I liquids shall be provided with continuous ventilation at a rate of not less than 1 cfm/ft² of floor area [0.00508 m³/(s • m²)], but not less than 150 cfm (4 m³/min).
Failure of the exhaust airflow shall automatically shut down the dispensing system. The exhaust system shall be designed to provide air movement across all parts of the vault floor. Supply and exhaust ducts shall extend to a point not greater than 12 inches (305 mm) and not less than 3 inches (76 mm) above the floor. The exhaust system shall be installed in accordance with the provisions of NFPA 91. Means shall be provided to automatically detect any flammable vapors and to automatically shut down the dispensing system upon detection of such flammable vapors in the exhaust duct at a concentration of 25 percent of the LFL.

502.9.5.2 Storage rooms and warehouses. Liquid storage rooms and liquid storage warehouses for quantities of liquids exceeding those specified in the building code shall be ventilated in accordance with Section 502.8.1.

502.9.5.3 Cleaning machines. Areas containing machines used for parts cleaning in accordance with the fire code shall be adequately ventilated to prevent accumulation of vapors.

502.9.5.4 Use, dispensing and mixing. Continuous mechanical ventilation shall be provided for the use, dispensing and mixing of flammable and combustible liquids in open or closed systems in amounts exceeding the maximum allowable quantity per control area and for bulk transfer and process transfer operations. The ventilation rate shall be not less than 1 cfm/ft\(^2\) \((0.00508 \text{ m}^3/(\text{s} \cdot \text{m}^2))\) of floor area over the design area. Provisions shall be made for the introduction of makeup air in a manner that will include all floor areas or pits where vapors can collect. Local or spot ventilation shall be provided where needed to prevent the accumulation of hazardous vapors.

Exception: Where natural ventilation can be shown to be effective for the materials used, dispensed or mixed.

502.9.5.5 Bulk plants or terminals. Ventilation shall be provided for portions of properties where flammable and combustible liquids are received by tank vessels, pipelines, tank cars or tank vehicles and which are stored or blended in bulk for the purpose of distributing such liquids by tank vessels, pipelines, tank cars, tank vehicles or containers as required by Sections 502.9.5.5.1 through 502.9.5.5.3.

502.9.5.5.1 General. Ventilation shall be provided for rooms,
buildings and enclosures in which Class I liquids are pumped, used or transferred. Design of ventilation systems shall consider the relatively high specific gravity of the vapors. Where natural ventilation is used, adequate openings in outside walls at floor level, unobstructed except by louvers or coarse screens, shall be provided. Where natural ventilation is inadequate, mechanical ventilation shall be provided.

502.9.5.5.2 Basements and pits. Class I liquids shall not be stored or used within a building having a basement or pit into which flammable vapors can travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

502.9.5.5.3 Dispensing of Class I liquids. Containers of Class I liquids shall not be drawn from or filled within buildings unless a provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable vapors could be present.

502.9.6 Highly toxic and toxic liquids. Ventilation exhaust shall be provided for highly toxic and toxic liquids as required by Sections 502.9.6.1 and 502.9.6.2.

502.9.6.1 Treatment system. This provision shall apply to indoor and outdoor storage and use of highly toxic and toxic liquids in amounts exceeding the maximum allowable quantities per control area. Exhaust scrubbers or other systems for processing vapors of highly toxic liquids shall be provided where a spill or accidental release of such liquids can be expected to release highly toxic vapors at normal temperature and pressure.

502.9.6.2 Open and closed systems. Mechanical exhaust ventilation shall be provided for highly toxic and toxic liquids used in open systems in accordance with Section 502.8.4. Mechanical exhaust ventilation shall be provided for highly toxic and toxic liquids used in closed systems in accordance with Section 502.8.5.

Exception: Liquids or solids that do not generate highly toxic or toxic fumes, mists or vapors.

502.9.7 Highly toxic and toxic compressed gases—any quantity. Ventilation exhaust shall be provided for highly toxic and toxic compressed gases in any quantity as required by Sections 502.9.7.1 and 502.9.7.2.
502.9.7.1 Gas cabinets. Gas cabinets containing highly toxic or toxic compressed gases in any quantity shall comply with Section 502.8.2 and the following requirements:

1. The average ventilation velocity at the face of gas cabinet access ports or windows shall be not less than 200 feet per minute (1.02 m/s) with a minimum velocity of 150 feet per minute (0.76 m/s) at any point at the access port or window.
2. Gas cabinets shall be connected to an exhaust system.
3. Gas cabinets shall not be used as the sole means of exhaust for any room or area.

502.9.7.2 Exhausted enclosures. Exhausted enclosures containing highly toxic or toxic compressed gases in any quantity shall comply with Section 502.8.2 and the following requirements:

1. The average ventilation velocity at the face of the enclosure shall be not less than 200 feet per minute (1.02 m/s) with a minimum velocity of 150 feet per minute (0.76 m/s).
2. Exhausted enclosures shall be connected to an exhaust system.
3. Exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

502.9.8 Highly toxic and toxic compressed gases—quantities exceeding the maximum allowable quantity per control area. Ventilation exhaust shall be provided for highly toxic and toxic compressed gases in amounts exceeding the maximum allowable quantities per control area as required by Sections 502.9.8.1 through 502.9.8.6.

502.9.8.1 Ventilated areas. The room or area in which indoor gas cabinets or exhausted enclosures are located shall be provided with exhaust ventilation. Gas cabinets or exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

502.9.8.2 Local exhaust for portable tanks. A means of local exhaust shall be provided to capture leakage from indoor and outdoor portable tanks. The local exhaust shall consist of portable ducts or collection systems designed to be applied to the site of a leak in a valve or fitting on the tank. The local exhaust system shall be located in a gas room. Exhaust shall be directed to a treatment system where required by Section 6004.2.2.7 of the fire code.
502.9.8.3 Piping and controls—stationary tanks. Filling or dispensing connections on indoor stationary tanks shall be provided with a means of local exhaust. Such exhaust shall be designed to capture fumes and vapors. The exhaust shall be directed to a treatment system where required by the fire code.

502.9.8.4 Gas rooms. The ventilation system for gas rooms shall be designed to operate at a negative pressure in relation to the surrounding area. The exhaust ventilation from gas rooms shall be directed to an exhaust system.

502.9.8.5 Treatment system. The exhaust ventilation from gas cabinets, exhausted enclosures and gas rooms, and local exhaust systems required in Sections 502.9.8.2 and 502.9.8.3 shall be directed to a treatment system where required by the fire code.

502.9.8.6 Process equipment. Effluent from indoor and outdoor process equipment containing highly toxic or toxic compressed gases which could be discharged to the atmosphere shall be processed through an exhaust scrubber or other processing system. Such systems shall be in accordance with the fire code.

502.9.9 Ozone gas generators. Ozone cabinets and ozone gas-generator rooms for systems having a maximum ozone-generating capacity of $\frac{1}{2}$ pound (0.23 kg) or more over a 24-hour period shall be mechanically ventilated at a rate of not less than six air changes per hour. For cabinets, the average velocity of ventilation at makeup air openings with cabinet doors closed shall be not less than 200 feet per minute (1.02 m/s).

502.9.10 LP-gas distribution facilities. LP-gas distribution facilities shall be ventilated in accordance with NFPA 58.

502.9.10.1 Portable container use. Above-grade underfloor spaces or basements in which portable LP gas containers are used or are stored awaiting use or resale shall be provided with an approved means of ventilation.

  Exception: Department of Transportation (DOT) specification cylinders with a maximum water capacity of 2.5 pounds (1 kg) for use in completely self-contained hand torches and similar applications. The quantity of LP-gas shall not exceed 20 pounds (9 kg).
502.9.11 Silane gas. Exhausted enclosures and gas cabinets for the indoor storage of silane gas in amounts exceeding the maximum allowable quantities per control area shall comply with Chapter 64 of the fire code.

502.10 Hazardous production materials (HPM). Exhaust ventilation systems and materials for ducts utilized for the exhaust of HPM shall comply with this section, other applicable provisions of this code, the building code and the fire code.

502.10.1 Where required. Exhaust ventilation systems shall be provided in the following locations in accordance with the requirements of this section and the building code.

1. Fabrication areas: Exhaust ventilation for fabrication areas shall comply with the building code. Additional manual control switches shall be provided where required by the code official.
2. Workstations: A ventilation system shall be provided to capture and exhaust gases, fumes and vapors at workstations.
3. Liquid storage rooms: Exhaust ventilation for liquid storage rooms shall comply with Section 502.8.1.1 and the building code.
4. HPM rooms: Exhaust ventilation for HPM rooms shall comply with Section 502.8.1.1 and the building code.
5. Gas cabinets: Exhaust ventilation for gas cabinets shall comply with Section 502.8.2. The gas cabinet ventilation system is allowed to connect to a workstation ventilation system. Exhaust ventilation for gas cabinets containing highly toxic or toxic gases shall also comply with Sections 502.9.7 and 502.9.8.
6. Exhausted enclosures: Exhaust ventilation for exhausted enclosures shall comply with Section 502.8.2. Exhaust ventilation for exhausted enclosures containing highly toxic or toxic gases shall also comply with Sections 502.9.7 and 502.9.8.
7. Gas rooms: Exhaust ventilation for gas rooms shall comply with Section 502.8.2. Exhaust ventilation for gas rooms containing highly toxic or toxic gases shall also comply with Sections 502.9.7 and 502.9.8.
8. Cabinets containing pyrophoric liquids or Class 3 water-reactive liquids: Exhaust ventilation for cabinets in fabrication areas containing pyrophoric liquids shall be as required in Section 2705.2.3.4 of the fire code.

502.10.2 Penetrations. Exhaust ducts penetrating fire barriers constructed in accordance with Section 707 of the building code or horizontal assemblies
constructed in accordance with Section 711 of the building code shall be contained in a shaft of equivalent fire-resistance-rated construction. Exhaust ducts shall not penetrate fire walls. Fire dampers shall not be installed in exhaust ducts.

502.10.3 Treatment systems. Treatment systems for highly toxic and toxic gases shall comply with Section 6004.2.2.7 of the fire code.

502.11 Motion picture projectors. Motion picture projectors shall be exhausted in accordance with Section 502.11.1 or 502.11.2.

502.11.1 Projectors with an exhaust discharge. Projectors equipped with an exhaust discharge shall be directly connected to a mechanical exhaust system. The exhaust system shall operate at an exhaust rate as indicated by the manufacturer’s installation instructions.

502.11.2 Projectors without exhaust connection. Projectors without an exhaust connection shall have contaminants exhausted through a mechanical exhaust system. The exhaust rate for electric arc projectors shall be not less than 200 cubic feet per minute (cfm) (0.09 m³/s) per lamp. The exhaust rate for xenon projectors shall be not less than 300 cfm (0.14 m³/s) per lamp. Xenon projector exhaust shall be at a rate such that the exterior temperature of the lamp housing does not exceed 130°F (54°C). The lamp and projection room exhaust systems, whether combined or independent, shall not be interconnected with any other exhaust or return system within the building.

502.12 Organic coating processes. Enclosed structures involving organic coating processes in which Class I liquids are processed or handled shall be ventilated at a rate of not less than 1 cfm/ft² [0.00508 m³/(s · m²)] of solid floor area. Ventilation shall be accomplished by exhaust fans that intake at floor levels and discharge to a safe location outside the structure. Noncontaminated intake air shall be introduced in such a manner that all portions of solid floor areas are provided with continuous uniformly distributed air movement.

502.13 Public garages. Mechanical exhaust systems for public garages, as required in Chapter 4, shall operate continuously or in accordance with Section 404.

502.14 Motor vehicle operation. In areas where motor vehicles operate, mechanical ventilation shall be provided in accordance with Section 403. Additionally, areas in which stationary motor vehicles are operated shall be
provided with a source capture system that connects directly to the motor vehicle exhaust systems. Such system shall be engineered by a registered design professional or shall be factory-built equipment designed and sized for the purpose.

**Exceptions:**
1. This section shall not apply where the motor vehicles being operated or repaired are electrically powered.
2. *Deleted.*
3. This section shall not apply to motor vehicle service areas where engines are operated inside the building only for the duration necessary to move the motor vehicles in and out of the building.

**502.15 Repair garages.** Where Class I liquids or LP-gas are stored or used within a building having a basement or pit wherein flammable vapors could accumulate, the basement or pit shall be provided with ventilation designed to prevent the accumulation of flammable vapors therein.

**502.16 Repair garages for natural gas- and hydrogen-fueled vehicles.** Repair garages used for the repair of natural gas- or hydrogen-fueled vehicles shall be provided with an approved mechanical ventilation system. The mechanical ventilation system shall be in accordance with Sections 502.16.1 and 502.16.2.

**Exception:** Where approved by the code official, natural ventilation shall be permitted in lieu of mechanical ventilation.

**502.16.1 Design.** Indoor locations shall be ventilated utilizing air supply inlets and exhaust outlets arranged to provide uniform air movement to the extent practical. Inlets shall be uniformly arranged on exterior walls near floor level. Outlets shall be located at the high point of the room in exterior walls or the roof.

Ventilation shall be by a continuous mechanical ventilation system or by a mechanical ventilation system activated by a continuously monitoring natural gas detection system, or for hydrogen, a continuously monitoring flammable gas detection system, each activating at a gas concentration of 25 percent of the lower flammable limit (LFL). In all cases, the system shall shut down the fueling system in the event of failure of the ventilation system. The ventilation rate shall be not less than 1 cubic foot per minute per 12 cubic feet \(0.00138 \text{ m}^3/(s \cdot \text{m}^3)\) of room volume.

**502.16.2 Operation.** The mechanical ventilation system shall operate continuously.

**Exceptions:**
1. Mechanical ventilation systems that are interlocked with a gas detection system designed in accordance with the fire code.
2. Mechanical ventilation systems in garages that are used only for the repair of vehicles fueled by liquid fuels or odorized gases, such as CNG, where the ventilation system is electrically interlocked with the lighting circuit.

502.17 Tire rebuilding or recapping. Each room where rubber cement is used or mixed, or where flammable or combustible solvents are applied, shall be ventilated in accordance with the applicable provisions of NFPA 91.

502.17.1 Buffing machines. Each buffing machine shall be connected to a dust-collecting system that prevents the accumulation of the dust produced by the buffing process.

502.18 Specific rooms. Specific rooms, including bathrooms, locker rooms, smoking lounges and toilet rooms, shall be exhausted in accordance with the ventilation requirements of Chapter 4.

502.19 Indoor firing ranges. Ventilation shall be provided in an approved manner in areas utilized as indoor firing ranges. Ventilation shall be designed to protect employees and the public in accordance with DOL 29 CFR 1910.1025 where applicable.

502.20 Manicure and pedicure stations. Manicure and pedicure stations shall be provided with an exhaust system in accordance with Table 403.3.1.1, Note h. Manicure tables and pedicure stations not provided with factory-installed exhaust inlets shall be provided with exhaust inlets located not more than 12 inches (305 mm) horizontally and vertically from the point of chemical application.

SECTION 503
MOTORS AND FANS

503.1 General. Motors and fans shall be sized to provide the required air movement. Motors in areas that contain flammable vapors or dusts shall be of a type approved for such environments. A manually operated remote control installed at an approved location shall be provided to shut off fans or blowers in flammable vapor or dust systems. Electrical equipment and appliances used in operations that generate explosive or flammable vapors, fumes or dusts shall be interlocked with the ventilation system so that the equipment and appliances cannot be operated unless the ventilation fans are in operation. Motors for fans
used to convey flammable vapors or dusts shall be located outside the duct or shall be protected with approved shields and dustproofing. Motors and fans shall be provided with a means of access for servicing and maintenance.

503.2 Fans. Parts of fans in contact with explosive or flammable vapors, fumes or dusts shall be of nonferrous or nonsparking materials, or their casing shall be lined or constructed of such material. Where the size and hardness of materials passing through a fan are capable of producing a spark, both the fan and the casing shall be of nonsparking materials. Where fans are required to be spark resistant, their bearings shall not be within the airstream, and all parts of the fan shall be grounded. Fans in systems-handling materials that are capable of clogging the blades, and fans in buffing or woodworking exhaust systems, shall be of the radial-blade or tube-axial type.

503.3 Equipment and appliance identification plate. Equipment and appliances used to exhaust explosive or flammable vapors, fumes or dusts shall bear an identification plate stating the ventilation rate for which the system was designed.

503.4 Corrosion-resistant fans. Fans located in systems conveying corrosives shall be of materials that are resistant to the corrosive or shall be coated with corrosion-resistant materials.

SECTION 504
CLOTHES DRYER EXHAUST

504.1 Installation. Clothes dryers shall be exhausted in accordance with the manufacturer’s instructions. Dryer exhaust systems shall be independent of all other systems and shall convey the moisture and any products of combustion to the outside of the building.

   Exception: This section shall not apply to listed and labeled condensing (ductless) clothes dryers.

504.2 Exhaust penetrations. Where a clothes dryer exhaust duct penetrates a wall or ceiling membrane, the annular space shall be sealed with noncombustible material, approved fire caulking or a noncombustible dryer exhaust duct wall receptacle. Ducts that exhaust clothes dryers shall not penetrate or be located within any fireblocking, draftstopping, or any wall, floor/ceiling or other assembly required by the building code to be fire-resistance rated, unless such duct is constructed of galvanized steel or aluminum of the thickness specified in Section 603.4 and the fire-resistance rating is maintained in accordance with the
building code. Fire dampers, combination fire/smoke dampers and any similar devices that will obstruct the exhaust flow shall be prohibited in clothes dryer exhaust ducts.

504.3 Cleanout. Each vertical riser shall be provided with a means for cleanout.

504.4 Exhaust installation. Dryer exhaust ducts for clothes dryers shall terminate on the outside of the building and shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums.

504.5 Dryer exhaust duct power ventilators. Domestic dryer exhaust duct power ventilators shall be listed and labeled to UL 705 for use in dryer exhaust duct systems. The dryer exhaust duct power ventilator shall be installed in accordance with the manufacturer’s instructions.

504.6 Makeup air. Installations exhausting more than 200 cfm (0.09 m³/s) shall be provided with makeup air. Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches (0.0645 m²) shall be provided in the closet enclosure or makeup air shall be provided by other approved means.

504.7 Protection required. Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct. Shield plates shall be placed on the finished face of all framing members where there is less than 1 1/4 inches (32 mm) between the duct and the finished face of the framing member. Protective shield plates shall be constructed of steel, have a thickness of 0.062 inch (1.6 mm) and extend not less than 2 inches (51 mm) above sole plates and below top plates.

504.8 Domestic clothes dryer ducts. Exhaust ducts for domestic clothes dryers shall conform to the requirements of Sections 504.8.1 through 504.8.6.

504.8.1 Material and size. Exhaust ducts shall have a smooth interior finish and shall be constructed of metal a minimum 0.016 inch (0.4 mm) thick. The exhaust duct size shall be 4 inches (102 mm) nominal in diameter.

504.8.2 Duct installation. Exhaust ducts shall be supported at 4-foot (1219
mm) intervals and secured in place. The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow. Ducts shall not be joined with screws or similar fasteners that protrude more than $\frac{1}{8}$ inch (3.2 mm) into the inside of the duct.

**504.8.3 Transition ducts.** Transition ducts used to connect the dryer to the exhaust duct system shall be a single length that is listed and labeled in accordance with UL 2158A. Transition ducts shall be not greater than 8 feet (2438 mm) in length and shall not be concealed within construction.

**504.8.4 Duct length.** The maximum allowable exhaust duct length shall be determined by one of the methods specified in Sections 504.8.4.1 through 504.8.4.3.

**504.8.4.1 Specified length.** The maximum length of the exhaust duct shall be 35 feet (10 668 mm) from the connection to the transition duct from the dryer to the outlet terminal. Where fittings are used, the maximum length of the exhaust duct shall be reduced in accordance with Table 504.8.4.1.

**TABLE 504.8.4.1**

<table>
<thead>
<tr>
<th>DRYER EXHAUST DUCT FITTING TYPE</th>
<th>EQUIVALENT LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; radius mitered 45-degree elbow</td>
<td>2 feet 6 inches</td>
</tr>
<tr>
<td>4&quot; radius mitered 90-degree elbow</td>
<td>5 feet</td>
</tr>
<tr>
<td>6&quot; radius smooth 45-degree elbow</td>
<td>1 foot</td>
</tr>
<tr>
<td>6&quot; radius smooth 90-degree elbow</td>
<td>1 foot 9 inches</td>
</tr>
<tr>
<td>8&quot; radius smooth 45-degree elbow</td>
<td>1 foot</td>
</tr>
<tr>
<td>8&quot; radius smooth 90-degree elbow</td>
<td>1 foot 7 inches</td>
</tr>
<tr>
<td>10&quot; radius smooth 45-degree elbow</td>
<td>9 inches</td>
</tr>
<tr>
<td>10&quot; radius smooth 90-degree elbow</td>
<td>1 foot 6 inches</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad.

**504.8.4.2 Manufacturer’s instructions.** The maximum length of the exhaust duct shall be determined by the dryer manufacturer’s installation instructions. The code official shall be provided with a copy of the installation instructions for the make and model of the dryer. Where the exhaust duct is to be concealed, the installation instructions shall be provided to the code official prior to the concealment inspection. In the absence of fitting equivalent length calculations from the clothes dryer manufacturer, Table 504.8.4.1 shall be used.
504.8.4.3 **Dryer exhaust duct power ventilator length.** The maximum length of the exhaust duct shall be determined by the dryer exhaust duct power ventilator manufacturer’s installation instructions.

504.8.5 **Length identification.** Where the exhaust duct equivalent length exceeds 35 feet (10 668 mm), the equivalent length of the exhaust duct shall be identified on a permanent label or tag. The label or tag shall be located within 6 feet (1829 mm) of the exhaust duct connection.

504.8.6 **Exhaust duct required.** Where space for a clothes dryer is provided, an exhaust duct system shall be installed. Where the clothes dryer is not installed at the time of occupancy, the exhaust duct shall be capped at the location of the future dryer.

**Exception:** Where a listed condensing clothes dryer is installed prior to occupancy of structure.

504.9 **Commercial clothes dryers.** The installation of dryer exhaust ducts serving commercial clothes dryers shall comply with the appliance manufacturer’s installation instructions. Exhaust fan motors installed in exhaust systems shall be located outside of the airstream. In multiple installations, the fan shall operate continuously or be interlocked to operate when any individual unit is operating. Ducts shall have a minimum clearance of 6 inches (152 mm) to combustible materials. Clothes dryer transition ducts used to connect the appliance to the exhaust duct system shall be limited to single lengths not to exceed 8 feet (2438 mm) in length and shall be listed and labeled for the application. Transition ducts shall not be concealed within construction.

504.10 **Common exhaust systems for clothes dryers located in multistory structures.** Where a common multistory duct system is designed and installed to convey exhaust from multiple clothes dryers, the construction of the system shall be in accordance with all of the following:

1. The shaft in which the duct is installed shall be constructed and fire-resistant rated as required by the building code.
2. Dampers shall be prohibited in the exhaust duct. Penetrations of the shaft and ductwork shall be protected in accordance with Section 607.5.5, Exception 2.
3. Rigid metal ductwork shall be installed within the shaft to convey the exhaust. The ductwork shall be constructed of sheet steel having a minimum thickness of 0.0187 inch (0.4712 mm) (No. 26 gage) and in accordance with SMACNA Duct Construction Standards.
4. The ductwork within the shaft shall be designed and installed without offsets.
5. The exhaust fan motor design shall be in accordance with Section 503.2.
6. The exhaust fan motor shall be located outside of the airstream.
7. The exhaust fan shall run continuously, and shall be connected to a standby power source.
8. Exhaust fan operation shall be monitored in an approved location and shall initiate an audible or visual signal when the fan is not in operation.
9. Makeup air shall be provided for the exhaust system.
10. A cleanout opening shall be located at the base of the shaft to provide access to the duct to allow for cleaning and inspection. The finished opening shall be not less than 12 inches by 12 inches (305 mm by 305 mm).
11. Screens shall not be installed at the termination.
12. The common multistory duct system shall serve only clothes dryers and shall be independent of other exhaust systems.

SECTION 505
DOMESTIC KITCHEN EXHAUST EQUIPMENT

505.1 Domestic systems. Where domestic cooking appliances are installed within buildings regulated by this code and the appliances are utilized for domestic purposes, such appliances shall be provided with domestic range hoods.

Where domestic range hoods and domestic cooking appliances equipped with downdraft exhaust are provided, such hoods and appliances shall discharge to the outdoors through sheet metal ducts constructed of galvanized steel, stainless steel, aluminum or copper. Such ducts shall have smooth inner walls, shall be air tight, shall be equipped with a backdraft damper, and shall be independent of all other exhaust systems.

Exceptions:
1. In Group R dwelling units provided with domestic cooking appliances utilized for domestic purposes, domestic range hoods are optional.
2. In other than Group I-1 and I-2, where installed in accordance with the manufacturer’s instructions and where mechanical or natural ventilation is otherwise provided in accordance with Chapter 4, listed and labeled ductless range hoods shall not be required to discharge to the outdoors.
3. Ducts for domestic cooking appliances equipped with downdraft exhaust systems shall be permitted to be constructed of Schedule 40 PVC pipe and fittings provided that the installation complies with all of the following: 3.1. The duct shall be installed under a concrete slab poured on grade.
3.2. The underfloor trench in which the duct is installed shall be completely backfilled with sand or gravel.
3.3. The PVC duct shall extend not more than 1 inch (25 mm) above the indoor concrete floor surface.
3.4. The PVC duct shall extend not more than 1 inch (25 mm) above grade outside of the building.
3.5. The PVC ducts shall be solvent cemented.

505.2 Makeup air required. Exhaust hood systems capable of exhausting in excess of 400 cfm (0.19 m³/s) shall be provided with makeup air at a rate approximately equal to the exhaust air rate. Such makeup air systems shall be equipped with a means of closure and shall be automatically controlled to start and operate simultaneously with the exhaust system.

505.3 Common exhaust systems for domestic kitchens located in multistory structures. Where a common multistory duct system is designed and installed to convey exhaust from multiple domestic kitchen exhaust systems, the construction of the system shall be in accordance with all of the following:

1. The shaft in which the duct is installed shall be constructed and fire-resistance rated as required by the building code.
2. Dampers shall be prohibited in the exhaust duct, except as specified in Section 505.1. Penetrations of the shaft and ductwork shall be protected in accordance with Section 607.5.5, Exception 2.
3. Rigid metal ductwork shall be installed within the shaft to convey the exhaust. The ductwork shall be constructed of sheet steel having a minimum thickness of 0.0187 inch (0.4712 mm) (No. 26 gage) and in accordance with SMACNA Duct Construction Standards.
4. The ductwork within the shaft shall be designed and installed without offsets.
5. The exhaust fan motor design shall be in accordance with Section 503.2.
6. The exhaust fan motor shall be located outside of the airstream.
7. The exhaust fan shall run continuously, and shall be connected to a standby power source.
8. Exhaust fan operation shall be monitored in an approved location and shall initiate an audible or visual signal when the fan is not in operation.
9. Where the exhaust rate for an individual kitchen exceeds 400 cfm (0.19 m³/s) makeup air shall be provided in accordance with Section 505.2.
10. A cleanout opening shall be located at the base of the shaft to provide access to the duct to allow for cleanout and inspection. The finished openings shall be not less than 12 inches by 12 inches (305 mm by 305 mm).
11. Screens shall not be installed at the termination.
12. The common multistory duct system shall serve only kitchen exhaust and shall be independent of other exhaust systems.

505.4 Other than Group R. Deleted.

505.5 Group I-2. Where domestic cooking appliances are installed within Group I-2 nursing homes, rooms or spaces and the appliances are utilized for domestic purposes, such appliances shall be provided with domestic range hoods in accordance with this section and Section 407.2.6 of the building code.

SECTION 506
COMMERCIAL KITCHEN HOOD VENTILATION SYSTEM DUCTS AND EXHAUST EQUIPMENT

506.1 General. Commercial kitchen hood ventilation ducts and exhaust equipment shall comply with the requirements of this section. Commercial kitchen grease ducts shall be designed for the type of cooking appliance and hood served.

506.2 Corrosion protection. Ducts exposed to the outside atmosphere or subject to a corrosive environment shall be protected against corrosion in an approved manner.

506.3 Ducts serving Type I hoods. Type I exhaust ducts shall be independent of all other exhaust systems except as provided in Section 506.3.5. Commercial kitchen duct systems serving Type I hoods shall be designed, constructed and installed in accordance with Sections 506.3.1 through 506.3.13.3.

506.3.1 Duct materials. Ducts serving Type I hoods shall be constructed of materials in accordance with Sections 506.3.1.1 and 506.3.1.2.

506.3.1.1 Grease duct materials. Grease ducts serving Type I hoods shall be constructed of steel having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) or stainless steel not less than 0.0450 inch (1.14 mm) (No. 18 gage) in thickness.

   Exception: Factory-built commercial kitchen grease ducts listed and labeled in accordance with UL 1978 and installed in accordance with Section 304.1.

506.3.1.2 Makeup air ducts. Makeup air ducts connecting to or within 18
inches (457 mm) of a Type I hood shall be constructed and installed in accordance with Sections 603.1, 603.3, 603.4, 603.9, 603.10 and 603.12. Duct insulation installed within 18 inches (457 mm) of a Type I hood shall be noncombustible or shall be listed for the application.

506.3.2 Joints, seams and penetrations of grease ducts. Joints, seams and penetrations of grease ducts shall be made with a continuous liquid-tight weld or braze made on the external surface of the duct system.

Exceptions:
1. Penetrations shall not be required to be welded or brazed where sealed by devices that are listed for the application.
2. Internal welding or brazing shall not be prohibited provided that the joint is formed or ground smooth and is provided with ready access for inspection.
3. Factory-built commercial kitchen grease ducts listed and labeled in accordance with UL 1978 and installed in accordance with Section 304.1.

506.3.2.1 Duct joint types. Duct joints shall be butt joints, welded flange joints with a maximum flange depth of \(\frac{1}{2}\) inch (12.7 mm) or overlapping duct joints of either the telescoping or bell type. Overlapping joints shall be installed to prevent ledges and obstructions from collecting grease or interfering with gravity drainage to the intended collection point. The difference between the inside cross-sectional dimensions of overlapping sections of duct shall not exceed \(\frac{1}{4}\) inch (6.4 mm). The length of overlap for overlapping duct joints shall not exceed 2 inches (51 mm).

506.3.2.2 Duct-to-hood joints. Duct-to-hood joints shall be made with continuous internal or external liquid-tight welded or brazed joints. Such joints shall be smooth, accessible for inspection, and without grease traps.

Exceptions: This section shall not apply to:
1. A vertical duct-to-hood collar connection made in the top plane of the hood in accordance with all of the following:
   1.1. The hood duct opening shall have a 1-inch-deep (25 mm), full perimeter, welded flange turned down into the hood interior at an angle of 90 degrees (1.57 rad) from the plane of the opening.
   1.2. The duct shall have a 1-inch-deep (25 mm) flange made by a 1-inch by 1-inch (25 mm by 25 mm) angle iron welded to the full perimeter of the duct not less than 1 inch (25 mm) above the bottom end of the duct.
1.3. A gasket rated for use at not less than 1500ºF (816ºC) is installed between the duct flange and the top of the hood.
1.4. The duct-to-hood joint shall be secured by stud bolts not less than 1/4 inch (6.4 mm) in diameter welded to the hood with a spacing not greater than 4 inches (102 mm) on center for the full perimeter of the opening. The bolts and nuts shall be secured with lockwashers.

2. Listed and labeled duct-to-hood collar connections installed in accordance with Section 304.1.

506.3.2.3 Duct-to-exhaust fan connections. Duct-to-exhaust fan connections shall be flanged and gasketed at the base of the fan for vertical discharge fans; shall be flanged, gasketed and bolted to the inlet of the fan for side-inlet utility fans; and shall be flanged, gasketed and bolted to the inlet and outlet of the fan for in-line fans. Gasket and sealing materials shall be rated for continuous duty at a temperature of not less than 1500ºF (816ºC).

506.3.2.4 Vibration isolation. A vibration isolation connector for connecting a duct to a fan shall consist of noncombustible packing in a metal sleeve joint of approved design or shall be a coated-fabric flexible duct connector listed and labeled for the application. Vibration isolation connectors shall be installed only at the connection of a duct to a fan inlet or outlet.

506.3.2.5 Grease duct test. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed. Ducts shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary equipment and perform the grease duct leakage test. A light test shall be performed to determine that all welded and brazed joints are liquid tight. A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls. A test shall be performed for the entire duct system, including the hood-to-duct connection. The duct work shall be permitted to be tested in sections, provided that every joint is tested. For listed factory-built grease ducts, this test shall be limited to duct joints assembled in the field and shall exclude factory welds.
506.3.3 Grease duct supports. Grease duct bracing and supports shall be of noncombustible material securely attached to the structure and designed to carry gravity and seismic loads within the stress limitations of the building code. Bolts, screws, rivets and other mechanical fasteners shall not penetrate duct walls.

506.3.4 Air velocity. Grease duct systems serving a Type I hood shall be designed and installed to provide an air velocity within the duct system of not less than 500 feet per minute (2.5 m/s).

Exception: The velocity limitations shall not apply within duct transitions utilized to connect ducts to differently sized or shaped openings in hoods and fans, provided that such transitions do not exceed 3 feet (914 mm) in length and are designed to prevent the trapping of grease.

506.3.5 Separation of grease duct system. A separate grease duct system shall be provided for each Type I hood. A separate grease duct system is not required where all of the following conditions are met:

1. All interconnected hoods are located within the same story.
2. All interconnected hoods are located within the same room or in adjoining rooms.
3. Interconnecting ducts do not penetrate assemblies required to be fire-resistance rated.
4. The grease duct system does not serve solid-fuel fired appliances.

506.3.6 Grease duct clearances. Where enclosures are not required, grease duct systems and exhaust equipment serving a Type I hood shall have a clearance to combustible construction of not less than 18 inches (457 mm), and shall have a clearance to noncombustible construction and gypsum wallboard attached to noncombustible structures of not less than 3 inches (76 mm).

Exceptions:
1. Factory-built commercial kitchen grease ducts listed and labeled in accordance with UL 1978.
2. Listed and labeled exhaust equipment installed in accordance with Section 304.1.
3. Where commercial kitchen grease ducts are continuously covered on all sides with a listed and labeled field-applied grease duct enclosure material, system, product or method of construction specifically evaluated for such purpose in accordance with ASTM E 2336, the
required clearance shall be in accordance with the listing of such material, system, product or method.

506.3.7 Prevention of grease accumulation in grease ducts. Duct systems serving a Type I hood shall be constructed and installed so that grease cannot collect in any portion thereof, and the system shall slope not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) toward the hood or toward a grease reservoir designed and installed in accordance with Section 506.3.7.1. Where horizontal ducts exceed 75 feet (22 860 mm) in length, the slope shall be not less than one unit vertical in 12 units horizontal (8.3-percent slope).

506.3.7.1 Grease duct reservoirs. Grease duct reservoirs shall:
1. Be constructed as required for the grease duct they serve.
2. Be located on the bottom of the horizontal duct or the bottommost section of the duct riser.
3. Extend across the full width of the duct and have a length of not less than 12 inches (305 mm).
4. Have a depth of not less than 1 inch (25 mm).
5. Have a bottom that slopes to a drain.
6. Be provided with a cleanout opening constructed in accordance with Section 506.3.8 and installed to provide direct access to the reservoir. The cleanout opening shall be located on a side or on top of the duct so as to permit cleaning of the reservoir.
7. Be installed in accordance with the manufacturer’s instructions where manufactured devices are utilized.

506.3.8 Grease duct cleanouts and openings. Grease duct cleanouts and openings shall comply with all of the following:
1. Grease ducts shall not have openings except where required for the operation and maintenance of the system.
2. Sections of grease ducts that are inaccessible from the hood or discharge openings shall be provided with cleanout openings spaced not more than 20 feet (6096 mm) apart and not more than 10 feet (3048 mm) from changes in direction greater than 45 degrees (0.79 rad).
3. Cleanouts and openings shall be equipped with tight-fitting doors constructed of steel having a thickness not less than that required for the duct.
4. Cleanout doors shall be installed liquid tight.
5. Door assemblies including any frames and gaskets shall be approved for the application and shall not have fasteners that penetrate the duct.
6. Gasket and sealing materials shall be rated for not less than 1500°F (816°C).
7. Listed door assemblies shall be installed in accordance with the manufacturer’s instructions.

506.3.8.1 Personnel entry. Where ductwork is large enough to allow entry of personnel, not less than one approved or listed opening having dimensions not less than 22 inches by 20 inches (559 mm by 508 mm) shall be provided in the horizontal sections, and in the top of vertical risers. Where such entry is provided, the duct and its supports shall be capable of supporting the additional load, and the cleanouts specified in Section 506.3.8 are not required.

506.3.8.2 Cleanouts serving in-line fans. A cleanout shall be provided for both the inlet side and outlet side of an in-line fan except where a duct does not connect to the fan. Such cleanouts shall be located within 3 feet (914 mm) of the fan duct connections.

506.3.9 Grease duct horizontal cleanouts. Cleanouts serving horizontal sections of grease ducts shall:
1. Be spaced not more than 20 feet (6096 mm) apart.
2. Be located not more than 10 feet (3048 mm) from changes in direction that are greater than 45 degrees (0.79 rad).
3. Be located on the bottom only where other locations are not available and shall be provided with internal damming of the opening such that grease will flow past the opening without pooling. Bottom cleanouts and openings shall be approved for the application and installed liquid-tight.
4. Not be closer than 1 inch (25 mm) from the edges of the duct.
5. Have opening dimensions of not less than 12 inches by 12 inches (305 mm by 305 mm). Where such dimensions preclude installation, the opening shall be not less than 12 inches (305 mm) on one side and shall be large enough to provide access for cleaning and maintenance.
6. Shall be located at grease reservoirs.

506.3.10 Underground grease duct installation. Underground grease duct installations shall comply with all of the following:
1. Underground grease ducts shall be constructed of steel having a minimum thickness of 0.0575 inch (1.463 mm) (No. 16 gage) and shall
be coated to provide protection from corrosion or shall be constructed of stainless steel having a minimum thickness of 0.0450 inch (1.140 mm) (No. 18 gage).

2. The underground duct system shall be tested and approved in accordance with Section 506.3.2.5 prior to coating or placement in the ground.

3. The underground duct system shall be completely encased in concrete with a minimum thickness of 4 inches (102 mm).

4. Ducts shall slope toward grease reservoirs.

5. A grease reservoir with a cleanout to allow cleaning of the reservoir shall be provided at the base of each vertical duct riser.

6. Cleanouts shall be provided with access to permit cleaning and inspection of the duct in accordance with Section 506.3.

7. Cleanouts in horizontal ducts shall be installed on the topside of the duct.

8. Cleanout locations shall be legibly identified at the point of access from the interior space.

506.3.11 Grease duct enclosures. A commercial kitchen grease duct serving a Type I hood that penetrates a ceiling, wall, floor or any concealed space shall be enclosed from the point of penetration to the outlet terminal. In-line exhaust fans not located outdoors shall be enclosed as required for grease ducts. A duct shall penetrate exterior walls only at locations where unprotected openings are permitted by the building code. The duct enclosure shall serve a single grease duct and shall not contain other ducts, piping or wiring systems. Duct enclosures shall be a shaft enclosure in accordance with Section 506.3.11.1, a field-applied enclosure assembly in accordance with Section 506.3.11.2 or a factory-built enclosure assembly in accordance with Section 506.3.11.3. Duct enclosures shall have a fire-resistance rating of not less than that of the assembly penetrated and not less than 1 hour. Fire dampers and smoke dampers shall not be installed in grease ducts.

Exception: A duct enclosure shall not be required for a grease duct that penetrates only a nonfire-resistance-rated roof/ceiling assembly.

506.3.11.1 Shaft enclosure. Grease ducts constructed in accordance with Section 506.3.1 shall be permitted to be enclosed in accordance with the building code requirements for shaft construction. Such grease duct systems and exhaust equipment shall have a clearance to combustible construction of not less than 18 inches (457 mm), and shall have a clearance to noncombustible construction and gypsum wallboard attached to noncombustible structures of not less than 6 inches (76 mm). Duct
enclosures shall be sealed around the duct at the point of penetration and vented to the outside of the building through the use of weather protected openings.

506.3.11.2 Field-applied grease duct enclosure. Grease ducts constructed in accordance with Section 506.3.1 shall be enclosed by a listed and labeled field applied grease duct enclosure material, systems, product, or method of construction specifically evaluated for such purpose in accordance with ASTM E 2336. The surface of the duct shall be continuously covered on all sides from the point at which the duct originates to the outlet terminal. Duct penetrations shall be protected with a through-penetration firestop system tested and listed in accordance with ASTM E 814 or UL 1479 and having a “F” and “T” rating equal to the fire-resistance rating of the assembly being penetrated. The grease duct enclosure and firestop system shall be installed in accordance with the listing and the manufacturer’s instructions. Partial application of a field applied grease duct enclosure shall not be installed for the sole purpose of reducing clearances to combustibles at isolated sections of grease duct. Exposed duct-wrap systems shall be protected where subject to physical damage.

506.3.11.3 Factory-built grease duct enclosure assemblies. Factory-built grease ducts incorporating integral enclosure materials shall be listed and labeled for use as grease duct enclosure assemblies specifically evaluated for such purpose in accordance with UL 2221. Duct penetrations shall be protected with a through-penetration firestop system tested and listed in accordance with ASTM E 814 or UL 1479 and having an “F” and “T” rating equal to the fire-resistance rating of the assembly being penetrated. The grease duct enclosure assembly and firestop system shall be installed in accordance with the listing and the manufacturer’s instructions.

506.3.12 Grease duct fire-resistive access opening. Where cleanout openings are located in ducts within a fire-resistance-rated enclosure, access openings shall be provided in the enclosure at each cleanout point. Access openings shall be equipped with tight-fitting sliding or hinged doors that are equal in fire-resistive protection to that of the shaft or enclosure. An approved sign shall be placed on access opening panels with wording as follows: “ACCESS PANEL. DO NOT OBSTRUCT.”

506.3.13 Exhaust outlets serving Type I hoods. Exhaust outlets for grease
ducts serving Type I hoods shall conform to the requirements of Sections 506.3.13.1 through 506.3.13.3.

506.3.13.1 Termination above the roof. Exhaust outlets that terminate above the roof shall have the discharge opening located not less than 40 inches (1016 mm) above the roof surface.

506.3.13.2 Termination through an exterior wall. Exhaust outlets shall be permitted to terminate through exterior walls where the smoke, grease, gases, vapors and odors in the discharge from such terminations do not create a public nuisance or a fire hazard. Such terminations shall not be located where protected openings are required by the building code. Other exterior openings shall not be located within 3 feet (914 mm) of such terminations.

506.3.13.3 Termination location. Exhaust outlets shall be located not less than 10 feet (3048 mm) horizontally from parts of the same or contiguous buildings, adjacent buildings and adjacent property lines and shall be located not less than 10 feet (3048 mm) above the adjoining grade level. Exhaust outlets shall be located not less than 10 feet (3048 mm) horizontally from or not less than 3 feet (914 mm) above air intake openings into any building.

Exception: Exhaust outlets shall terminate not less than 5 feet (1524 mm) horizontally from parts of the same or contiguous building, an adjacent building, adjacent property line and air intake openings into a building where air from the exhaust outlet discharges away from such locations.

506.4 Ducts serving Type II hoods. Commercial kitchen exhaust systems serving Type II hoods shall comply with Sections 506.4.1 and 506.4.2.

506.4.1 Ducts. Ducts and plenums serving Type II hoods shall be constructed of rigid metallic materials. Duct construction, installation, bracing and supports shall comply with Chapter 6. Ducts subject to positive pressure and ducts conveying moisture-laden or waste-heat-laden air shall be constructed, joined and sealed in an approved manner.

506.4.2 Type II terminations. Exhaust outlets serving Type II hoods shall terminate in accordance with the hood manufacturer’s installation instructions and shall comply with all of the following:
1. Exhaust outlets shall terminate not less than 3 feet (914 mm) in any direction from openings into the building.
2. Outlets shall terminate not less than 10 feet (3048 mm) from property lines or buildings on the same lot.
3. Outlets shall terminate not less than 10 feet (3048 mm) above grade.
4. Outlets that terminate above a roof shall terminate not less than 30 inches (762 mm) above the roof surface.
5. Outlets shall terminate not less than 30 inches (762 mm) from exterior vertical walls.
6. Outlets shall be protected against local weather conditions.
7. Outlets shall not be directed onto walkways.
8. Outlets shall meet the provisions for exterior wall opening protective in accordance with the building code.

506.5 Exhaust equipment. Exhaust equipment, including fans and grease reservoirs, shall comply with Sections 506.5.1 through 506.5.5 and shall be of an approved design or shall be listed for the application.

506.5.1 Exhaust fans. Exhaust fan housings serving a Type I hood shall be constructed as required for grease ducts in accordance with Section 506.3.1.1. Exception: Fans listed and labeled in accordance with UL 762.

506.5.1.1 Fan motor. Exhaust fan motors shall be located outside of the exhaust airstream.

506.5.1.2 In-line fan location. Where enclosed duct systems are connected to in-line fans not located outdoors, the fan shall be located in a room or space having the same fire-resistance rating as the duct enclosure. Access shall be provided for servicing and cleaning of fan components. Such rooms or spaces shall be ventilated in accordance with the fan manufacturer’s installation instructions.

506.5.2 Exhaust fan discharge. Exhaust fans shall be positioned so that the discharge will not impinge on the roof, other equipment or appliances or parts of the structure. A vertical discharge fan shall be manufactured with an approved drain outlet at the lowest point of the housing to permit drainage of grease to an approved grease reservoir.

506.5.3 Exhaust fan mounting. Up-blast fans serving Type I hoods and installed in a vertical or horizontal position shall be hinged, supplied with a flexible weatherproof electrical cable to permit inspection and cleaning and
shall be equipped with a means of restraint to limit the swing of the fan on its hinge. The ductwork shall extend not less than 18 inches (457 mm) above the roof surface.

506.5.4 Clearances. Exhaust equipment serving a Type I hood shall have a clearance to combustible construction of not less than 18 inches (457 mm). Exception: Factory-built exhaust equipment installed in accordance with Section 304.1 and listed for a lesser clearance.

506.5.5 Termination location. The outlet of exhaust equipment serving Type I hoods shall be in accordance with Section 506.3.13. Exception: The minimum horizontal distance between vertical discharge fans and parapet-type building structures shall be 2 feet (610 mm) provided that such structures are not higher than the top of the fan discharge opening.

SECTION 507 COMMERCIAL KITCHEN EXHAUST HOODS

507.1 General. Commercial kitchen exhaust hoods shall comply with the requirements of this section. Hoods shall be Type I or II and shall be designed to capture and confine cooking vapors and residues. A Type I or Type II hood shall be installed at or above all commercial cooking appliances in accordance with Sections 507.2 and 507.3. Where any cooking appliance under a single hood requires a Type I hood, a Type I hood shall be installed. Where a Type II hood is required, a Type I or Type II hood shall be installed. Where a Type I hood is installed, the installation of the entire system, including the hood, ducts, exhaust equipment and makeup air system shall comply with the requirements of Sections 506, 507, 508 and 509.

Exceptions:
1. Factory-built commercial exhaust hoods that are listed and labeled in accordance with UL 710, and installed in accordance with Section 304.1, shall not be required to comply with Sections 507.1.5, 507.2.3, 507.2.5, 507.2.8, 507.3.1, 507.3.3, 507.4 and 507.5.
2. Factory-built commercial cooking recirculating systems that are listed and labeled in accordance with UL 710B, and installed in accordance with Section 304.1, shall not be required to comply with Sections 507.1.5, 507.2.3, 507.2.5, 507.2.8, 507.3.1, 507.3.3, 507.4 and 507.5. Spaces in which such systems are located shall be considered to be kitchens and shall be ventilated in accordance with Table 403.3.1.1. For the purpose of determining the floor area required to be ventilated, each individual
appliance shall be considered as occupying not less than 100 square feet (9.3 m²).

3. Where cooking appliances are equipped with integral down-draft exhaust systems and such appliances and exhaust systems are listed and labeled for the application in accordance with NFPA 96, a hood shall not be required at or above them.

507.1.1 Operation. Commercial kitchen exhaust hood systems shall operate during the cooking operation. The hood exhaust rate shall comply with the listing of the hood or shall comply with Section 507.5. The exhaust fan serving a Type I hood shall have automatic controls that will activate the fan when any appliance that requires such Type I Hood is turned on, or a means of interlock shall be provided that will prevent operation of such appliances when the exhaust fan is not turned on. Where one or more temperature or radiant energy sensors are used to activate a Type I hood exhaust fan, the fan shall activate not more than 15 minutes after the first appliance served by that hood has been turned on. A method of interlock between an exhaust hood system and appliances equipped with standing pilot burners shall not cause the pilot burners to be extinguished. A method of interlock between an exhaust hood system and cooking appliances shall not involve or depend upon any component of a fire-extinguishing system.

The net exhaust volumes for hoods shall be permitted to be reduced during part-load cooking conditions, where engineered or listed multispeed or variable speed controls automatically operate the exhaust system to maintain capture and removal of cooking effluents as required by this section. Reduced volumes shall not be below that required to maintain capture and removal of effluents from the idle cooking appliances that are operating in a standby mode.

507.1.1.1 Multiple hoods utilizing a single exhaust system. Where heat or radiant energy sensors are utilized in hood systems consisting of multiple hoods served by a single exhaust system, such sensors shall be provided in each hood. Sensors shall be capable of being accessed from the hood outlet or from a cleanout location.

507.1.2 Domestic cooking appliances used for commercial purposes. Domestic cooking appliances utilized for commercial purposes shall be provided with Type I or Type II hoods as required for the type of appliances and processes in accordance with Sections 507.2 and 507.3. Domestic cooking appliances utilized for domestic purposes shall comply with Section 505.
507.1.3 Fuel-burning appliances. Where vented fuel-burning appliances are located in the same room or space as the hood, provisions shall be made to prevent the hood system from interfering with normal operation of the appliance vents.

507.1.4 Cleaning. A hood shall be designed to provide for thorough cleaning of the entire hood.

507.1.5 Exhaust outlets. Exhaust outlets located within the hood shall be located so as to optimize the capture of particulate matter. Each outlet shall serve not more than a 12-foot (3658 mm) section of hood.

507.2 Type I hoods. Type I hoods shall be installed where commercial cooking appliances produce grease or smoke as a result of the cooking process. Type I hoods shall be installed over medium-duty, heavy-duty and extra-heavy-duty cooking appliances.

Exceptions:
1. A Type I hood shall not be required for an electric cooking appliance where an approved testing agency provides documentation that the appliance effluent contains 5 mg/m³ or less of grease when tested at an exhaust flow rate of 500 cfm (0.236 m³/s) in accordance with UL 710B.
2. A Type II hood shall be permitted to be installed in lieu of a Type I hood over conveyor pizza ovens where grease laden vapors or smoke are generated in quantities that do not constitute a hazard.

507.2.1 Type I exhaust flow rate label. Type I hoods shall bear a label indicating the minimum exhaust flow rate in cfm per linear foot (1.55 L/s per linear meter) of hood that provides for capture and containment of the exhaust effluent for the cooking appliances served by the hood, based on the cooking appliance duty classifications defined in this code.

507.2.2 Type I extra-heavy-duty. Type I hoods for use over extra-heavy-duty cooking appliances shall not cover heavy-, medium- or light-duty appliances. Such hoods shall discharge to an exhaust system that is independent of other exhaust systems.

507.2.3 Type I materials. Type I hoods shall be constructed of steel having a minimum thickness of 0.0466 inch (1.181 mm) (No. 18 gage) or stainless steel not less than 0.0335 inch [0.8525 mm (No. 20 MSG)] in thickness.

507.2.4 Type I supports. Type I hoods shall be secured in place by
noncombustible supports. Type I hood supports shall be adequate for the applied load of the hood, the unsupported ductwork, the effluent loading and the possible weight of personnel working in or on the hood.

507.2.5 Type I hoods. External hood joints, seams and penetrations for Type I hoods shall be made with a continuous external liquid-tight weld or braze to the lowest outermost perimeter of the hood. Internal hood joints, seams, penetrations, filter support frames and other appendages attached inside the hood shall not be required to be welded or brazed but shall be otherwise sealed to be grease tight.

Exceptions:
1. Penetrations shall not be required to be welded or brazed where sealed by devices that are listed for the application.
2. Internal welding or brazing of seams, joints and penetrations of the hood shall not be prohibited provided that the joint is formed smooth or ground so as to not trap grease, and is readily cleanable.

507.2.6 Clearances for Type I hood. A Type I hood shall be installed with a clearance to combustibles of not less than 18 inches (457 mm).

Exception: Exceptions:
1. Clearance shall not be required from gypsum wallboard or 1/2-inch (12.7 mm) or thicker cementitious wallboard attached to noncombustible structures provided that a smooth, cleanable, nonabsorbent and noncombustible material is installed between the hood and the gypsum or cementitious wallboard over an area extending not less than 18 inches (457 mm) in all directions from the hood.
2. Type I hoods listed and labeled for clearances less than 18 inches in accordance with UL 710 shall be installed with the clearances specified by such listings.

507.2.7 Type I hoods penetrating a ceiling. Type I hoods or portions thereof penetrating a ceiling, wall or furred space shall comply with Section 506.3.11. Field-applied grease duct enclosure systems, as addressed in Section 506.3.11.2, shall not be utilized to satisfy the requirements of this section.

507.2.8 Type I grease filters. Type I hoods shall be equipped with grease filters listed and labeled in accordance with UL 1046. Grease filters shall be provided with access for cleaning or replacement. The lowest edge of a grease filter located above the cooking surface shall be not less than the height specified in Table 507.2.8.
### TABLE 507.2.8
MINIMUM DISTANCE BETWEEN THE LOWEST EDGE OF A GREASE FILTER AND THE COOKING SURFACE OR THE HEATING SURFACE

<table>
<thead>
<tr>
<th>TYPE OF COOKING APPLIANCES</th>
<th>HEIGHT ABOVE COOKING SURFACE (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without exposed flame</td>
<td>0.5</td>
</tr>
<tr>
<td>Exposed flame and burners</td>
<td>2</td>
</tr>
<tr>
<td>Exposed charcoal and charbroil type</td>
<td>3.5</td>
</tr>
</tbody>
</table>

For SI: 1 foot = 304.8 mm.

507.2.8.1 **Criteria.** Filters shall be of such size, type and arrangement as will permit the required quantity of air to pass through such units at rates not exceeding those for which the filter or unit was designed or approved. Filter units shall be installed in frames or holders so as to be readily removable without the use of separate tools, unless designed and installed to be cleaned in place and the system is equipped for such cleaning in place. Where filters are designed and required to be cleaned, removable filter units shall be of a size that will allow them to be cleaned in a dishwashing machine or pot sink. Filter units shall be arranged in place or provided with drip-intercepting devices to prevent grease or other condensate from dripping into food or on food preparation surfaces.

507.2.8.2 **Mounting position of grease filters.** Filters shall be installed at an angle of not less than 45 degrees (0.79 rad) from the horizontal and shall be equipped with a drip tray beneath the lower edge of the filters.

507.2.9 **Grease gutters for Type I hood.** Grease gutters shall drain to an approved collection receptacle that is fabricated, designed and installed to allow access for cleaning.

507.3 **Type II hoods.** Type II hoods shall be installed above dishwashers and appliances that produce heat or moisture and do not produce grease or smoke as a result of the cooking process, except where the heat and moisture loads from such appliances are incorporated into the HVAC system design or into the design of a separate removal system. Type II hoods shall be installed above all appliances that produce products of combustion and do not produce grease or smoke as a result of the cooking process. Spaces containing cooking appliances that do not require Type II hoods shall be provided with exhaust at a rate of 0.70 cfm per square foot (0.00033 m³/s).
For the purpose of determining the floor area required to be exhausted, each individual appliance that is not required to be installed under a Type II hood shall be considered as occupying not less than 100 square feet (9.3 m²). Such additional square footage shall be provided with exhaust at a rate of 0.70 cfm per square foot [0.00356 m³/(s × m²)].

**507.3.1 Type II hood materials.** Type II hoods shall be constructed of steel having a minimum thickness of 0.0296 inch (0.7534 mm) (No. 22 gage) or stainless steel not less than 0.0220 inch (0.5550 mm) (No. 24 gage) in thickness, copper sheets weighing not less than 24 ounces per square foot (7.3 kg/m²) or of other approved material and gage.

**507.3.2 Type II supports.** Type II hood supports shall be adequate for the applied load of the hood, the unsupported ductwork, the effluent loading and the possible weight of personnel working in or on the hood.

**507.3.3 Type II hoods joint, seams and penetrations.** Joints, seams and penetrations for Type II hoods shall be constructed as set forth in Chapter 6, shall be sealed on the interior of the hood and shall provide a smooth surface that is readily cleanable and water tight.

**507.4 Hood size and location.** Hoods shall comply with the overhang, setback and height requirements in accordance with Sections 507.4.1 and 507.4.2, based on the type of hood.

**507.4.1 Canopy size and location.** The inside lower edge of canopy-type Type I and II commercial hoods shall overhang or extend a horizontal distance of not less than 6 inches (152 mm) beyond the edge of the top horizontal surface of the appliance on all open sides. The vertical distance between the front lower lip of the hood and such surface shall not exceed 4 feet (1219 mm).

Exception: The hood shall be permitted to be flush with the outer edge of the cooking surface where the hood is closed to the appliance side by a noncombustible wall or panel.

**507.4.2 Noncanopy size and location.** Noncanopy-type hoods shall be located not greater than 3 feet (914 mm) above the cooking surface. The edge of the hood shall be set back not greater than 1 foot (305 mm) from the edge of the cooking surface.

**507.5 Capacity of hoods.** Commercial food service hoods shall exhaust a
minimum net quantity of air determined in accordance with this section and Sections 507.5.1 through 507.5.5. The net quantity of exhaust air shall be calculated by subtracting any airflow supplied directly to a hood cavity from the total exhaust flow rate of a hood. Where any combination of heavy-duty, medium-duty and light-duty cooking appliances are utilized under a single hood, the exhaust rate required by this section for the heaviest duty appliance covered by the hood shall be used for the entire hood. See Chapter 2 of this code for the definitions of light-duty, medium-duty, heavy-duty, and extra-heavy-duty cooking appliances.

507.5.1 Extra-heavy-duty cooking appliances. The minimum net airflow for hoods, as determined by Section 507.1, used for extra-heavy-duty cooking appliances shall be determined as follows:

<table>
<thead>
<tr>
<th>Type of Hood</th>
<th>CFM per linear foot of hood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backshelf/pass-over</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Double island canopy</td>
<td>550</td>
</tr>
<tr>
<td>(per side)</td>
<td></td>
</tr>
<tr>
<td>Eyebrow</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Single island canopy</td>
<td>700</td>
</tr>
<tr>
<td>Wall-mounted canopy</td>
<td>550</td>
</tr>
</tbody>
</table>

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

507.5.2 Heavy-duty cooking appliances. The minimum net airflow for hoods, as determined by Section 507.1, used for heavy-duty cooking appliances shall be determined as follows:

<table>
<thead>
<tr>
<th>Type of Hood</th>
<th>CFM per linear foot of hood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backshelf/pass-over</td>
<td>400</td>
</tr>
<tr>
<td>Double island canopy</td>
<td>400</td>
</tr>
<tr>
<td>(per side)</td>
<td></td>
</tr>
<tr>
<td>Eyebrow</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Single island canopy</td>
<td>600</td>
</tr>
<tr>
<td>Wall-mounted canopy</td>
<td>400</td>
</tr>
</tbody>
</table>

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

507.5.3 Medium-duty cooking appliances. The minimum net airflow for hoods, as determined by Section 507.1, used for medium-duty cooking appliances shall be determined as follows:
## Type of Hood CFM per linear foot of hood

<table>
<thead>
<tr>
<th>Type of Hood</th>
<th>CFM per linear foot of hood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backshelf/pass-over</td>
<td>300</td>
</tr>
<tr>
<td>Double island canopy (per side)</td>
<td>300</td>
</tr>
<tr>
<td>Eyebrow</td>
<td>250</td>
</tr>
<tr>
<td>Single island canopy</td>
<td>500</td>
</tr>
<tr>
<td>Wall-mounted canopy</td>
<td>300</td>
</tr>
</tbody>
</table>

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

### 507.5.4 Light-duty cooking appliances.

The minimum net airflow for hoods, as determined by Section 507.1, used for light-duty cooking appliances and food service preparation shall be determined as follows:

<table>
<thead>
<tr>
<th>Type of Hood</th>
<th>CFM per linear foot of hood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backshelf/pass-over</td>
<td>250</td>
</tr>
<tr>
<td>Double island canopy (per side)</td>
<td>250</td>
</tr>
<tr>
<td>Eyebrow</td>
<td>250</td>
</tr>
<tr>
<td>Single island canopy</td>
<td>400</td>
</tr>
<tr>
<td>Wall-mounted canopy</td>
<td>200</td>
</tr>
</tbody>
</table>

For SI: 1 cfm per linear foot = 1.55 L/s per linear meter.

### 507.5.5 Dishwashing appliances.

The minimum net airflow for Type II hoods used for dishwashing appliances shall be 100 cfm per linear foot (155 L/s per linear meter) of hood length.

**Exception:** Dishwashing appliances and equipment installed in accordance with Section 507.3.

### 507.6 Performance test.

A performance test shall be conducted upon completion and before final approval of the installation of a ventilation system serving commercial cooking appliances. The test shall verify the rate of exhaust airflow required by Section 507.5, makeup airflow required by Section 508 and proper operation as specified in this chapter. The permit holder shall furnish the necessary test equipment and devices required to perform the tests.

### 507.6.1 Capture and containment test.

The permit holder shall verify capture and containment performance of the exhaust system. This field test shall be conducted with all appliances under the hood at operating temperatures, with all sources of outdoor air providing makeup air for the hood operating and with all sources of recirculated air providing conditioning for the space in which the hood is located operating. Capture and containment
shall be verified visually by observing smoke or steam produced by actual or simulated cooking, such as with smoke candles, smoke puffers, and similar means.

SECTION 508
COMMERCIAL KITCHEN MAKEUP AIR

508.1 Makeup air. Makeup air shall be supplied during the operation of commercial kitchen exhaust systems that are provided for commercial cooking appliances. The amount of makeup air supplied to the building from all sources shall be approximately equal to the amount of exhaust air for all exhaust systems for the building. The makeup air shall not reduce the effectiveness of the exhaust system. Makeup air shall be provided by gravity or mechanical means or both. Mechanical makeup air systems shall be automatically controlled to start and operate simultaneously with the exhaust system. Makeup air intake opening locations shall comply with Section 401.4.

508.1.1 Makeup air temperature. The temperature differential between makeup air and the air in the conditioned space shall not exceed 10°F (6°C).

Exceptions:
1. Makeup air that is part of the air-conditioning system.
2. Makeup air that does not decrease the comfort conditions of the occupied space.

508.1.2 Air balance. Design plans for a facility with a commercial kitchen ventilation system shall include a schedule or diagram indicating the design outdoor air balance. The design outdoor air balance shall indicate all exhaust and replacement air for the facility, plus the net exfiltration if applicable. The total replacement air airflow rate shall equal the total exhaust airflow rate plus the net exfiltration.

508.2 Compensating hoods. Manufacturers of compensating hoods shall provide a label indicating minimum exhaust flow and/or maximum makeup airflow that provides capture and containment of the exhaust effluent.

Exception: Compensating hoods with makeup air supplied only from the front face discharge and side face discharge openings shall not be required to be labeled with the maximum makeup airflow.

SECTION 509
FIRE SUPPRESSION SYSTEMS
509.1 **Where required.** Commercial cooking appliances required by Section 507.2 to have a Type I hood shall be provided with an approved automatic fire suppression system complying with the *building code* and the *fire code*.

**SECTION 510**

HAZARDOUS EXHAUST SYSTEMS

510.1 **General.** This section shall govern the design and construction of duct systems for hazardous exhaust and shall determine where such systems are required. Hazardous exhaust systems are systems designed to capture and control hazardous emissions generated from product handling or processes, and convey those emissions to the outdoors. Hazardous emissions include flammable vapors, gases, fumes, mists or dusts, and volatile or airborne materials posing a health hazard, such as toxic or corrosive materials. For the purposes of this section, the health-hazard rating of materials shall be as specified in NFPA 704.

For the purposes of the provisions of Section 510, a laboratory shall be defined as a facility where the use of chemicals is related to testing, analysis, teaching, research or developmental activities. Chemicals are used or synthesized on a nonproduction basis, rather than in a manufacturing process.

510.2 **Where required.** A hazardous exhaust system shall be required wherever operations involving the handling or processing of hazardous materials, in the absence of such exhaust systems and under normal operating conditions, have the potential to create one of the following conditions:

1. A flammable vapor, gas, fume, mist or dust is present in concentrations exceeding 25 percent of the lower flammability limit of the substance for the expected room temperature.
2. A vapor, gas, fume, mist or dust with a health-hazard rating of 4 is present in any concentration.
3. A vapor, gas, fume, mist or dust with a health-hazard rating of 1, 2 or 3 is present in concentrations exceeding 1 percent of the median lethal concentration of the substance for acute inhalation toxicity.

**Exception:** Laboratories, as defined in Section 510.1, except where the concentrations listed in Item 1 are exceeded or a vapor, gas, fume, mist or dust with a health hazard rating of 1, 2, 3 or 4 is present in concentrations exceeding 1 percent of the median lethal concentration of the substance for acute inhalation toxicity.

510.2.1 **Lumber yards and woodworking facilities.** Equipment or machinery located inside buildings at lumber yards and woodworking facilities which generates or emits combustible dust shall be provided with an
approved dust-collection and exhaust system installed in accordance with this section and the fire code. Equipment and systems that are used to collect, process or convey combustible dusts shall be provided with an approved explosion-control system.

510.2.2 Combustible fibers. Equipment or machinery within a building which generates or emits combustible fibers shall be provided with an approved dust-collecting and exhaust system. Such systems shall comply with this code and the fire code.

510.3 Design and operation. The design and operation of the exhaust system shall be such that flammable contaminants are diluted in noncontaminated air to maintain concentrations in the exhaust flow below 25 percent of the contaminant’s lower flammability limit.

510.4 Independent system. Hazardous exhaust systems shall be independent of other types of exhaust systems.

510.5 Incompatible materials and common shafts. Incompatible materials, as defined in the fire code, shall not be exhausted through the same hazardous exhaust system. Hazardous exhaust systems shall not share common shafts with other duct systems, except where such systems are hazardous exhaust systems originating in the same fire area.

Exception: The provisions of this section shall not apply to laboratory exhaust systems where all of the following conditions apply:

1. All of the hazardous exhaust ductwork and other laboratory exhaust within both the occupied space and the shafts are under negative pressure while in operation.
2. The hazardous exhaust ductwork manifolded together within the occupied space must originate within the same fire area.
3. Hazardous exhaust ductwork originating in different fire areas and manifolded together in a common shaft shall meet the provisions of Section 717.5.3, Exception 1, Item 1.1 of the building code.
4. Each control branch has a flow regulating device.
5. Perchloric acid hoods and connected exhaust shall be prohibited from manifolding.
6. Radioisotope hoods are equipped with filtration, carbon beds or both where required by the registered design professional.
7. Biological safety cabinets are filtered.
8. Each hazardous exhaust duct system shall be served by redundant exhaust fans that comply with either of the following:
8.1. The fans shall operate simultaneously in parallel and each fan shall be individually capable of providing the required exhaust rate.
8.2. Each of the redundant fans is controlled so as to operate when the other fan has failed or is shut down for servicing.

510.6 **Design.** Systems for removal of vapors, gases and smoke shall be designed by the constant velocity or equal friction methods. Systems conveying particulate matter shall be designed employing the constant velocity method.

510.6.1 **Balancing.** Systems conveying explosive or radioactive materials shall be prebalanced by duct sizing. Other systems shall be balanced by duct sizing with balancing devices, such as dampers. Dampers provided to balance airflow shall be provided with securely fixed minimum-position blocking devices to prevent restricting flow below the required volume or velocity.

510.6.2 **Emission control.** The design of the system shall be such that the emissions are confined to the area in which they are generated by air currents, hoods or enclosures and shall be exhausted by a duct system to a safe location or treated by removing contaminants.

510.6.3 **Hoods required.** Hoods or enclosures shall be used where contaminants originate in a limited area of a space. The design of the hood or enclosure shall be such that air currents created by the exhaust systems will capture the contaminants and transport them directly to the exhaust duct.

510.6.4 **Contaminant capture and dilution.** The velocity and circulation of air in work areas shall be such that contaminants are captured by an airstream at the area where the emissions are generated and conveyed into a product-conveying duct system. Contaminated air from work areas where hazardous contaminants are generated shall be diluted below the thresholds specified in Section 510.2 with air that does not contain other hazardous contaminants.

510.6.5 **Makeup air.** Makeup air shall be provided at a rate approximately equal to the rate that air is exhausted by the hazardous exhaust system. Makeup air intakes shall be located in accordance with Section 401.4.

510.6.6 **Clearances.** The minimum clearance between hoods and combustible construction shall be the clearance required by the duct system.

510.6.7 **Ducts.** Hazardous exhaust duct systems shall extend directly to the exterior of the building and shall not extend into or through ducts and
plenums.

510.7 Penetrations. Penetrations of structural elements by a hazardous exhaust system shall conform to Sections 510.7.1 through 510.7.4.
   Exception: Duct penetrations within Group H-5 occupancies as allowed by the building code.

510.7.1 Fire dampers and smoke dampers. Fire dampers and smoke dampers are prohibited in hazardous exhaust ducts.

510.7.1.1 Shaft penetrations. Hazardous exhaust ducts that penetrate fire-resistance-rated shafts shall comply with Section 714.3.1 or 714.3.1.2 of the building code.

510.7.2 Floors. Hazardous exhaust systems that penetrate a floor/ceiling assembly shall be enclosed in a fire-resistance-rated shaft constructed in accordance with the building code.

510.7.3 Wall assemblies. Hazardous exhaust duct systems that penetrate fire-resistance-rated wall assemblies shall be enclosed in fire-resistance-rated construction from the point of penetration to the outlet terminal, except where the interior of the duct is equipped with an approved automatic fire suppression system. Ducts shall be enclosed in accordance with the building code requirements for shaft construction and such enclosure shall have a minimum fire-resistance rating of not less than the highest fire-resistance-rated wall assembly penetrated.

510.7.4 Fire walls. Ducts shall not penetrate a fire wall.

510.8 Suppression required. Ducts shall be protected with an approved automatic fire suppression system installed in accordance with the building code.
   Exceptions:
   1. An approved automatic fire suppression system shall not be required in ducts conveying materials, fumes, mists and vapors that are nonflammable and noncombustible under all conditions and at any concentrations.
   2. Automatic fire suppression systems shall not be required in metallic and noncombustible, nonmetallic exhaust ducts in semiconductor fabrication facilities.
   3. An approved automatic fire suppression system shall not be required in ducts where the largest cross-sectional diameter of the duct is less than 10 inches (254 mm).
4. For laboratories, as defined in Section 510.1, automatic fire protection systems shall not be required in laboratory hoods or exhaust systems.

510.9 Duct construction. Ducts used to convey hazardous exhaust shall be constructed of materials approved for installation in such an exhaust system and shall comply with one of the following:

1. Ducts shall be constructed of approved G90 galvanized sheet steel, with a minimum nominal thickness as specified in Table 510.9.

2. Ducts used in systems exhausting nonflammable corrosive fumes or vapors shall be constructed of nonmetallic materials that exhibit a flame spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E 84 or UL 723 and that are listed and labeled for the application.

Where the products being exhausted are detrimental to the duct material, the ducts shall be constructed of alternative materials that are compatible with the exhaust.

### TABLE 510.9
**MINIMUM DUCT THICKNESS**

<table>
<thead>
<tr>
<th>DIAMETER OF DUCT OR MAXIMUM SIDE DIMENSION</th>
<th>MINIMUM NOMINAL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nonabrasive materials</td>
</tr>
<tr>
<td>0-8 inches</td>
<td>0.028 inch (No. 24 gage)</td>
</tr>
<tr>
<td>9-18 inches</td>
<td>0.034 inch (No. 22 gage)</td>
</tr>
<tr>
<td>19-30 inches</td>
<td>0.040 inch (No. 20 gage)</td>
</tr>
<tr>
<td>Over 30 inches</td>
<td>0.052 inch (No. 18 gage)</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

510.9.1 Duct joints. Ducts shall be made tight with lap joints having a minimum lap of 1 inch (25 mm). Joints used in ANSI/SMACNA Round Industrial Duct Construction Standards and ANSI/SMACNA Rectangular Industrial Duct Construction Standards are also acceptable.

510.9.2 Clearance to combustibles. Ducts shall have a clearance to combustibles in accordance with Table 510.9.2. Exhaust gases having temperatures in excess of 600°F (316°C) shall be exhausted to a chimney in accordance with Section 511.2.
TABLE 510.9.2
CLEARANCE TO COMBUSTIBLES

<table>
<thead>
<tr>
<th>TYPE OF EXHAUST OR TEMPERATURE OF EXHAUST (°F)</th>
<th>CLEARANCE TO COMBUSTIBLES (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100</td>
<td>1</td>
</tr>
<tr>
<td>100-600</td>
<td>12</td>
</tr>
<tr>
<td>Flammable vapors</td>
<td>6</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, °C = ([°F] - 32)/1.8.

510.9.3 Explosion relief. Systems exhausting potentially explosive mixtures shall be protected with an approved explosion relief system or by an approved explosion prevention system designed and installed in accordance with NFPA 69. An explosion relief system shall be designed to minimize the structural and mechanical damage resulting from an explosion or deflagration within the exhaust system. An explosion prevention system shall be designed to prevent an explosion or deflagration from occurring.

510.10 Supports. Ducts shall be supported at intervals not exceeding 10 feet (3048 mm). Supports shall be constructed of noncombustible material.

SECTION 511
DUST, STOCK AND REFUSE CONVEYING SYSTEMS

511.1 Dust, stock and refuse conveying systems. Dust, stock and refuse conveying systems shall comply with the provisions of Section 510 and Sections 511.1.1 through 511.2.

511.1.1 Collectors and separators. Collectors and separators involving such systems as centrifugal separators, bag filter systems and similar devices, and associated supports shall be constructed of noncombustible materials and shall be located on the exterior of the building or structure. A collector or separator shall not be located nearer than 10 feet (3048 mm) to combustible construction or to an unprotected wall or floor opening, unless the collector is provided with a metal vent pipe that extends above the highest part of any roof with a distance of 30 feet (9144 mm).

Exceptions:
1. Collectors such as “Point of Use” collectors, close extraction weld fume collectors, spray finishing booths, stationary grinding tables, sanding booths, and integrated or machine-mounted collectors shall be
permitted to be installed indoors provided the installation is in accordance with the *fire code* and NFPA 70.

2. Collectors in independent exhaust systems handling combustible dusts shall be permitted to be installed indoors provided that such collectors are installed in compliance with the *fire code* and NFPA 70.

511.1.2 Discharge pipe. Discharge piping shall conform to the requirements for ducts, including clearances required for high-heat appliances, as contained in this code. A delivery pipe from a cyclone collector shall not convey refuse directly into the firebox of a boiler, furnace, dutch oven, refuse burner, incinerator or other appliance.

511.1.3 Conveying systems exhaust discharge. An exhaust system shall discharge to the outside of the building either directly by flue or indirectly through the bin or vault into which the system discharges except where the contaminants have been removed. Exhaust system discharge shall be permitted to be recirculated provided that the solid particulate has been removed at a minimum efficiency of 99.9 percent at 10 microns (10.01 mm), vapor concentrations are less than 25 percent of the LFL, and approved equipment is used to monitor the vapor concentration.

511.1.4 Spark protection. The outlet of an open-air exhaust terminal shall be protected with an approved metal or other noncombustible screen to prevent the entry of sparks.

511.1.5 Explosion relief vents. A safety or explosion relief vent shall be provided on all systems that convey combustible refuse or stock of an explosive nature, in accordance with the requirements of the building code.

511.1.5.1 Screens. Where a screen is installed in a safety relief vent, the screen shall be attached so as to permit ready release under the explosion pressure.

511.1.5.2 Hoods. The relief vent shall be provided with an approved noncombustible cowl or hood, or with a counterbalanced relief valve or cover arranged to prevent the escape of hazardous materials, gases or liquids.

511.2 Exhaust outlets. Outlets for exhaust that exceed 600ºF (315ºC) shall be designed as a chimney in accordance with Table 511.2.
SECTION 512
SUBSLAB SOIL EXHAUST SYSTEMS

512.1 General. Where a subslab soil exhaust system is provided, the duct shall conform to the requirements of this section.

512.2 Materials. Subslab soil exhaust system duct material shall be air duct material listed and labeled to the requirements of UL 181 for Class 0 air ducts, or any of the following piping materials that comply with the plumbing code as building sanitary drainage and vent pipe: cast iron; galvanized steel; brass or copper pipe; copper tube of a weight not less than that of copper drainage tube, Type DWV; and plastic piping.

512.3 Grade. Exhaust system ducts shall not be trapped and shall have a minimum slope of one-eighth unit vertical in 12 units horizontal (1-percent slope).

512.4 Termination. Subslab soil exhaust system ducts shall extend through the roof and terminate not less than 6 inches (152 mm) above the roof and not less than 10 feet (3048 mm) from any operable openings or air intake.

### TABLE 511.2
CONSTRUCTION, CLEARANCE AND TERMINATION REQUIREMENTS FOR SINGLE-WALL METAL CHIMNEYS

<table>
<thead>
<tr>
<th>CHIMNEYS SERVING</th>
<th>MINIMUM THICKNESS</th>
<th>TERMINATION</th>
<th>CLEARANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Walls (inch)</td>
<td>Lining</td>
<td>Above any part of building within (feet)</td>
</tr>
<tr>
<td>High-heat appliances (Over 2,000°F)a</td>
<td>0.127 (No. 10 MSG)</td>
<td>4½” laid on 4½” bed</td>
<td>20</td>
</tr>
<tr>
<td>Low-heat appliances (1,000°F normal operation)</td>
<td>0.127 (No. 10 MSG)</td>
<td>none</td>
<td>3</td>
</tr>
<tr>
<td>Medium-heat appliances (2,000°F maximum)b</td>
<td>0.127 (No. 10 MSG)</td>
<td>Up to 18” dia.: 2½” Over 18” - 4½” On 4½” bed</td>
<td>10</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, °C = [(°F) - 32]/1.8.

a. Lining shall extend from bottom to top of outlet.
b. Lining shall extend from 24 inches below connector to 24 feet above.
c. Clearance shall be as specified by the design engineer and shall have sufficient clearance from buildings and structures to avoid overheating combustible materials (maximum 160°F).
512.5 **Identification.** Subslab soil exhaust ducts shall be permanently identified within each floor level by means of a tag, stencil or other approved marking.

SECTION 513

SMOKE CONTROL SYSTEMS

513.1 **Scope and purpose.** This section applies to mechanical and passive smoke control systems that are required by the building code. The purpose of this section is to establish minimum requirements for the design, installation and acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are not intended for the preservation of contents, the timely restoration of operations, or for assistance in fire suppression or overhaul activities. Smoke control systems regulated by this section serve a different purpose than the smoke- and heat-venting provisions found in Section 910 of the building code.

513.2 **General design requirements.** Buildings, structures, or parts thereof required by this code to have a smoke control system or systems shall have such systems designed in accordance with the applicable requirements of Section 909 of the building code and the generally accepted and well-established principles of engineering relevant to the design. The construction documents shall include sufficient information and detail to describe adequately the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied with sufficient information and analysis to demonstrate compliance with these provisions.

513.3 **Special inspection and test requirements.** In addition to the ordinary inspection and test requirements that buildings, structures and parts thereof are required to undergo, smoke control systems subject to the provisions of Section 909 of the building code shall undergo special inspections and tests sufficient to verify the proper commissioning of the smoke control design in its final installed condition. The design submission accompanying the construction documents shall clearly detail procedures and methods to be used and the items subject to such inspections and tests. Such commissioning shall be in accordance with generally accepted engineering practice and, where possible, based on published standards for the particular testing involved. The special inspections and tests required by this section shall be conducted under the same terms as found in Section 1704 of the building code.

513.4 **Analysis.** A rational analysis supporting the types of smoke control systems to be employed, their methods of operation, the systems supporting them and the
methods of construction to be utilized shall accompany the submitted construction documents and shall include, but not be limited to, the items indicated in Sections 513.4.1 through 513.4.7.

513.4.1 Stack effect. The system shall be designed such that the maximum probable normal or reverse stack effects will not adversely interfere with the system’s capabilities. In determining the maximum probable stack effects, altitude, elevation, weather history and interior temperatures shall be used.

513.4.2 Temperature effect of fire. Buoyancy and expansion caused by the design fire in accordance with Section 513.9 shall be analyzed. The system shall be designed such that these effects do not adversely interfere with its capabilities.

513.4.3 Wind effect. The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of the building code.

513.4.4 HVAC systems. The design shall consider the effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems’ status. The design shall consider the effects of fire on the HVAC systems.

513.4.5 Climate. The design shall consider the effects of low temperatures on systems, property and occupants. Air inlets and exhausts shall be located so as to prevent snow or ice blockage.

513.4.6 Duration of operation. All portions of active or engineered smoke control systems shall be capable of continued operation after detection of the fire event for a period of not less than either 20 minutes or 1.5 times the calculated egress time, whichever is greater.

513.4.7 Smoke control system interaction. The design shall consider the interaction effects of the operation of multiple smoke control systems for all design scenarios.

513.5 Smoke barrier construction. Where provided, smoke barriers required for passive smoke control and a smoke control system using the pressurization method shall comply with Section 709 of the building code. The maximum allowable leakage area shall be the aggregate area calculated using the following leakage area ratios:
1. Walls: $A/A_w = 0.00100$
2. Interior exit stairways and ramps and exit passageways:
   
   $A/A_w = 0.00035$
3. Enclosed exit access stairways and ramps and all other shafts:
   
   $A/A_w = 0.00150$
4. Floors and roofs: $A/A_f = 0.00050$

where:

- $A =$ Total leakage area, square feet ($m^2$).
- $A_f =$ Unit floor or roof area of barrier, square feet ($m^2$).
- $A_w =$ Unit wall area of barrier, square feet ($m^2$).

The leakage area ratios shown do not include openings created by gaps around doors and operable windows. The total leakage area of the smoke barrier shall be determined in accordance with Section 513.5.1 and tested in accordance with Section 513.5.2.

**513.5.1 Total leakage area.** Total leakage area of the barrier is the product of the smoke barrier gross area times the allowable leakage area ratio, plus the area of other openings such as gaps around doors and operable windows.

**513.5.2 Testing of leakage area.** Compliance with the maximum total leakage area shall be determined by achieving the minimum air pressure difference across the barrier with the system in the smoke control mode for mechanical smoke control systems utilizing the pressurization method. Compliance with the maximum total leakage area of passive smoke control systems shall be verified through methods such as door fan testing or other methods, as approved by the building official.

**513.5.3 Opening protection.** Openings in smoke barriers shall be protected by automatic-closing devices actuated by the required controls for the mechanical smoke control system. Door openings shall be protected by door assemblies complying with the requirements of the building code for doors in smoke barriers.

**Exceptions:**
1. Passive smoke control systems with automatic closing devices actuated by spot-type smoke detectors listed for releasing service installed in accordance with the building code.
2. Fixed openings between smoke zones which are protected utilizing the airflow method.
3. In Group I-1 Condition 2, Group I-2 and ambulatory care facilities, where a pair of opposite swinging doors are installed across a corridor in accordance with Section 513.5.3.1, the doors shall not be required to be protected in accordance with Section 716 of the building code. The doors shall be close-fitting within operational tolerances and shall not have a center mullion or undercuts in excess of 3/4 inch (19.1 mm), louvers or grilles. The doors shall have head and jamb stops and astragals or rabbets at meeting edges and, where permitted by the door manufacturer’s listing, positive-latching devices are not required.

4. In Group I-2 and ambulatory care facilities, where such doors are special-purpose horizontal sliding, accordion or folding door assemblies installed in accordance with Section 1010.1.4.3 of the building code and are automatic closing by smoke detection in accordance with Section 716.5.9.3 of the building code.

5. Group I-3.

6. Openings between smoke zones with clear ceiling heights of 14 feet (4267 mm) or greater and bank down capacity of greater than 20 minutes as determined by the design fire size.

513.5.3.1 Group I-1 Condition 2; Group I-2 and ambulatory care facilities. In Group I-1 Condition 2; Group I-2 and ambulatory care facilities, where doors are installed across a corridor, the doors shall be automatic closing by smoke detection in accordance with Section 716.5.9.3 of the building code and shall have a vision panel with fire-protection-rated glazing materials in fire-protection-rated frames, the area of which shall not exceed that tested.

513.5.3.2 Ducts and air transfer openings. Ducts and air transfer openings are required to be protected with a minimum Class II, 250°F (121°C) smoke damper complying with the building code.

513.6 Pressurization method. The primary mechanical means of controlling smoke shall be by pressure differences across smoke barriers. Maintenance of a tenable environment is not required in the smoke control zone of fire origin.

513.6.1 Minimum pressure difference. The minimum pressure difference across a smoke barrier shall be 0.05 inch water gage (12.4 Pa) in fully sprinklered buildings.

In buildings permitted to be other than fully sprinklered, the smoke control system shall be designed to achieve pressure differences not less than two times the maximum calculated pressure difference produced by the design.
513.6.2 Maximum pressure difference. The maximum air pressure difference across a smoke barrier shall be determined by required door-opening or closing forces. The actual force required to open exit doors when the system is in the smoke control mode shall be in accordance with the building code. Opening and closing forces for other doors shall be determined by standard engineering methods for the resolution of forces and reactions. The calculated force to set a side-hinged, swinging door in motion shall be determined by:

\[ F = F_{dc} + K(WA\Delta P)/2(W-d) \]  
(Equation 5-1)

where:
- \( A \) = Door area, square feet (\( m^2 \)).
- \( d \) = Distance from door handle to latch edge of door, feet (\( m \)).
- \( F \) = Total door opening force, pounds (\( N \)).
- \( F_{dc} \) = Force required to overcome closing device, pounds (\( N \)).
- \( K \) = Coefficient 5.2 (1.0).
- \( W \) = Door width, feet (\( m \)).
- \( \Delta P \) = Design pressure difference, inches (\( Pa \)) water gage.

513.6.3 Pressurized stairways and elevator hoistways. Where stairways or elevator hoistways are pressurized, such pressurization systems shall comply with Section 513 as smoke control systems, in addition to the requirements of Sections 909.20 and 909.21 of the building code.

513.7 Airflow design method. Where approved by the code official, smoke migration through openings fixed in a permanently open position, which are located between smoke control zones by the use of the airflow method, shall be permitted. The design airflow shall be in accordance with this section. Airflow shall be directed to limit smoke migration from the fire zone. The geometry of openings shall be considered to prevent flow reversal from turbulent effects. Smoke control systems using the airflow method shall be designed in accordance with NFPA 92.

513.7.1 Prohibited conditions. This method shall not be employed where either the quantity of air or the velocity of the airflow will adversely affect other portions of the smoke control system, unduly intensify the fire, disrupt plume dynamics or interfere with exiting. Airflow toward the fire shall not exceed 200 feet per minute (1.02 m/s). Where the calculated airflow exceeds
this limit, the airflow method shall not be used.

513.8 Exhaust method. Where approved by the building official, mechanical smoke control for large enclosed volumes, such as in atriums or malls, shall be permitted to utilize the exhaust method. Smoke control systems using the exhaust method shall be designed in accordance with NFPA 92.

513.8.1 Exhaust rate. The height of the lowest horizontal surface of the accumulating smoke layer shall be maintained not less than 6 feet (1829 mm) above any walking surface which forms a portion of a required egress system within the smoke zone.

513.9 Design fire. The design fire shall be based on a rational analysis performed by the registered design professional and approved by the code official. The design fire shall be based on the analysis in accordance with Section 513.4 and this section.

513.9.1 Factors considered. The engineering analysis shall include the characteristics of the fuel, fuel load, effects included by the fire and whether the fire is likely to be steady or unsteady.

513.9.2 Design fire fuel. Determination of the design fire shall include consideration of the type of fuel, fuel spacing and configuration.

513.9.3 Heat-release assumptions. The analysis shall make use of the best available data from approved sources and shall not be based on excessively stringent limitations of combustible material.

513.9.4 Sprinkler effectiveness assumptions. A documented engineering analysis shall be provided for conditions that assume fire growth is halted at the time of sprinkler activation.

513.10 Equipment. Equipment such as, but not limited to, fans, ducts, automatic dampers and balance dampers shall be suitable for their intended use, suitable for the probable exposure temperatures that the rational analysis indicates, and as approved by the building official.

513.10.1 Exhaust fans. Components of exhaust fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed. This temperature rise shall be computed by:
\[ T_s = \left( \frac{Q_c}{mc} \right) + (T_a) \]  

(Equation 5-2)

where:
- \( c \) = Specific heat of smoke at smoke-layer temperature, Btu/lb°F (kJ/kg · K).
- \( m \) = Exhaust rate, pounds per second (kg/s).
- \( Q_c \) = Convective heat output of fire, Btu/s (kW).
- \( T_a \) = Ambient temperature, °F (K).
- \( T_s \) = Smoke temperature, °F (K).

Exception: Reduced \( T_s \) as calculated based on the assurance of adequate dilution air.

513.10.2 Ducts. Duct materials and joints shall be capable of withstanding the probable temperatures and pressures to which they are exposed as determined in accordance with Section 513.10.1. Ducts shall be constructed and supported in accordance with Chapter 6. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5 percent of design flow. Results of such testing shall be a part of the documentation procedure. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports.

Exception: Flexible connections, for the purpose of vibration isolation, that are constructed of approved fire-resistance-rated materials.

513.10.3 Equipment, inlets and outlets. Equipment shall be located so as to not expose uninvolved portions of the building to an additional fire hazard. Outdoor air inlets shall be located so as to minimize the potential for introducing smoke or flame into the building. Exhaust outlets shall be so located as to minimize reintroduction of smoke into the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.

513.10.4 Automatic dampers. Automatic dampers, regardless of the purpose for which they are installed within the smoke control system, shall be listed and conform to the requirements of Section 607.3.

513.10.5 Fans. In addition to other requirements, belt-driven fans shall have 1.5 times the number of belts required for the design duty with the minimum number of belts being two. Fans shall be selected for stable performance based on normal temperature and, where applicable, elevated temperature. Calculations and manufacturer’s fan curves shall be part of the documentation procedures. Fans shall be supported and restrained by noncombustible devices in accordance with the structural design requirements of the building code.
Motors driving fans shall not be operating beyond their nameplate horsepower (kilowatts) as determined from measurement of actual current draw. Motors driving fans shall have a minimum service factor of 1.15.

513.11 Standby power. The smoke control system shall be supplied with standby power in accordance with Section 2702 of the building code.

513.11.1 Equipment room. The standby power source and its transfer switches shall be in a room separate from the normal power transformers and switch gear and ventilated directly to and from the exterior. The room shall be enclosed with not less than 1-hour fire-resistance-rated fire barriers constructed in accordance with Section 707 of the building code or horizontal assemblies constructed in accordance with Section 711 of the building code, or both.

513.11.2 Power sources and power surges. Elements of the smoke management system relying on volatile memories or the like shall be supplied with uninterruptible power sources of sufficient duration to span 15-minute primary power interruption. Elements of the smoke management system susceptible to power surges shall be suitably protected by conditioners, suppressors or other approved means.

513.12 Detection and control systems. Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Section 907 of the building code. Such systems shall be equipped with a control unit complying with UL 864 and listed as smoke control equipment.

513.12.1 Verification. Control systems for mechanical smoke control systems shall include provisions for verification. Verification shall include positive confirmation of actuation, testing, manual override and the presence of power downstream of all disconnects. A preprogrammed weekly test sequence shall report abnormal conditions audibly, visually and by printed report. The preprogrammed weekly test shall operate all devices, equipment and components used for smoke control.

Exception: Where verification of individual components tested through the preprogrammed weekly testing sequence will interfere with, and produce unwanted effects to, normal building operation, such individual components are permitted to be bypassed from the preprogrammed weekly testing, where approved by the building official and in accordance with both of the following:
1. Where the operation of components is bypassed from the preprogrammed weekly test, presence of power downstream of all disconnects shall be verified weekly by a listed control unit.

2. Testing of all components bypassed from the preprogrammed weekly test shall be in accordance with Section 909.20.6 of the fire code.

**513.12 Wiring.** In addition to meeting the requirements of NFPA 70, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.

**513.12.3 Activation.** Smoke control systems shall be activated in accordance with the building code.

**513.12.4 Automatic control.** Where complete automatic control is required or used, the automatic control sequences shall be initiated from an appropriately zoned automatic sprinkler system complying with Section 903.3.1.1 of the building code, from manual controls that are readily accessible to the fire department, and any smoke detectors required by engineering analysis.

**513.13 Control-air tubing.** Control-air tubing shall be of sufficient size to meet the required response times. Tubing shall be flushed clean and dry prior to final connections. Tubing shall be adequately supported and protected from damage. Tubing passing through concrete or masonry shall be sleeved and protected from abrasion and electrolytic action.

**513.13.1 Materials.** Control-air tubing shall be hard-drawn copper, Type L, ACR in accordance with ASTM B 42, ASTM B 43, ASTM B 68, ASTM B 88, ASTM B 251 and ASTM B 280. Fittings shall be wrought copper or brass, solder type in accordance with ASME B 16.18 or ASME B 16.22. Changes in direction shall be made with appropriate tool bends. Brass compression-type fittings shall be used at final connection to devices; other joints shall be brazed using a BCuP5 brazing alloy with solidus above 1,100°F (593°C) and liquids below 1,500°F (816°C). Brazing flux shall be used on copper-to-brass joints only.

**Exception:** Nonmetallic tubing used within control panels and at the final connection to devices provided all of the following conditions are met:

1. Tubing shall comply with the requirements of Section 602.2.1.3.

2. Tubing and connected device shall be completely enclosed within a galvanized or paint-grade steel enclosure having a minimum thickness of 0.0296 inch (0.7534 mm) (No. 22 gage). Entry to the enclosure shall
be by copper tubing with a protective grommet of Neoprene or Teflon or by suitable brass compression to male barbed adapter.

3. Tubing shall be identified by appropriately documented coding.

4. Tubing shall be neatly tied and supported within the enclosure. Tubing bridging cabinets and doors or moveable devices shall be of sufficient length to avoid tension and excessive stress. Tubing shall be protected against abrasion. Tubing serving devices on doors shall be fastened along hinges.

513.13.2 Isolation from other functions. Control tubing serving other than smoke control functions shall be isolated by automatic isolation valves or shall be an independent system.

513.13.3 Testing. Control-air tubing shall be tested at three times the operating pressure for not less than 30 minutes without any noticeable loss in gauge pressure prior to final connection to devices.

513.14 Marking and identification. The detection and control systems shall be clearly marked at all junctions, accesses and terminations.

513.15 Control diagrams. Identical control diagrams shall be provided and maintained as required by the building code.

513.16 Fire fighter’s smoke control panel. A fire fighter’s smoke control panel for fire department emergency response purposes only shall be provided in accordance with the building code.

513.17 System response time. Smoke control system activation shall comply with the building code.

513.18 Acceptance testing. Devices, equipment, components and sequences shall be tested in accordance with the building code.

513.19 System acceptance. Acceptance of the smoke control system shall be in accordance with the building code.

SECTION 514
ENERGY RECOVERY VENTILATION SYSTEMS

514.1 General. Energy recovery ventilation systems shall be installed in accordance with this section. Where required for purposes of energy conservation,
energy recovery ventilation systems shall comply with *the applicable energy conservation code referenced from Chapter 13 of the building code*. Ducted heat recovery ventilators shall be listed and labeled in accordance with UL 1812. Nonducted heat recovery ventilators shall be listed and labeled in accordance with UL 1815.

**514.2 Prohibited applications.** Energy recovery ventilation systems shall not be used in the following systems:

1. Hazardous exhaust systems covered in Section 510.
2. Dust, stock and refuse systems that convey explosive or flammable vapors, fumes or dust.
3. Smoke control systems covered in Section 513.
4. Commercial kitchen exhaust systems serving Type I or Type II hoods.
5. Clothes dryer exhaust systems covered in Section 504.

   **Exception:** The application of ERV equipment that recovers sensible heat only utilizing coil-type heat exchangers shall not be limited by this section.

**514.3 Access.** A means of access shall be provided to the heat exchanger and other components of the system as required for service, maintenance, repair or replacement.

**514.4 Recirculated air.** Air conveyed within energy recovery systems shall not be considered as recirculated air where the energy recovery ventilation system is constructed to limit cross-leakage between air streams to less than 10 percent of the total airflow design capacity.
4101:2-9-01 Specific appliances, fireplaces and solid fuel-burning equipment.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:2-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 901
GENERAL

901.1 Scope. This chapter shall govern the approval, design, installation, construction, maintenance, alteration and repair of the appliances and equipment specifically identified herein and factory-built fireplaces. The approval, design, installation, construction, maintenance, alteration and repair of gas-fired appliances shall be regulated by the “International Fuel Gas Code”.

Exception: Section 501.8 of the “International Fuel Gas Code” permits certain gas fired appliances to be installed without venting. This section should not be construed as permitting the installation of portable unvented heaters in locations otherwise prohibited by section 3701.82 of the Revised Code or rules adopted by the state fire marshal pursuant to 3701.82 of the Revised Code.

901.2 General. The requirements of this chapter shall apply to the mechanical equipment and appliances regulated by this chapter, in addition to the other requirements of this code.

901.3 Hazardous locations. Fireplaces and solid fuel-burning appliances shall not be installed in hazardous locations.

SECTION 902
MASONRY FIREPLACES

902.1 General. Masonry fireplaces shall be constructed in accordance with the building code.

902.2 Fireplace accessories. Listed and labeled fireplace accessories shall be installed in accordance with the conditions of the listing and the manufacturer’s instructions. Fireplace accessories shall comply with UL 907.
SECTION 903
FACTORY-BUILT FIREPLACES

903.1 General. Factory-built fireplaces shall be listed and labeled and shall be installed in accordance with the conditions of the listing. Factory-built fireplaces shall be tested in accordance with UL 127.

903.2 Hearth extensions. Hearth extensions of approved factory-built fireplaces shall be installed in accordance with the listing of the fireplace. The hearth extension shall be readily distinguishable from the surrounding floor area. Listed and labeled hearth extensions shall comply with UL 1618.

903.3 Unvented gas log heaters. An unvented gas log heater shall not be installed in a factory-built fireplace unless the fireplace system has been specifically tested, listed and labeled for such use in accordance with UL 127.

903.4 Gasketed fireplace doors. A gasketed fireplace door shall not be installed on a factory-built fireplace except where the fireplace system has been specifically tested, listed and labeled for such use in accordance with UL 127.

SECTION 904
PELLET FUEL-BURNING APPLIANCES

904.1 General. Pellet fuel-burning appliances shall be listed and labeled in accordance with ASTM E 1509 and shall be installed in accordance with the terms of the listing.

SECTION 905
FIREPLACE STOVES AND ROOM HEATERS

905.1 General. Fireplace stoves and solid-fuel-type room heaters shall be listed and labeled and shall be installed in accordance with the conditions of the listing. Fireplace stoves shall be tested in accordance with UL 737. Solid-fuel-type room heaters shall be tested in accordance with UL 1482. Fireplace inserts intended for installation in fireplaces shall be listed and labeled in accordance with the requirements of UL 1482 and shall be installed in accordance with the manufacturer’s instructions.

905.2 Connection to fireplace. The connection of solid fuel appliances to chimney flues serving fireplaces shall comply with Sections 801.7 and 801.10.
905.3 Hearth extensions. Hearth extensions for fireplace stoves shall be installed in accordance with the listing of the fireplace stove. The hearth extension shall be readily distinguishable from the surrounding floor area. Listed and labeled hearth extensions shall comply with UL 1618.

SECTION 906
FACTORY-BUILT BARBECUE APPLIANCES

906.1 General. Factory-built barbecue appliances shall be of an approved type and shall be installed in accordance with the manufacturer’s instructions, this chapter and Chapters 3, 5, 7 and 8, and the International Fuel Gas Code.

SECTION 907
INCINERATORS AND CREMATORIES

907.1 General. Incinerators and crematories shall be listed and labeled in accordance with UL 791 and shall be installed in accordance with the manufacturer’s instructions.

SECTION 908
COOLING TOWERS, EVAPORATIVE CONDENSERS AND FLUID COOLERS

908.1 General. A cooling tower used in conjunction with an air-conditioning appliance shall be installed in accordance with the manufacturer’s instructions. Factory-built cooling towers shall be listed in accordance with UL 1995.

908.2 Access. Cooling towers, evaporative condensers and fluid coolers shall be provided with ready access.

908.3 Location. Cooling towers, evaporative condensers and fluid coolers shall be located to prevent the discharge vapor plumes from entering occupied spaces or outdoor public areas. Plume discharges shall be not less than 5 feet (1524 mm) above or 20 25 feet (60967620 mm) away from any ventilation inlet to a building including operable windows. Location on the property shall be as required for buildings in accordance with the building code.


908.4 Support and anchorage. Supports for cooling towers, evaporative
condensers and fluid coolers shall be designed in accordance with the building code. Seismic restraints shall be as required by the building code.

908.5 Water supply. Cooling towers, evaporative coolers and fluid coolers shall be provided with an approved water supply, sized for peak demand. The quality of water shall be provided in accordance with the equipment manufacturer’s recommendations. The piping system and protection of the potable water supply system shall be installed as required by the plumbing code.

908.6 Drainage. Drains, overflows and blowdown provisions shall be indirectly connected to an approved disposal location. Discharge of chemical waste shall be approved by the appropriate regulatory authority.

908.7 Refrigerants and hazardous fluids. Heat exchange equipment that contains a refrigerant and that is part of a closed refrigeration system shall comply with Chapter 11. Heat exchange equipment containing heat transfer fluids which are flammable, combustible or hazardous shall comply with the fire code.

908.8 Cooling towers. Cooling towers, both open circuit and closed circuit type, and evaporative condensers shall comply with Sections 908.8.1 and 908.8.2.

908.8.1 Conductivity or flow-based control of cycles of concentration. Cooling towers and evaporative condensers shall include controls that automate system bleed based on conductivity, fraction of metered makeup volume, metered bleed volume, recirculating pump run time or bleed time.

908.8.2 Drift eliminators. Cooling towers and evaporative condensers shall be equipped with drift eliminators that have a maximum drift rate of 0.005 percent of the circulated water flow rate as established in the equipment’s design specifications.

SECTION 909
VENTED WALL FURNACES

909.1 General. Vented wall furnaces shall be installed in accordance with their listing and the manufacturer’s instructions. Oil-fired furnaces shall be tested in accordance with UL 730.

909.2 Location. Vented wall furnaces shall be located so as not to cause a fire hazard to walls, floors, combustible furnishings or doors. Vented wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from
bathrooms to other parts of the building.

909.3 Door swing. Vented wall furnaces shall be located so that a door cannot swing within 12 inches (305 mm) of an air inlet or air outlet of such furnace measured at right angles to the opening. Doorstops or door closers shall not be installed to obtain this clearance.

909.4 Ducts prohibited. Ducts shall not be attached to wall furnaces. Casing extension boots shall not be installed unless listed as part of the appliance.

909.5 Manual shutoff valve. A manual shutoff valve shall be installed ahead of all controls.

909.6 Access. Vented wall furnaces shall be provided with access for cleaning of heating surfaces, removal of burners, replacement of sections, motors, controls, filters and other working parts, and for adjustments and lubrication of parts requiring such attention. Panels, grilles and access doors that must be removed for normal servicing operations shall not be attached to the building construction.

SECTION 910
FLOOR FURNACES

910.1 General. Floor furnaces shall be installed in accordance with their listing and the manufacturer’s instructions. Oil-fired furnaces shall be tested in accordance with UL 729.

910.2 Placement. Floor furnaces shall not be installed in the floor of any aisle or passageway of any auditorium, public hall, place of assembly, or in any egress element from any such room or space.

With the exception of wall register models, a floor furnace shall not be placed closer than 6 inches (152 mm) to the nearest wall, and wall register models shall not be placed closer than 6 inches (152 mm) to a corner.

The furnace shall be placed such that a drapery or similar combustible object will not be nearer than 12 inches (305 mm) to any portion of the register of the furnace. Floor furnaces shall not be installed in concrete floor construction built on grade. The controlling thermostat for a floor furnace shall be located within the same room or space as the floor furnace or shall be located in an adjacent room or space that is permanently open to the room or space containing the floor furnace.

910.3 Bracing. The floor around the furnace shall be braced and headed with a support framework design in accordance with the building code.
910.4 Clearance. The lowest portion of the floor furnace shall have not less than a 6-inch (152 mm) clearance from the grade level; except where the lower 6-inch (152 mm) portion of the floor furnace is sealed by the manufacturer to prevent entrance of water, the minimum clearance shall be reduced to not less than 2 inches (51 mm). Where these clearances are not present, the ground below and to the sides shall be excavated to form a pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A 12-inch (305 mm) minimum clearance shall be provided on all sides except the control side, which shall have an 18-inch (457 mm) minimum clearance.

SECTION 911
DUCT FURNACES

911.1 General. Duct furnaces shall be installed in accordance with the manufacturer’s instructions. Electric duct furnaces shall comply with UL 1996.

SECTION 912
INFRARED RADIANT HEATERS

912.1 General. Electric infrared radiant heaters shall comply with UL 499.

912.2 Support. Infrared radiant heaters shall be fixed in a position independent of fuel and electric supply lines. Hangers and brackets shall be noncombustible material.

912.3 Clearances. Heaters shall be installed with clearances from combustible material in accordance with the manufacturer’s installation instructions.

SECTION 913
CLOTHES DRYERS

913.1 General. Clothes dryers shall be installed in accordance with the manufacturer’s instructions. Electric residential clothes dryers shall be tested in accordance with UL 2158. Electric coin-operated clothes dryers shall be tested in accordance with UL 2158. Electric commercial clothes dryers shall be tested in accordance with UL 1240.

913.2 Exhaust required. Clothes dryers shall be exhausted in accordance with Section 504.
913.3 Clearances. Clothes dryers shall be installed with clearance to combustibles in accordance with the manufacturer’s instructions.

SECTION 914
SAUNA HEATERS

914.1 Location and protection. Sauna heaters shall be located so as to minimize the possibility of accidental contact by a person in the room.

914.1.1 Guards. Sauna heaters shall be protected from accidental contact by an approved guard or barrier of material having a low coefficient of thermal conductivity. The guard shall not substantially affect the transfer of heat from the heater to the room.

914.2 Installation. Sauna heaters shall be listed and labeled in accordance with UL 875 and shall be installed in accordance with their listing and the manufacturer’s instructions.

914.3 Access. Panels, grilles and access doors that are required to be removed for normal servicing operations shall not be attached to the building.

914.4 Heat and time controls. Sauna heaters shall be equipped with a thermostat that will limit room temperature to 194°F (90°C). If the thermostat is not an integral part of the sauna heater, the heat-sensing element shall be located within 6 inches (152 mm) of the ceiling. If the heat-sensing element is a capillary tube and bulb, the assembly shall be attached to the wall or other support, and shall be protected against physical damage.

914.4.1 Timers. A timer, if provided to control main burner operation, shall have a maximum operating time of 1 hour. The control for the timer shall be located outside the sauna room.

914.5 Sauna room. A ventilation opening into the sauna room shall be provided. The opening shall be not less than 4 inches by 8 inches (102 mm by 203 mm) located near the top of the door into the sauna room.

914.5.1 Warning notice. The following permanent notice, constructed of approved material, shall be mechanically attached to the sauna room on the outside:
WARNING: DO NOT EXCEED 30 MINUTES IN SAUNA. EXCESSIVE EXPOSURE CAN BE HARMFUL TO HEALTH. ANY PERSON WITH
SECTION 915
ENGINE AND GAS TURBINE-POWERED EQUIPMENT AND APPLIANCES

915.1 General. The installation of liquid-fueled stationary internal combustion engines and gas turbines, including exhaust, fuel storage and piping, shall meet the requirements of this section.

915.2 Powered equipment and appliances. Permanently installed equipment and appliances powered by internal combustion engines and turbines shall be installed in accordance with the manufacturer’s instructions and NFPA 37.

Section 915.2.1 Fuel tanks connected to engine-driven building services equipment. Fuel tanks piped to and supplying fuel for engine-driven building service equipment may be engine-mounted, located inside of a building, outside of a building, or on a roof in accordance with NFPA 37 or NFPA 30 and as modified by Section 1308 of the mechanical code for fuel oil and diesel oil tank installations.

Section 915.2.1.1 Engine-mounted tanks. Engine-mounted tanks located outdoors may be located in accordance with Section 4.1.4 of NFPA 37 and shall be vented in accordance with NFPA 30. Engine-mounted tanks shall be provided with adequate clearance to enable filling, maintenance, and testing, shall be safeguarded against public access, and shall be protected from impact.

Section 915.2.1.2 Other fuel tanks. Fuel tanks, other than engine-mounted tanks, piped to and supplying the engine shall be located, installed, and vented in accordance with the applicable sections of NFPA 37 or located, installed, and vented in accordance with NFPA 30.

Section 915.2.2 Gaseous fuel supply. Where an internal combustion engine supplied with gaseous fuel powers building service equipment, the fuel gas storage and piping system shall comply with NFPA 37 and the “International
Section 915.3 Engine-driven Stationary generators. Stationary emergency and standby power generator assemblies shall be listed in accordance with UL 2200 and shall comply with Section 2702.1 of the building code.

SECTION 916
POOL AND SPA HEATERS

916.1 General. Pool and spa heaters shall be installed in accordance with the manufacturer’s instructions. Oil-fired pool and spa heaters shall be tested in accordance with UL 726. Electric pool and spa heaters shall be tested in accordance with UL 1261.

SECTION 917
COOKING APPLIANCES

917.1 Cooking appliances. Cooking appliances that are designed for permanent installation, including ranges, ovens, stoves, broilers, grills, fryers, griddles and barbecues, shall be listed, labeled and installed in accordance with the manufacturer’s instructions. Commercial electric cooking appliances shall be listed and labeled in accordance with UL 197. Household electric ranges shall be listed and labeled in accordance with UL 858. Microwave cooking appliances shall be listed and labeled in accordance with UL 923. Oil-burning stoves shall be listed and labeled in accordance with UL 896. Solid-fuel-fired ovens shall be listed and labeled in accordance with UL 2162.

917.2 Domestic cooking appliances. Cooking appliances installed within dwelling units and within areas where domestic-type cooking operations occur shall be listed and labeled as domestic or household type appliances for domestic use.

SECTION 918
FORCED-AIR WARM-AIR FURNACES

918.1 Forced-air furnaces. Oil-fired furnaces shall be tested in accordance with UL 727. Electric furnaces shall be tested in accordance with UL 1995. Solid fuel furnaces shall be tested in accordance with UL 391. Forced-air furnaces shall be installed in accordance with the listings and the manufacturer’s instructions.
918.2 Heat pumps. Electric heat pumps shall be tested in accordance with UL 1995.

918.3 Dampers. Volume dampers shall not be placed in the air inlet to a furnace in a manner that will reduce the required air to the furnace.

918.4 Circulating air ducts for forced-air warm-air furnaces. Circulating air for fuel-burning, forced-air-type, warm-air furnaces shall be conducted into the blower housing from outside the furnace enclosure by continuous air-tight ducts.

918.5 Outdoor and return air openings. Outdoor intake openings shall be located in accordance with Section 401.4. Return air openings shall be located in accordance with Section 601.5.

918.6 Outdoor opening protection. Outdoor air intake openings shall be protected in accordance with Section 401.5.

SECTION 919
CONVERSION BURNERS

919.1 Conversion burners. The installation of conversion burners shall conform to ANSI Z21.8.

SECTION 920
UNIT HEATERS

920.1 General. Unit heaters shall be installed in accordance with the listing and the manufacturer’s instructions. Oil-fired unit heaters shall be tested in accordance with UL 731.

This section should not be construed as permitting the installation of portable unvented heaters in locations otherwise prohibited by section 3701.82 of the Revised Code or rules adopted by the state fire marshal pursuant to 3701.82 of the Revised Code.

920.2 Support. Suspended-type unit heaters shall be supported by elements that are designed and constructed to accommodate the weight and dynamic loads. Hangers and brackets shall be of noncombustible material. Suspended type oil-fired unit heaters shall be installed in accordance with NFPA 31.

920.3 Ductwork. A unit heater shall not be attached to a warm-air duct system unless listed for such installation.
SECTION 921
VENTED ROOM HEATERS

921.1 General. Vented room heaters shall be listed and labeled and shall be installed in accordance with the conditions of the listing and the manufacturer’s instructions.

SECTION 922
KEROSENE AND OIL-FIRED STOVES

922.1 General. Kerosene and oil-fired stoves shall be listed and labeled and shall be installed in accordance with the conditions of the listing and the manufacturer’s instructions. Kerosene and oil-fired stoves shall comply with NFPA 31 and UL 896. 

This section should not be construed as permitting the installation of portable unvented heaters in locations otherwise prohibited by section 3701.82 of the Revised Code or rules adopted by the state fire marshal pursuant to 3701.82 of the Revised Code.

SECTION 923
SMALL CERAMIC KILNS

923.1 General. Kilns shall be listed and labeled unless otherwise approved in accordance with Sections 106.5 or 114 of the building code. Electric kilns shall comply with UL 499.

923.1.1 Installation. Kilns shall be installed in accordance with the manufacturer’s instructions and the provisions of this code.

SECTION 924
STATIONARY FUEL CELL POWER SYSTEMS

924.1 General. Stationary fuel cell power systems having a power output not exceeding 10 MW shall be tested in accordance with ANSI/CSA America FC 1 and shall be installed in accordance with the manufacturer’s instructions, NFPA 853, the building code and the fire code.

SECTION 925
MASONRY HEATERS
925.1 General. Masonry heaters shall be constructed in accordance with the building code.

SECTION 926
GASEOUS HYDROGEN SYSTEMS

926.1 Installation. The installation of gaseous hydrogen systems shall be in accordance with the applicable requirements of this code, the fire code, the “International Fuel Gas Code” and the building code.

SECTION 927
RADIANT HEATING SYSTEMS

927.1 General. Electric radiant heating systems shall be installed in accordance with the manufacturer’s instructions and shall be listed for the application.

927.2 Clearances. Clearances for radiant heating panels or elements to any wiring, outlet boxes and junction boxes used for installing electrical devices or mounting luminaires shall be in accordance with the building code and NFPA 70.

927.3 Installation on wood or steel framing. Radiant panels installed on wood or steel framing shall conform to the following requirements:
   1. Heating panels shall be installed parallel to framing members and secured to the surface of framing members or shall be mounted between framing members.
   2. Mechanical fasteners shall penetrate only the unheated portions provided for this purpose. Panels shall not be fastened at any point closer than 1/4 inch (6.4 mm) to an element. Other methods of attachment of the panels shall be in accordance with the panel installation instructions.
   3. Unless listed and labeled for field cutting, heating panels shall be installed as complete units.

927.4 Installation in concrete or masonry. Radiant heating systems installed in concrete or masonry shall conform to the following requirements:
   1. Radiant heating systems shall be identified as being suitable for the installation, and shall be secured in place as specified in the manufacturer’s instructions.
   2. Radiant heating panels and radiant heating panel sets shall not be installed where they bridge expansion joints unless they are protected from expansion and contraction.
927.5 Finish surfaces. Finish materials installed over radiant heating panels and systems shall be installed in accordance with the manufacturer’s instructions. Surfaces shall be secured so that fasteners do not pierce the radiant heating elements.

SECTION 928
EVAPORATIVE COOLING EQUIPMENT

928.1 General. Evaporative cooling equipment shall:
1. Be installed in accordance with the manufacturer’s instructions.
2. Be installed on level platforms in accordance with Section 304.10.
3. Have openings in exterior walls or roofs flashed in accordance with the building code.
4. Be provided with an approved water supply, sized for peak demand. The quality of water shall be provided in accordance with the equipment manufacturer’s recommendations. The piping system and protection of the potable water supply system shall be installed as required by the plumbing code.
5. Have air intake opening locations in accordance with Section 401.4.
4101:2-11-01 Refrigeration.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:2-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 1101
GENERAL

1101.1 Scope. This chapter shall govern the design, installation, construction and repair of refrigeration systems that vaporize and liquefy a fluid during the refrigerating cycle. Refrigerant piping design and installation, including pressure vessels and pressure relief devices, shall conform to this code. Permanently installed refrigerant storage systems and other components shall be considered as part of the refrigeration system to which they are attached.

1101.2 Factory-built equipment and appliances. Listed and labeled self-contained, factory-built equipment and appliances shall be tested in accordance with UL 207, 412, 471 or 1995. Such equipment and appliances are deemed to meet the design, manufacture and factory test requirements of this code if installed in accordance with their listing and the manufacturer’s instructions.

1101.3 Protection. Any portion of a refrigeration system that is subject to physical damage shall be protected in an approved manner.

1101.4 Water connection. Water supply and discharge connections associated with refrigeration systems shall be made in accordance with this code and the plumbing code.

1101.5 Fuel gas connection. Fuel gas devices, equipment and appliances used with refrigeration systems shall be installed in accordance with the International Fuel Gas Code.

1101.6 General. Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15. Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15 and IIAR 2.
1101.7 Maintenance. Mechanical refrigeration systems shall be maintained in proper operating condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris and leaks.

1101.8 Change in refrigerant type. The type of refrigerant in refrigeration systems having a refrigerant circuit containing more than 220 pounds (99.8 kg) of Group A1 or 30 pounds (13.6 kg) of any other group refrigerant shall not be changed without prior notification to the code official and compliance with the applicable code provisions for the new refrigerant type.

1101.9 Refrigerant discharge. Notification of refrigerant discharge shall be provided in accordance with the fire code.

1101.10 Locking access port caps. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper-resistant caps or shall be otherwise secured to prevent unauthorized access.

Exception: This section shall not apply to refrigerant circuit access ports on equipment installed in controlled areas such as on roofs with locked access hatches or doors.

SECTION 1102
SYSTEM REQUIREMENTS

1102.1 General. The system classification, allowable refrigerants, maximum quantity, enclosure requirements, location limitations, and field pressure test requirements shall be determined as follows:

1. Determine the refrigeration system's classification, in accordance with Section 1103.3.
2. Determine the refrigerant classification in accordance with Section 1103.1.
3. Determine the maximum allowable quantity of refrigerant in accordance with Section 1104, based on type of refrigerant, system classification and occupancy.
4. Determine the system enclosure requirements in accordance with Section 1104.
5. Refrigeration equipment and appliance location and installation shall be subject to the limitations of Chapter 3.
6. Nonfactory-tested, field-erected equipment and appliances shall be pressure tested in accordance with Section 1108.

1102.2 Refrigerants. The refrigerant shall be that which the equipment or
appliance was designed to utilize or converted to utilize. Refrigerants not identified in Table 1103.1 shall be approved before use.

1102.2.1 Mixing. Refrigerants, including refrigerant blends, with different designations in ASHRAE 34 shall not be mixed in a system.

Exception: Addition of a second refrigerant is allowed where permitted by the equipment or appliance manufacturer to improve oil return at low temperatures. The refrigerant and amount added shall be in accordance with the manufacturer’s instructions.

1102.2.2 Purity. Refrigerants used in refrigeration systems shall be new, recovered or reclaimed refrigerants in accordance with Section 1102.2.2.1, 1102.2.2.2 or 1102.2.2.3. Where required by the equipment or appliance owner or the code official, the installer shall furnish a signed declaration that the refrigerant used meets the requirements of Section 1102.2.2.1, 1102.2.2.2 or 1102.2.2.3.

Exception: The refrigerant used shall meet the purity specifications set by the manufacturer of the equipment or appliance in which such refrigerant is used where such specifications are different from that specified in Sections 1102.2.2.1, 1102.2.2.2 and 1102.2.2.3.

1102.2.2.1 New refrigerants. Refrigerants shall be of a purity level specified by the equipment or appliance manufacturer.

1102.2.2.2 Recovered refrigerants. Refrigerants that are recovered from refrigeration and air-conditioning systems shall not be reused in other than the system from which they were recovered and in other systems of the same owner. Recovered refrigerants shall be filtered and dried before reuse. Recovered refrigerants that show clear signs of contamination shall not be reused unless reclaimed in accordance with Section 1102.2.2.3.

1102.2.2.3 Reclaimed refrigerants. Used refrigerants shall not be reused in a different owner’s equipment or appliances unless tested and found to meet the purity requirements of ARI 700. Contaminated refrigerants shall not be used unless reclaimed and found to meet the purity requirements of ARI 700.

1102.3 Access port protection. Refrigerant access ports shall be protected in accordance with Section 1101.10 whenever refrigerant is added to or recovered from refrigeration or air-conditioning systems.
SECTION 1103
REFRIGERATION SYSTEM CLASSIFICATION

1103.1 Refrigerant classification. Refrigerants shall be classified in accordance with ASHRAE 34 as listed in Table 1103.1.

1103.2 Occupancy classification. Locations of refrigerating systems are described by occupancy classifications that consider the ability of people to respond to potential exposure to refrigerants. Where equipment or appliances, other than piping, are located outside a building and within 20 feet (6096 mm) of any building opening, such equipment or appliances shall be governed by the occupancy classification of the building. Occupancy classifications shall be defined as follows:

1. Institutional occupancy is that portion of premises from which occupants cannot readily leave without the assistance of others because they are disabled, debilitated or confined. Institutional occupancies include, among others, hospitals, nursing homes, asylums and spaces containing locked cells.

2. Public assembly occupancy is that portion of premises where large numbers of people congregate and from which occupants cannot quickly vacate the space. Public assembly occupancies include, among others, auditoriums, ballrooms, classrooms, passenger depots, restaurants and theaters.

3. Residential occupancy is that portion of premises that provides the occupants with complete independent living facilities, including permanent provisions for living, sleeping, eating, cooking and sanitation. Residential occupancies include, among others, dormitories, hotels, multiunit apartments and private residences.

4. Commercial occupancy is that portion of premises where people transact business, receive personal service or purchase food and other goods. Commercial occupancies include, among others, office and professional buildings, markets (but not large mercantile occupancies) and work or storage areas that do not qualify as industrial occupancies.

5. Large mercantile occupancy is that portion of premises where more than 100 persons congregate on levels above or below street level to purchase personal merchandise.

6. Industrial occupancy is that portion of premises that is not open to the public, where access by authorized persons is controlled, and that is used to manufacture, process or store goods such as chemicals, food, ice, meat or petroleum.
7. Mixed occupancy occurs where two or more occupancies are located within the same building. Where each occupancy is isolated from the rest of the building by tight walls, floors and ceilings and by self-closing doors, the requirements for each occupancy shall apply to its portion of the building. Where the various occupancies are not so isolated, the occupancy having the most stringent requirements shall be the governing occupancy.

1103.3 System classification. Refrigeration systems shall be classified according to the degree of probability that refrigerant leaked from a failed connection, seal or component could enter an occupied area. The distinction is based on the basic design or location of the components.

1103.3.1 Low-probability systems. Double-indirect open-spray systems, indirect closed systems and indirect vented closed systems shall be classified as low-probability systems, provided that all refrigerant-containing piping and fittings are isolated when the quantities in Table 1103.1 are exceeded.

1103.3.2 High-probability systems. Direct systems and indirect open-spray systems shall be classified as high probability systems.

Exception: An indirect open-spray system shall not be required to be classified as a high-probability system if the pressure of the secondary coolant is at all times (operating and standby) greater than the pressure of the refrigerant.
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<th>CHEMICAL REFRIGERANT</th>
<th>FORMULA</th>
<th>CHEMICAL NAME OF BLEND</th>
<th>REFRIGERANT CLASSIFICATION</th>
<th>AMOUNT OF REFRIGERANT PER OCCUPIED SPACE</th>
<th>[F] DEGREES OF HAZARD</th>
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PART B - OMC Rules
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## TABLE 1103.1—continued

**REFRIGERANT CLASSIFICATION, AMOUNT AND OEL**

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<th>CHEMICAL REFRIGERANT</th>
<th>FORMULA</th>
<th>CHEMICAL NAME OF BLEND</th>
<th>REFRIGERANT CLASSIFICATION</th>
<th>AMOUNT OF REFRIGERANT PER OCCUPIED SPACE</th>
<th>[F] DEGREES OF HAZARD*</th>
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<td>azoetrap</td>
<td>R-22/115 (48.8/51.2)</td>
<td>A1</td>
<td>21 73,000 330 1,000</td>
<td>2-0-0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-503&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-23/13 (40.1/59.9)</td>
<td>—</td>
<td>—   —</td>
<td>2-0-0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-504&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-32/115 (48.2/51.8)</td>
<td>—</td>
<td>28 140,000 450 1,000</td>
<td>—</td>
</tr>
<tr>
<td>R-507&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-125/143a (50.0/50.0)</td>
<td>A1</td>
<td>32 130,000 520 1,000</td>
<td>2-0-0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-508&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-23/116 (39.0/61.0)</td>
<td>A1</td>
<td>14 55,000 220 1,000</td>
<td>2-0-0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-508&lt;sup&gt;b&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-23/116 (46.0/54.0)</td>
<td>A1</td>
<td>13 52,000 200 1,000</td>
<td>2-0-0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-509&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-22/218 (44.0/56.0)</td>
<td>A1</td>
<td>24 75,000 390 1,000</td>
<td>2-0-0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-510&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-E170/600a (88.0/12.0)</td>
<td>A3</td>
<td>0.87 7,300 14 1,000</td>
<td>—</td>
</tr>
<tr>
<td>R-511&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-290/E170 (95.0/5.0)</td>
<td>A3</td>
<td>0.59 5,300 9.5 1,000</td>
<td>—</td>
</tr>
<tr>
<td>R-512&lt;sup&gt;a&lt;/sup&gt;</td>
<td>azoetrap</td>
<td>R-134a/152a (5.0/95.0)</td>
<td>A2</td>
<td>1.9 11,000 31 1,000</td>
<td>—</td>
</tr>
<tr>
<td>R-600</td>
<td>CH₃CH₂CH₂CH₂</td>
<td>butane</td>
<td>A3</td>
<td>0.15 1,000 2.4 1,000</td>
<td>1-4-0</td>
</tr>
<tr>
<td>R-600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>CH(CH₃)CH₃</td>
<td>2-methylpropane (isobutane)</td>
<td>A3</td>
<td>0.59 4,000 9.6 1,000</td>
<td>2-4-0</td>
</tr>
<tr>
<td>R-601</td>
<td>CH₃CH₂CH₂CH₂CH₃</td>
<td>pentane</td>
<td>A3</td>
<td>0.18 1,000 2.9 600</td>
<td>—</td>
</tr>
<tr>
<td>R-601&lt;sup&gt;a&lt;/sup&gt;</td>
<td>CH₃CH₂CH₂CH₂CH₂</td>
<td>2-methylbutane (isopentane)</td>
<td>A3</td>
<td>0.18 1,000 2.9 600</td>
<td>—</td>
</tr>
<tr>
<td>R-717</td>
<td>NH₃</td>
<td>ammonia</td>
<td>B&lt;sup&gt;f&lt;/sup&gt;</td>
<td>0.014 320 0.22 25</td>
<td>3-3-0&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-718</td>
<td>H₂O</td>
<td>water</td>
<td>A1</td>
<td>—   —</td>
<td>0-0-0</td>
</tr>
<tr>
<td>R-744</td>
<td>CO₂</td>
<td>carbon dioxide</td>
<td>A1</td>
<td>4.5 40,000 72 5,000</td>
<td>2-0-0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>R-1150</td>
<td>CH₂=CH₂</td>
<td>ethene (ethylene)</td>
<td>A3</td>
<td>—   —</td>
<td>200</td>
</tr>
<tr>
<td>R-1234&lt;sup&gt;f&lt;/sup&gt;</td>
<td>CF₃CF=CF₂</td>
<td>2,3,3,3-tetrafluoro-1 propane</td>
<td>A&lt;sup&gt;f&lt;/sup&gt;</td>
<td>4.7 16,000 75 500</td>
<td>1-4-2</td>
</tr>
<tr>
<td>R-1234&lt;sup&gt;e&lt;/sup&gt;</td>
<td>CF3CH=CH₂</td>
<td>trans,1,3,3,3-tetrafluoro-1-propene</td>
<td>A&lt;sup&gt;f&lt;/sup&gt;</td>
<td>4.7 16,000 75 800</td>
<td>—</td>
</tr>
<tr>
<td>R-1270</td>
<td>CH₃CH=CH₂</td>
<td>Propene (propylene)</td>
<td>A3</td>
<td>0.1 1,000 1.7 500</td>
<td>1-4-1</td>
</tr>
</tbody>
</table>

<sup>a</sup> pound = 0.454 kg, 1 cubic foot = 0.0283 m³.

<sup>b</sup> Degrees of hazard are for health, fire, and reactivity, respectively, in accordance with NFPA 704.

<sup>c</sup> The ASHRAE Standard 34 flammability classification for this refrigerant is 2L, which is a subclass of Class 2.

<sup>d</sup> Carbon dioxide is prohibited in new installations.

<sup>e</sup> Ozone-depleting substance; prohibited for new installations.

<sup>f</sup> The maximum concentration for a rupture or full loss of refrigerant charge would not exceed the IDLH, considering both refrigerant quantity and room volume.

<sup>g</sup> Additional Exposure Limit based on the OSHA PEL, ACGIH TLV-TWA, the AIHA WEEL or consistent value on a time-weighted average (TWA) basis (unless noted C for ceiling) for an 8 hr/d and 40 hr/wk.

<sup>h</sup> Concentration-to-1-0-0 is allowed if analysis satisfactory to the code official shows that the maximum concentration for a rupture or full loss of refrigerant charge would not exceed the IDLH, considering both refrigerant quantity and room volume.

<sup>i</sup> The additional exposure limit is based on the OSHA PEL, ACGIH TLV-TWA, the AIHA WEEL or consistent value on a time-weighted average (TWA) basis (unless noted C for ceiling) for an 8 hr/d and 40 hr/wk.
SECTION 1104
SYSTEM APPLICATION REQUIREMENTS

1104.1 General. The refrigerant, occupancy and system classification cited in this section shall be determined in accordance with Sections 1103.1, 1103.2 and 1103.3, respectively.

1104.2 Machinery room. Except as provided in Sections 1104.2.1 and 1104.2.2, all components containing the refrigerant shall be located either outdoors or in a machinery room where the quantity of refrigerant in an independent circuit of a system exceeds the amounts shown in Table 1103.1. For refrigerant blends not listed in Table 1103.1, the same requirement shall apply when the amount for any blend component exceeds that indicated in Table 1103.1 for that component. This requirement shall also apply when the combined amount of the blend components exceeds a limit of 69,100 parts per million (ppm) by volume. Machinery rooms required by this section shall be constructed and maintained in accordance with Section 1105 for Group A1 and B1 refrigerants and in accordance with Sections 1105 and 1106 for Group A2, B2, A3 and B3 refrigerants.

Exceptions:
1. Machinery rooms are not required for listed equipment and appliances containing not more than 6.6 pounds (3 kg) of refrigerant, regardless of the refrigerant’s safety classification, where installed in accordance with the equipment’s or appliance’s listing and the equipment or appliance manufacturer’s installation instructions.
2. Piping in conformance with Section 1107 is allowed in other locations to connect components installed in a machinery room with those installed outdoors.

1104.2.1 Institutional occupancies. The amounts shown in Table 1103.1 shall be reduced by 50 percent for all areas of institutional occupancies except kitchens, laboratories and mortuaries. The total of all Group A2, B2, A3 and B3 refrigerants shall not exceed 550 pounds (250 kg) in occupied areas or machinery rooms.

1104.2.2 Industrial occupancies and refrigerated rooms. This section applies only to industrial occupancies and refrigerated rooms for manufacturing, food and beverage preparation, meat cutting, other processes and storage. Machinery rooms are not required where all of the following conditions are met:
1. The space containing the machinery is separated from other occupancies by tight construction with tight-fitting doors.
2. Access is restricted to authorized personnel.
3. The floor area per occupant is not less than 100 square feet (9.3 m²) where machinery is located on floor levels with exits more than 6.6 feet (2012 mm) above the ground. Where provided with egress directly to the outdoors or into approved building exits, the minimum floor area shall not apply.
4. Refrigerant detectors are installed as required for machinery rooms in accordance with Section 1105.3.
5. Surfaces having temperatures exceeding 800°F (427°C) and open flames are not present where any Group A2, B2, A3 or B3 refrigerant is used (see Section 1104.3.4).
6. All electrical equipment and appliances conform to Class 1, Division 2, hazardous location classification requirements of NFPA 70 where the quantity of any Group A2, B2, A3 or B3 refrigerant, other than ammonia, in a single independent circuit would exceed 25 percent of the lower flammability limit (LFL) upon release to the space.
7. All refrigerant-containing parts in systems exceeding 100 horsepower (hp) (74.6 kW) drive power, except evaporators used for refrigeration or dehumidification; condensers used for heating; control and pressure relief valves for either; and connecting piping, shall be located either outdoors or in a machinery room.

1104.3 Refrigerant restrictions. Refrigerant applications, maximum quantities and use shall be restricted in accordance with Sections 1104.3.1 through 1104.3.4.

1104.3.1 Air-conditioning for human comfort. In other than industrial occupancies where the quantity in a single independent circuit does not exceed the amount in Table 1103.1, Group B1, B2 and B3 refrigerants shall not be used in high-probability systems for air-conditioning for human comfort.

1104.3.2 Nonindustrial occupancies. Group A2 and B2 refrigerants shall not be used in high-probability systems where the quantity of refrigerant in any independent refrigerant circuit exceeds the amount shown in Table 1104.3.2. Group A3 and B3 refrigerants shall not be used except where approved.

Exception: This section does not apply to laboratories where the floor area per occupant is not less than 100 square feet (9.3 m²).
1104.3.3 All occupancies. The total of all Group A2, B2, A3 and B3 refrigerants other than R-717, ammonia, shall not exceed 1,100 pounds (499 kg) except where approved.

1104.3.4 Protection from refrigerant decomposition. Where any device having an open flame or surface temperature greater than 800°F (427°C) is used in a room containing more than 6.6 pounds (3 kg) of refrigerant in a single independent circuit, a hood and exhaust system shall be provided in accordance with Section 510. Such exhaust system shall exhaust combustion products to the outdoors.

Exception: A hood and exhaust system shall not be required where any of the following apply:
1. The refrigerant is R-717, R-718 or R-744.
2. The combustion air is ducted from the outdoors in a manner that prevents leaked refrigerant from being combusted.
3. A refrigerant detector is used to stop the combustion in the event of a refrigerant leak (see Sections 1105.3 and 1105.5).

### TABLE 1104.3.2
MAXIMUM PERMISSIBLE QUANTITIES OF REFRIGERANTS

<table>
<thead>
<tr>
<th>TYPE OF REFRIGERATION SYSTEM</th>
<th>MAXIMUM POUNDS FOR VARIOUS OCCUPANCIES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Institutional</td>
</tr>
<tr>
<td>Sealed absorption system</td>
<td></td>
</tr>
<tr>
<td>In exit access</td>
<td>0</td>
</tr>
<tr>
<td>In adjacent outdoor locations</td>
<td>0</td>
</tr>
<tr>
<td>In other than exit access</td>
<td>0</td>
</tr>
<tr>
<td>Unit systems</td>
<td></td>
</tr>
<tr>
<td>In other than exit access</td>
<td>0</td>
</tr>
</tbody>
</table>

For SI: 1 pound = 0.454 kg.

1104.4 Volume calculations. Volume calculations shall be in accordance with Sections 1104.4.1 through 1104.4.3.

1104.4.1 Noncommunicating spaces. Where the refrigerant-containing parts of a system are located in one or more spaces that do not communicate through permanent openings or HVAC ducts, the volume of the smallest, enclosed occupied space shall be used to determine the permissible quantity of refrigerant in the system.

1104.4.2 Communicating spaces. Where an evaporator or condenser is located in an air duct system, the volume of the smallest, enclosed occupied
space served by the duct system shall be used to determine the maximum allowable quantity of refrigerant in the system.

**Exception:** If airflow to any enclosed space cannot be reduced below one-quarter of its maximum, the entire space served by the air duct system shall be used to determine the maximum allowable quantity of refrigerant in the system.

1104.4.3 Plenums. Where the space above a suspended ceiling is continuous and part of the supply or return air plenum system, this space shall be included in calculating the volume of the enclosed space.

**SECTION 1105**

**MACHINERY ROOM, GENERAL REQUIREMENTS**

1105.1 Design and construction. Machinery rooms shall be designed and constructed in accordance with the building code and this section.

1105.2 Openings. Ducts and air handlers in the machinery room that operate at a lower pressure than the room shall be sealed to prevent any refrigerant leakage from entering the airstream.

1105.3 Refrigerant detector. Refrigerant detectors in machinery rooms shall be provided as required by Section 606.8 of the fire code.

1105.4 Tests. Periodic tests of the mechanical ventilating system shall be performed in accordance with manufacturer’s specifications and as required by the code official.

1105.5 Fuel-burning appliances. Fuel-burning appliances and equipment having open flames and that use combustion air from the machinery room shall not be installed in a machinery room.

**Exceptions:**
1. Where the refrigerant is carbon dioxide or water.
2. Fuel-burning appliances shall not be prohibited in the same machinery room with refrigerant-containing equipment or appliances where combustion air is ducted from outside the machinery room and sealed in such a manner as to prevent any refrigerant leakage from entering the combustion chamber, or where a refrigerant vapor detector is employed to automatically shut off the combustion process in the event of refrigerant leakage.
1105.6 Ventilation. Machinery rooms shall be mechanically ventilated to the outdoors.

**Exception:** Where a refrigerating system is located outdoors more than 20 feet (6096 mm) from any building opening and is enclosed by a penthouse, lean-to or other open structure, natural or mechanical ventilation shall be provided. Location of the openings shall be based on the relative density of the refrigerant to air. The free-aperture cross section for the ventilation of the machinery room shall be not less than:

\[ F = \sqrt{G} \]  

(Equation 11-1)

For SI: \( F = 0.138 \sqrt{G} \)

where:

\( F \) = The free opening area in square feet (m²).
\( G \) = The mass of refrigerant in pounds (kg) in the largest system, any part of which is located in the machinery room.

1105.6.1 Discharge location. The discharge of the air shall be to the outdoors in accordance with Chapter 5. Exhaust from mechanical ventilation systems shall be discharged not less than 20 feet (6096 mm) from a property line or openings into buildings.

1105.6.2 Makeup air. Provisions shall be made for makeup air to replace that being exhausted. Openings for makeup air shall be located to avoid intake of exhaust air. Supply and exhaust ducts to the machinery room shall not serve any other area, shall be constructed in accordance with Chapter 5 and shall be covered with corrosion-resistant screen of not less than 1/4-inch (6.4 mm) mesh.

1105.6.3 Ventilation rate. For other than ammonia systems, the mechanical ventilation systems shall be capable of exhausting the minimum quantity of air both at normal operating and emergency conditions, as required by Sections 1105.6.3.1 and 1105.6.3.2. The minimum required ventilation rate for ammonia shall be 30 air changes per hour in accordance with IIAR2. Multiple fans or multispeed fans shall be allowed to produce the emergency ventilation rate and to obtain a reduced airflow for normal ventilation.

1105.6.3.1 Quantity—normal ventilation. During occupied conditions, the mechanical ventilation system shall exhaust the larger of the following:
1. Not less than 0.5 cfm per square foot (0.0025 m³/s • m²) of machinery room area or 20 cfm (0.009 m³/s) per person.

2. A volume required to limit the room temperature rise to 18°F (10°C) taking into account the ambient heating effect of all machinery in the room.

**1105.6.3.2 Quantity—emergency conditions.** Upon actuation of the refrigerant detector required in Section 1105.3, the mechanical ventilation system shall exhaust air from the machinery room in the following quantity:

\[ Q = 100 \sqrt{G} \]  
\[ \text{(Equation 11-2)} \]

For SI: \[ Q = 0.67 \sqrt{G} \]

where:

- \( Q \) = The airflow in cubic feet per minute (m³/s).
- \( G \) = The design mass of refrigerant in pounds (kg) in the largest system, any part of which is located in the machinery room.

**1105.7 Termination of relief devices.** Pressure relief devices, fusible plugs and purge systems located within the machinery room shall terminate outside of the structure at a location not less than 15 feet (4572 mm) above the adjoining grade level and not less than 20 feet (6096 mm) from any window, ventilation opening or exit.

**1105.8 Ammonia discharge.** Pressure relief valves for ammonia systems shall discharge in accordance with ASHRAE 15.

**1105.9 Emergency pressure control system.** Permanently installed refrigeration systems containing more than 6.6 pounds (3 kg) of flammable, toxic or highly toxic refrigerant or ammonia shall be provided with an emergency pressure control system in accordance with Section 606.10 of the fire code.

**SECTION 1106**

**MACHINERY ROOM, SPECIAL REQUIREMENTS**

**1106.1 General.** Where required by Section 1104.2, the machinery room shall meet the requirements of this section in addition to the requirements of Section 1105.
1106.2 Elevated temperature. There shall not be an open flame-producing device or continuously operating hot surface over 800°F (427°C) permanently installed in the room.

1106.3 Ammonia room ventilation. Ventilation systems in ammonia machinery rooms shall be operated continuously at the ventilation rate specified in Section 1105.6.3.

Exceptions:
1. Machinery rooms equipped with a vapor detector that will automatically start the ventilation system at the ventilation rate specified in Section 1105.6.3, and that will actuate an alarm at a detection level not to exceed 1,000 ppm.
2. Machinery rooms conforming to the Class 1, Division 2, hazardous location classification requirements of NFPA 70.

1106.4 Flammable refrigerants. Where refrigerants of Groups A2, A3, B2 and B3 are used, the machinery room shall conform to the Class 1, Division 2, hazardous location classification requirements of NFPA 70.

Exception: Ammonia machinery rooms that are provided with ventilation in accordance with Section 1106.3.

1106.5 Remote controls. Remote control of the mechanical equipment and appliances located in the machinery room shall comply with Sections 1106.5.1 and 1106.5.2.

1106.5.1 Refrigeration system emergency shutoff. A clearly identified switch of the break-glass type or with an approved tamper-resistant cover shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally closed, automatic refrigerant valves located in the machinery room. Additionally, this equipment shall be automatically shut off whenever the refrigerant vapor concentration in the machinery room exceeds the vapor detector’s upper detection limit or 25 percent of the LEL, whichever is lower.

1106.5.2 Ventilation system. A clearly identified switch of the break-glass type or with an approved tamper resistant cover shall provide on-only control of the machinery room ventilation fans.

1106.6 Emergency signs and labels. Refrigeration units and systems shall be provided with approved emergency signs, charts, and labels in accordance with the fire code.
SECTION 1107
REFRIGERANT PIPING

1107.1 General. The design of refrigerant piping shall be in accordance with ASME B31.5. Refrigerant piping shall be installed, tested and placed in operation in accordance with this chapter.

1107.2 Piping location. Refrigerant piping that crosses an open space that affords passageway in any building shall be not less than 7 feet 3 inches (2210 mm) above the floor unless the piping is located against the ceiling of such space. Refrigerant piping shall not be placed in any of the following: elevator, dumbwaiter or other shaft containing a moving object or in any shaft that has openings to living quarters or to means of egress. Refrigerant piping shall not be installed in an enclosed public stairway, stairway landing or means of egress.

1. A fire-resistance-rated exit access corridor.
2. An interior exit stairway.
3. An interior exit ramp.
4. An exit passageway.
5. An elevator, dumbwaiter or other shaft containing a moving object.
6. A shaft that has one or more openings into a fire-resistance-rated exit access corridor, interior exit stairway or ramp or exit passageway.

1107.2.1 Piping in concrete floors. Refrigerant piping installed in concrete floors shall be encased in pipe ducts. The piping shall be isolated and supported to prevent damaging vibration, stress and corrosion.

1107.2.2 Refrigerant penetrations. Refrigerant piping shall not penetrate floors, ceilings or roofs.

Exceptions:
1. Penetrations connecting the basement and the first floor.
2. Penetrations connecting the top floor and a machinery penthouse or roof installation.
3. Penetrations connecting adjacent floors served by the refrigeration system.
4. Penetrations by piping in a direct system where the refrigerant quantity does not exceed Table 1103.1 for the smallest occupied space through which the piping passes.
5. In other than industrial occupancies and where the refrigerant quantity exceeds Table 1103.1 for the smallest space, penetrations for piping that connects separate pieces of equipment that are either:
5.1. Enclosed by an approved gas-tight, fire-resistant duct or shaft with openings to those floors served by the refrigeration system.
5.2. Located on the exterior of the building where vented to the outdoors or to the space served by the system and not used as an air shaft, closed court or similar space.

1107.3 **Pipe enclosures.** Rigid or flexible metal enclosures or pipe ducts shall be provided for soft, annealed copper tubing and used for refrigerant piping erected on the premises and containing other than Group A1 or B1 refrigerants. Enclosures shall not be required for connections between condensing units and the nearest riser box(es), provided such connections do not exceed 6 feet (1829 mm) in length.

1107.4 **Condensation.** Refrigerating piping and fittings, brine piping and fittings that, during normal operation, will reach a surface temperature below the dew point of the surrounding air, and are located in spaces or areas where condensation will cause a safety hazard to the building occupants, structure, electrical equipment or any other equipment or appliances, shall be protected in an approved manner to prevent such damage.

1107.5 **Materials for refrigerant pipe and tubing.** Piping materials shall be as set forth in Sections 1107.5.1 through 1107.5.5.

1107.5.1 **Steel pipe.** Carbon steel pipe with a wall thickness not less than Schedule 80 shall be used for Group A2, A3, B2 or B3 refrigerant liquid lines for sizes 1.5 inches (38 mm) and smaller. Carbon steel pipe with a wall thickness not less than Schedule 40 shall be used for Group A1 or B1 refrigerant liquid lines 6 inches (152 mm) and smaller, Group A2, A3, B2 or B3 refrigerant liquid lines sizes 2 inches (51 mm) through 6 inches (152 mm) and all refrigerant suction and discharge lines 6 inches (152 mm) and smaller. Type F steel pipe shall not be used for refrigerant lines having an operating temperature less than -20°F (-29°C).

1107.5.2 **Copper and brass pipe.** Standard iron-pipe size, copper and red brass (not less than 80-percent copper) pipe shall conform to ASTM B 42 and ASTM B 43.

1107.5.3 **Copper tube.** Copper tube used for refrigerant piping erected on the premises shall be seamless copper tube of Type ACR (hard or annealed) complying with ASTM B 280. Where approved, copper tube for refrigerant piping erected on the premises shall be seamless copper tube of Type K, L or
M (drawn or annealed) in accordance with ASTM B 88. Annealed temper copper tube shall not be used in sizes larger than a 2-inch (51 mm) nominal size. Mechanical joints shall not be used on annealed temper copper tube in sizes larger than 7/8-inch (22.2 mm) OD size.

1107.5.4 Copper tubing joints. Copper tubing joints used in refrigerating systems containing Group A2, A3, B2 or B3 refrigerants shall be brazed. Soldered joints shall not be used in such refrigerating systems.

1107.5.5 Aluminum tube. Type 3003-0 aluminum tubing with high-pressure fittings shall not be used with methyl chloride and other refrigerants known to attack aluminum.

1107.6 Joints and refrigerant-containing parts in air ducts. Joints and all refrigerant-containing parts of a refrigerating system located in an air duct of an air-conditioning system carrying conditioned air to and from human-occupied space shall be constructed to withstand, without leakage, a pressure of 150 percent of the higher of the design pressure or pressure relief device setting.

1107.7 Exposure of refrigerant pipe joints. Refrigerant pipe joints erected on the premises shall be exposed for visual inspection prior to being covered or enclosed.

1107.8 Stop valves. Systems containing more than 6.6 pounds (3 kg) of a refrigerant in systems using positive-displacement compressors shall have stop valves installed as follows:
1. At the inlet of each compressor, compressor unit or condensing unit.
2. At the discharge outlet of each compressor, compressor unit or condensing unit and of each liquid receiver.

Exceptions:
1. Systems that have a refrigerant pumpout function capable of storing the entire refrigerant charge in a receiver or heat exchanger.
2. Systems that are equipped with provisions for pumpout of the refrigerant using either portable or permanently installed recovery equipment.
3. Self-contained systems.

1107.8.1 Liquid receivers. Systems containing 100 pounds (45 kg) or more of a refrigerant, other than systems utilizing nonpositive displacement compressors, shall have stop valves, in addition to those required by Section 1107.8, on each inlet of each liquid receiver. Stop valves shall not be required
on the inlet of a receiver in a condensing unit, nor on the inlet of a receiver which is an integral part of the condenser.

1107.8.2 Copper tubing. Stop valves used with soft annealed copper tubing or hard-drawn copper tubing 7/8-inch (22.2 mm) OD standard size or smaller shall be securely mounted, independent of tubing fastenings or supports.

1107.8.3 Identification. Stop valves shall be identified where their intended purpose is not obvious. Numbers shall not be used to label the valves, unless a key to the numbers is located near the valves.

SECTION 1108
FIELD TEST

1108.1 General. Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, vessels, evaporators, safety devices, pressure gauges and control mechanisms that are listed and factory tested, shall be tested and proved tight after complete installation, and before operation. Tests shall include both the high- and low-pressure sides of each system at not less than the lower of the design pressures or the setting of the pressure relief device(s). The design pressures for testing shall be those listed on the condensing unit, compressor or compressor unit nameplate, as required by ASHRAE 15.

Exceptions:
1. Gas bulk storage tanks that are not permanently connected to a refrigeration system.
2. Systems erected on the premises with copper tubing not exceeding 5/8-inch (15.8 mm) OD, with wall thickness as required by ASHRAE 15, shall be tested in accordance with Section 1108.1, or by means of refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 70°F (21°C) or higher.
3. Limited-charge systems equipped with a pressure relief device, erected on the premises, shall be tested at a pressure not less than one and one-half times the pressure setting of the relief device. If the equipment or appliance has been tested by the manufacturer at one and one-half times the design pressure, the test after erection on the premises shall be conducted at the design pressure.

1108.1.1 Booster compressor. Where a compressor is used as a booster to obtain an intermediate pressure and discharges into the suction side of another
compressor, the booster compressor shall be considered a part of the low side, provided that it is protected by a pressure relief device.

1108.1.2 Centrifugal/nonpositive displacement compressors. In field-testing systems using centrifugal or other nonpositive displacement compressors, the entire system shall be considered as the low-side pressure for field test purposes.

1108.2 Test gases. Tests shall be performed with an inert dried gas including, but not limited to, nitrogen and carbon dioxide. Oxygen, air, combustible gases and mixtures containing such gases shall not be used.

Exception: The use of air is allowed to test R-717, ammonia, systems provided that they are subsequently evacuated before charging with refrigerant.

1108.3 Test apparatus. The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gauge on the outlet side.

1108.4 Declaration. A certificate of test shall be provided for all systems containing 55 pounds (25 kg) or more of refrigerant. The certificate shall give the name of the refrigerant and the field test pressure applied to the high side and the low side of the system. The certification of test shall be signed by the installer and shall be made part of the public record.

SECTION 1109
PERIODIC TESTING

1109.1 Testing required. The following emergency devices and systems shall be periodically tested in accordance with the manufacturer’s instructions and as required by the code official:

1. Treatment and flaring systems.
2. Valves and appurtenances necessary to the operation of emergency refrigeration control boxes.
3. Fans and associated equipment intended to operate emergency pure ventilation systems.
4. Detection and alarm systems.
4101:2-15-01 Referenced standards.

1501.1 General. This chapter lists the codes and standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and the title. The application of the referenced standards shall be as specified in Section 102.5 of the building code.

1501.2 Referenced codes: When indicated in the OMC, the following codes refer to provisions in the listed chapters of the Administrative Code:

<table>
<thead>
<tr>
<th>Referenced code</th>
<th>Ohio Administrative Code chapters</th>
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<tr>
<td>Building Code</td>
<td>4101:1-1 to 4101:1-35</td>
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<td>Fire Code</td>
<td>1301:7-1 to 1301:7-7</td>
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<td>Ohio Boiler and Pressure Vessel Rules</td>
<td>4101:4-1 to 4101:4-10</td>
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<td>Plumbing Code</td>
<td>4101:3-1 to 4101:3-15</td>
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1501.3 Referenced Standards.

ACCA Air Conditioning Contractors of America
2800 Shirlington Road, Suite 300
Arlington, VA 22206

<table>
<thead>
<tr>
<th>Standard Referenced</th>
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<tr>
<td>Manual D—2014</td>
<td>Residential Duct Systems</td>
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AHRI Air-Conditioning, Heating and Refrigeration Institute
4100 North Fairfax Drive, Suite 200
Arlington, VA 22203

<table>
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<tr>
<td>700—2016</td>
<td>Purity Specifications for Fluorocarbon and</td>
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with Addendum 1 Other Refrigerants

**AMCA** Air Movement and Control Association International
30 West University Drive
Arlington Heights, IL 60004

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<td>230-CD1</td>
<td>Laboratory Methods of Testing Air Circulating Fans for Rating and Certification</td>
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<td>550—15</td>
<td>Test Method for High Velocity Wind Driven Rain Resistant Louvers</td>
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**ANSI** American National Standards Institute
11 West 42nd Street
New York, NY 10036

<table>
<thead>
<tr>
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<td>Z21.8—1994 (R2012)</td>
<td>Installation of Domestic Gas Conversion Burners</td>
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**ASHRAE** American Society of Heating, Refrigerating and Air-Conditioning Engineers
1791 Tullie Circle, NE
Atlanta, GA 30329

<table>
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<td>15—2013</td>
<td>Safety Standard for Refrigeration Systems</td>
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<td>34—2013</td>
<td>Designation and Safety Classification of Refrigerants</td>
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<tr>
<td>62.1—2016</td>
<td>Ventilation for Acceptable Indoor Air Quality</td>
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<tr>
<td>62.2-2016</td>
<td>Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings</td>
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<td>170—2013</td>
<td>Ventilation of Health Care Facilities</td>
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</table>
180—2012 Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems

**ASME** American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

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<td>B1.20.1—2013</td>
<td>Pipe Threads, General Purpose (Inch)</td>
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<td>Malleable Iron Threaded Fittings, Classes 150 &amp; 300</td>
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<td>Pipe Flanges and Flanged Fittings NPS ½ through NPS 24</td>
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<td>Factory Made Wrought Steel Buttwelding Fittings</td>
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<td>Forged Fittings, Socket-welding and Threaded</td>
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<td>Cast Copper Alloy Solder Joint Pressure Fittings</td>
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<td>B16.22—2-13</td>
<td>Wrought Copper and Copper Alloy Solder Joint Pressure Fittings</td>
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<td>B16.24—2011</td>
<td>Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500</td>
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<td>B16.26—2013</td>
<td>Cast Copper Alloy Fittings for Flared Copper Tubes</td>
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<td>Wrought Steel Buttwelding Short Radius Elbows and Returns</td>
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<td>B16.51—2013</td>
<td>Copper and Copper Alloy Press-Connect Pressure Fittings</td>
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<td>B31.5—2016</td>
<td>Refrigeration Piping and Heat Transfer Components</td>
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<td>BPVC— the edition referenced in rule 4101:4-3-01 of the Administrative Code</td>
<td>ASME Boiler &amp; Pressure Vessel Code</td>
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<td>CSD-1—the edition referenced</td>
<td>Controls and Safety Devices for</td>
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in rule 4101:4-3-01 of the Administrative Code

**ASSE** American Society of Safety Engineers  
1800 East Oakton Street  
Des Plaines, IL 60018

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<thead>
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<tr>
<td>ANSI/ASSE Z359.1-2007</td>
<td>Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components, Part of the Fall Protection Code</td>
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**ASSE** American Society of Sanitary Engineering  
901 Canterbury, Suite A  
Westlake, OH 44145

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<td>1017—2010</td>
<td>Performance Requirements for Temperature Actuated Mixing Values for Hot Water Distribution Systems</td>
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**ASTM** International  
100 Barr Harbor Drive  
West Conshohocken, PA 19428

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<td>A 53/A 53M—12</td>
<td>Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated Welded and Seamless</td>
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<td>A 106/A106M—14</td>
<td>Specification for Seamless Carbon Steel Pipe for High-Temperature Service</td>
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<td>A 126—14</td>
<td>Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings</td>
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<tr>
<td>A 234/A234M—15</td>
<td>Standard Specification for Piping Fittings of Wrought Carbon Steel And Alloy Steel For</td>
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A 254/A254-12: Specification for Copper Brazed Steel Tubing
A 420/A 420M—16: Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
A 536-14: Standard Specification for Ductile Iron Castings
A 539—99: Specification for Electric-resistance-welded Coiled Steel Tubing for Gas and Fuel Oil Lines
B 32—14: Specification for Solder Metal
B 42—15: Specification for Seamless Copper Pipe, Standard Sizes
B 68—11: Specification for Seamless Copper Tube, Bright Annealed
B 75—11: Specification for Seamless Copper Tube
B 88—14: Specification for Seamless Copper Water Tube
B 135—10: Specification for Seamless Brass Tube
B 251—10: Specification for General Requirements for Wrought Seamless Copper and Copper-alloy Tube
B 280—16: Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
B 302—12: Specification for Threadless Copper Pipe, Standard Sizes
B 813—16: Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
D 56—16: Test Method for Flash Point by Tag Closed Tester
D 93—16  Test Method for Flash Point of Pensky-Martens Closed Cup Tester
D 1693—15  Test Method for Environmental Stress-Cracking of Ethylene Plastics
D 1785—15  Specification for Poly (Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80 and 120
D 2241—15  Specification for Poly (Vinyl Chloride)(PVC) Pressure-rated Pipe (SDR-Series)
D 2412—11  Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-plate Loading
D 2466—15  Specification for Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
D 2467—15  Specification for Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 80
D 2564—12  Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
D 2683—14  Specification for Socket-type Polyethylene Fittings for Outside Diameter-controlled Polyethylene Pipe and Tubing
D2737—12A  Standard Specification for Polyethylene (PE) Plastic Tubing
D 2846/D 2846M—14  Specification for Chlorinated Poly (Vinyl...
Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems

D 2996—15 Specification for Filament-wound Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe

D 3035—2015 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

D 3261—15 Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing


E 84—16 Test Method for Surface Burning Characteristics of Building Materials


E 136—16 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

E 814—2013a Test Method for Fire Tests of Through-penetration Fire Stops

E 1509—12 Specification for Room Heaters, Pellet Fuel-burning Type

E 2231—15 Standard Practice For Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

E 2336—16 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems

F 437—15 Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F 438—15 Specification for Socket Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40

F 439—13 Specification for Socket Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F 441/F 441M—15 Specification for Chlorinated Poly (Vinyl
Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

F 442/F 442M—13 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

F 493—14 Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

F 714—13 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter

F 876—2015a Specification for Cross-linked Polyethylene (PEX) Tubing

F 877—2011A Specification for Cross-linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems

F 1055—15 Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Cross-linked Polyethylene Pipe and Tubing

F 1281—11 Specification for Cross-linked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe

F 1282—10 Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe


F 1807—15 Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR 9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing

F 1924—12 Standard Specification for Plastic Mechanical Fittings for Use on Outside
Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing

F1960—15 Specification for Cold-Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing


F2080—15a Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Cross-linked Polyethylene (PEX) Pipe

F2098—15 Standard Specification for Stainless Steel Clamps for SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal and Plastic Insert Fittings

F 2159—14 Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR 9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing

F 2389—15 Specification for Pressure-rated Polypropylene Piping Systems

F2434—14 Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/ Cross-linked Polyethylene (PEX-AL-PEX) Tubing

F 2623—14 Standard Specification for Polyethylene of Raised Temperature (PE-RT) SDR 9 Tubing


F 2769—14 Polyethylene of Raised Temperature (PE-RT) Plastic Hot- and Cold-water Tubing and Distribution Systems

**AWS**  American Welding Society  
8669 NW 36 Street, #130  
Doral, FL 33166

<table>
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<tr>
<td>A5.8M/A5.8—2011</td>
<td>Specifications for Filler Metals for Brazing and Braze Welding</td>
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**AWWA**  American Water Work Association  
6666 West Quincy Avenue  
Denver, CO 80235

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<tr>
<td>C901—08</td>
<td>Polyethylene (PE) Pressure Pipe and Tubing, 1/16 in. (13mm) through 3 in. (76mm) for Water Service</td>
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<tr>
<td>C110/A21.10—12</td>
<td>Standard for Ductile Iron &amp; Gray Iron Fittings</td>
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<tr>
<td>C151/A21.51—09</td>
<td>Standard for Ductile-Iron Pipe, Centrifugally Cast for Water</td>
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**CSA**  CSA Group  
8501 East Pleasant Valley Road  
Cleveland, OH 44131-5516

<table>
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B137.2—13 Polyvinylchloride (PVC) Injection-moulded Gasketed Fittings for Pressure Applications
B137.3—13 Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications
B137.6—13 Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing and Fittings for Hot- and Cold-water Distribution Systems
B137.9—13 Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure-Pipe Systems
B137.10—13 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Composite Pressure-Pipe Systems
CSA B137.1—13 Polyethylene (PE) Pipe, Tubing and Fittings for Cold Water Pressure Services.
CSA B137.5—13 Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications
CSA B137.11—13 Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
ANSI CSA America FC1—2014 Stationary Fuel Cell Power Systems

**DOL** Department of Labor
Occupational Safety and Health Administration c/o Superintendent of Documents
US Government Printing Office
Washington, DC 20402-9325

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<tr>
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**FS** Federal Specifications*
General Services Administration 7th & D Streets
Specification Section, Room 6039 Washington, DC 20407
<table>
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<tr>
<td>WW-P-325B (1976)</td>
<td>Pipe, Bends, Traps, Caps and Plugs; Lead (for Industrial Pressure and Soil and Waste Applications)</td>
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<tr>
<td></td>
<td>*Standards are available from the Supt. of Documents, U.S. Government Printing Office, Washington, DC 20402-9325</td>
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**ICC** International Code Council, Inc.  
500 New Jersey Ave, NW  
6th Floor  
Washington, DC 20001

<table>
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<td>IECC—12</td>
<td>International Energy Conservation Code®</td>
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**IIAR** International Institute of Ammonia Refrigeration  
1110 North Glebe Road  
Arlington, VA 22201

<table>
<thead>
<tr>
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<td>MSS</td>
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<td>SP 58—2009</td>
<td>Pipe Hangers and Supports—Materials Design and Manufacture, Selection, Application and Installation</td>
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<tr>
<th>NAIMA</th>
<th>North American Insulation Manufacturers Association</th>
<th>44 Canal Center Plaza, Suite 310</th>
<th>Alexandria, VA 22314</th>
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<td>AH116—09</td>
<td>Fibrous Glass Duct Construction Standards</td>
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<th>NBBI</th>
<th>National Board of Boiler and Pressure Vessel Inspectors</th>
<th>1055 Crupper Avenue</th>
<th>Columbus, OH 43229-1183</th>
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<td><strong>Standard Referenced</strong></td>
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<td>NBIC— <em>the edition referenced in rule 4101:4-3-01 of the Administrative Code</em></td>
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<th>National Fire Protection Association</th>
<th>1 Batterymarch Park</th>
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<td>Code for Motor Fuel-dispensing Facilities and Repair Garages</td>
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<td>31—16</td>
<td>Standard for the Installation of Oil-burning Equipment</td>
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<td>37—15</td>
<td>Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines</td>
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<td>58—17</td>
<td>Liquefied Petroleum Gas Code</td>
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<td>69—14</td>
<td>Standard on Explosion Prevention Systems</td>
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<td>70—17</td>
<td>National Electrical Code (including TIA 17-8)</td>
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<td>72—16</td>
<td>National Fire Alarm and Signaling Code</td>
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<td><em>Protection of Information Technology Equipment</em></td>
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<td>82—14</td>
<td>Standard on Incinerators and Waste and Linen Handling Systems and Equipment</td>
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<td>91—15</td>
<td>Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids</td>
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<td>92—15</td>
<td>Standard for Smoke Control Systems</td>
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<td>211—16</td>
<td>Standard for Chimneys, Fireplaces, Vents and Solid Fuel-burning Appliances</td>
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<td>262—15</td>
<td>Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-handling Spaces</td>
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<td>286—15</td>
<td>Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 602.2.1.6.2</td>
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<td>704—17</td>
<td>Standard System for Identification of the Hazards of Materials for Emergency Response</td>
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<td>853—15</td>
<td>Standard on Installation of Stationary Fuel Power Plants</td>
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### NSF
NSF International  
789 Dixboro Road, P. O. Box 130140  
Ann Arbor, MI 48113-0140

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<td>NSF 14-2011</td>
<td>Plastic Piping System Components and Related Materials</td>
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<td>NSF 358-1-2014</td>
<td>Polyethylene Pipe and Fittings for Water Based Ground Source “Geothermal” Heat Pump Systems</td>
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### SMACNA  
Sheet Metal & Air-Conditioning Contractors National Assoc., Inc.  
4201 Lafayette Center Drive  
Chantilly, VA 20151-1209

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<tr>
<td>SMACNA—10</td>
<td>Fibrous Glass Duct Construction Standards</td>
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### UL
Underwriters Laboratories LLC  
333 Pfingsten Road  
Northbrook, IL 60062-2096

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<td>17—2008</td>
<td>Vent or Chimney Connector Dampers for Oil-fired Appliances— with revisions Through January 2010803.6</td>
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<td>103—2010</td>
<td>Factory-built Chimneys, Residential Type and Building Heating Appliance— with revisions through July 2012</td>
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<td>127—2011</td>
<td>Factory-built Fireplaces</td>
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<td>174—04</td>
<td>Household Electric Storage Tank Water</td>
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Heaters—with revisions through September 2012
180—2012 Liquid-level Indicating Gauges for Oil Burner Fuels and Other Combustible Liquids
181—13 Factory-made Air Ducts and Air Connectors
181A—2013 Closure Systems for Use with Rigid Air Ducts and Air Connectors
181B—2013 Closure Systems for Use with Flexible Air Ducts and Air Connectors
197—10 Commercial Electric Cooking Appliances—with revisions through June 2011
207—2009 Refrigerant-containing Components and Accessories, Nonelectrical
263—2011 Standard for Fire Test of Building Construction and Materials
268—2016 Smoke Detectors for Fire Alarm Systems
268A—2008 Smoke Detectors for Duct Application—with revisions through September 2009
343—2008 Pumps for Oil-Burning Appliances—with revisions through June 2013
378—06 Draft Equipment—with revisions through January 2010
391—2010 Solid-fuel and Combination-fuel Central and Supplementary Furnaces—with revisions through March 2010
412—2011 Refrigeration Unit Coolers—with revisions through August 2012
471—2010 Commercial Refrigerators and Freezers—with revisions through December 2012
499—14 Electric Heating Appliances
508—99 Industrial Control Equipment—with revisions through March 2013
536—14 Flexible Metallic Hose
555—06 Fire Dampers—with revisions through May 2012
555C—14 Ceiling Dampers
555S—14 Smoke Dampers
586—2009 High-Efficiency, Particulate, Air Filter Units
641—2010 Type L Low-temperature Venting Systems—with revisions through May 2013
705—2004 Standard for Power Ventilators—with
710—2012 Exhaust Hoods for Commercial Cooking Equipment
710B—2011 Recirculating Systems
723—2008 Standard for Test for Surface Burning Characteristics of Building Materials
726—95 Oil-fired Boiler Assemblies—with revisions through March 2012
727—06 Oil-fired Central Furnace—with revisions through April 2011
729—03 Oil-fired Floor Furnaces—with revisions through August 2012
730—03 Oil-fired Wall Furnaces—with revisions through August 2012
731—95 Oil-fired Unit Heaters—with revisions through August 2012
732—95 Oil-fired Storage Tank Water Heaters—with revisions through April 2010
737—2011 Fireplace Stoves
762—2013 Outline of Investigation for Power Ventilators for Restaurant Exhaust Appliances
791—06 Residential Incinerators—with revisions through April 2010
834—04 Heating, Water Supply and Power Boilers Electric—with revisions through January 2013
842—15 Valves for Flammable Fluids
858—14 Household Electric Ranges
867—2011 Electrostatic Air Cleaners—with revisions through February 2013
875—09 Electric Dry Bath Heater—with revisions through November 2011
896—93 Oil-burning Stoves—with revisions through August 2012
900—15 Air Filter Units
907—16 Fireplace Accessories
923—2013 Microwave Cooking Appliances
959—2010 Medium Heat Appliance Factory-built Chimneys
1046—2010 Grease Filters for Exhaust Ducts—with
revisions through January 2012

1240—2012 Electric Commercial Clothes—Drying Equipment—with revisions through October 2012

1261—01 Electric Water Heaters for Pools and Tubs—with revisions through July 2012

1453—16 Electric Booster and Commercial Storage Tank Water Heaters

1479—15 Fire Tests of Through-penetration Firestops

1482—2011 Solid-fuel Type Room Heaters

1618—15 Wall Protectors, Floor Protectors and Hearth Extensions

1777—2015 Chimney Liners

1812—2013 Standard for Ducted Heat Recovery Ventilators

1815—2012 Standard for Nonducted Heat Recovery

1820—04 Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics—with revisions through May 2013

1887—04 Fire Tests of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics—with revisions through May 2013

1978—2010 Grease Ducts

1995—2015 Heating and Cooling Equipment

1996—2009 Electric Duct Heaters—with revisions through November 2011

2024—2014 Standard for Safety Optical-Fiber and Communications Cable Raceway—with revisions through April 2011

2043—2013 Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-handling Spaces

2085-10 Protected Above-Ground Tanks for Flammable and Combustible Liquids

2158—15 Electric Clothes Dryers

2158A—2013 Outline of Investigation for Clothes Dryer Transition Duct

2162—14 Outline of Investigation for Commercial Wood-fired Baking Ovens-Refractory Type

2200—2012 Stationery Engine Generator Assemblies—with revisions through June 2013
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<td>Tests of Fire Resistive Grease Duct Enclosure Assemblies</td>
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<td>2518—16</td>
<td>Air Dispersion System Materials</td>
</tr>
<tr>
<td>2523—09</td>
<td>Solid Fuel-fired Hydronic Heating Appliances—with revisions through February 2013</td>
</tr>
</tbody>
</table>
PART C - OHIO PLUMBING CODE RULES

4101:3-4-01 Fixtures, faucets and fixture fittings.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:3-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 401
GENERAL

401.1 Scope. This chapter shall govern the materials, design and installation of plumbing fixtures, faucets and fixture fittings in accordance with the type of occupancy, and shall provide for the minimum number of fixtures for various types of occupancies.

401.2 Prohibited fixtures and connections. Water closets having a concealed trap seal or an unventilated space or having walls that are not thoroughly washed at each discharge in accordance with ASME A112.19.2/CSA B45.1 shall be prohibited. Any water closet that permits siphonage of the contents of the bowl back into the tank shall be prohibited. Trough urinals shall be prohibited.

401.3 Water conservation. The maximum water flow rates and flush volume for plumbing fixtures and fixture fittings shall comply with Section 604.4.

SECTION 402
FIXTURE MATERIALS

402.1 Quality of fixtures. Plumbing fixtures shall be constructed of approved materials, with smooth, impervious surfaces, free from defects and concealed fouling surfaces, and shall conform to standards cited in this code. All porcelain enameled surfaces on plumbing fixtures shall be acid resistant.

402.2 Materials for specialty fixtures. Materials for specialty fixtures not otherwise covered in this code shall be of stainless steel, soapstone, chemical stoneware or plastic, or shall be lined with lead, copper-base alloy, nickel-copper alloy, corrosion-resistant steel or other material especially suited to the application for which the fixture is intended.

402.3 Sheet copper. Sheet copper for general applications shall conform to
ASTM B 152 and shall not weigh less than 12 ounces per square foot (3.7 kg/m²).

**402.4 Sheet lead.** Sheet lead for pans shall not weigh less than 4 pounds per square foot (19.5 kg/m²) and shall be coated with an asphalt paint or other approved coating.

### SECTION 403
**MINIMUM PLUMBING FACILITIES**

**403.1 Minimum number of fixtures.** Plumbing fixtures shall be provided in the minimum number as shown in Table 403.1, based on the actual use of the building or space. Uses not shown in Table 403.1 shall be considered individually by the building official. The number of occupants shall be determined by the building code. When the actual occupant load will be significantly different than that determined by section 1004 of the building code, the building official may establish an alternate basis for determining the occupant load. This alternate basis shall be included in the special stipulations and conditions section of the certificate of occupancy issued for that structure pursuant to section 110 of the building code. For accessibility requirements, see “Chapter 11, Accessibility” of the building code.

**Exception:** Facilities are not required in buildings less than 100 square feet in area if fixtures are available within 500 feet of the building.

<table>
<thead>
<tr>
<th>NO.</th>
<th>CLASSIFICATION</th>
<th>OCCUPANCY</th>
<th>DESCRIPTION</th>
<th>WATER CLOSETS (URINALS: See footnote g)</th>
<th>LAVATORIES</th>
<th>BATHTUBS/SHOWER</th>
<th>DRINKING FOUNTAINS (See Section 410 for exceptions)</th>
<th>OTHER</th>
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<tr>
<td></td>
<td>A-1d</td>
<td>Assembly</td>
<td>Theaters and other buildings for the performing arts and motion pictures</td>
<td>1 per 125 1 per 65</td>
<td>1 per 200</td>
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<td>1 per 500</td>
<td>1 service sink</td>
</tr>
<tr>
<td>1</td>
<td>A-2d</td>
<td>Casino gaming areas</td>
<td>Nightclubs, bars, taverns, dance halls and buildings for similar purposes</td>
<td>1:1-100 3:1-50</td>
<td>1:1-200</td>
<td>—</td>
<td>1 per 500</td>
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<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>MALE</th>
<th>FEMALE</th>
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<td>1/1-100</td>
<td>4:51-100</td>
<td>2:201-400</td>
<td>1 service sink</td>
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</table>

Public Hearing Draft
Amendments Group XCIX (99)
PART C - OPC Rules
Page C-2
| A-3d | Auditoriums without permanent seating, art galleries, exhibition halls, museums, lecture halls, libraries, arcades and gymnasiu | 1 per 125 | 1 per 65 | 1 per 200 | — | 1 per 500 | 1 service sink |
| A-3d | Passenger terminals and transportation facilities | 1 per 500 | 1 per 500 | 1 per 750 | — | 1 per 1,000 | 1 service sink |
| A-3d | Places of worship and other religious services. | 1 per 150 | 1 per 75 | 1 per 200 | — | 1 per 1,000 | 1 service sink |

| A-4 | Coliseums, arenas, skating rinks, pools and tennis courts for indoor sporting events and activities | 1 per 75 | 1 per 120 for the first 1,500 and 1 per 120 for the remainder exceeding 1,500 | 1 per 40 for the first 1,520 and 1 per 60 for the remainder exceeding 1,520 | 1 per 200 | — | 1 per 1,000 | 1 service sink |

| A-5 | Stadiums, amusement parks, bleachers and grandstands for outdoor sporting events and activities | 1 per 75 | 1 per 120 for the first 1,500 and 1 per 120 for the remainder exceeding 1,500 | 1 per 40 for the first 1,520 and 1 per 60 for the remainder exceeding 1,520 | 1 per 200 | — | 1 per 1,000 | 1 service sink |

| 2 Business B | Buildings for the transaction of business, professional services, other services involving merchandise, office buildings, banks, ambulatory care, light industrial and similar uses | 1 per 50 | 1 per 80 | — | 1 per 100 | 1 service sink |

<p>| 3 Educational E | Educational facilities | 1 per 50 | 1 per 50 | — | 1 per 100 | 1 service sink |</p>
<table>
<thead>
<tr>
<th></th>
<th>Category</th>
<th>Use</th>
<th>per 100</th>
<th>per 100</th>
<th>(see Section 411)</th>
<th>per 400</th>
<th>per floor</th>
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<tr>
<td>4</td>
<td>Factory and industrial</td>
<td>F-1 and F-2</td>
<td>Structures in which occupants are engaged in work fabricating, assembly or processing of products or materials</td>
<td>1 per 100</td>
<td>1 per 100</td>
<td>(see Section 411)</td>
<td>1 per 400</td>
<td>1 service sink</td>
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<td>5</td>
<td>Institutional</td>
<td>I-1</td>
<td>Residential care</td>
<td>1 per 10</td>
<td>1 per 10</td>
<td>1 per 8</td>
<td>1 per 100</td>
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<td></td>
<td></td>
<td>I-2</td>
<td>Hospitals, ambulatory nursing home care recipient</td>
<td>1 per room</td>
<td>1 per room</td>
<td>1 per 15</td>
<td>1 per 100</td>
<td>1 service sink per floor</td>
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<td></td>
<td>I-2</td>
<td>Employees, other than residential care</td>
<td>1 per 25</td>
<td>1 per 35</td>
<td>—</td>
<td>1 per 100</td>
<td>—</td>
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<tr>
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<td></td>
<td>I-2</td>
<td>Visitors, other than residential care</td>
<td>1 per 75</td>
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<td>—</td>
<td>1 per 500</td>
<td>—</td>
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<td></td>
<td></td>
<td>I-3</td>
<td>Prisons</td>
<td>1 per cell</td>
<td>1 per cell</td>
<td>1 per 15</td>
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<td>I-3</td>
<td>Reformitories, detention centers, and correctional centers</td>
<td>1 per 15</td>
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<td>I-4</td>
<td>Employees</td>
<td>1 per 25</td>
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<td>—</td>
<td>1 per 100</td>
<td>—</td>
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<td>6</td>
<td>Mercantile</td>
<td>M</td>
<td>Retail stores, service stations, shops, salesrooms, markets and shopping centers</td>
<td>1 per 500</td>
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<td>Residential</td>
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<td>Hotels, motels, boarding houses (transient)</td>
<td>1 per sleeping unit</td>
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<td>R-2</td>
<td>Dormitories, fraternities, sororities and boarding houses (not transient)</td>
<td>1 per 10</td>
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<td>1 per 8</td>
<td>1 per 100</td>
<td>1 service sink</td>
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<td>R-2</td>
<td>Apartment house</td>
<td>1 per dwelling unit</td>
<td>1 per dwelling unit</td>
<td>1 per dwelling unit</td>
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<td>1 kitchen sink per dwelling unit; 1 automatic clothes washer connection per 20 dwelling units</td>
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<td>One-, Two-, and Three-family dwellings, Multiple single-family dwellings, and lodging houses with five or fewer</td>
<td>1 per dwelling unit</td>
<td>1 per dwelling unit</td>
<td>1 per dwelling unit</td>
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<td>1 kitchen sink per dwelling unit; 1 automatic clothes washer connection per dwelling unit</td>
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<td>8 Storage</td>
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<td>Guestrooms</td>
<td>Congregate living facilities with 16 or fewer persons and other R-3 occupancies</td>
<td>Congregate care/residential care/assisted living facilities</td>
<td>Structures for the storage of goods, warehouses, storehouse and freight depots. Low and Moderate Hazard.</td>
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</table>

a. The fixtures shown are based on one fixture being the minimum required for the number of persons indicated or any fraction of the number of persons indicated. The number of occupants shall be determined by the building code.
b. Toilet facilities for employees shall be separate from facilities for inmates or care recipients.
c. A single-occupant toilet room with one water closet and one lavatory serving not more than two adjacent patient sleeping units shall be permitted, provided that each patient sleeping unit has direct access to the toilet room and provisions for privacy for the toilet room user are provided.
d. The occupant load for seasonal outdoor seating and entertainment areas shall be included when determining the minimum number of facilities required.
e. For business and mercantile occupancies with an occupant load of 15 or fewer, service sinks shall not be required.
f. Mercantile occupancies are not required to provide customer facilities when the occupant load is 50 or less.
g. In each bathroom or toilet room, urinals shall not be substituted for more than 67 percent of the required water closets in assembly and educational occupancies. Urinals shall not be substituted for more than 50 percent of the required water closets in all other occupancies.
403.1.1 Fixture calculations. To determine the occupant load of each sex, the total occupant load shall be divided in half. To determine the required number of fixtures, the fixture ratio or ratios for each fixture type shall be applied to the occupant load of each sex in accordance with Table 403.1. Fractional numbers resulting from applying the fixture ratios of Table 403.1 shall be rounded up to the next whole number. For calculations involving multiple occupancies, such fractional numbers for each occupancy shall first be summed and then rounded up to the next whole number.

Exception:
1. The total occupant load shall not be required to be divided in half where approved statistical data indicates a distribution of the sexes of other than 50 percent of each sex.
2. Distribution of the sexes is not required where single-user water closets and bathing room fixtures are provided in accordance with Section 403.1.2.

403.1.2 Single-user toilet facility and bathing room fixtures. The plumbing fixtures located in single-user toilet facilities and bathing rooms, including family or assisted-use toilet and bathing rooms that are required by Section 1109.2.1 of the building code shall contribute towards the total number of required plumbing fixtures for a building or tenant space. Single-user toilet facilities and bathing rooms, and family or assisted-use toilet and bathing rooms shall be identified for use by either sex.

The total number of fixtures shall be permitted to be based on the required number of separate facilities or based on the aggregate of any combination of single-user or separate facilities.

403.2 Separate facilities. Where plumbing fixtures are required, separate facilities shall be provided for each sex.

Exceptions:
1. Separate facilities shall not be required for dwelling units and sleeping units.
2. Separate facilities shall not be required in structures or tenant spaces with a total occupant load, including both employees and customers, of 15 or fewer.
3. Separate facilities shall not be required in mercantile occupancies in which the maximum occupant load is 100 or fewer.
4. Separate facilities shall not be required in business occupancies in which the maximum occupant load is 25 or fewer.
5. Separate facilities shall not be required to be designated by sex where single-user toilets rooms are provided in accordance with Section 403.1.2.

6. Separate facilities shall not be required where rooms having both water closets and lavatory fixtures are designed for use by both sexes and privacy for water closets are installed in accordance with Section 405.3.4. Urinals shall be located in an area visually separated from the remainder of the facility or each urinal that is provided shall be located in a stall.

403.2.1 Family or assisted-use toilet facilities serving as separate facilities. Where a building or tenant space requires a separate toilet facility for each sex and each toilet facility is required to have only one water closet, two family or assisted-use toilet facilities shall be permitted to serve as the required separate facilities. Family or assisted use toilet facilities shall not be required to be identified for exclusive use by either sex as required by Section 403.4.

403.3 Required public toilet facilities. Customers, patrons and visitors shall be provided with public toilet facilities in structures and tenant spaces intended for public utilization. The number of plumbing fixtures located within the required toilet facilities shall be provided in accordance with Section 403 for all users. Employees shall be provided with toilet facilities in all occupancies. Employee toilet facilities shall be either separate or combined employee and public toilet facilities.

Exception: Public toilet facilities shall not be required in:
1. Open or enclosed parking garages.
2. Structures and tenant spaces intended for quick transactions, including takeout, pickup and dropoff, having a public access area less than or equal to 300 square feet (28 m²).

403.3.1 Access. The route to the public toilet facilities required by Section 403.3 shall not pass through kitchens, storage rooms, closets or similar spaces not available to the public. Access to the required facilities shall be from within the building or from the exterior of the building. Routes shall comply with the accessibility requirements of the building code. The public shall have access to the required toilet facilities at all times that the building is occupied. The building owner is permitted to control access to the toilet facilities. Where such access is controlled, a sign shall be posted indicating how access is to be obtained.

403.3.2 Prohibited toilet room location. Toilet rooms shall not open directly into a room used for the preparation of food for service to the public.
403.3.3 Location of toilet facilities in occupancies other than malls. In occupancies other than covered and open mall buildings, the required public and employee toilet facilities shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 500 feet (152 m).

Exception: The location and maximum distances of travel to required employee facilities in factory and industrial occupancies are permitted to exceed that required by this section, provided that the location and maximum distance of travel are approved.

403.3.4 Location of toilet facilities in malls. In covered and open mall buildings, the required public and employee toilet facilities shall be located not more than one story above or below the space required to be provided with toilet facilities, and the path of travel to such facilities shall not exceed a distance of 300 feet (91 m). In mall buildings, the required facilities shall be based on total square footage within a covered mall building or within the perimeter line of an open mall building, and facilities shall be installed in each individual store or in a central toilet area located in accordance with this section. The maximum distance of travel to central toilet facilities in mall buildings shall be measured from the main entrance of any store or tenant space. In mall buildings, where employees’ toilet facilities are not provided in the individual store, the maximum distance of travel shall be measured from the employees’ work area of the store or tenant space.

403.3.5 Pay facilities. Where pay facilities are installed, such facilities shall be in excess of the required minimum facilities. Required facilities shall be free of charge.

403.3.6 Door locking. Where a toilet room is provided for the use of multiple occupants, the egress door for the room shall not be lockable from the inside of the room. This section does not apply to family or assisted-use toilet rooms.

403.4 Signage. Required public facilities shall be provided with signs that designate the sex, as required by Section 403.2. Signs shall be readily visible and located near the entrance to each toilet facility. Signs for accessible toilet facilities shall comply with Section 1111 of the building code.

403.4.1 Directional signage. Deleted.
403.5 Drinking fountain location. Drinking fountains shall not be required to be located in individual tenant spaces provided that public drinking fountains are located within a distance of travel of 500 feet (152 m) of the most remote location in the tenant space and not more than one story above or below the tenant space. Where the tenant space is in a covered or open mall, such distance shall not exceed 300 feet (91 m). Drinking fountains shall be located on an accessible route.

403.6 Enforcement. This section is identical to Section 2902 of the building code. It is provided in this code for reference only. Enforcement of the provisions of Section 2902 of the building code and this section is the responsibility of the certified building official of the certified municipal, county, or township building department having jurisdiction or the superintendent of the division of industrial compliance.

SECTION 404
ACCESSIBLE PLUMBING FACILITIES

404.1 Where required. Accessible plumbing facilities and fixtures shall be provided in accordance with the building code. The provisions of “Chapter 11, Accessibility” of the building code shall control the design and construction of facilities for accessibility to physically disabled persons.

404.2 Accessible fixture requirements. Accessible plumbing fixtures shall be installed with the clearances, heights, spacings and arrangements in accordance with ICC A117.1 and chapter 11 of the building code.

404.3 Exposed pipes and surfaces. Water supply and drain pipes under accessible lavatories and sinks shall be covered or otherwise configured to protect against contact. Pipe coverings shall comply with ASME A112.18.9.

404.4 Enforcement. Enforcement of the provisions of this section is the responsibility of the certified building official of the certified municipal, county, or township building department having jurisdiction or the superintendent of the division of industrial compliance.

SECTION 405
INSTALLATION OF FIXTURES

405.1 Water supply protection. The supply lines and fittings for every plumbing fixture shall be installed so as to prevent backflow.
405.2 Access for cleaning. Plumbing fixtures shall be installed so as to afford easy access for cleaning both the fixture and the area around the fixture.

405.3 Setting. Fixtures shall be set level and in proper alignment with reference to adjacent walls.

405.3.1 Water closets, urinals, lavatories and bidets. A water closet, urinal, lavatory or bidet shall not be set closer than 15 inches (381 mm) from its center to any side wall, partition, vanity or other obstruction, or closer than 30 inches (762 mm) center to center between adjacent fixtures. There shall be not less than a 21-inch (533 mm) clearance in front of the water closet, urinal, lavatory or bidet to any wall, fixture or door. Water closet compartments shall be not less than 30 inches (762 mm) in width and not less than 60 inches (1524 mm) in depth for floor-mounted water closets and not less than 30 inches (762 mm) in width and 56 inches (1422 mm) in depth for wall-hung water closets. See Chapter 11 of the building code for the minimum required dimensions for accessible fixtures.

405.3.2 Public lavatories. In employee and public toilet rooms, the required lavatory shall be located in the same room as the required water closet.

405.3.3 Location of fixtures and piping. Piping, fixtures or equipment shall not be located in such a manner as to interfere with the normal operation of windows, doors or other means of egress openings.

405.3.4 Water closet compartment. Each water closet utilized by the public or employees shall occupy a separate compartment with walls or partitions and a door enclosing the fixtures to ensure privacy.

Exceptions:
1. Water closet compartments shall not be required in a single-occupant toilet room with a lockable door.
2. Toilet rooms located in child day care facilities and containing two or more water closets shall be permitted to have one water closet without an enclosing compartment.
3. This provision is not applicable to toilet areas located within Group I-3 housing areas.

405.3.5 Urinal partitions. Each urinal utilized by the public or employees shall occupy a separate area with walls or partitions to provide privacy. The
walls or partitions shall begin at a height not greater than 12 inches (305 mm) from and extend not less than 60 inches (1524 mm) above the finished floor surface. The walls or partitions shall extend from the wall surface at each side of the urinal not less than 18 inches (457 mm) or to a point not less than 6 inches (152 mm) beyond the outermost front lip of the urinal measured from the finished back wall surface, whichever is greater.

Exceptions:
1. Urinal partitions shall not be required in a single occupant or family/assisted-use toilet room with a lockable door.
2. Toilet rooms located in child day care facilities and containing two or more urinals shall be permitted to have one urinal without partitions.

405.4 Floor and wall drainage connections. Connections between the drain and floor outlet plumbing fixtures shall be made with a floor flange or a waste connector and sealing gasket. The waste connector and sealing gasket joint shall comply with the joint tightness test of ASME A112.4.3 and shall be installed in accordance with the manufacturer’s instructions. The flange shall be attached to the drain and anchored to the structure. Connections between the drain and wall-hung water closets shall be made with an approved extension nipple or horn adaptor. The water closet shall be bolted to the hanger with corrosion-resistant bolts or screws. Joints shall be sealed with an approved elastomeric gasket, flange-to-fixture connection complying with ASME A112.4.3 or an approved setting compound.

405.4.1 Floor flanges. Floor flanges for water closets or similar fixtures shall be not less than 0.125 inch (3.2 mm) thick for brass, 0.25 inch (6.4 mm) thick for plastic and 0.25 inch (6.4 mm) thick and not less than a 2-inch (51 mm) caulking depth for cast iron or galvanized malleable iron. Closet screws and bolts shall be of brass. Flanges shall be secured to the building structure with corrosion-resistant screws or bolts.

405.4.2 Securing floor outlet fixtures. Floor outlet fixtures shall be secured to the floor or floor flanges by screws or bolts of corrosion-resistant material.

405.4.3 Securing wall-hung water closet bowls. Wall-hung water closet bowls shall be supported by a concealed metal carrier that is attached to the building structural members so that strain is not transmitted to the closet connector or any other part of the plumbing system. The carrier shall conform to ASME A112.6.1M or ASME A112.6.2.
405.5 **Water-tight joints.** Joints formed where fixtures come in contact with walls or floors shall be sealed.

405.6 **Plumbing in mental health centers.** *Deleted.*

405.7 **Design of overflows.** Where any fixture is provided with an overflow, the waste shall be designed and installed so that standing water in the fixture will not rise in the overflow when the stopper is closed, and no water will remain in the overflow when the fixture is empty.

405.7.1 **Connection of overflows.** The overflow from any fixture shall discharge into the drainage system on the inlet or fixture side of the trap.

**Exception:** The overflow from a flush tank serving a water closet or urinal shall discharge into the fixture served.

405.8 **Slip joint connections.** Slip joints shall be made with an approved elastomeric gasket and shall only be installed on the trap outlet, trap inlet and within the trap seal. Fixtures with concealed slip-joint connections shall be provided with an access panel or utility space not less than 12 inches (305 mm) in its smallest dimension or other approved arrangement so as to provide access to the slip joint connections for inspection and repair.

405.9 **Design and installation of plumbing fixtures.** Integral fixture fitting mounting surfaces on manufactured plumbing fixtures or plumbing fixtures constructed on site shall meet the design requirements of ASME A112.19.2/CSA B45.1 or ASME A112.19.3/CSA B45.4.

### SECTION 406

**AUTOMATIC CLOTHES WASHERS**

406.1 **Water connection.** The water supply to an automatic clothes washer shall be protected against backflow by an air gap that is integral with the machine or a backflow preventer shall be installed in accordance with Section 802.4. Air gaps shall comply with ASME A112.1.2 or A112.1.3.

406.2 **Waste connection.** The waste from an automatic clothes washer shall discharge through an air break into a standpipe in accordance with Section 802.4 802.3.3 or into a laundry sink. The trap and fixture drain for an automatic clothes washer standpipe shall be not less than 2 inches (51 mm) in diameter. The fixture drain for the standpipe serving an automatic clothes washer shall connect to a 3-inch (76 mm) or larger diameter fixture branch or stack. Automatic clothes...
washers that discharge by gravity shall be permitted to drain to a waste receptor or an approved trench drain.

**SECTION 407**

**BATHTUBS**

407.1 **Approval.** Bathtubs shall conform to ASME A112.19.1/ CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/ CSA B45.4 or CSA B45.5/IAPMO Z124.

407.2 **Bathtub waste outlets and overflows.** Bathtubs shall be equipped with a waste outlet and an overflow outlet. The outlets shall be connected to waste tubing or piping not less than 1 1/2 inches (38 mm) in diameter. The waste outlet shall be equipped with a water-tight stopper.

407.3 **Glazing.** Windows and doors within a bathtub enclosure shall conform to the safety glazing requirements of the building code.

407.4 **Bathtub enclosure.** Doors in a bathtub enclosure shall conform to ASME A112.19.15.

**SECTION 408**

**BIDETS**

408.1 **Approval.** Bidets shall conform to ASME A112.19.2/ CSA B45.1.

408.2 **Water connection.** The water supply to a bidet shall be protected against backflow by an air gap or backflow preventer in accordance with Section 608.13.1, 608.13.2, 608.13.3, 608.13.5, 608.13.6 or 608.13.8.

408.3 **Bidet water temperature.** The discharge water temperature from a bidet fitting shall be limited to a maximum temperature of 110°F (43°C) by a water temperature limiting device conforming to ASSE 1070 or CSA B125.3.

**SECTION 409**

**DISHWASHING MACHINES**

409.1 **Approval.** Commercial dishwashing machines shall conform to ASSE 1004 and NSF 3.
409.2 Water connection. The water supply to a dishwashing machine shall be protected against backflow by an air gap that is integral with the machine or a backflow preventer shall be installed in accordance with Section 608. Air gaps shall comply with ASME A112.1.2 or A112.1.3.

409.3 Waste connection. The waste connection of a dishwashing machine shall comply with Section 802.1.6 or 802.1.7, as applicable.

SECTION 410

DRINKING FOUNTAINS

410.1 Approval. Drinking fountains shall conform to ASME A112.19.1/CSA B45.2 or ASME A112.19.2/CSA B45.1 and water coolers shall conform to AHRI 1010. Drinking fountains and water coolers shall conform to NSF 61, Section 9. Electrically operated, refrigerated drinking water coolers shall be listed and labeled in accordance with UL 399.

410.2 Small occupancies. Drinking fountains shall not be required for an occupant load of 15 or fewer.

410.3 Provide high and low drinking fountains. Where drinking fountains are required, not fewer than two drinking fountains shall be provided. One drinking fountain shall comply with the requirements for people who use a wheelchair and one drinking fountain shall comply with the requirements for standing persons.

Exception Exceptions:
1. A single drinking fountain with two separate spouts that complies with the requirements for people who use a wheelchair and standing persons shall be permitted to be substituted for two separate drinking fountains.
2. Where drinking fountains are primarily for children’s use, the drinking fountains for people using wheelchairs shall be permitted to comply with the children’s provisions in ICC A117.1 and drinking fountains for standing children shall be permitted to provide the spout at 30 inches (762 mm) minimum above the floor.

410.4 Substitution. Where restaurants provide drinking water in a container free of charge, drinking fountains shall not be required in those restaurants. In other occupancies, where water dispensers are provided, drinking fountains shall not be required.

410.5 Prohibited location. Drinking fountains, water coolers and water dispensers shall not be installed in public toilet facilities.
SECTION 411
EMERGENCY SHOWERS AND EYEWASH STATIONS

411.1 Approval. Emergency showers and eyewash stations shall conform to ISEA Z358.1.

411.2 Waste connection. Waste connections shall not be required for emergency showers and eyewash stations.

SECTION 412
FLOOR AND TRENCH DRAINS

412.1 Approval. Floor drains shall conform to ASME A112.3.1, ASME A112.6.3 or CSA B79. Trench drains shall comply with ASME A112.6.3.

412.2 Floor drains. Floor drains shall have removable strainers. The floor drain shall be constructed so that the drain is capable of being cleaned. Access shall be provided to the drain inlet. Ready access shall be provided to floor drains.

Exception: Floor drains serving refrigerated display cases shall be provided with access.

412.3 Size of floor drains. Floor drains shall have a drain outlet not less than 2 inches (51 mm) in diameter.

412.4 Public laundries and central washing facilities. In public coin-operated laundries and in the central washing facilities of multiple-family dwellings, the rooms containing automatic clothes washers shall be provided with floor drains located to readily drain the entire floor area. Such drains shall have an outlet of not less than 3 inches (76 mm) in diameter.

SECTION 413
FOOD WASTE DISPOSER UNITS

413.1 Approval. Domestic food waste disposers shall conform to ASSE 1008 and shall be listed and labeled in accordance with UL 430. Food waste disposers shall not increase the drainage fixture unit load on the sanitary drainage system.

413.2 Domestic food waste disposer waste outlets. Domestic food waste disposers shall be connected to a drain of not less than 1 1/2 inches (38 mm) in diameter.
413.3 **Commercial food waste disposer waste outlets.** Commercial food waste disposers shall be connected to a drain not less than 1\(\frac{1}{2}\) inches (38 mm) in diameter. Commercial food waste disposers shall be connected and trapped separately from any other fixtures or sink compartments.

413.4 **Water supply required.** Food waste disposers shall be provided with a supply of cold water. The water supply shall be protected against backflow by an air gap or backflow preventer in accordance with Section 608.

**SECTION 414**

**GARBAGE CAN WASHERS**

414.1 **Water connection.** The water supply to a garbage can washer shall be protected against backflow by an air gap or a backflow preventer in accordance with Section 608.13.1, 608.13.2, 608.13.3, 608.13.5, 608.13.6 or 608.13.8.

414.2 **Waste connection.** Garbage can washers shall be trapped separately. The receptacle receiving the waste from the washer shall have a removable basket or strainer to prevent the discharge of large particles into the drainage system.

**SECTION 415**

**LAUNDRY TRAYS**

415.1 **Approval.** Laundry trays shall conform to ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5/IAPMO Z124.

415.2 **Waste outlet.** Each compartment of a laundry tray shall be provided with a waste outlet not less than 1\(\frac{1}{2}\) inches (38 mm) in diameter and a strainer or crossbar to restrict the clear opening of the waste outlet.

**SECTION 416**

**LAVATORIES**

416.1 **Approval.** Lavatories shall conform to ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5/IAPMO Z124. Group wash-up equipment shall conform to the requirements of Section 402. Every 20 inches (508 mm) of rim space shall be considered as one lavatory.
416.2 Cultured marble lavatories. Cultured marble vanity tops with an integral lavatory shall conform to CSA B45.5/IAPMO Z124.

416.3 Lavatory waste outlets. Lavatories shall have waste outlets not less than 1\(\frac{1}{4}\) inches (32 mm) in diameter. A strainer, pop-up stopper, crossbar or other device shall be provided to restrict the clear opening of the waste outlet.

416.4 Moveable lavatory systems. Moveable lavatory systems shall comply with ASME A112.19.12.

416.5 Tempered water for public hand-washing facilities. Tempered water shall be delivered from lavatories and group wash fixtures located in public toilet facilities provided for customers, patrons and visitors. Tempered water shall be delivered through an approved water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3.

SECTION 417
SHOWERS

417.1 Approval. Prefabricated showers and shower compartments shall conform to ASME A112.19.2/CSA B45.1 or CSA B45.5/IAPMO Z124. Shower valves for individual showers shall conform to the requirements of Section 424.3.

417.2 Water supply riser. Water supply risers from the shower valve to the shower head outlet, whether exposed or concealed, shall be attached to the structure. The attachment to the structure shall be made by the use of support devices designed for use with the specific piping material or by fittings anchored with screws.

417.3 Shower waste outlet. Waste outlets serving showers shall be not less than 1\(\frac{1}{2}\) inches (38 mm) in diameter and, for other than waste outlets in bathtubs, shall have removable strainers not less than 3 inches (76 mm) in diameter with strainer openings not less than \(\frac{1}{4}\) inch (6.4 mm) in least dimension. Where each shower space is not provided with an individual waste outlet, the waste outlet shall be located and the floor pitched so that waste from one shower does not flow over the floor area serving another shower. Waste outlets shall be fastened to the waste pipe in an approved manner.

417.4 Shower compartments. Shower compartments shall be not less than 900 square inches (0.58 m²) in interior cross-sectional area. Shower compartments shall be not less than 30 inches (762 mm) in least dimension as measured from
the finished interior dimension of the compartment, exclusive of fixture valves, showerheads, soap dishes and safety grab bars or rails. Except as required in Section 404, the minimum required area and dimension shall be measured from the finished interior dimension at a height equal to the top of the threshold and at a point tangent to its centerline and shall be continued to a height not less than 70 inches (1778 mm) above the shower drain outlet.

**Exception:** Shower compartments having not less than 25 inches (635 mm) in minimum dimension measured from the finished interior dimension of the compartment, provided that the shower compartment has not less than 1,300 square inches (0.838 m²) of cross-sectional area.

### 417.4.1 Floor and wall area.
Bathtub floors, shower floors, wall areas above built-in tubs that have installed shower heads and walls in shower compartments shall be constructed of smooth, corrosion-resistant and nonabsorbent waterproof materials. Wall materials shall extend to a height of not less than 6 feet (1829 mm) above the room floor level, and not less than 70 inches (1778 mm) above the drain of the tub or shower. Such walls shall form a water-tight joint with each other and with either the tub or shower floor.

### 417.4.2 Access.
The shower compartment access and egress opening shall have a clear and unobstructed finished width of not less than 22 inches (559 mm). Shower compartments required to be designed in conformance to accessibility provisions shall comply with Section 404.1.

### 417.5 Shower floors or receptors.
Floor surfaces shall be constructed of impervious, noncorrosive, nonabsorbent and waterproof materials.

#### 417.5.1 Support.
Floors or receptors under shower compartments shall be laid on, and supported by, a smooth and structurally sound base.

#### 417.5.2 Shower lining.
Floors under shower compartments, except where prefabricated receptors have been provided, shall be lined and made water tight utilizing material complying with Sections 417.5.2.1 through 417.5.2.6. Such liners shall turn up on all sides not less than 2 inches (51 mm) above the finished threshold level. Liners shall be recessed and fastened to an approved backing so as not to occupy the space required for wall covering, and shall not be nailed or perforated at any point less than 1 inch (25 mm) above the finished threshold. Liners shall be pitched one-fourth unit vertical in 12 units horizontal (2-percent slope) and shall be sloped toward the fixture drains and be securely fastened to the waste outlet at the seepage entrance, making a water-tight joint.
between the liner and the outlet. The completed liner shall be tested in accordance with Section 312.9.

**Exceptions:**
1. Floor surfaces under shower heads provided for rinsing laid directly on the ground are not required to comply with this section.
2. Where a sheet-applied, load-bearing, bonded, waterproof membrane is installed as the shower lining, the membrane shall not be required to be recessed.
3. *The shower liner test is not required for one-, two-, or three-family dwellings unless required by the shower liner manufacturer’s installation instructions.*

**417.5.2.1 PVC sheets.** Plasticized polyvinyl chloride (PVC) sheets shall meet the requirements of ASTM D 4551. Sheets shall be joined by solvent welding in accordance with the manufacturer’s installation instructions.

**417.5.2.2 Chlorinated polyethylene (CPE) sheets.** Nonplasticized chlorinated polyethylene sheet shall meet the requirements of ASTM D 4068. The liner shall be joined in accordance with the manufacturer’s installation instructions.

**417.5.2.3 Sheet lead.** Sheet lead shall weigh not less than 4 pounds per square foot (19.5 kg/m²) and shall be coated with an asphalt paint or other approved coating. The lead sheet shall be insulated from conducting substances other than the connecting drain by 15-pound (6.80 kg) asphalt felt or an equivalent. Sheet lead shall be joined by burning.

**417.5.2.4 Sheet copper.** Sheet copper shall conform to ASTM B 152 and shall weigh not less than 12 ounces per square foot (3.7 kg/m²). The copper sheet shall be insulated from conducting substances other than the connecting drain by 15-pound (6.80 kg) asphalt felt or an equivalent. Sheet copper shall be joined by brazing or soldering.

**417.5.2.5 Sheet-applied, load-bearing, bonded, waterproof membranes.** Sheet-applied, load-bearing, bonded, waterproof membranes shall meet requirements of ANSI A118.10 and shall be applied in accordance with the manufacturer’s installation instructions.

**417.5.2.6 Liquid-type, trowel-applied, load-bearing, bonded waterproof materials.** Liquid-type, trowel-applied, load-bearing, bonded
waterproof materials shall meet the requirements of ANSI A118.10 and shall be applied in accordance with the manufacturer’s instructions.

417.6 Glazing. Windows and doors within a shower enclosure shall conform to the safety glazing requirements of the building code.

SECTION 418
SINKS

418.1 Approval. Sinks shall conform to ASME A112.19.1/CSA B45.2, ASME A112.19.2/CSA B45.1, ASME A112.19.3/CSA B45.4 or CSA B45.5/IAPMO Z124.

418.2 Sink waste outlets. Sinks shall be provided with waste outlets having a diameter not less than 1 1/2 inches (38 mm). A strainer or crossbar shall be provided to restrict the clear opening of the waste outlet.

418.3 Moveable sink systems. Moveable sink systems shall comply with ASME A112.19.12.

SECTION 419
URINALS

419.1 Approval. Urinals shall conform to ASME A112.19.2/CSA B45.1, ASME A112.19.19 or CSA B45.5/IAPMO Z124. Urinals shall conform to the water consumption requirements of Section 604.4. Water-supplied urinals shall conform to the hydraulic performance requirements of ASME A112.19.2/CSA B45.1 or CSA B45.5/IAPMO Z124.

419.2 Substitution for water closets. See Table 403.1 footnote g.

419.3 Surrounding material. Wall and floor space to a point 2 feet (610 mm) in front of a urinal lip and 4 feet (1219 mm) above the floor and at least 2 feet (610 mm) to each side of the urinal shall be waterproofed with a smooth, readily cleanable, nonabsorbent material.

SECTION 420
WATER CLOSETS

420.1 Approval. Water closets shall conform to the water consumption requirements of Section 604.4 and shall conform to ASME A112.19.2/CSA

420.2 Water closets for public or employee toilet facilities. Water closet bowls for public or employee toilet facilities shall be of the elongated type.

420.3 Water closet seats. Water closets shall be equipped with seats of smooth, nonabsorbent material. All seats of water closets provided for public or employee toilet facilities shall be of the hinged open-front type. Integral water closet seats shall be of the same material as the fixture. Water closet seats shall be sized for the water closet bowl type.

420.4 Water closet connections. A 4-inch by 3-inch (102 mm by 76 mm) closet bend shall be acceptable. Where a 3-inch (76 mm) bend is utilized on water closets, a 4-inch by 3-inch (102 mm by 76 mm) flange shall be installed to receive the fixture horn.

SECTION 421
WHIRLPOOL BATHTUBS

421.1 Approval. Whirlpool bathtubs shall comply with ASME A112.19.7/CSA B45.10 and shall be listed and labeled in accordance with UL 1795.

421.2 Installation. Whirlpool bathtubs shall be installed and tested in accordance with the manufacturer’s instructions. The pump shall be located above the weir of the fixture trap.

421.3 Drain. The pump drain and circulation piping shall be sloped to drain the water in the volute and the circulation piping when the whirlpool bathtub is empty.

421.4 Suction fittings. Suction fittings for whirlpool bathtubs shall comply with ASME A112.19.7/CSA B45.10.

421.5 Access to pump. Access shall be provided to circulation pumps in accordance with the fixture or pump manufacturer’s installation instructions.
Where the manufacturer’s instructions do not specify the location and minimum size of field-fabricated access openings, an opening not less than 12 inches by 12 inches (305 mm by 305 mm) shall be installed to provide access to the circulation pump. Where pumps are located more than 2 feet (609 mm) from the access opening, an opening not less than 18 inches by 18 inches (457 mm by 457 mm) shall be installed. A door or panel shall be permitted to close the opening. In all cases, the access opening shall be unobstructed and of the size necessary to permit the removal and replacement of the circulation pump.

421.6 **Whirlpool enclosure.** Doors within a whirlpool enclosure shall conform to ASME A112.19.15.

**SECTION 422**

**HEALTH CARE FIXTURES AND EQUIPMENT**

422.1 **Scope.** This section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to the requirements of this section in addition to the other requirements of this code. The provisions of this section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes, homes for the aged, orphanages, infirmaries, first aid stations, psychiatric facilities, clinics, professional offices of dentists and doctors, mortuaries, educational facilities, surgery, dentistry, research and testing laboratories, establishments manufacturing pharmaceutical drugs and medicines and other structures with similar apparatus and equipment classified as plumbing.

422.2 **Approval.** All special plumbing fixtures, equipment, devices and apparatus shall be of an approved type.

422.3 **Protection.** All devices, appurtenances, appliances and apparatus intended to serve some special function, such as sterilization, distillation, processing, cooling, or storage of ice or foods, and that connect to either the water supply or drainage system, shall be provided with protection against backflow, flooding, fouling, contamination of the water supply system and stoppage of the drain.

422.4 **Materials.** Fixtures designed for therapy, special cleansing or disposal of waste materials, combinations of such purposes, or any other special purpose, shall be of smooth, impervious, corrosion-resistant materials and, where subjected to temperatures in excess of 180°F (82°C), shall be capable of withstanding, without damage, higher temperatures.
422.5 **Access.** Access shall be provided to concealed piping in connection with special fixtures where such piping contains steam traps, valves, relief valves, check valves, vacuum breakers or other similar items that require periodic inspection, servicing, maintenance or repair. Access shall be provided to concealed piping that requires periodic inspection, maintenance or repair.

422.6 **Clinical sink.** A clinical sink shall have an integral trap in which the upper portion of a visible trap seal provides a water surface. The fixture shall be designed so as to permit complete removal of the contents by siphonic or blowout action and to reseal the trap. A flushing rim shall provide water to cleanse the interior surface. The fixture shall have the flushing and cleansing characteristics of a water closet.

422.7 **Prohibited usage of clinical sinks and service sinks.** A clinical sink serving a soiled utility room shall not be considered as a substitute for, or be utilized as, a service sink. A service sink shall not be utilized for the disposal of urine, fecal matter or other human waste.

422.8 **Ice prohibited in soiled utility room.** Machines for manufacturing ice, or any device for the handling or storage of ice, shall not be located in a soiled utility room.

422.9 **Sterilizer equipment requirements.** The approval and installation of all sterilizers shall conform to the requirements of the *mechanical code*.

422.9.1 **Sterilizer piping.** Access for the purposes of inspection and maintenance shall be provided to all sterilizer piping and devices necessary for the operation of sterilizers.

422.9.2 **Steam supply.** Steam supplies to sterilizers, including those connected by pipes from overhead mains or branches, shall be drained to prevent any moisture from reaching the sterilizer. The condensate drainage from the steam supply shall be discharged by gravity.

422.9.3 **Steam condensate return.** Steam condensate returns from sterilizers shall be a gravity return system.

422.9.4 **Condensers.** Pressure sterilizers shall be equipped with a means of condensing and cooling the exhaust steam vapors. Nonpressure sterilizers shall be equipped with a device that will automatically control the vapor, confining the vapors within the vessel.
422.10 Special elevations. Control valves, vacuum outlets and devices protruding from a wall of an operating, emergency, recovery, examining or delivery room, or in a corridor or other location where patients are transported on a wheeled stretcher, shall be located at an elevation that prevents bumping the patient or stretcher against the device.

SECTION 423
SPECIALTY PLUMBING FIXTURES

423.1 Water connections. Baptisteries, ornamental and lily pools, aquariums, ornamental fountain basins, swimming pools, and similar constructions, where provided with water supplies, shall be protected against backflow in accordance with Section 608.

423.2 Approval. Specialties requiring water and waste connections shall be submitted for approval.

423.3 Footbaths, pedicure baths and head shampoo sinks. The water supplied to specialty plumbing fixtures, such as pedicure chairs having an integral foot bathtub, footbaths, and head shampoo sinks, shall be limited to a maximum temperature of 120°F (49°C) by a water temperature limiting device that conforms to ASSE 1070 or CSA B125.3.

SECTION 424
FAUCETS AND OTHER FIXTURE FITTINGS

424.1 Approval. Faucets and fixture fittings shall conform to ASME A112.18.1/CSA B125.1. Faucets and fixture fittings that supply drinking water for human ingestion shall conform to the requirements of NSF 61, Section 9. Flexible water connectors exposed to continuous pressure shall conform to the requirements of Section 605.6.

424.1.1 Faucets and supply fittings. Faucets and supply fittings shall conform to the water consumption requirements of Section 604.4.

424.1.2 Waste fittings. Waste fittings shall conform to ASME A112.18.2/CSA B125.2, ASTM F 409 or to one of the standards listed in Tables 702.1 and 702.4 for aboveground drainage and vent pipe and fittings.
424.2 Hand showers. Hand-held showers shall conform to ASME A112.18.1/CSA B125.1. Hand-held showers shall provide backflow protection in accordance with ASME A112.18.1/CSA B125.1 or shall be protected against backflow by a device complying with ASME A112.18.3.

424.3 Individual shower valves. Individual shower and tub-shower combination valves shall be balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valves that conform to the requirements of ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 and shall be installed at the point of use. Shower and tub-shower combination valves required by this section shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer’s instructions. In-line thermostatic valves shall not be utilized for compliance with this section.

424.4 Multiple (gang) showers. Multiple (gang) showers supplied with a single-tempered water supply pipe shall have the water supply for such showers controlled by an approved automatic temperature control mixing valve that conforms to ASSE 1069 or CSA B125.3, or each shower head shall be individually controlled by a balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valve that conforms to ASSE 1016/ASME A112.1016/CSA B125.16 or ASME A112.18.1/CSA B125.1 and is installed at the point of use. Such valves shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturers’ instructions.

424.5 Bathtub and whirlpool bathtub valves. The hot water supplied to bathtubs and whirlpool bathtubs shall be limited to a maximum temperature of 120°F (49°C) by a water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3, except where such protection is otherwise provided by a combination tub/shower valve in accordance with Section 424.3.

424.6 Hose-connected outlets. Faucets and fixture fittings with hose-connected outlets shall conform to ASME A112.18.3 or ASME A112.18.1/CSA B125.1.

424.7 Temperature-actuated, flow reduction valves for individual fixture fittings. Temperature-actuated, flow reduction devices, where installed for individual fixture fittings, shall conform to ASSE 1062. Such valves shall not be used alone as a substitute for the balanced-pressure, thermostatic or combination shower valves required in Section 424.3.
424.8 Transfer valves. Deck-mounted bath/shower transfer valves containing an integral atmospheric vacuum breaker shall conform to the requirements of ASME A112.18.1/CSA B125.1.

424.9 Water closet personal hygiene devices. Personal hygiene devices integral to water closets or water closet seats shall conform to the requirements of ASME A112.4.2.

SECTION 425
FLUSHING DEVICES FOR WATER CLOSETS AND URINALS

425.1 Flushing devices required. Each water closet, urinal, clinical sink and any plumbing fixture that depends on trap siphonage to discharge the fixture contents to the drainage system shall be provided with a flushometer valve, flushometer tank or a flush tank designed and installed to supply water in quantity and rate of flow to flush the contents of the fixture, cleanse the fixture and refill the fixture trap.

425.1.1 Separate for each fixture. A flushing device shall not serve more than one fixture.

425.2 Flushometer valves and tanks. Flushometer valves and tanks shall comply with ASSE 1037 or CSA B125.3. Vacuum breakers on flushometer valves shall conform to the performance requirements of ASSE 1001 or CSA B64.1.1. Access shall be provided to vacuum breakers. Flushometer valves shall be of the water conservation type and shall not be used where the water pressure is lower than the minimum required for normal operation. When operated, the valve shall automatically complete the cycle of operation, opening fully and closing positively under the water supply pressure. Each flushometer valve shall be provided with a means for regulating the flow through the valve. The trap seal to the fixture shall be automatically refilled after each flushing cycle.

425.3 Flush tanks. Flush tanks equipped for manual flushing shall be controlled by a device designed to refill the tank after each discharge and to shut off completely the water flow to the tank when the tank is filled to operational capacity. The trap seal to the fixture shall be automatically refilled after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled with a timing device or sensor control devices.

425.3.1 Fill valves. Flush tanks shall be equipped with an antisiphon fill valve conforming to ASSE 1002 or CSA B125.3. The fill valve backflow
preventer shall be located not less than 1 inch (25 mm) above the full opening of the overflow pipe.

425.3.2 **Overflows in flush tanks.** Flush tanks shall be provided with overflows discharging to the water closet or urinal connected thereto and shall be sized to prevent flooding the tank at the maximum rate at which the tanks are supplied with water according to the manufacturer’s design conditions. The opening of the overflow pipe shall be located above the flood level rim of the water closet or urinal or above a secondary overflow in the flush tank.

425.3.3 **Sheet copper.** Sheet copper utilized for flush tank linings shall conform to ASTM B 152 and shall not weigh less than 10 ounces per square foot (0.03 kg/m²).

425.3.4 **Access required.** All parts in a flush tank shall be accessible for repair and replacement.

425.4 **Flush pipes and fittings.** Flush pipes and fittings shall be of nonferrous material and shall conform to ASME A112.19.5/CSA B45.15.

SECTION 426
**MANUAL FOOD AND BEVERAGE DISPENSING EQUIPMENT**

426.1 **Approval.** Manual food and beverage dispensing equipment shall conform to the requirements of NSF 18.

SECTION 427
**FLOOR SINKS**

427.1 **Approval.** Sanitary floor sinks shall conform to the requirements of ASME A112.6.7.
4101:3-7-01 Sanitary drainage.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:3-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 701
GENERAL

701.1 Scope. The provisions of this chapter shall govern the materials, design, construction and installation of sanitary drainage systems. In accordance with section 3781.03 of the Revised Code, the department of the city engineer, in cities having such departments, the boards of health districts, or the sewer purveyor, as appropriate, shall have complete supervision and regulation of the entire sewerage and drainage system of the jurisdiction, including the building sewer and all laterals draining into the street sewers.

Exception: Private sewage disposal systems within the scope of the “Ohio Department of Health” rules contained within Chapter 3701-29 of the Administrative Code, “Household Sewage Disposal Systems”.

701.2 Sewer required. Except where permitted by the “Ohio Environmental Protection Agency”, every building in which plumbing fixtures are installed and premises having drainage piping shall be connected to a public sewer, where available, or an approved private sewage disposal system.

701.3 Separate sewer connection. Except where permitted by the “Ohio Environmental Protection Agency”, every building having plumbing fixtures installed and intended for human habitation, occupancy or use on premises abutting on a street, alley or easement in which there is a public sewer shall have a separate connection with the sewer. Where located on the same lot, multiple buildings shall not be prohibited from connecting to a common building sewer that connects to the public sewer.

701.4 Sewage treatment. Sewage or other waste from a plumbing system that is deleterious to surface or subsurface waters shall not be discharged into the ground or into any waterway without prior approval from the “Ohio Environmental Protection Agency” for the form of treatment and for the location of discharge.
701.5 **Damage to drainage system or public sewer.** *Except where permitted by the “Ohio Environmental Protection Agency”, wastes detrimental to the public sewer system or to the functioning of the sewage-treatment plant shall be treated and disposed of in accordance with requirements of the local sewer purveyor.*

701.6 **Tests.** The sanitary drainage system shall be tested in accordance with Section 312.

701.7 **Engineered systems.** Engineered sanitary drainage systems shall conform to the provisions of Sections 106.5 of the building code and 714.

701.8 **Drainage piping in food service areas.** Exposed soil or waste piping shall not be installed above any areas used for food preparation or storage, or above storage or eating surfaces in food service establishments. *Reuse of existing sanitary drainage piping. Reuse of existing sanitary drainage piping shall comply with Section 3404.1.1 of the building code.*

### SECTION 702

**MATERIALS**

702.1 **Above-ground sanitary drainage and vent pipe.** Above-ground soil, waste and vent pipe shall conform to one of the standards listed in Table 702.1.

702.2 **Underground building sanitary drainage and vent pipe.** Underground building sanitary drainage and vent pipe shall conform to one of the standards listed in Table 702.2.

702.3 **Building sewer pipe.** *Deleted.*

#### TABLE 702.1

**ABOVE-GROUND DRAINAGE AND VENT PIPE**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall</td>
<td>ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1</td>
</tr>
<tr>
<td>Brass pipe</td>
<td>ASTM B 43</td>
</tr>
<tr>
<td>Cast-iron pipe</td>
<td>ASTM A 74; ASTM A 888; CISPI 301</td>
</tr>
<tr>
<td>MATERIAL</td>
<td>STANDARD</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Copper or copper-alloy pipe</td>
<td>ASTM B 42; ASTM B 302</td>
</tr>
<tr>
<td>Copper or copper-alloy tubing (Type K, L, M or DWV)</td>
<td>ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306</td>
</tr>
<tr>
<td>Galvanized steel pipe</td>
<td>ASTM A 53</td>
</tr>
<tr>
<td>Glass pipe</td>
<td>ASTM C 1053</td>
</tr>
<tr>
<td>Polyolefin pipe</td>
<td>ASTM F 1412; CSA B181.3</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200), and DR 24 (PS 140); with a solid, cellular core or composite wall</td>
<td>ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core or composite wall</td>
<td>ASTM D 2949, ASTM F 1488</td>
</tr>
<tr>
<td>Polyvinylidene fluoride (PVDF) plastic pipe</td>
<td>ASTM F 1673; CSA B181.3</td>
</tr>
<tr>
<td>Stainless steel drainage systems, Types 304 and 316L</td>
<td>ASME A112.3.1</td>
</tr>
</tbody>
</table>

702.4 **Fittings.** Pipe fittings shall be approved for installation with the piping material installed and shall comply with the applicable standards listed in Table 702.4.

702.5 **Temperature rating.** Where the waste water temperature will be greater than 140°F (60°C), the sanitary drainage piping material shall be rated for the highest temperature of the waste water.

702.6 **Chemical waste system.** A chemical waste system shall be completely separated from the sanitary drainage system. The chemical waste shall be treated in accordance with Section 803.2 before discharging to the sanitary drainage system. Separate drainage systems for chemical wastes and vent pipes shall be of an approved material that is resistant to corrosion and degradation for the concentrations of chemicals involved.

702.7 **Lead bends and traps.** The wall thickness of lead bends and traps shall be not less than \( \frac{1}{8} \) inch (3.2 mm).

### TABLE 702.2

**UNDERGROUND BUILDING DRAINAGE AND VENT PIPE**

| MATERIAL                                      | STANDARD                                      |
### TABLE 702.3 BUILDING SEWER PIPE

*Deleted.*

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall</td>
<td>ASTM D 2661; ASTM F 628; ASTM F 1488; CSA B181.1</td>
</tr>
<tr>
<td>Cast-iron pipe</td>
<td>ASTM A 74; ASTM A 888; CISPI 301</td>
</tr>
<tr>
<td>Copper or copper-alloy tubing (Type K, L, M or DWV)</td>
<td>ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306</td>
</tr>
<tr>
<td>Polyolefin pipe</td>
<td>ASTM F 1412; CSA B181.3</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic pipe in IPS diameters, including Schedule 40, DR 22 (PS 200) and DR 24 (PS 140); with a solid, cellular core or composite wall</td>
<td>ASTM D 2665; ASTM F 891; ASTM F 1488; CSA B181.2</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D. and a solid, cellular core or composite wall</td>
<td>ASTM D 2949, ASTM F 1488</td>
</tr>
<tr>
<td>Polyvinylidene fluoride (PVDF) plastic pipe</td>
<td>ASTM F 1673; CSA B181.3</td>
</tr>
<tr>
<td>Stainless steel drainage systems, Type 316L</td>
<td>ASME A 112.3.1</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

### TABLE 702.4 PIPE FITTINGS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile butadiene styrene (ABS) plastic pipe in IPS diameters</td>
<td>ASTM D 2661; ASTM F 628; CSA B181.1</td>
</tr>
<tr>
<td>Acrylonitrile butadiene styrene (ABS) plastic pipe in sewer and drain diameters</td>
<td></td>
</tr>
<tr>
<td>Cast iron</td>
<td>ASME B 16.4; ASME B 16.12; ASTM A 74; ASTM A 888; CISPI 301</td>
</tr>
</tbody>
</table>

---

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<table>
<thead>
<tr>
<th>Material</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper or copper alloy</td>
<td>ASME B 16.15; ASME B 16.18; ASME B 16.22; ASME B 16.23; ASME B 16.26; ASME B 16.29</td>
</tr>
<tr>
<td>Glass</td>
<td>ASTM C 1053</td>
</tr>
<tr>
<td>Gray iron and ductile iron</td>
<td>AWWA C 110/A21.10</td>
</tr>
<tr>
<td>Malleable iron</td>
<td>ASME B 16.3</td>
</tr>
<tr>
<td>Polyolefin</td>
<td>ASTM F 1412; CSA B181.3</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC)</td>
<td>ASTM D 2665; ASTM F 1866</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic in IPS diameters</td>
<td>ASTM D 3034</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic pipe in sewer and drain diameters</td>
<td>ASTM D 2949</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) plastic pipe with a 3.25-inch O.D.</td>
<td>ASTM F 1673; CSA B181.3</td>
</tr>
<tr>
<td>Polyvinylidene fluoride (PVDF) plastic pipe</td>
<td>ASTM A 112.3.1</td>
</tr>
<tr>
<td>Stainless steel drainage systems, Types 304 and 316L</td>
<td>ASME A 112.3.1</td>
</tr>
<tr>
<td>Steel</td>
<td>ASME B 16.9; ASME B 16.11; ASME B 16.28</td>
</tr>
<tr>
<td>Vitrified clay</td>
<td>ASTM C 700</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

SECTION 703
BUILDING SEWER

703.1 Building sewer pipe near the water service. Deleted.

703.2 Drainage pipe in filled ground. Deleted.

703.3 Sanitary and storm sewers. Deleted.

703.4 Existing building sewers and drains. Deleted.

703.5 Cleanouts on building sewers. Deleted.

703.6 Combined sanitary and storm public sewer. Deleted.

SECTION 704
DRAINAGE PIPING INSTALLATION

704.1 Slope of horizontal drainage piping. Horizontal drainage piping shall be installed in uniform alignment at uniform slopes. The slope of a horizontal drainage pipe shall be not less than that indicated in Table 704.1.

<table>
<thead>
<tr>
<th>SIZE (inches)</th>
<th>MINIMUM SLOPE (inch per foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1/2 or less</td>
<td>1/4</td>
</tr>
<tr>
<td>3 to 6</td>
<td>1/8</td>
</tr>
<tr>
<td>8 or larger</td>
<td>1/16</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 inch per foot = 83.33 mm/m.

704.2 Change in size. The size of the drainage piping shall not be reduced in size in the direction of the flow. A 4-inch by 3-inch (102 mm by 76 mm) water closet connection shall not be considered as a reduction in size.

704.3 Connections to offsets and bases of stacks. Horizontal branches shall connect to the bases of stacks at a point located not less than 10 times the diameter of the drainage stack downstream from the stack. Horizontal branches shall connect to horizontal stack offsets at a point located not less than 10 times the diameter of the drainage stack downstream from the upper stack.

704.4 Future fixtures. Drainage piping for future fixtures shall terminate with an approved cap or plug.

SECTION 705
JOINTS

705.1 General. This section contains provisions applicable to joints specific to sanitary drainage piping.

705.2 ABS plastic. Joints between ABS plastic pipe or fittings shall comply with Sections 705.2.1 through 705.2.3.

705.2.1 Mechanical joints. Mechanical joints on drainage pipes shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed only in underground systems unless otherwise approved. Joints shall be installed in accordance
with the manufacturer’s instructions.

**705.2.2 Solvent cementing.** Joint surfaces shall be clean and free from moisture. Solvent cement that conforms to ASTM D 2235 or CSA B181.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet. Joints shall be made in accordance with ASTM D 2235, ASTM D 2661, ASTM F 628 or CSA B181.1. Solvent cement joints shall be permitted above or below ground.

**705.2.3 Threaded joints.** Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

**705.3 Brass.** Joints between brass pipe or fittings shall comply with Sections 705.3.1 through 705.3.4.

**705.3.1 Brazed joints.** All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

**705.3.2 Mechanical joints.** Mechanical joints shall be installed in accordance with the manufacturer’s instructions.

**705.3.3 Threaded joints.** Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

**705.3.4 Welded joints.** All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

**705.4 Cast iron.** Joints between cast-iron pipe or fittings shall comply with Sections 705.4.1 through 705.4.3.

**705.4.1 Caulked joints.** Joints for hub and spigot pipe shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation to a depth of not less than 1 inch (25 mm). The lead shall not recede more than 1/8 inch (3.2 mm) below the rim of the hub and shall be caulked tight. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. Acid-resistant rope and acid-proof cement shall be permitted.
705.4.2 Compression gasket joints. Compression gaskets for hub and spigot pipe and fittings shall conform to ASTM C 564 and shall be tested to ASTM C 1563. Gaskets shall be compressed when the pipe is fully inserted.

705.4.3 Mechanical joint coupling. Mechanical joint couplings for hubless pipe and fittings shall consist of an elastomeric sealing sleeve and a metallic shield that comply with CISPI 310, ASTM C 1277 or ASTM C 1540. The elastomeric sealing sleeve shall conform to ASTM C 564 or CSA B602 and shall be provided with a center stop. Mechanical joint couplings shall be installed in accordance with the manufacturer’s instructions.

705.5 Concrete joints. Joints between concrete pipe and fittings shall be made with an elastomeric seal conforming to ASTM C 443, ASTM C 1173, CSA A257.3M or CSA B602.

705.6 Copper pipe. Joints between copper or copper-alloy pipe or fittings shall comply with Sections 705.6.1 through 705.6.5.

705.6.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

705.6.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer’s instructions.

705.6.3 Solder joints. Solder joints shall be made in accordance with the methods of ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32.

705.6.4 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

705.6.5 Welded joints. All joint surfaces shall be cleaned. The joint shall be welded with an approved filler metal.

705.7 Copper tubing. Joints between copper or copper-alloy tubing or fittings shall comply with Sections 705.7.1 through 705.7.3.

705.7.1 Brazed joints. All joint surfaces shall be cleaned. An approved flux
shall be applied where required. The joint shall be brazed with a filler metal conforming to AWS A5.8.

705.7.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer’s instructions.

705.7.3 Solder joints. Solder joints shall be made in accordance with the methods of ASTM B 828. Cut tube ends shall be reamed to the full inside diameter of the tube end. All joint surfaces shall be cleaned. A flux conforming to ASTM B 813 shall be applied. The joint shall be soldered with a solder conforming to ASTM B 32.

705.8 Borosilicate glass joints. Glass-to-glass connections shall be made with a bolted compression-type, 300 series stainless steel coupling with contoured acid-resistant elastomeric compression ring and a fluorocarbon polymer inner seal ring; or with caulked joints in accordance with Section 705.8.1.

705.8.1 Caulked joints. Lead-caulked joints for hub and spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch (25 mm) in depth and not to recede more than ⅛ inch (3.2 mm) below the rim of the hub. Paint, varnish or other coatings shall not be permitted on the jointing material until after the joint has been tested and approved. Lead shall be run in one pouring and shall be caulked tight. Acid-resistant rope and acidproof cement shall be permitted.

705.9 Steel. Joints between galvanized steel pipe or fittings shall comply with Sections 705.9.1 and 705.9.2.

705.9.1 Threaded joints. Threads shall conform to ASME B1.20.1. Pipe-joint compound or tape shall be applied on the male threads only.

705.9.2 Mechanical joints. Joints shall be made with an approved elastomeric seal. Mechanical joints shall be installed in accordance with the manufacturer’s instructions.

705.10 Lead. Joints between lead pipe or fittings shall comply with Sections 705.10.1 and 705.10.2.

705.10.1 Burned. Burned joints shall be uniformly fused together into one continuous piece. The thickness of the joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe.
705.10.2 Wiped. Joints shall be fully wiped, with an exposed surface on each side of the joint not less than 3/4 inch (19.1 mm). The joint shall be not less than 3/8 inch (9.5 mm) thick at the thickest point.

705.11 PVC plastic. Joints between PVC plastic pipe or fittings shall comply with Sections 705.11.1 through 705.11.3.

705.11.1 Mechanical joints. Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer’s instructions.

705.11.2 Solvent cementing. Joint surfaces shall be clean and free from moisture. A primer that conforms to ASTM F 656 shall be applied. Solvent cement conforming to ASTM D 2564, CSA B137.3, CSA B181.2 or CSA B182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent cement joints shall be permitted above or below ground.

**Exception:** A primer is not required where both of the following conditions apply:
1. The solvent cement used is third-party certified as conforming to ASTM D 2564.
2. The solvent cement is used only for joining PVC drain, waste and vent pipe and fittings in nonpressure applications in sizes up to and including 4 inches (102 mm) in diameter.

705.11.3 Threaded joints. Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

705.12 Vitrified clay. Joints between vitrified clay pipe or fittings shall be made with an elastomeric seal conforming to ASTM C 425, ASTM C 1173 or CSA B602.

705.13 Polyethylene plastic pipe. Joints between polyethylene plastic pipe and fittings shall be underground and shall comply with Section 705.13.1 or 705.13.2.
705.13.1 **Heat-fusion joints.** Joint surfaces shall be clean and free from moisture. All joint surfaces shall be cut, heated to melting temperature and joined using tools specifically designed for the operation. Joints shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657 and the manufacturer’s instructions.

705.13.2 **Mechanical joints.** Mechanical joints in drainage piping shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA B602. Mechanical joints shall be installed in accordance with the manufacturer’s instructions.

705.14 **Polyolefin plastic.** Joints between polyolefin plastic pipe and fittings shall comply with Sections 705.14.1 and 705.14.2.

705.14.1 **Heat-fusion joints.** Heat-fusion joints for polyolefin pipe and tubing joints shall be installed with socket-type heat-fused polyolefin fittings or electrofusion polyolefin fittings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 1412 or CSA B181.3.

705.14.2 **Mechanical and compression sleeve joints.** Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer’s instructions.

705.15 **Polyvinylidene fluoride plastic.** Joints between polyvinylidene plastic pipe and fittings shall comply with Sections 705.15.1 and 705.15.2.

705.15.1 **Heat-fusion joints.** Heat-fusion joints for polyvinylidene fluoride pipe and tubing joints shall be installed with socket-type heat-fused polyvinylidene fluoride fittings or electrofusion polyvinylidene fittings and couplings. Joint surfaces shall be clean and free from moisture. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM F 1673.

705.15.2 **Mechanical and compression sleeve joints.** Mechanical and compression sleeve joints shall be installed in accordance with the manufacturer’s instructions.

705.16 **Joints between different materials.** Joints between different piping materials shall be made with a mechanical joint of the compression or mechanical-sealing type conforming to ASTM C 1173, ASTM C 1460 or ASTM
C 1461. Connectors and adapters shall be approved for the application and such joints shall have an elastomeric seal conforming to ASTM C 425, ASTM C 443, ASTM C 564, ASTM C 1440, ASTM F 477, CSA A257.3M or CSA B602, or as required in Sections 705.16.1 through 705.16.7. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal. Joints shall be installed in accordance with the manufacturer’s instructions.

705.16.1 Copper or copper-alloy tubing to cast-iron hub pipe. Joints between copper or copper-alloy tubing and cast-iron hub pipe shall be made with a brass ferrule or compression joint. The copper or copper-alloy tubing shall be soldered to the ferrule in an approved manner, and the ferrule shall be joined to the cast-iron hub by a caulked joint or a mechanical compression joint.

705.16.2 Copper or copper-alloy tubing to galvanized steel pipe. Joints between copper or copper-alloy tubing and galvanized steel pipe shall be made with a brass converter fitting or dielectric fitting. The copper tubing shall be soldered to the fitting in an approved manner, and the fitting shall be screwed to the threaded pipe.

705.16.3 Cast-iron pipe to galvanized steel or brass pipe. Joints between cast-iron and galvanized steel or brass pipe shall be made by either caulked or threaded joints or with an approved adapter fitting.

705.16.4 Plastic pipe or tubing to other piping material. Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with an approved adapter fitting. Joints between plastic pipe and cast-iron hub pipe shall be made by a caulked joint or a mechanical compression joint.

705.16.5 Lead pipe to other piping material. Joints between lead pipe and other piping material shall be made by a wiped joint to a caulking ferrule, soldering nipple or bushing or shall be made with an approved adapter fitting.

705.16.6 Borosilicate glass to other materials. Joints between glass pipe and other types of materials shall be made with adapters having a TFE seal and shall be installed in accordance with the manufacturer’s instructions.

705.16.7 Stainless steel drainage systems to other materials. Joints between stainless steel drainage systems and other piping materials shall be made with approved mechanical couplings.
705.17 **Drainage slip joints.** Slip joints shall comply with Section 405.8.

705.18 **Caulking ferrules.** Ferrules shall be of red brass and shall be in accordance with Table 705.18.

**TABLE 705.18**

**CAULKING FERRULE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>PIPE SIZES (inches)</th>
<th>INSIDE DIAMETER (inches)</th>
<th>LENGTH (inches)</th>
<th>MINIMUM WEIGHT EACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2 ½</td>
<td>4 ½</td>
<td>1 pound</td>
</tr>
<tr>
<td>3</td>
<td>3 ½</td>
<td>4 ½</td>
<td>1 pound 12 ounces</td>
</tr>
<tr>
<td>4</td>
<td>4 ½</td>
<td>4 ½</td>
<td>2 pounds 8 ounces</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 ounce = 28.35 g, 1 pound = 0.454 kg.

705.19 **Soldering bushings.** Soldering bushings shall be of red brass and shall be in accordance with Table 705.19.

**TABLE 705.19**

**SOLDERING BUSHING SPECIFICATIONS**

<table>
<thead>
<tr>
<th>PIPE SIZES (inches)</th>
<th>MINIMUM WEIGHT EACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ⅛</td>
<td>6 ounces</td>
</tr>
<tr>
<td>1 ½</td>
<td>8 ounces</td>
</tr>
<tr>
<td>2</td>
<td>14 ounces</td>
</tr>
<tr>
<td>2 ⅛</td>
<td>1 pound 6 ounces</td>
</tr>
<tr>
<td>3</td>
<td>2 pounds</td>
</tr>
<tr>
<td>4</td>
<td>3 pounds 8 ounces</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 ounce = 28.35 g, 1 pound = 0.454 kg.

705.20 **Stainless steel drainage systems.** O-ring joints for stainless steel drainage systems shall be made with an approved elastomeric seal.

**SECTION 706**

**CONNECTIONS BETWEEN DRAINAGE PIPING AND FITTINGS**

706.1 **Connections and changes in direction.** All connections and changes in direction of the sanitary drainage system shall be made with approved drainage
fittings. Connections between drainage piping and fixtures shall conform to
Section 405.

706.2 Obstructions. The fittings shall not have ledges, shoulders or reductions
capable of retarding or obstructing flow in the piping. Threaded drainage pipe
fittings shall be of the recessed drainage type. This section shall not be applicable
to tubular waste fittings used to convey vertical flow upstream of the trap seal
liquid level of a fixture trap.

706.3 Installation of fittings. Fittings shall be installed to guide sewage and
waste in the direction of flow. Change in direction shall be made by fittings
installed in accordance with Table 706.3. Change in direction by combination
fittings, side inlets or increasers shall be installed in accordance with Table 706.3
based on the pattern of flow created by the fitting. Double sanitary tee patterns
shall not receive the discharge of back-to-back water closets and fixtures or
appliances with pumping action discharge.

When a through penetration of an exterior foundation wall assembly occurs, drainage fitting joints shall not occur within that exterior foundation wall assembly.

Exception: Back-to-back water closet connections to double sanitary tees
shall be permitted where the horizontal developed length between the outlet of
the water closet and the connection to the double sanitary tee pattern is 18
inches (457 mm) or greater.

<table>
<thead>
<tr>
<th>TABLE 706.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>FITTINGS FOR CHANGE IN DIRECTION</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE OF FITTING PATTERN</th>
<th>CHANGE IN DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizontal to vertical</td>
</tr>
<tr>
<td>Sixteenth bend</td>
<td>X</td>
</tr>
<tr>
<td>Eighth bend</td>
<td>X</td>
</tr>
<tr>
<td>Sixth bend</td>
<td>X</td>
</tr>
<tr>
<td>Quarter bend</td>
<td>X</td>
</tr>
<tr>
<td>Short sweep</td>
<td>X</td>
</tr>
<tr>
<td>Long sweep</td>
<td>X</td>
</tr>
<tr>
<td>Sanitary tee</td>
<td>X</td>
</tr>
<tr>
<td>Wye</td>
<td>X</td>
</tr>
</tbody>
</table>

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Combination wye and eighth bend

|   | X | X | X |

For SI: 1 inch = 25.4 mm.
a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.
b. Three inches or larger.
c. For a limitation on double sanitary tees, see Section 706.3.

706.4 Heel- or side-inlet quarter bends. Heel-inlet quarter bends shall be an acceptable means of connection, except where the quarter bend serves a water closet. A low-heel inlet shall not be used as a wet-vented connection. Side-inlet quarter bends shall be an acceptable means of connection for drainage, wet venting and stack venting arrangements.

SECTION 707
PROHIBITED JOINTS AND CONNECTIONS

707.1 Prohibited joints. The following types of joints and connections shall be prohibited:
1. Cement or concrete joints.
2. Mastic or hot-pour bituminous joints.
3. Joints made with fittings not approved for the specific installation.
4. Joints between different diameter pipes made with elastomeric rolling O-rings.
5. Solvent-cement joints between different types of plastic pipe.

SECTION 708
CLEANOUTS

708.1 Cleanouts required. Cleanouts shall be provided for drainage piping in accordance with Sections 708.1.1 through 708.1.11.

708.1.1 Horizontal drains and building drains. Horizontal drainage pipes in buildings shall have cleanouts located at intervals of not more than 100 feet (30 480 mm). Building drains shall have cleanouts located at intervals of not more than 100 feet (30 480 mm) except where manholes are used instead of cleanouts, the manholes shall be located at intervals of not more than 400 feet (122 m). The interval length shall be measured from the cleanout or manhole opening, along the developed length of the piping to the next drainage fitting providing access for cleaning, the end of the horizontal drain or the end of the building drain.

Exception: Horizontal fixture drain piping serving a nonremovable trap
shall not be required to have a cleanout for the section of piping between the trap and the vent connection for such trap.

708.1.2 Building sewers. Deleted.

708.1.3 Building drain and building sewer junction. The junction of the building drain and the building sewer shall be served by a cleanout that is located at the junction or within 10 feet (3048 mm) of the developed length of piping upstream of the junction. For the requirements of this section, the removal of the water closet shall not be required to provide cleanout access.

708.1.4 Changes of direction. Where a horizontal drainage pipe, a building drain or a building sewer has a change of horizontal direction greater than 45 degrees (0.79 rad), a cleanout shall be installed at the change of direction. Where more than one change of horizontal direction greater than 45 degrees (0.79 rad) occurs within 40 feet (12 192 mm) of developed length of piping, the cleanout installed for the first change of direction shall serve as the cleanout for all changes in direction within that 40 feet (12 192 mm) of developed length of piping.

708.1.5 Cleanout size. Cleanouts shall be the same size as the piping served by the cleanout, except that cleanouts for piping larger than 4 inches (102 mm) need not be larger than 4 inches (102 mm).

Exceptions:
1. A removable P-trap with slip or ground joint connections can serve as a cleanout for drain piping that is one size larger than the P-trap size.
2. Cleanouts located on stacks can be one size smaller than the stack size.
3. The size of cleanouts for cast-iron piping can be in accordance with the referenced standards for cast-iron fittings as indicated in Table 702.4.

708.1.6 Cleanout plugs. Cleanout plugs shall be of brass, plastic or other approved materials. Cleanout plugs for borosilicate glass piping systems shall be of borosilicate glass. Brass cleanout plugs shall conform to ASTM A 74 and shall be limited for use only on metallic piping systems. Plastic cleanout plugs shall conform to the referenced standards for plastic pipe fittings, as indicated in Table 702.4. Cleanout plugs shall have a raised square head, a countersunk square head or a countersunk slot head. Where a cleanout plug will have a trim cover screw installed into the plug, the plug shall be manufactured with a blind end threaded hole for such purpose.
708.1.7 Manholes. Manholes and manhole covers shall be of an approved type. Manholes located inside of a building shall have gas-tight covers that require tools for removal.

708.1.8 Installation arrangement. The installation arrangement of a cleanout shall enable cleaning of drainage piping only in the direction of drainage flow.

Exceptions:
1. Test tees serving as cleanouts.
2. A two-way cleanout installation that is approved for meeting the requirements of Section 708.1.3.

708.1.9 Required clearance. Cleanouts for 6-inch (153 mm) and smaller piping shall be provided with a clearance of not less than 18 inches (457 mm) from, and perpendicular to, the face of the opening to any obstruction. Cleanouts for 8-inch (203 mm) and larger piping shall be provided with a clearance of not less than 36 inches (914 mm) from, and perpendicular to, the face of the opening to any obstruction.

708.1.10 Cleanout access. Required cleanouts shall not be installed in concealed locations. For the purposes of this section, concealed locations include, but are not limited to, the inside of plenums, within walls, within floor/ceiling assemblies, below grade and in crawl spaces where the height from the crawl space floor to the nearest obstruction along the path from the crawl space opening to the cleanout location is less than 24 inches (610 mm). Cleanouts with openings at a finished wall shall have the face of the opening located within 1 1/2 inches (38 mm) of the finished wall surface. Cleanouts located below grade shall be extended to grade level so that the top of the cleanout plug is at or above grade. A cleanout installed in a floor or walkway that will not have a trim cover installed shall have a countersunk plug installed so the top surface of the plug is flush with the finished surface of the floor or walkway.

708.1.10.1 Cleanout plug trim covers. Trim covers and access doors for cleanout plugs shall be designed for such purposes and shall be approved. Trim cover fasteners that thread into cleanout plugs shall be corrosion resistant. Cleanout plugs shall not be covered with mortar, plaster or any other permanent material.
708.1.10.2 Floor cleanout assemblies. Where it is necessary to protect a cleanout plug from the loads of vehicular traffic, cleanout assemblies in accordance with ASME A112.36.2M shall be installed.

708.1.11 Prohibited use. The use of a threaded cleanout opening to add a fixture or to extend piping shall be prohibited except where another cleanout of equal size is installed with the required access and clearance.

SECTION 709
FIXTURE UNITS

709.1 Values for fixtures. Drainage fixture unit values as given in Table 709.1 designate the relative load weight of different kinds of fixtures that shall be employed in estimating the total load carried by a soil or waste pipe, and shall be used in connection with Tables 710.1(1) and 710.1(2) of sizes for soil, waste and vent pipes for which the permissible load is given in terms of fixture units.

709.2 Fixtures not listed in Table 709.1. Fixtures not listed in Table 709.1 shall have a drainage fixture unit load based on the outlet size of the fixture in accordance with Table 709.2. The minimum trap size for unlisted fixtures shall be the size of the drainage outlet but not less than 1 1/4 inches (32 mm).

**TABLE 709.2**
DRAINAGE FIXTURE UNITS FOR FIXTURE DRAINS OR TRAPS

<table>
<thead>
<tr>
<th>FIXTURE DRAIN OR TRAP SIZE (inches)</th>
<th>DRAINAGE FIXTURE UNIT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3/4</td>
<td>1</td>
</tr>
<tr>
<td>1 1/2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2 3/4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

709.3 Values for continuous and semicontinuous flow. Drainage fixture unit values for continuous and semicontinuous flow into a drainage system shall be computed on the basis that 1 gpm (0.06 L/s) of flow is equivalent to two fixture units.
709.4 Values for indirect waste receptor. The drainage fixture unit load of an indirect waste receptor receiving the discharge of indirectly connected fixtures shall be the sum of the drainage fixture unit values of the fixtures that discharge to the receptor, but not less than the drainage fixture unit value given for the indirect waste receptor in Table 709.1 or 709.2.

709.4.1 Clear-water waste receptors. Where waste receptors such as floor drains, floor sinks and hub drains receive only clear-water waste from display cases, refrigerated display cases, ice bins, coolers and freezers, such receptors shall have a drainage fixture unit value of one-half.

SECTION 710 DRAINAGE SYSTEM SIZING

710.1 Maximum fixture unit load. The maximum number of drainage fixture units connected to a given size of building sewer, building drain or horizontal branch of the building drain shall be determined using Table 710.1(1). The maximum number of drainage fixture units connected to a given size of horizontal branch or vertical soil or waste stack shall be determined using Table 710.1(2).

<table>
<thead>
<tr>
<th>DIAMETER OF PIPE (inches)</th>
<th>MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS CONNECTED TO ANY PORTION OF THE BUILDING DRAIN OR THE BUILDING SEWER, INCLUDING BRANCHES OF THE BUILDING DRAINa</th>
<th>Slope per foot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/16 inch</td>
<td>1/8 inch</td>
</tr>
<tr>
<td>11/4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>11/2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>21/2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>—</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>—</td>
<td>180</td>
</tr>
<tr>
<td>5</td>
<td>—</td>
<td>390</td>
</tr>
<tr>
<td>6</td>
<td>—</td>
<td>700</td>
</tr>
</tbody>
</table>

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

a. The minimum size of any building drain serving a water closet shall be 3 inches.

**TABLE 709.1**

<table>
<thead>
<tr>
<th>FIXTURE TYPE</th>
<th>DRAINAGE FIXTURE UNIT VALUE AS LOAD FACTORS</th>
<th>MINIMUM SIZE OF TRAP (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic clothes washers, commercial&lt;sup&gt;a&lt;/sup&gt;,&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Note a</td>
<td>Note a</td>
</tr>
<tr>
<td>Automatic clothes washers, residential&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bathroom group as defined in Section 202 (1.6 gpf water closet)&lt;sup&gt;f&lt;/sup&gt;</td>
<td>5</td>
<td>—</td>
</tr>
<tr>
<td>Bathroom group as defined in Section 202 (water closet flushing greater than 1.6 gpf)&lt;sup&gt;f&lt;/sup&gt;</td>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td>Bathtub&lt;sup&gt;b&lt;/sup&gt; (with or without overhead shower or whirlpool attachments)</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Bidet</td>
<td>1</td>
<td>1¼</td>
</tr>
<tr>
<td>Combination sink and tray</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Dental lavatory</td>
<td>1</td>
<td>1¾</td>
</tr>
<tr>
<td>Dental unit or cuspidor</td>
<td>1</td>
<td>1¾</td>
</tr>
<tr>
<td>Dishwashing machine&lt;sup&gt;c&lt;/sup&gt;, domestic</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Drinking fountain</td>
<td>½</td>
<td>1½</td>
</tr>
<tr>
<td>Emergency floor drain</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Floor drains&lt;sup&gt;h&lt;/sup&gt;</td>
<td>2h</td>
<td>2</td>
</tr>
<tr>
<td>Floor sinks</td>
<td>Note h</td>
<td>2</td>
</tr>
<tr>
<td>Kitchen sink, domestic</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Kitchen sink, domestic with food waste disposer and/or dishwasher</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Laundry tray (1 or 2 compartments)</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Lavatory</td>
<td>1</td>
<td>1¾</td>
</tr>
</tbody>
</table>
Shower (based on the total flow rate through showerheads and body sprays)  
Flow rate:  
- 5.7 gpm or less: 2
- Greater than 5.7 gpm to 12.3 gpm: 3
- Greater than 12.3 gpm to 25.8 gpm: 5
- Greater than 25.8 gpm to 55.6 gpm: 6

Service sink: 2
Sink: 2
Urinal: 4
Urinal, 1 gallon per flush or less: 2e
Urinal, nonwater supplied: ½
Wash sink (circular or multiple) each set of faucets: 2
Water closet, flushometer tank, public or private: 4e
Water closet, private (1.6 gpf): 3e
Water closet, private (flushing greater than 1.6 gpf): 4e
Water closet, public (1.6 gpf): 4e
Water closet, public (flushing greater than 1.6 gpf): 6e

For SI: 1 inch = 25.4 mm, 1 gallon = 3.785 L, gpf = gallon per flushing cycle, gpm = gallon per minute.

a. Calculate per Section 709.3.
b. A showerhead over a bathtub or whirlpool bathtub attachment does not increase the drainage fixture unit value.
c. See Sections 709.2 through 709.4.1 for methods of computing unit value of fixtures not listed in this table or for rating of devices with intermittent flows.
d. Trap size shall be consistent with the fixture outlet size.
e. For the purpose of computing loads on building drains and sewers, water closets and urinals shall not be rated at a lower drainage fixture unit unless the lower values are confirmed by testing.
f. For fixtures added to a bathroom group, add the dfu value of those additional fixtures to the bathroom group fixture count.
g. See Section 406.2 for sizing requirements for fixture drain, branch drain and drainage stack for an automatic clothes washer standpipe.
h. See Sections 709.4 and 709.4.1.

### TABLE 710.1(2)  
HORIZONTAL FIXTURE BRANCHES AND STACKS

<table>
<thead>
<tr>
<th>DIAMETER OF PIPE (inches)</th>
<th>MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (dfu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total for Stacksb</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1½</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1½</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Note d</td>
<td></td>
</tr>
<tr>
<td>2e</td>
<td></td>
</tr>
<tr>
<td>Note d</td>
<td></td>
</tr>
<tr>
<td>½</td>
<td></td>
</tr>
<tr>
<td>Note d</td>
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<td>1½</td>
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</tr>
<tr>
<td>6e</td>
<td></td>
</tr>
<tr>
<td>Note d</td>
<td></td>
</tr>
</tbody>
</table>

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### Table 710.1(1)

<table>
<thead>
<tr>
<th>horizontal branch</th>
<th>Total discharge into one branch interval</th>
<th>Total for stack of three branch Intervals or less</th>
<th>Total for stack greater than three branch intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>12/2</td>
<td>12</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>20</td>
<td>48</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>4</td>
<td>160</td>
<td>90</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>500</td>
</tr>
<tr>
<td>5</td>
<td>360</td>
<td>200</td>
<td>540</td>
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<td>1,100</td>
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<tr>
<td>6</td>
<td>620</td>
<td>350</td>
<td>960</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,900</td>
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<td>8</td>
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<td>2,200</td>
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<td>10</td>
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<td>3,800</td>
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<td></td>
<td>5,600</td>
</tr>
<tr>
<td>12</td>
<td>3,900</td>
<td>1,500</td>
<td>6,000</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>8,400</td>
</tr>
<tr>
<td>15</td>
<td>7,000</td>
<td>Note c</td>
<td>Note c</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note c</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

a. Does not include branches of the building drain. Refer to Table 710.1(1).

b. Stacks shall be sized based on the total accumulated connected load at each story or branch interval. As the total accumulated connected load decreases, stacks are permitted to be reduced in size. Stack diameters shall not be reduced to less than one-half of the diameter of the largest stack size required.

c. Sizing load based on design criteria.

### 710.1.1 Horizontal stack offsets.
Horizontal stack offsets shall be sized as required for building drains in accordance with Table 710.1(1), except as required by Section 711.3.

### 710.1.2 Vertical stack offsets.
Vertical stack offsets shall be sized as required for straight stacks in accordance with Table 710.1(2), except where required to be sized as a building drain in accordance with Section 711.1.1.

### 710.2 Future fixtures.
Where provision is made for the future installation of fixtures, those provided for shall be considered in determining the required sizes of drain pipes.

**SECTION 711**
OFFSETS IN DRAINAGE PIPING IN BUILDINGS OF FIVE STORIES OR MORE

711.1 Horizontal branch connections above or below vertical stack offsets. If a horizontal branch connects to the stack within 2 feet (610 mm) above or below a vertical stack offset, and the offset is located more than four branch intervals below the top of the stack, the offset shall be vented in accordance with Section 907.

711.1.1 Omission of vents for vertical stack offsets. Vents for vertical offsets required by Section 711.1 shall not be required where the stack and its offset are sized as a building drain [see Table 710.1(1)].

711.2 Horizontal stack offsets. A stack with a horizontal offset located more than four branch intervals below the top of the stack shall be vented in accordance with Section 907 and sized as follows:
1. The portion of the stack above the offset shall be sized as for a vertical stack based on the total number of drainage fixture units above the offset.
2. The offset shall be sized in accordance with Section 710.1.1.
3. The portion of the stack below the offset shall be sized as for the offset or based on the total number of drainage fixture units on the entire stack, whichever is larger [see Table 710.1(2), Column 5].

711.2.1 Omission of vents for horizontal stack offsets. Vents for horizontal stack offsets required by Section 711.2 shall not be required where the stack and its offset are one pipe size larger than required for a building drain [see Table 710.1(1)] and the entire stack and offset are not less in cross-sectional area than that required for a straight stack plus the area of an offset vent as provided for in Section 907.

711.3 Offsets below lowest branch. Where a vertical offset occurs in a soil or waste stack below the lowest horizontal branch, a change in diameter of the stack because of the offset shall not be required. If a horizontal offset occurs in a soil or waste stack below the lowest horizontal branch, the required diameter of the offset and the stack below it shall be determined as for a building drain in accordance with Table 710.1(1).

SECTION 712
SUMPS AND EJECTORS
712.1 Building subdrains. Building subdrains that cannot be discharged to the sewer by gravity flow shall be discharged into a tightly covered and vented sump from which the liquid shall be lifted and discharged into the building gravity drainage system by automatic pumping equipment or other approved method. In other than existing structures, the sump shall not receive drainage from any piping within the building capable of being discharged by gravity to the building sewer.

712.2 Valves required. A check valve and a full open valve located on the discharge side of the check valve shall be installed in the pump or ejector discharge piping between the pump or ejector and the gravity drainage system. Access shall be provided to such valves. Such valves shall be located above the sump cover required by Section 712.1 or, where the discharge pipe from the ejector is below grade, the valves shall be accessibly located outside the sump below grade in an access pit with a removable access cover.

**Exception:** In buildings where the “Residential Code of Ohio” applies, only a check valve shall be required, located on the discharge piping from the sewage pump or ejector.

712.3 Sump design. The sump pump, pit and discharge piping shall conform to the requirements of Sections 712.3.1 through 712.3.5.

712.3.1 Sump pump. The sump pump capacity and head shall be appropriate to anticipated use requirements.

712.3.2 Sump pit. The sump pit shall be not less than 18 inches (457 mm) in diameter and not less than 24 inches (610 mm) in depth, unless otherwise approved. The pit shall be accessible and located such that all drainage flows into the pit by gravity. The sump pit shall be constructed of tile, concrete, steel, plastic or other approved materials. The pit bottom shall be solid and provide permanent support for the pump. The sump pit shall be fitted with a gastight removable cover that is installed flush with grade or floor level, or above grade or floor level. The cover shall be adequate to support anticipated loads in the area of use. The sump pit shall be vented in accordance with Chapter 9.

712.3.3 Discharge pipe and fittings. Discharge pipe and fittings serving sump pumps and ejectors shall be constructed of materials in accordance with Sections 712.3.3.1 and 712.3.3.2 and shall be approved.

712.3.3.1 Materials. Pipe and fitting materials shall be constructed of brass, copper, CPVC, ductile iron, PE, or PVC.
712.3.3.2 Ratings. Pipe and fittings shall be rated for the maximum system operating pressure and temperature. Pipe fitting materials shall be compatible with the pipe material. Where pipe and fittings are buried in the earth, they shall be suitable for burial.

712.3.4 Maximum effluent level. The effluent level control shall be adjusted and maintained to at all times prevent the effluent in the sump from rising to within 2 inches (51 mm) of the invert of the gravity drain inlet into the sump.

712.3.5. Pump connection to the drainage system. Pumps connected to the drainage system shall connect to a building sewer, building drain, soil stack, waste stack or horizontal branch drain. Where the discharge line connects into horizontal drainage piping, the connection shall be made through a wye fitting into the top of the drainage piping and such wye fitting shall be located not less than 10 pipe diameters from the base of any soil stack, waste stack or fixture drain.

712.4 Sewage pumps and sewage ejectors. A sewage pump or sewage ejector shall automatically discharge the contents of the sump to the building drainage system.

712.4.1 Macerating toilet systems. Macerating toilet systems shall comply with ASME A112.3.4/CSA B45.9 and shall be installed in accordance with the manufacturer’s instructions.

712.4.2 Capacity. A sewage pump or sewage ejector shall have the capacity and head for the application requirements. Pumps or ejectors that receive the discharge of water closets shall be capable of handling spherical solids with a diameter of up to and including 2 inches (51 mm). Other pumps or ejectors shall be capable of handling spherical solids with a diameter of up to and including 1 inch (25 mm). The capacity of a pump or ejector based on the diameter of the discharge pipe shall be not less than that indicated in Table 712.4.2.

Exceptions:
1. Grinder pumps or grinder ejectors that receive the discharge of water closets shall have a discharge opening of not less than 1 1/4 inches (32 mm).
2. Macerating toilet assemblies that serve single water closets shall have a discharge opening of not less than 3/4 inch (19.1 mm).
TABLE 712.4.2
MINIMUM CAPACITY OF SEWAGE PUMP OR SEWAGE EJECTOR

<table>
<thead>
<tr>
<th>DIAMETER OF THE DISCHARGE PIPE (inches)</th>
<th>CAPACITY OF PUMP OR EJECTOR (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾-2</td>
<td>21</td>
</tr>
<tr>
<td>2½</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 gallon per minute = 3.785 L/m.

SECTION 713
HEALTH CARE PLUMBING

713.1 Scope. This section shall govern those aspects of health care plumbing systems that differ from plumbing systems in other structures. Health care plumbing systems shall conform to this section in addition to the other requirements of this code. The provisions of this section shall apply to the special devices and equipment installed and maintained in the following occupancies: nursing homes; homes for the aged; orphanages; infirmaries; first aid stations; psychiatric facilities; clinics; professional offices of dentists and doctors; mortuaries; educational facilities; surgery, dentistry, research and testing laboratories; establishments manufacturing pharmaceutical drugs and medicines; and other structures with similar apparatus and equipment classified as plumbing.

713.2 Bedpan washers and clinical sinks. Bedpan washers and clinical sinks shall connect to the drainage and vent system in accordance with the requirements for a water closet. Bedpan washers shall also connect to a local vent.

713.3 Indirect waste. Sterilizers, steamers and condensers shall discharge to the drainage through an indirect waste pipe by means of an air gap. Where a battery of not more than three sterilizers discharges to an individual receptor, the distance between the receptor and a sterilizer shall not exceed 8 feet (2438 mm). The indirect waste pipe on a bedpan steamer shall be trapped.

713.4 Vacuum system station. Ready access shall be provided to vacuum system station receptacles. Such receptacles shall be built into cabinets or recesses and shall be visible.

713.5 Bottle system. Vacuum (fluid suction) systems intended for collecting, removing and disposing of blood, pus or other fluids by the bottle system shall be provided with receptacles equipped with an overflow prevention device at each vacuum outlet station.
713.6 **Central disposal system equipment.** Central vacuum (fluid suction) systems shall provide continuous service. Systems equipped with collecting or control tanks shall provide for draining and cleaning of the tanks while the system is in operation. In hospitals, the system shall be connected to the emergency power system. The exhausts from a vacuum pump serving a vacuum (fluid suction) system shall discharge separately to open air above the roof.

713.7 **Central vacuum or disposal systems.** Where the waste from a central vacuum (fluid suction) system of the barometric-lag, collection-tank or bottle-disposal type is connected to the drainage system, the waste shall be directly connected to the sanitary drainage system through a trapped waste.

713.7.1 **Piping.** The piping of a central vacuum (fluid suction) system shall be of corrosion-resistant material with a smooth interior surface. A branch shall be not less than ½ inch (12.7 mm) nominal pipe size for one outlet and shall be sized in accordance with the number of vacuum outlets. A main shall be not less than 1-inch (25 mm) nominal pipe size. The pipe sizing shall be increased in accordance with the manufacturer's instructions as stations are increased.

713.7.2 **Velocity.** The velocity of airflow in a central vacuum (fluid suction) system shall be less than 5,000 feet per minute (25 m/s).

713.8 **Vent connections prohibited.** Connections between local vents serving bedpan washers or sterilizer vents serving sterilizing apparatus and normal sanitary plumbing systems are prohibited. Only one type of apparatus shall be served by a local vent.

713.9 **Local vents and stacks for bedpan washers.** Bedpan washers shall be vented to open air above the roof by means of one or more local vents. The local vent for a bedpan washer shall be not less than a 2-inch-diameter (51 mm) pipe. A local vent serving a single bedpan washer is permitted to drain to the fixture served.

713.9.1 **Multiple installations.** Where bedpan washers are located above each other on more than one floor, a local vent stack is permitted to be installed to receive the local vent on the various floors. Not more than three bedpan washers shall be connected to a 2-inch (51 mm) local vent stack, not more than six to a 3-inch (76 mm) local vent stack and not more than 12 to a 4-inch (102 mm) local vent stack. In multiple installations, the connections
between a bedpan washer local vent and a local vent stack shall be made with
tee or tee-wye sanitary pattern drainage fittings installed in an upright
position.

713.9.2 Trap required. The bottom of the local vent stack, except where
serving only one bedpan washer, shall be drained by means of a trapped and
vented waste connection to the sanitary drainage system. The trap and waste
shall be the same size as the local vent stack.

713.9.3 Trap seal maintenance. A water supply pipe not less than $\frac{1}{4}$ inch
(6.4 mm) in diameter shall be taken from the flush supply of each bedpan
washer on the discharge or fixture side of the vacuum breaker, shall be
trapped to form not less than a 3-inch (76 mm) water seal and shall be
connected to the local vent stack on each floor. The water supply shall be
installed so as to provide a supply of water to the local vent stack for
cleansing and drain trap seal maintenance each time a bedpan washer is
flushed.

713.10 Sterilizer vents and stacks. Multiple installations of pressure and
nonpressure sterilizers shall have the vent connections to the sterilizer vent stack
made by means of inverted wye fittings. Access shall be provided to vent
connections for the purpose of inspection and maintenance.

713.10.1 Drainage. The connection between sterilizer vent or exhaust
openings and the sterilizer vent stack shall be designed and installed to drain
to the funnel or basket type waste fitting. In multiple installations, the
sterilizer vent stack shall be drained separately to the lowest sterilizer funnel
or basket-type waste fitting or receptor.

713.11 Sterilizer vent stack sizes. Sterilizer vent stack sizes shall comply with
Sections 713.11.1 through 713.11.4.

713.11.1 Bedpan steamers. The minimum size of a sterilizer vent serving a
bedpan steamer shall be $1\frac{1}{2}$ inches (38 mm) in diameter. Multiple
installations shall be sized in accordance with Table 713.11.1.

### TABLE 713.11.1

<table>
<thead>
<tr>
<th>STACK SIZE</th>
<th>CONNECTION SIZE</th>
</tr>
</thead>
</table>

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713.11.2 Boiling-type sterilizers. The size of a sterilizer vent stack shall be not less than 2 inches (51 mm) in diameter where serving a utensil sterilizer and not less than 1 1/2 inches (38 mm) in diameter where serving an instrument sterilizer. Combinations of boiling-type sterilizer vent connections shall be sized in accordance with Table 713.11.1.

713.11.3 Pressure sterilizers. Pressure sterilizer vent stacks shall be 2 1/2 inches (64 mm) minimum. Those serving combinations of pressure sterilizer exhaust connections shall be sized in accordance with Table 713.11.3.

713.11.4 Pressure instrument washer sterilizer sizes. The diameter of a sterilizer vent stack serving an instrument washer sterilizer shall be not less than 2 inches (51 mm). Not more than two sterilizers shall be installed on a 2-inch (51 mm) stack, and not more than four sterilizers shall be installed on a 3-inch (76 mm) stack.

### TABLE 713.11.3

STACK SIZES FOR PRESSURE STERILIZERS (Number of Connections of Various Sizes Permitted To Various-sized Vent Stacks)

<table>
<thead>
<tr>
<th>STACK SIZE (inches)</th>
<th>1/4&quot;</th>
<th>1&quot;</th>
<th>1 1/4&quot;</th>
<th>1 1/2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2a</td>
<td>1</td>
<td>or</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>2</td>
<td>or</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2b</td>
<td>1</td>
<td>and</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>4</td>
<td>or</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>2</td>
<td>and</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4a</td>
<td>8</td>
<td>or</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>4b</td>
<td>4</td>
<td>and</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

a. Total of each size.
b. Combination of sizes.
SECTION 714
COMPUTERIZED DRAINAGE DESIGN

714.1 **Design of drainage system.** The sizing, design and layout of the drainage system shall be permitted to be designed by approved computer design methods.

714.2 **Load on drainage system.** The load shall be computed from the simultaneous or sequential discharge conditions from fixtures, appurtenances and appliances or the peak usage design condition.

714.2.1 **Fixture discharge profiles.** The discharge profiles for flow rates versus time from fixtures and appliances shall be in accordance with the manufacturer’s specifications.

714.3 **Selections of drainage pipe sizes.** Pipe shall be sized to prevent full-bore flow.

714.3.1 **Selecting pipe wall roughness.** Pipe size calculations shall be conducted with the pipe wall roughness factor (ks), in accordance with the manufacturer’s specifications and as modified for aging roughness factors with deposits and corrosion.

714.3.2 **Slope of horizontal drainage piping.** Horizontal drainage piping shall be designed and installed at slopes in accordance with Table 704.1.

SECTION 715
BACKWATER VALVES

715.1 **Sewage backflow.** If required by the “Ohio Environmental Protection Agency” or local sewer purveyor, a backwater valve shall be installed only for plumbing fixtures installed on a floor with a finished floor elevation below the elevation of the manhole cover of the next upstream manhole in the public sewer. Such fixtures shall be protected by a backwater valve installed in the building drain, or horizontal branch serving such fixtures. Plumbing fixtures installed on a
floor with a finished floor elevation above the elevation of the manhole cover of the next upstream manhole in the public sewer shall not discharge through a backwater valve.

**Exception:** In existing buildings, fixtures above the elevation of the manhole cover of the next upstream manhole in the public sewer shall not be prohibited from discharging through a backwater valve.

715.2 Material. Bearing parts of backwater valves shall be of corrosion-resistant material. Backwater valves shall comply with ASME A112.14.1, CSA B181.1 or CSA B181.2.

715.3 Seal. Backwater valves shall be so constructed as to provide a mechanical seal against backflow.

715.4 Diameter. Backwater valves, when fully opened, shall have a capacity not less than that of the pipes in which they are installed.

715.5 Location. Backwater valves shall be installed so that access is provided to the working parts for service and repair.

**SECTION 716**

**VACUUM DRAINAGE SYSTEMS**

716.1 Scope. Vacuum drainage systems shall be in accordance with Sections 716.2 through 716.4.

716.2 System design. Vacuum drainage systems shall be designed in accordance with the vacuum drainage system manufacturer’s instructions. The system layout, including piping layout, tank assemblies, vacuum pump assembly and other components necessary for proper function of the system shall be in accordance with the manufacturer’s instructions. Plans, specifications and other data for such systems shall be submitted to the code official for review and approval prior to installation.

716.2.1 Fixtures. Gravity-type fixtures installed in vacuum drainage systems shall comply with Chapter 4.

716.2.2 Drainage fixture units. Drainage fixture units for gravity drainage systems that discharge into, or receive discharge from, vacuum drainage systems shall be based on the values in this chapter.
716.2.3 Water supply fixture units. Water supply fixture units shall be based on the values in Chapter 6 of this code, except that the water supply fixture unit for a vacuum-type water closet shall be 1.

716.2.4 Traps and cleanouts. Gravity drainage fixtures shall be provided with traps and cleanouts in accordance with this chapter and Chapter 10.

716.2.5 Materials. Vacuum drainage pipe, fitting and valve materials shall be in accordance with the vacuum drainage system manufacturer’s instructions and the requirements of this chapter.

716.3 Testing and demonstrations. After completion of the entire system installation, the system shall be subjected to a vacuum test of 19 inches (483 mm) of mercury and shall be operated to function as required by the code official and the manufacturer of the vacuum drainage system. Recorded proof of all tests shall be submitted to the code official.

716.4 Written instructions. Written instructions for the operation, maintenance, safety and emergency procedures shall be provided to the building owner. The code official shall verify that the building owner is in receipt of such instructions.

SECTION 717
REPLACEMENT OF UNDERGROUND SEWERS BY PIPE-BURSTING METHODS

717.1 General. Deleted.

717.2 Applicability. Deleted.

717.3 Pre-installation inspection. Deleted.

717.4 Pipe. Deleted.

717.5 Pipe fittings. Deleted.

717.6 Cleanouts. Deleted.

717.7 Post-installation inspection. Deleted.

717.8 Pressure testing. Deleted.
4101:3-8-01 Indirect/special waste.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:3-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 801
GENERAL

801.1 Scope. This chapter shall govern matters concerning indirect waste piping and special wastes. This chapter shall further control matters concerning food-handling establishments, sterilizers, clear-water waste, swimming pools, methods of providing air breaks or air gaps, and neutralizing devices for corrosive wastes.

801.2 Protection. Devices, appurtenances, appliances and apparatus intended to serve some special function, such as sterilization, distillation, processing, cooling, or storage of ice or foods, and that discharge to the drainage system, shall be provided with protection against backflow, flooding, fouling, contamination and stoppage of the drain.

SECTION 802
INDIRECT WASTES

802.1 Where required. Food-handling equipment, in other than dwelling units, clear-water waste, dishwashing machines and utensils, pots, pans and dishwashing sinks shall discharge through an indirect waste pipe as specified in Sections 802.1.1 through 802.1.8. Health-care related fixtures, devices and equipment shall discharge to the drainage system through an indirect waste pipe by means of an air gap in accordance with this chapter and Section 713.3. Fixtures not required by this section to be indirectly connected shall be directly connected to the plumbing system in accordance with Chapter 7.

Exception: Approved health care related fixtures, devices, and equipment may be directly connected to the drainage system if required to be directly connected in accordance with the manufacturer’s installation instructions.

802.1.1 Food handling. Equipment and fixtures utilized for the storage, preparation and handling of food shall discharge through an indirect waste pipe by means of an air gap. Each well of a multiple-compartment sink shall
discharge independently to a waste receptor.

802.1.2 **Floor drains in food storage areas.** Floor drains located within walk-in refrigerators or freezers in food service and food establishments shall be indirectly connected to the sanitary drainage system by means of an air gap. Where a floor drain is located within an area subject to freezing, the waste line serving the floor drain shall not be trapped and shall indirectly discharge into a waste receptor located outside of the area subject to freezing.

**Exception:** Where protected against backflow by a backwater valve, such floor drains shall be indirectly connected to the sanitary drainage system by means of an air break or an air gap.

802.1.3 **Potable clear-water waste.** Where devices and equipment, such as sterilizers and relief valves, discharge potable water to the building drainage system, the discharge shall be through an indirect waste pipe by means of an air gap.

802.1.4 **Swimming pools.** Where waste water from swimming pools, backwash from filters and water from pool deck drains discharge to the building drainage system, the discharge shall be through an indirect waste pipe by means of an air gap.

802.1.5 **Nonpotable clear-water waste.** Where devices and equipment such as process tanks, filters, drips and boilers discharge nonpotable water to the building drainage system, the discharge shall be through an indirect waste pipe by means of an air break or an air gap.

802.1.6 **Domestic dishwashing machines.** Domestic dishwashing machines shall discharge indirectly through an air gap or air break into a waste receptor in accordance with Section 802.2, or discharge into a wye branch fitting on the tailpiece of the kitchen sink or the dishwasher connection of a food waste disposer. The waste line of a domestic dishwashing machine discharging into a kitchen sink tailpiece or food waste disposer shall connect to a deck-mounted air gap or the waste line shall rise and be securely fastened to the underside of the sink rim or counter.

802.1.7 **Commercial dishwashing machines.** The discharge from a commercial dishwashing machine shall be through an air gap or air break into a waste receptor in accordance with Section 802.2.

802.1.8 **Food utensils, dishes, pots and pans sinks.** Sinks, in other than
dwellings, used for the washing, rinsing or sanitizing of utensils, dishes, pots, pans or service ware used in the preparation, serving or eating of food shall discharge indirectly through an air gap or an air break or directly connect to the drainage system. \textit{Food handling sinks shall comply with Section 802.1.1.}

802.2 Installation. Indirect waste piping shall discharge through an air gap or air break into a waste receptor. Waste receptors shall be trapped and vented and shall connect to the building drainage system. Indirect waste piping that exceeds 30 inches (762 mm) in developed length measured horizontally, or 54 inches (1372 mm) in total developed length, shall be trapped.

\textbf{Exception:} Where a waste receptor receives only clear water waste and does not directly connect to a sanitary drainage system, the receptor shall not require a trap.

802.2.1 Air gap. The air gap between the indirect waste pipe and the flood level rim of the waste receptor shall be not less than twice the effective opening of the indirect waste pipe.

802.2.2 Air break. An air break shall be provided between the indirect waste pipe and the trap seal of the waste receptor.

802.3 Waste receptors. For other than hub drains that receive only clear-water waste and standpipes, a removable strainer or basket shall be installed in waste receptors. Waste receptors shall not be installed in concealed spaces. Waste receptors shall not be installed in plenums, crawl spaces, attics, interstitial spaces above ceilings and below floors. Ready access shall be provided to waste receptors.

802.3.1 Size of receptors. A waste receptor shall be sized for the maximum discharge of all indirect waste pipes served by the receptor. Receptors shall be installed to prevent splashing or flooding.

802.3.2 Hub drains. A hub drain shall be in the form of a hub or a pipe extending not less than 1 inch (25 mm) above a water-impervious floor.

802.3.3 Standpipes. Standpipes shall be individually trapped. Standpipes shall extend not less than 18 inches (457 mm) but not greater than 42 inches (1066 mm) above the trap weir. Access shall be provided to standpipes and drains for rodding.
SECTION 803
SPECIAL WASTES

803.1 Neutralizing device required for corrosive wastes. Corrosive liquids, spent acids or other harmful chemicals that destroy or injure a drain, sewer, soil or waste pipe, or create noxious or toxic fumes or interfere with sewage treatment processes shall not be discharged into the plumbing system without being thoroughly diluted, neutralized or treated by passing through an approved dilution or neutralizing device. Such devices shall be automatically provided with a sufficient supply of diluting water or neutralizing medium so as to make the contents non injurious before discharge into the drainage system. The nature of the corrosive or harmful waste and the method of its treatment or dilution shall be approved prior to installation.

803.2 System design. A chemical drainage and vent system shall be designed and installed in accordance with this code. Chemical drainage and vent systems shall be completely separated from the sanitary systems. Chemical waste shall not discharge to a sanitary drainage system until such waste has been treated in accordance with Section 803.1.

SECTION 804
MATERIALS, JOINTS AND CONNECTIONS

804.1 General. The materials and methods utilized for the construction and installation of indirect waste pipes and systems shall comply with the applicable provisions of Chapter 7.
4101:3-9-01 Vents.

<Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:3-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 901
GENERAL

901.1 Scope. The provisions of this chapter shall govern the materials, design, construction and installation of vent systems.

901.2 Trap seal protection. The plumbing system shall be provided with a system of vent piping that will permit the admission or emission of air so that the seal of any fixture trap shall not be subjected to a pressure differential of more than 1 inch of water column (249 Pa).

901.2.1 Venting required. Traps and trapped fixtures shall be vented in accordance with one of the venting methods specified in this chapter.

901.3 Chemical waste vent systems. The vent system for a chemical waste system shall be independent of the sanitary vent system and shall terminate separately through the roof to the outdoors or to an air admittance valve that complies with ASSE 1049. Air admittance valves for chemical waste systems shall comply with Section 918.8 and shall be constructed of materials approved in accordance with Section 702.5 and shall be tested for chemical resistance in accordance with ASTM F 1412.

901.4 Use limitations. The plumbing vent system shall not be utilized for purposes other than the venting of the plumbing system.

901.5 Tests. The vent system shall be tested in accordance with Section 312.

901.6 Engineered systems. Engineered venting systems shall conform to the provisions of Section 919.

SECTION 902
MATERIALS
902.1 **Vents.** The materials and methods utilized for the construction and installation of venting systems shall comply with the applicable provisions of Section 702.

902.2 **Sheet copper.** Sheet copper for vent pipe flashings shall conform to ASTM B 152 and shall weigh not less than 8 ounces per square foot (2.5 kg/m²).

902.3 **Sheet lead.** Sheet lead for vent pipe flashings shall weigh not less than 3 pounds per square foot (15 kg/m²) for field-constructed flashings and not less than $2\frac{1}{2}$ pounds per square foot (12 kg/m²) for prefabricated flashings.

**SECTION 903**

**VENT TERMINALS**

903.1 **Roof extension.** Open vent pipes that extend through a roof shall be terminated not less than 12 inches (304.8 mm) above the roof. Where a roof is to be used for assembly or as a promenade, observation deck, sunbathing deck or similar purposes, open vent pipes shall terminate not less than 7 feet (2134 mm) above the roof within 10 feet of the occupiable area.

903.2 **Frost closure.** Where the 97.5-percent value for outside design temperature is 0°F (-18°C) or less, vent extensions through a roof or wall shall be not less than 3 inches (76 mm) in diameter. Any increase in the size of the vent shall be made not less than 1 foot (305 mm) inside the thermal envelope of the building.

903.3 **Flashings.** The juncture of each vent pipe with the roof line shall be made water tight by an approved flashing.

903.4 **Prohibited use.** A vent terminal shall not be used for any purpose other than a vent terminal.

903.5 **Location of vent terminal.** An open vent terminal from a drainage system shall not be located directly beneath any door, openable window, or other air intake opening of the building or of an adjacent building, and any such vent terminal shall not be within 10 feet (3048 mm) horizontally of such an opening unless it is 3 feet (914 mm) or more above the top of such opening.

903.6 **Extension through the wall.** Vent terminals extending through the wall shall terminate at a point not less than 10 feet (3048 mm) from a lot line and not less than 10 feet (3048 mm) above average ground level. Vent terminals shall not
terminate under the overhang of a structure with soffit vents. Side wall vent terminals shall be protected to prevent birds or rodents from entering or blocking the vent opening.

**903.7 Extension outside a structure.** In climates where the 97.5-percent value for outside design temperature is less than 0°F (-18°C), vent pipes installed on the exterior of the structure shall be protected against freezing by insulation, heat or both.

**SECTION 904 OUTDOOR VENT EXTENSIONS**

**904.1 Required vent extension.** The vent system serving each building drain shall have not less than one vent pipe that extends to the outdoors.

**904.1.1 Installation.** The required vent shall be a dry vent that connects to the building drain or an extension of a drain that connects to the building drain. Such vent shall not be an island fixture vent as allowed by Section 916.

**904.1.2 Size.** The required vent shall be sized in accordance with Section 906.2 based on the required size of the building drain.

**904.2 Vent stack required.** A vent stack shall be required for every drainage stack that has five branch intervals or more.

Exception: Drainage stacks installed in accordance with Section 913.

**904.3 Vent termination.** Vent stacks or stack vents shall terminate outdoors to the open air or to a stack-type air admittance valve in accordance with Section 918.

**904.4 Vent connection at base.** Vent stacks shall connect to the base of the drainage stack. The vent stack shall connect at or below the lowest horizontal branch. Where the 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.

**904.5 Vent headers.** Stack vents and vent stacks connected into a common vent header at the top of the stacks and extending to the open air at one point shall be sized in accordance with the requirements of Section 906.1. The number of fixture units shall be the sum of all fixture units on all stacks connected thereto, and the developed length shall be the longest vent length from the intersection at
the base of the most distant stack to the vent terminal in the open air, as a direct extension of one stack.

SECTION 905
VENT CONNECTIONS AND GRADES

905.1 Connection. Individual, branch and circuit vents shall connect to a vent stack, stack vent, air admittance valve or extend to the open air.

905.2 Grade. Vent and branch vent pipes shall be so graded and connected as to drain back to the drainage pipe by gravity.

905.3 Vent connection to drainage system. Every dry vent connecting to a horizontal drain shall connect above the centerline of the horizontal drain pipe.

905.4 Vertical rise of vent. Every dry vent shall rise vertically to a point not less than 6 inches (152 mm) above the flood level rim of the highest trap or trapped fixture being vented.

   Exception: Vents for interceptors located outdoors.

905.5 Height above fixtures. A connection between a vent pipe and a vent stack or stack vent shall be made at not less than 6 inches (152 mm) above the flood level rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents, relief vents or loop vents shall be located not less than 6 inches (152 mm) above the flood level rim of the highest fixture served.

905.6 Vent for future fixtures. Where the drainage piping has been roughed-in for future fixtures, a rough-in connection for a vent shall be installed. The vent size shall be not less than one-half the diameter of the rough-in drain to be served. The vent rough-in shall connect to the vent system, or shall be vented by other means as provided for in this chapter. The connection shall be identified to indicate that it is a vent.

SECTION 906
VENT PIPE SIZING

906.1 Size of stack vents and vent stacks. The minimum required diameter of stack vents and vent stacks shall be determined from the developed length and the total of drainage fixture units connected thereto in accordance with Table 906.1, but in no case shall the diameter be less than one-half the diameter of the drain served or less than 1 1/4 inches (32 mm).
906.2 Vents other than stack vents or vent stacks. The diameter of individual vents, branch vents, circuit vents and relief vents shall be not less than one-half the required diameter of the drain served. The required size of the drain shall be determined in accordance with Table 710.1(2). Vent pipes shall not be less than 1\(\frac{1}{4}\) inches (32 mm) in diameter. Vents exceeding 40 feet (12 192 mm) in developed length shall be increased by one nominal pipe size for the entire developed length of the vent pipe. Relief vents for soil and waste stacks in buildings having more than 10 branch intervals shall be sized in accordance with Section 908.2.

906.3 Developed length. The developed length of individual, branch, circuit and relief vents shall be measured from the farthest point of vent connection to the drainage system to the point of connection to the vent stack, stack vent or termination outside of the building.

906.4 Multiple branch vents. Where multiple branch vents are connected to a common branch vent, the common branch vent shall be sized in accordance with this section based on the size of the common horizontal drainage branch that is or would be required to serve the total drainage fixture unit load being vented.

906.5 Sump vents. Sump vent sizes shall be determined in accordance with Sections 906.5.1 and 906.5.2.

906.5.1 Sewage pumps and sewage ejectors other than pneumatic. Drainage piping below the building sewer level shall be vented in the same manner as that of a gravity system. Building sump vent sizes for sumps with sewage pumps or sewage ejectors, other than pneumatic, shall be determined in accordance with Table 906.5.1.

906.5.2 Pneumatic sewage ejectors. The air pressure relief pipe from a pneumatic sewage ejector shall be connected to an independent vent stack terminating as required for vent extensions through the roof. The relief pipe shall be sized to relieve air pressure inside the ejector to atmospheric pressure, but shall be not less than 1\(\frac{1}{4}\) inches (32 mm) in size.

SECTION 907
VENTS FOR STACK OFFSETS

907.1 Vent for horizontal offset of drainage stack. Horizontal offsets of drainage stacks shall be vented where five or more branch intervals are located.
above the offset. The offset shall be vented by venting the upper section of the drainage stack and the lower section of the drainage stack.

907.2 **Upper section.** The upper section of the drainage stack shall be vented as a separate stack with a vent stack connection installed in accordance with Section 904.4. The offset shall be considered the base of the stack.

### TABLE 906.1
**SIZE AND DEVELOPED LENGTH OF STACK VENTS AND VENT STACKS**

<table>
<thead>
<tr>
<th>DIAMETER OF SOIL OR WASTE STACK (inches)</th>
<th>TOTAL FIXTURE UNITS BEING VENTED (dfu)</th>
<th>1¼</th>
<th>1½</th>
<th>2</th>
<th>2½</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>10</th>
<th>12</th>
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TABLE 906.5.1
SIZE AND LENGTH OF SUMP VENTS

<table>
<thead>
<tr>
<th>DISCHARGE CAPACITY OF PUMP (gpm)</th>
<th>MAXIMUM DEVELOPED LENGTH OF VENT (feet)</th>
<th>Diameter of vent (inches)</th>
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<tbody>
<tr>
<td></td>
<td>1¼</td>
<td>1½</td>
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<tr>
<td>10</td>
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<tr>
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<td>Not permitted</td>
<td>10c</td>
</tr>
<tr>
<td>200</td>
<td>Not permitted</td>
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<tr>
<td>250</td>
<td>Not permitted</td>
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<tr>
<td>300</td>
<td>Not permitted</td>
<td>Not permitted</td>
</tr>
<tr>
<td>400</td>
<td>Not permitted</td>
<td>Not permitted</td>
</tr>
<tr>
<td>500</td>
<td>Not permitted</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm,

a. The developed length shall be measured from the vent connection to the open air.

b. Actual values greater than 500 feet.

c. Less than 10 feet.
907.3 Lower section. The lower section of the drainage stack shall be vented by a yoke vent connecting between the offset and the next lower horizontal branch. The yoke vent connection shall be permitted to be a vertical extension of the drainage stack. The size of the yoke vent and connection shall be a minimum of the size required for the vent stack of the drainage stack.

SECTION 908
RELIEF VENTS—STACKS OF MORE THAN 10 BRANCH INTERVALS

908.1 Where required. Soil and waste stacks in buildings having more than 10 branch intervals shall be provided with a relief vent at each tenth interval installed, beginning with the top floor.

908.2 Size and connection. The size of the relief vent shall be equal to the size of the vent stack to which it connects. The lower end of each relief vent shall connect to the soil or waste stack through a wye below the horizontal branch serving the floor, and the upper end shall connect to the vent stack through a wye not less than 3 feet (914 mm) above the floor.

SECTION 909
FIXTURE VENTS

909.1 Distance of trap from vent. Each fixture trap shall have a protecting vent located so that the slope and the developed length in the fixture drain from the trap weir to the vent fitting are within the requirements set forth in Table 909.1.

Exception: The developed length of the fixture drain from the trap weir to the vent fitting for self-siphoning fixtures, such as water closets, shall not be limited.

TABLE 909.1
MAXIMUM DISTANCE OF FIXTURE TRAP FROM VENT

<table>
<thead>
<tr>
<th>SIZE OF TRAP (inches)</th>
<th>TRAP SLOPE (inch per foot)</th>
<th>DISTANCE FROM TRAP (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4</td>
<td>1/4</td>
<td>5</td>
</tr>
<tr>
<td>1 1/2</td>
<td>1/4</td>
<td>6</td>
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<tr>
<td>2</td>
<td>1/4</td>
<td>8</td>
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<tr>
<td>3</td>
<td>1/8</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>1/8</td>
<td>16</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m.
909.2 Venting of fixture drains. The total fall in a fixture drain due to pipe slope shall not exceed the diameter of the fixture drain, nor shall the vent connection to a fixture drain, except for water closets, be below the weir of the trap.

909.3 Crown vent. A vent shall not be installed within two pipe diameters of the trap weir.

SECTION 910
INDIVIDUAL VENT

910.1 Individual vent permitted. Each trap and trapped fixture is permitted to be provided with an individual vent. The individual vent shall connect to the fixture drain of the trap or trapped fixture being vented.

SECTION 911
COMMON VENT

911.1 Individual vent as common vent. An individual vent is permitted to vent two traps or trapped fixtures as a common vent. The traps or trapped fixtures being common vented shall be located on the same floor level.

911.2 Connection at the same level. Where the fixture drains being common vented connect at the same level, the vent connection shall be at the interconnection of the fixture drains or downstream of the interconnection.

911.3 Connection at different levels. Where the fixture drains connect at different levels, the vent shall connect as a vertical extension of the vertical drain. The vertical drain pipe connecting the two fixture drains shall be considered the vent for the lower fixture drain, and shall be sized in accordance with Table 911.3. The upper fixture shall not be a water closet.

<table>
<thead>
<tr>
<th>PIPE SIZE (inches)</th>
<th>MAXIMUM DISCHARGE FROM UPPER FIXTURE DRAIN (dfu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2 1/2 to 3</td>
<td>6</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.
SECTION 912
WET VENTING

912.1 Horizontal wet vent permitted. Any combination of fixtures within two bathroom groups located on the same floor level is permitted to be vented by a horizontal wet vent. The wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent along the direction of the flow in the drain pipe to the most downstream fixture drain connection to the horizontal branch drain. Each wet-vented fixture drain shall connect independently to the horizontal wet vent. Only the fixtures within the bathroom groups shall connect to the wet-vented horizontal branch drain. Any additional fixtures shall discharge downstream of the horizontal wet vent.

912.1.1 Vertical wet vent permitted. Any combination of fixtures within two bathroom groups located on the same floor level is permitted to be vented by a vertical wet vent. The vertical wet vent shall be considered the vent for the fixtures and shall extend from the connection of the dry vent down to the lowest fixture drain connection. Each wet-vented fixture shall connect independently to the vertical wet vent. Water closet drains shall connect at the same elevation. Other fixture drains shall connect above or at the same elevation as the water closet fixture drains. The dry-vent connection to the vertical wet vent shall be an individual or common vent serving one or two fixtures.

912.2 Dry vent connection. The required dry-vent connection for wet-vented systems shall comply with Sections 912.2.1 and 912.2.2.

912.2.1 Horizontal wet vent. The dry-vent connection for a horizontal wet-vent system shall be an individual vent or a common vent for any bathroom group fixture, except an emergency floor drain. Where the dry-vent connects to a water closet fixture drain, the drain shall connect horizontally to the horizontal wet-vent system. Not more than one wet-vented fixture drain shall discharge upstream of the dry-vented fixture drain connection.

912.2.2 Vertical wet vent. The dry-vent connection for a vertical wet-vent system shall be an individual vent or common vent for the most upstream fixture drain.

912.3 Size. The dry vent serving the wet vent shall be sized based on the largest required diameter of pipe within the wetvent system served by the dry vent. The wet vent shall be of a size not less than that specified in Table 912.3, based on the
fixture unit discharge to the wet vent.

### TABLE 912.3

<table>
<thead>
<tr>
<th>WET VENT PIPE SIZE (inches)</th>
<th>DRAINAGE FIXTURE UNIT LOAD (dfu)</th>
<th>UNIT</th>
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<tr>
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<td>1</td>
<td>1</td>
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<tr>
<td>3</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

### SECTION 913

**WASTE STACK VENT**

**913.1 Waste stack vent permitted.** A waste stack shall be considered a vent for all of the fixtures discharging to the stack where installed in accordance with the requirements of this section.

**913.2 Stack installation.** The waste stack shall be vertical, and both horizontal and vertical offsets shall be prohibited between the lowest fixture drain connection and the highest fixture drain connection. Fixture drains shall connect separately to the waste stack. The stack shall not receive the discharge of water closets, urinals, clinic or flushing rim sinks.

**913.3 Stack vent.** A stack vent shall be provided for the waste stack. The size of the stack vent shall be not less than the size of the waste stack. Offsets shall be permitted in the stack vent, shall be located not less than 6 inches (152 mm) above the flood level of the highest fixture and shall be in accordance with Section 905.2. The stack vent shall be permitted to connect with other stack vents and vent stacks in accordance with Section 904.5.

**913.4 Waste stack size.** The waste stack shall be sized based on the total discharge to the stack and the discharge within a branch interval in accordance with Table 913.4. The waste stack shall be the same size throughout its length.

### TABLE 913.4

<table>
<thead>
<tr>
<th>STACK SIZE (inches)</th>
<th>MAXIMUM NUMBER OF DRAINAGE FIXTURE UNITS (dfu)</th>
</tr>
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<table>
<thead>
<tr>
<th>Total discharge into one branch interval</th>
<th>Total discharge for stack</th>
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</thead>
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<tr>
<td>1 ½</td>
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<tr>
<td>6</td>
<td>No limit</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

**SECTION 914**

**CIRCUIT VENTING**

**914.1 Circuit vent permitted.** A maximum of eight fixtures connected to a horizontal branch drain shall be permitted to be circuit vented. Each fixture drain shall connect horizontally to the horizontal branch being circuit vented. The horizontal branch drain shall be classified as a vent from the most downstream fixture drain connection to the most upstream fixture drain connection to the horizontal branch.

**914.1.1 Multiple circuit-vented branches.** Circuit-vented horizontal branch drains are permitted to be connected together. Each group of a maximum of eight fixtures shall be considered a separate circuit vent and shall conform to the requirements of this section.

**914.2 Vent connection.** The circuit vent connection shall be located between the two most upstream fixture drains. The vent shall connect to the horizontal branch and shall be installed in accordance with Section 905. The circuit vent pipe shall not receive the discharge of any soil or waste.

**914.3 Slope and size of horizontal branch.** The slope of the vent section of the horizontal branch drain shall be not greater than one unit vertical in 12 units horizontal (8.3-percent slope). The entire length of the vent section of the horizontal branch drain shall be sized for the total drainage discharge to the branch.

**914.3.1 Size of multiple circuit vent.** Each separate circuit-vented horizontal branch that is interconnected shall be sized independently in accordance with Section 914.3. The downstream circuit-vented horizontal branch shall be sized...
for the total discharge into the branch, including the upstream branches and the fixtures within the branch.

914.4 Relief vent. A relief vent shall be provided for circuit-vented horizontal branches receiving the discharge of four or more water closets and connecting to a drainage stack that receives the discharge of soil or waste from upper horizontal branches.

914.4.1 Connection and installation. The relief vent shall connect to the horizontal branch drain between the stack and the most downstream fixture drain of the circuit vent. The relief vent shall be installed in accordance with Section 905.

914.4.2 Fixture drain or branch. The relief vent is permitted to be a fixture drain or fixture branch for fixtures located within the same branch interval as the circuit-vented horizontal branch. The maximum discharge to a relief vent shall be four fixture units.

914.5 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.

SECTION 915
COMBINATION WASTE AND VENT SYSTEM

915.1 Type of fixtures. A combination waste and vent system shall not serve fixtures other than floor drains, sinks, lavatories and drinking fountains. Combination waste and vent systems shall not receive the discharge from a food waste disposer or clinical sink.

915.2 Installation. The only vertical pipe of a combination waste and vent system shall be the connection between the fixture drain of a sink, lavatory or drinking fountain, and the horizontal combination waste and vent pipe. The vertical distance shall not exceed 8 feet (2438 mm).

915.2.1 Slope. The slope of a horizontal combination waste and vent pipe shall not exceed one-half unit vertical in 12 units horizontal (4-percent slope) and shall not be less than that indicated in Table 704.1.
915.2.2 **Size and length.** The size of a combination waste and vent pipe shall be not less than that indicated in Table 915.2.2. The horizontal length of a combination waste and vent system shall be unlimited.

**TABLE 915.2.2**

<table>
<thead>
<tr>
<th>DIAMETER PIPE (inches)</th>
<th>MAXIMUM DRAINAGE (dfu)</th>
<th>NUMBER OF FIXTURE UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting to a horizontal branch or stack</td>
<td>Connecting to a building drain or building subdrain</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2½</td>
<td>6</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>31</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>160</td>
<td>250</td>
</tr>
<tr>
<td>6</td>
<td>360</td>
<td>575</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

915.2.3 **Connection.** The combination waste and vent system shall be provided with a dry vent connected at any point within the system or the system shall connect to a horizontal drain that serves vented fixtures located on the same floor. Combination waste and vent systems connecting to building drains receiving only the discharge from one or more stacks shall be provided with a dry vent. The vent connection to the combination waste and vent pipe shall extend vertically to a point not less than 6 inches (152 mm) above the flood level rim of the highest fixture being vented before offsetting horizontally.

915.2.4 **Vent size.** The vent shall be sized for the total drainage fixture unit load in accordance with Section 906.2.

915.2.5 **Fixture branch or drain.** The fixture branch or fixture drain shall connect to the combination waste and vent within a distance specified in Table 909.1. The combination waste and vent pipe shall be considered the vent for the fixture.

**SECTION 916**

**ISLAND FIXTURE VENTING**
916.1 Limitation. Island fixture venting shall not be permitted for fixtures other than sinks and lavatories. Residential kitchen sinks with a dishwasher waste connection, a food waste disposer, or both, in combination with the kitchen sink waste, shall be permitted to be vented in accordance with this section.

916.2 Vent connection. The island fixture vent shall connect to the fixture drain as required for an individual or common vent. The vent shall rise vertically to above the drainage outlet of the fixture being vented before offsetting horizontally or vertically downward. The vent or branch vent for multiple island fixture vents shall extend to a point not less than 6 inches (152 mm) above the highest island fixture being vented before connecting to the outside vent terminal.

916.3 Vent installation below the fixture flood level rim. The vent located below the flood level rim of the fixture being vented shall be installed as required for drainage piping in accordance with Chapter 7, except for sizing. The vent shall be sized in accordance with Section 906.2. The lowest point of the island fixture vent shall connect full size to the drainage system. The connection shall be to a vertical drain pipe or to the top half of a horizontal drain pipe. Cleanouts shall be provided in the island fixture vent to permit rodding of all vent piping located below the flood level rim of the fixtures. Rodding in both directions shall be permitted through a cleanout.

SECTION 917
SINGLE STACK VENT SYSTEM

917.1 Where permitted. A drainage stack shall serve as a single stack vent system where sized and installed in accordance with Sections 917.2 through 917.9. The drainage stack and branch piping shall be the vents for the drainage system. The drainage stack shall have a stack vent.

917.2 Stack size. Drainage stacks shall be sized in accordance with Table 917.2. Stacks shall be uniformly sized based on the total connected drainage fixture unit load. The stack vent shall be the same size as the drainage stack. A 3inch (76 mm) stack shall serve not more than two water closets.

<table>
<thead>
<tr>
<th>STACK SIZE</th>
<th>MAXIMUM CONNECTED DRAINAGE FIXTURE UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
917.3 **Branch size.** Horizontal branches connecting to a single stack vent system shall be sized in accordance with Table 710.1(2). Not more than one water closet shall discharge into a 3-inch (76 mm) horizontal branch at a point within a developed length of 18 inches (457 mm) measured horizontally from the stack. Where a water closet is within 18 inches (457 mm) measured horizontally from the stack and not more than one fixture with a drain size of not more than 1 1/2 inches (38 mm) connects to a 3-inch (76 mm) horizontal branch, the branch drain connection to the stack shall be made with a sanitary tee.

917.4 **Length of horizontal branches.** The length of horizontal branches shall conform to the requirements of Sections 917.4.1 through 917.4.3.

917.4.1 **Water closet connection.** Water closet connections shall be not greater than 4 feet (1219 mm) in developed length measured horizontally from the stack.

Exception: Where the connection is made with a sanitary tee, the maximum developed length shall be 8 feet (2438 mm).

917.4.2 **Fixture connections.** Fixtures other than water closets shall be located not greater than 12 feet (3657 mm) in developed length, measured horizontally from the stack.

917.4.3 **Vertical piping in branch.** The length of vertical piping in a fixture drain connecting to a horizontal branch shall not be considered in
computing the fixture’s distance in developed length measured horizontally from the stack.

917.5 Minimum vertical piping size from fixture. The vertical portion of piping in a fixture drain to a horizontal branch shall be 2 inches (51 mm). The minimum size of the vertical portion of piping for a water-supplied urinal or standpipe shall be 3 inches (76 mm). The maximum vertical drop shall be 4 feet (1219 mm). Fixture drains that are not increased in size, or have a vertical drop in excess of 4 feet (1219 mm), shall be individually vented.

917.6 Additional venting required. Additional venting shall be provided where more than one water closet discharges to a horizontal branch and where the distance from a fixture trap to the stack exceeds the limits in Section 917.4. Where additional venting is required, the fixture(s) shall be vented by individual vents, common vents, wet vents, circuit vents, or a combination waste and vent pipe. The dry vent extensions for the additional venting shall connect to a branch vent, vent stack, stack vent, air admittance valve, or shall terminate outdoors.

917.7 Stack offsets. Where fixture drains are not connected below a horizontal offset in a stack, a horizontal offset shall not be required to be vented. Where horizontal branches or fixture drains are connected below a horizontal offset in a stack, the offset shall be vented in accordance with Section 907. Fixture connections shall not be made to a stack within 2 feet (610 mm) above or below a horizontal offset.

917.8 Prohibited lower connections. Stacks greater than 2 branch intervals in height shall not receive the discharge of horizontal branches on the lower two floors. There shall be no connections to the stack between the lower two floors and a distance of not less than 10 pipe diameters downstream from the base of the single stack vented system.

917.9 Sizing building drains and sewers. The building drain and building sewer receiving the discharge of a single stack vent system shall be sized in accordance with Table 710.1(1).

SECTION 918
AIR ADMITTANCE VALVES

918.1 General. Vent systems utilizing air admittance valves shall comply with this section. Stack-type air admittance valves shall conform to ASSE 1050. Individual and branch type air admittance valves shall conform to ASSE 1051.
918.2 **Installation.** The valves shall be installed in accordance with the requirements of this section and the manufacturer’s instructions. Air admittance valves shall be installed after the DWV testing required by Section 312.2 or 312.3 has been performed.

918.3 **Where permitted.** Individual, branch and circuit vents shall be permitted to terminate with a connection to an individual or branch-type air admittance valve in accordance with Section 918.3.1. Stack vents and vent stacks shall be permitted to terminate to stack-type air admittance valves in accordance with Section 918.3.2.

918.3.1 **Horizontal branches.** Individual and branch-type air admittance valves shall vent only fixtures that are on the same floor level and connect to a horizontal branch drain. Where the horizontal branch is located more than four branch intervals from the top of the stack, the horizontal branch shall be provided with a relief vent that shall connect to a vent stack or stack vent, or extend outdoors to the open air. The relief vent shall connect to the horizontal branch drain between the stack and the most downstream fixture drain connected to the horizontal branch drain. The relief vent shall be sized in accordance with Section 906.2 and installed in accordance with Section 905. The relief vent shall be permitted to serve as the vent for other fixtures.

918.3.2 **Stack.** Stack-type air admittance valves shall be prohibited from serving as the vent terminal for vent stacks or stack vents that serve drainage stacks having more than six branch intervals.

918.4 **Location.** Individual and branch-type air admittance valves shall be located a minimum of 4 inches (102 mm) above the horizontal branch drain or fixture drain being vented. Stack-type air admittance valves shall be located not less than 6 inches (152 mm) above the flood level rim of the highest fixture being vented. The air admittance valve shall be located within the maximum developed length permitted for the vent. The air admittance valve shall be installed not less than 6 inches (152 mm) above insulation materials.

918.5 **Access and ventilation.** Access shall be provided to all air admittance valves. Such valves shall be installed in a location that allows air to enter the valve.

918.6 **Size.** The air admittance valve shall be rated in accordance with the standard for the size of the vent to which the valve is connected.
918.7 **Vent required.** Within each plumbing system, not less than one stack vent or vent stack shall extend outdoors to the open air.

918.8 **Prohibited installations.** Air admittance valves shall not be installed in nonneutralized special waste systems as described in Chapter 8 except where such valves are in compliance with ASSE 1049, are constructed of materials approved in accordance with Section 702.5 and are tested for chemical resistance in accordance with ASTM F 1412. Air admittance valves shall not be located in spaces utilized as supply or return air plenums or where limited by the manufacturer’s installation instructions. Air admittance valves without an engineered design shall not be utilized to vent sumps or tanks of any type.

**SECTION 919**

**ENGINEERED VENT SYSTEMS**

919.1 **General.** Engineered vent systems shall comply with this section and the design, submittal, approval, inspection and testing requirements of Section 106.5 of the building code.

919.2 **Individual branch fixture and individual fixture header vents.** The maximum developed length of individual fixture vents to vent branches and vent headers shall be determined in accordance with Table 919.2 for the minimum pipe diameters at the indicated vent airflow rates. The individual vent airflow rate shall be determined in accordance with the following:

\[ Q_{h,b} = N_{n,b} Q_v \]  

(Equation 9-1)

For SI: \[ Q_{h,b} = N_{n,b} Q_v (0.4719 \text{ L/s}) \]

where:

- \( N_{n,b} \) = Number of fixtures per header (or vent branch) ÷ total number of fixtures connected to vent stack.
- \( Q_{h,b} \) = Vent branch or vent header airflow rate (cfm).
- \( Q_v \) = Total vent stack airflow rate (cfm).

\[ Q_v (\text{gpm}) = 27.8 \ r_s^{2/3} (1 - r_s) D^{8/3} \]

\[ Q_v (\text{cfm}) = 0.134 \ Q_v (\text{gpm}) \]

where:
- \( D \) = Drainage stack diameter (inches).
\[ Q_w = \text{Design discharge load (gpm)} \]
\[ r_s = \text{Waste water flow area to total area} \]

\[ = \frac{Q_w}{27.8 D^{8/3}} \]

Individual vent airflow rates are obtained by equally distributing \( Q_{h,b} \) into one-half the total number of fixtures on the branch or header for more than two fixtures; for an odd number of total fixtures, decrease by one; for one fixture, apply the full value of \( Q_{h,b} \).

Individual vent developed length shall be increased by 20 percent of the distance from the vent stack to the fixture vent connection on the vent branch or header.

<table>
<thead>
<tr>
<th>TABLE 919.2</th>
<th>MINIMUM DIAMETER AND MAXIMUM LENGTH OF INDIVIDUAL BRANCH FIXTURE VENTS AND INDIVIDUAL FIXTURE HEADER VENTS FOR SMOOTH PIPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIA.METER OF VENT PIPE (inches)</td>
<td>INDIVIDUAL VENT AIRFLOW RATE (cubic feet per minute)</td>
</tr>
<tr>
<td>1/2</td>
<td>95</td>
</tr>
<tr>
<td>3/4</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>1 1/8</td>
<td>—</td>
</tr>
<tr>
<td>1 1/4</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>—</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 cubic foot per minute = 0.4719 L/s, 1 foot = 304.8 mm.

SECTION 920
COMPUTERIZED VENT DESIGN

920.1 Design of vent system. The sizing, design and layout of the vent system shall be permitted to be determined by approved computer program design methods.

920.2 System capacity. The vent system shall be based on the air capacity requirements of the drainage system under a peak load condition.
4101:3-10-01 Traps, interceptors and separators.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:3-15-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:1-1-01 of the Administrative Code.]

SECTION 1001
GENERAL

1001.1 Scope. This chapter shall govern the material and installation of traps, interceptors and separators when installed inside a building and not on the building sewer. The rules of the “Ohio Environmental Protection Agency” may also govern the design and installation of pretreatment devices such as traps, interceptors, and separators.

SECTION 1002
TRAP REQUIREMENTS

1002.1 Fixture traps. Each plumbing fixture shall be separately trapped by a liquid-seal trap, except as otherwise permitted by this code. The vertical distance from the fixture outlet to the trap weir shall not exceed 24 inches (610 mm), and the horizontal distance shall not exceed 30 inches (610 mm) measured from the centerline of the fixture outlet to the centerline of the inlet of the trap. The height of a clothes washer standpipe above a trap shall conform to Section 802.4. A fixture shall not be double trapped.

Exceptions:
1. This section shall not apply to fixtures with integral traps, floor drains, floor sinks, and hub drains.
2. A combination plumbing fixture is permitted to be installed on one trap, provided that one compartment is not more than 6 inches (152 mm) deeper than the other compartment and the waste outlets are not more than 30 inches (762 mm) apart.
3. A grease interceptor intended to serve as a fixture trap in accordance with the manufacturer’s installation instructions shall be permitted to serve as the trap for a single fixture or a combination sink of not more than three compartments where the vertical distance from the fixture outlet to the inlet of the interceptor does not exceed 30 inches (762 mm) and the developed
length of the waste pipe from the most upstream fixture outlet to the inlet of the interceptor does not exceed 60 inches (1524 mm).

4. Floor drains in multilevel parking structures that discharge to a building storm sewer shall not be required to be individually trapped. Where floor drains in multilevel parking structures are required to discharge to a combined building sewer system, the floor drains shall not be required to be individually trapped provided that they are connected to a main trap in accordance with Section 1103.1.

1002.1.1 Vertical distance. The vertical distance from the fixture outlet to the trap weir shall not exceed 24 inches (610 mm). Exception: The height of a clothes washer standpipe above a trap shall conform to Section 802.3.3.

1002.1.2 Horizontal distance. The horizontal distance shall not exceed 30 inches (610 mm) measured from the centerline of the fixture outlet to the centerline of the inlet of the trap.

1002.2 Design of traps. Fixture traps shall be self-scouring. Fixture traps shall not have interior partitions, except where such traps are integral with the fixture or where such traps are constructed of an approved material that is resistant to corrosion and degradation. Slip joints shall be made with an approved elastomeric gasket and shall be installed only on the trap inlet, trap outlet and within the trap seal.

1002.3 Prohibited traps. The following types of traps are prohibited:
1. Traps that depend on moving parts to maintain the seal.
2. Bell traps.
4. Traps not integral with a fixture and that depend on interior partitions for the seal, except those traps constructed of an approved material that is resistant to corrosion and degradation.
5. “S” traps.
6. Drum traps. Exception: Drum traps used as solids interceptors and drum traps serving chemical waste systems shall not be prohibited.

1002.4 Trap seals. Each fixture trap shall have a liquid seal of not less than 2 inches (51 mm) and not more than 4 inches (102 mm), or deeper for special designs relating to accessible fixtures.
**1002.4.1 Trap seal protection.** Trap seals of emergency floor drain traps and trap seals subject to evaporation shall be protected by one of the methods in Sections 1002.4.1.1 through 1002.4.1.4.

*Exception:* Trap seal protection is not required in garage floor drains in one-, two-, and three-family dwellings.

1002.4.1.1 Potable water-supplied trap seal primer valve. A potable water-supplied trap seal primer valve shall supply water to the trap. Water-supplied trap seal primer valves shall conform to ASSE 1018. The discharge pipe from the trap seal primer valve shall connect to the trap above the trap seal on the inlet side of the trap.

1002.4.1.2 Reclaimed or gray water-supplied trap seal primer valve. A reclaimed or gray water-supplied trap seal primer valve shall supply water to the trap. Water-supplied trap seal primer valves shall conform to ASSE 1018. The quality of reclaimed or gray water supplied to trap seal primer valves shall be in accordance with the requirements of the manufacturer of the trap seal primer valve. The discharge pipe from the trap seal primer valve shall connect to the trap above the trap seal, on the inlet side of the trap.

1002.4.1.3 Waste water-supplied trap primer device. A waste water-supplied trap primer device shall supply water to the trap. Waste water-supplied trap primer devices shall conform to ASSE 1044. The discharge pipe from the trap seal primer device shall connect to the trap above the trap seal on the inlet side of the trap.

1002.4.1.4 Barrier-type trap seal protection device. A barrier-type trap seal protection device shall protect the floor drain trap seal from evaporation. Barrier-type floor drain trap seal protection devices shall conform to ASSE 1072. The devices shall be installed in accordance with the manufacturer’s instructions.

1002.4.1.5 Waste Water Trap Primer. Waste from the drinking fountain, lavatory or hand sink, is permitted to be indirectly connected by means of an air break to an emergency floor drain, trench drain, or floor sink located in the same room as the lavatory or hand sink, or an adjacent room for a drinking fountain as a method of providing trap seal protection. The connection shall be between the trap seal and the flood level rim of the floor drain, trench drain, or floor sink.
1002.5 Size of fixture traps. Fixture trap size shall be sufficient to drain the fixture rapidly and not less than the size indicated in Table 709.1. A trap shall not be larger than the drainage pipe into which the trap discharges.

1002.6 Building traps. Building (house) traps shall be prohibited.

1002.7 Trap setting and protection. Traps shall be set level with respect to the trap seal and, where necessary, shall be protected from freezing.

1002.8 Recess for trap connection. A recess provided for connection of the underground trap, such as one serving a bathtub in slab-type construction, shall have sides and a bottom of corrosion-resistant, insect- and vermin-proof construction.

1002.9 Acid-resisting traps. Where a vitrified clay or other brittleware, acid-resisting trap is installed underground, such trap shall be embedded in concrete extending 6 inches (152 mm) beyond the bottom and sides of the trap.

1002.10 Plumbing in mental health centers. In mental health centers, pipes and traps shall not be exposed.

SECTION 1003
INTERCEPTORS AND SEPARATORS

1003.1 Where required. Where required by the local sewer purveyor or as otherwise required in this section, interceptors and separators shall be provided to prevent the discharge of oil, grease, sand and other substances harmful or hazardous to the public sewer, the private sewage system or the sewage treatment plant or processes.

1003.1.1 Industrial processes, meat packing and food processing facilities. Wastes from industrial processes, meat packing and food processing facilities and similar processing plants shall be drained in accordance with the rules of the “Ohio Environmental Protection Agency”, or the authority in charge of the sewerage system into which the wastes are to be discharged. (See sections 6111.44 and 6111.45 of the Revised Code.)

1003.2 Approval. The size, type and location of each interceptor and of each separator shall be designed and installed in accordance with the manufacturer’s instructions and the requirements of this section based on the anticipated conditions
of use. Wastes that do not require treatment or separation shall not be discharged into any interceptor or separator.

1003.3 Grease interceptors. Grease interceptors shall comply with the requirements of Sections 1003.3.1 through 1003.3.5.

1003.3.1 Grease interceptors and automatic grease removal devices required. A grease interceptor or automatic grease removal device shall be required to receive the drainage from fixtures and equipment with grease-laden waste located in food preparation areas, such as in restaurants, hotel kitchens, hospitals, school kitchens, bars, factory cafeterias and clubs. Fixtures and equipment shall include pot sinks, prerinse sinks; soup kettles or similar devices; wok stations; floor drains or sinks into which kettles are drained; automatic hood wash units and dishwashers without prerinse sinks. Grease interceptors and automatic grease removal devices shall receive waste only from fixtures and equipment that allow fats, oils or grease to be discharged. Where lack of space or other constraints prevent the installation or replacement of a grease interceptor, one or more grease interceptors shall be permitted to be installed on or above the floor and upstream of an existing grease interceptor.

1003.3.2 Food waste disposers. Where food waste disposers connect to grease interceptors, a solids interceptor shall separate the discharge before connecting to the grease interceptor. Solids interceptors and grease interceptors shall be sized and rated for the discharge of the food waste disposers. Emulsifiers, chemicals, enzymes and bacteria shall not discharge into the food waste disposer.

1003.3.3 Grease interceptors and automatic grease removal devices not required. A grease interceptor or an automatic grease removal device shall not be required for individual dwelling units or any private living quarters.

1003.3.4 Hydromechanical grease interceptors, fats, oils and greases disposal systems and automatic grease removal devices. Hydromechanical grease interceptors; fats, oils, and greases disposal systems and automatic grease removal devices shall be sized in accordance with ASME A112.14.3, ASME A112.14.4, ASME A112.14.6, CSA B481.3 or PDI G101. Hydromechanical grease interceptors; fats, oils, and greases disposal systems and automatic grease removal devices shall be designed and tested in accordance with ASME A112.14.3, ASME A112.14.4, CSA B481.1, PDI G101 or PDI G102. Hydromechanical grease interceptors; fats, oils, and greases disposal systems and automatic grease removal devices shall be
installed in accordance with the manufacturer’s instructions. Where manufacturer’s instructions are not provided, hydromechanical grease interceptors; fats, oils, and greases disposal systems and automatic grease removal devices shall be installed in compliance with ASME A112.14.3, ASME A112.14.4, ASME A112.14.4A, ASME A112.14.6, CSA B481.3 or PDI G101.

1003.3.4.1 **Grease interceptor capacity.** Grease interceptors shall have the grease retention capacity indicated in Table 1003.3.4.1 for the flow-through rates indicated.

1003.3.4.2 **Rate of flow controls.** Grease interceptors shall be equipped with devices to control the rate of water flow so that the water flow does not exceed the rated flow. The flow-control device shall be vented and terminate not less than 6 inches (152 mm) above the flood rim level or be installed in accordance with the manufacturer’s instructions.

1003.3.5 **Automatic grease removal devices.** Where automatic grease removal devices are installed, such devices shall be located downstream of each fixture or multiple fixtures in accordance with the manufacturer’s instructions. The automatic grease removal device shall be sized to pretreat the measured or calculated flows for all connected fixtures or equipment. Ready access shall be provided for inspection and maintenance.

**TABLE 1003.3.4.1**

**CAPACITY OF GREASE INTERCEPTORS**

<table>
<thead>
<tr>
<th>TOTAL FLOW-THROUGH RATING (gpm)</th>
<th>GREASE RETENTION CAPACITY (pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
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<tr>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>35</td>
<td>70</td>
</tr>
</tbody>
</table>
For SI: 1 gallon per minute = 3.785 L/m, 1 pound = 0.454 kg.

a. For total flow-through ratings greater than 100 (gpm), double the flowthrough rating to determine the grease retention capacity (pounds).

1003.3.6 Gravity grease interceptors and gravity grease interceptors with fats, oils, and greases disposal systems. The required capacity of gravity grease interceptors and gravity grease interceptors with fats, oils, and greases disposal systems shall be determined by multiplying the peak drain flow into the interceptor in gallons per minute by a retention time of 30 minutes. Gravity grease interceptors shall be designed and tested in accordance with IAPMO/ANSI Z1001. Gravity grease interceptors with fats, oils, and greases disposal systems shall be designed and tested in accordance with ASME A112.14.6 and IAPMO/ANSI Z1001. Gravity grease interceptors and gravity grease interceptors with fats, oils, and greases disposal systems shall be installed in accordance with manufacturer’s instructions. Where manufacturer’s instructions are not provided, gravity grease interceptors and gravity grease interceptors with fats, oils, and greases disposal systems shall be installed in compliance with ASME A112.14.6 and IAPMO/ANSI Z1001.

1003.3.7 Direct connection. The discharge piping from a grease interceptor shall be directly connected to the sanitary drainage system.

1003.4 Oil separators required. At repair garages where floor or trench drains are provided, car washing facilities, factories where oily and flammable liquid wastes are produced, oil separators shall be installed into which oil-bearing, grease-bearing or flammable wastes shall be discharged before emptying into the building drainage system or other point of disposal.

1003.4.1 Separation of liquids. A mixture of treated or untreated light and heavy liquids with various specific gravities shall be separated in an approved receptacle.

1003.4.2 Oil separator design. Oil separators shall be listed and labeled, or designed in accordance with Sections 1003.4.2.1 and 1003.4.2.2.

1003.4.2.1 General design requirements. Oil separators shall have a depth of not less than 2 feet (610 mm) below the invert of the discharge drain. The outlet opening of the separator shall have not less than an 18inch (457 mm)
water seal.

1003.4.2.2 Garages and service stations. Where automobiles are serviced, greased, repaired or washed or where gasoline is dispensed, oil separators shall have a capacity of not less than 6 cubic feet (0.168 m³) for the first 100 square feet (9.3 m²) of area to be drained, plus 1 cubic foot (0.028 m³) for each additional 100 square feet (9.3 m²) of area to be drained into the separator. Parking garages in which servicing, repairing or washing is not conducted, and in which gasoline is not dispensed, shall not require a separator. Areas of commercial garages utilized only for storage of automobiles are not required to be drained through a separator.

1003.5 Sand interceptors in commercial establishments. Sand and similar interceptors for heavy solids shall be designed and located so as to be provided with ready access for cleaning, and shall have a water seal of not less than 6 inches (152 mm).

1003.6 Clothes washer discharge interceptor. Clothes washers shall discharge through an interceptor that is provided with a wire basket or similar device, removable for cleaning, that prevents passage into the drainage system of solids 1/2 inch (12.7 mm) or larger in size, string, rags, buttons or other materials detrimental to the public sewage system.

Exceptions:
1. Clothes washers in individual dwelling units shall not be required to discharge through an interceptor.
2. A single clothes washer designed for use in individual dwelling units and installed in a location other than an individual dwelling unit shall not be required to discharge through an interceptor.

1003.7 Bottling establishments. Bottling plants shall discharge process wastes into an interceptor that will provide for the separation of broken glass or other solids before discharging waste into the drainage system.

1003.8 Slaughterhouses. Slaughtering room and dressing room drains shall be equipped with approved separators. The separator shall prevent the discharge into the drainage system of feathers, entrails and other materials that cause clogging.

1003.9 Venting of interceptors and separators. Interceptors and separators shall be designed so as not to become air bound. Interceptors and separators shall be vented in accordance with one of the methods in Chapter 9.
1003.10 Access and maintenance of interceptors and separators. Access shall be provided to each interceptor and separator for service and maintenance. Interceptors and separators shall be maintained by periodic removal of accumulated grease, scum, oil, or other floating substances and solids deposited in the interceptor or separator.

SECTION 1004
MATERIALS, JOINTS AND CONNECTIONS

1004.1 General. The materials and methods utilized for the construction and installation of traps, interceptors and separators shall comply with this chapter and the applicable provisions of Chapters 4 and 7. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing flow of the piping.
4101:3-15-01 Referenced standards.

1501.1 General. This chapter lists the codes and standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date, and the title. The application of the referenced standards shall be as specified in Section 102.5 of the building code.

1501.2 Referenced codes. When indicated in the “OPC”, the following codes refer to provisions in the listed chapters of the Administrative Code:

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<thead>
<tr>
<th>Referenced code</th>
<th>Ohio Administrative Code chapters</th>
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<tbody>
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<td>Building Code</td>
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<td>1301:7-1 to 1301:7-7</td>
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<tr>
<td>Mechanical Code</td>
<td>4101:2-1 to 4101:2-15</td>
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<tr>
<td>Rules</td>
<td>4101:4-1 to 4101:4-10</td>
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1501.3 Referenced Standards.

ANSI American National Standards Institute
25 West 43rd Street, Fourth Floor
New York, NY 10036

<table>
<thead>
<tr>
<th>Standard Referenced</th>
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<tbody>
<tr>
<td>A118.10—14</td>
<td>Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin Set Ceramic Tile and Dimension Stone Installation</td>
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<tr>
<td>Z4.3—95 (R2005)</td>
<td>Minimum Requirements for Nonsewered Waste-disposal Systems (Standard is developed by the Portable Sanitation Association International-PSAI)</td>
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<tr>
<td>Z21.22—15</td>
<td>Relief Valves for Hot Water Supply Systems with Addenda (Standard is developed by the Canadian Standards Association-CSA and is the same as CSA 4.4)</td>
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### AHRI
Air-Conditioning, Heating, & Refrigeration Institute  
4100 North Fairfax Drive, Suite 200  
Arlington, VA 22203

<table>
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<th>Standard Referred</th>
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<tr>
<td>1010—02</td>
<td>Self-contained, Mechanically Refrigerated Drinking-Water Coolers</td>
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### API
American Petroleum Institute  
1220 L Street NW Washington, DC 20005-4070

<table>
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<td>12D—2008</td>
<td>Specification for Field Welded Tanks for Storage of Production Liquids, effective April 1, 2009</td>
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<td>12F—2008</td>
<td>Specification for Shop Welded Tanks for Storage of Production Liquids, effective April 1, 2009</td>
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### ASME
American Society of Mechanical Engineers  
Three Park Avenue  
New York, NY 10016-5990

<table>
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<tr>
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<td>A112.1.2—2012</td>
<td>Air Gaps in Plumbing Systems</td>
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<td>A112.3.1—2007 (R2014)</td>
<td>Stainless Steel Drainage Systems for Sanitary, DWV, Storm and Vacuum Applications Above and Below Ground</td>
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<td>Macerating Toilet Systems and Related Components</td>
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<td>Water Closet Personal Hygiene Devices</td>
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</table>
A112.4.3—1999 (R2015) Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System
A112.4.14—2004 (R2010) Manually Operated, Quarter-Turn Shutoff Valves for Use in Plumbing Systems
A112.6.1M—1997 (R2012) Floor-affixed Supports for Off-the-floor Plumbing Fixtures for Public Use
A112.6.2—2000 (R2010) Framing-affixed Supports for Off-the-floor Water Closets with Concealed Tanks
A112.6.3—2016 Floor and Trench Drains
A112.6.4—2003 (R2012) Roof, Deck, and Balcony Drains
A112.6.7—2010 (R2015) Enameled and Epoxy-coated Cast-iron and PVC Plastic Sanitary Floor Sinks
A112.6.9—2005 (R2015) Siphonic Roof Drains
A112.14.1—2003 (R2012) Backwater Valves
A112.14.6—2010 (R2015) FOG (Fats, Oils and Greases) Disposal Systems
A112.18.1—2012/CSA B125.1—2012 Plumbing Supply Fittings
A112.18.2—2015/CSA B125.2—2015 Plumbing Waste Fittings
A112.18.3—2002 (R2012) Performance Requirements for Backflow Protection Devices and Systems in Plumbing Fixture Fittings
A112.18.6/CSA B125.6—2009 (R2014) Flexible Water Connectors
A112.18.7—1999 (R2004) Deck mounted Bath/Shower Transfer Valves with Integral Backflow Protection
A112.18.9—2011 Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures
A112.19.1/—2013 Enameled Cast Iron and Enameled Steel Plumbing Fixtures
A112.19.2—2013/CSA B45.1—13 Ceramic Plumbing Fixtures
A112.19.3—2008/CSA B45.4—08(R2013) Stainless Steel Plumbing Fixtures
A112.19.5/—2011 Flush Valves and Spuds for Water-closets, Urinals, and Tanks
A112.19.7M—2012/CSA B45.15—2011 Hydromassage Bathtub Systems
CSA B45.10—2012
A112.19.12—2014  Wall Mounted and Pedestal Mounted, Adjustable, Elevating, Tilting and Pivoting Lavatory, Sink and Shampoo Bowl Carrier Systems and Drain Systems
A112.19.14-2013  Six-Liter Water Closets Equipped with a Dual Flushing Device
A112.19.15—2012  Bathtub/Whirlpool Bathtubs with Pressure Sealed Doors
A112.19.19—2006  Vitreous China Nonwater Urinals
A112.21.3-1985(R2007)  Hydrants for Utility and Maintenance Use
A112.36.2M—1991(R2012)  Cleanouts
ASSE 1016/ ASME  Performance Requirements for Individual Thermostatic, Pressure Balancing and Combination Control Valves for Individual Fixture Fittings
B1.20.1—2013  Pipe Threads, General Purpose (inch)
B16.3—2011  Malleable Iron Threaded Fittings Classes 150 and 300
B16.4—2011  Gray Iron Threaded Fittings Classes 125 and 250
B16.9—2012  Factory-made Wrought Steel Buttwelding Fittings
B16.11—2011  Forged Fittings, Socket-welding and Threaded
B16.12—2009 (R2014)  Cast-iron Threaded Drainage Fittings
B16.15—2013  Cast Bronze Threaded Fittings
B16.18—2012  Cast Copper Alloy Solder Joint Pressure Fittings
B16.22—2013  Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.23—2011  Cast Copper Alloy Solder Joint Drainage Fittings DWV
B16.26—2013  Cast Copper Alloy Fittings for Flared Copper Tubes
B16.28—1994  Wrought Steel Buttwelding Short Radius Elbows and Returns
B16.29—2012  Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings (DWV)
B16.34—2013  Valves Flanged, Threaded and Welding End
B16.51—2013  Copper and Copper Alloy Press-Connect
Pressure Fittings
Welding and Brazing Qualifications

**BPVC Section IX-the edition referenced in rule 4101:4-3-01 of the Administrative Code**

### ASPE American Society of Plumbing Engineers

8614 Catalpa Avenue, Suite 1007
Chicago, IL 60656-1116

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<th>Standard Referred</th>
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<td>45—2013</td>
<td>Siphonic Roof Drainage Systems</td>
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### ASSE American Society of Sanitary Engineering

901 Canterbury Road, Suite A
Westlake, OH 44145

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1013—2011 Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers

1015—2011 Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

ASSE 1016/ ASME A112.1016/ CSA B125.16—2011 Performance Requirements for Individual Thermostatic, Pressure Balancing and Combination Control Valves for Individual Fixture Fittings

1017—2010 Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems

1018—2010 Performance Requirements for Trap Seal Primer Valves; Potable Water Supplied

1019—2011 Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type

1020—2004 Performance Requirements for Pressure Vacuum Breaker Assembly

1022—2003 Performance Requirements for Backflow Preventer for Beverage Dispensing Equipment

1024—2004 Performance Requirements for Dual Check Valve Type Backflow Preventers (for Residential Supply Service or Individual Outlets)

1035—2008 Performance Requirements for Laboratory Faucet Backflow Preventers

1037—2015 Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures

1044—2015 Performance Requirements for Trap Seal Primer Devices Drainage Types and Electronic Design Types

1047—2011 Performance Requirements for Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies

1048—2011 Performance Requirements for Double
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1049—2009 Performance Requirements for Individual
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1050—2009 Performance Requirements for Stack Air
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1051—2009 Performance Requirements for Individual
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1052—2016 Performance Requirements for Hose
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1055—2009 Performance Requirements for Chemical
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1056—2013 Performance Requirements for Spill Resistant
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1060—2006 Performance Requirements for Outdoor
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1061—2015 Performance Requirements for Removable
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1062—2006 Performance Requirements for Temperature
Actuated, Flow Reduction Valves to
Individual Supply Fittings
1066—2009 Performance Requirements for Individual
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Individual Fixture Fittings
1069—2005 Performance Requirements for Automatic
Temperature Control Mixing Valves
1070—2015 Performance Requirements for Water-
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1072—2007 Performance Requirements for Barrier Type
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1079—2012 Performance Requirements for Dielectric
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5013—2015 Performance Requirements for Testing
Reduced Pressure Principle Backflow
Prevention Assembly (RPA) and Reduced
Pressure Fire Protection Backflow Preventers (RFP)
5015—2015 Performance Requirements for Testing Double Check Valve Backflow Prevention Assemblies (DC) and Double Check Fire Protection Backflow Prevention Assemblies (DCF)

5020—2015 Performance Requirements for Testing Pressure Vacuum Breaker Assemblies (PVBA)

5047—2015 Performance Requirements for Testing Reduced Pressure Detector Fire Protection Backflow Prevention Assemblies (RPDA)

5048—2015 Performance Requirements for Testing Double Check Valve Detector Assembly (DCDA)

5052—2015 Performance Requirements for Testing Hose Connection Backflow Preventers

5056—2015 Performance Requirements for Testing Spill Resistant Vacuum Breaker (SRVB)

**ASTM** ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

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<tr>
<td>A 53/A 53M—12</td>
<td>Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated Welded and Seamless</td>
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<td>A 312/A 312M—16</td>
<td>Specification for Seamless, Welded, And Heavily Cold Worked Austenitic Stainless Steel Pipes</td>
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<td>Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples</td>
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<td>Specification for Welded Unannealed Austenitic Stainless Steel Tubular Products</td>
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<td>A 888—15</td>
<td>Specification for Hubless Cast-iron Soil Pipe</td>
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B 32—08 (2014) Specification for Solder Metal
B 42—15a Specification for Seamless Copper Pipe,
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B 43—15 Specification for Seamless Red Brass Pipe,
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B 75—11 Specification for Seamless Copper Tube
B 88—14 Specification for Seamless Copper Water
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B 152/B 152M—13 Specification for Copper Sheet, Strip Plate
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B 251—10 Specification for General Requirements for
Wrought Seamless Copper
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B 302—12 Specification for Threadless Copper Pipe,
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B 306—13 Specification for Copper Drainage Tube
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B 447—12a Specification for Welded Copper Tube
B 687—99(2016) Specification for Brass, Copper and
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B 813—16 Specification for Liquid and Paste Fluxes for
Soldering of Copper and
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B 828—16 Practice for Making Capillary Joints by
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Copper Alloy Tube and Fittings
C 4—04(2014) Specification for Clay Drain Tile and
Perforated Clay Drain Tile
C 14—15a Specification for Nonreinforced Concrete
Sewer, Storm Drain and Culvert Pipe
C 76—15a Specification for Reinforced Concrete
Culvert, Storm Drain and Sewer Pipe
Vitrified Clay Pipe and Fittings
C 443—12 Specification for Joints for Concrete Pipe and
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C 564—14 Specification for Rubber Gaskets for Cast-
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<td>Specification for Shielded Coupling Joining Hubless Cast-iron Soil Pipe and Fittings</td>
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<td>C 1460—12</td>
<td>Specification for Shielded Transition Couplings for Use with Dissimilar DWV Pipe and Fittings Above Ground</td>
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<td>Specification for Heavy Duty Shielded Couplings Joining Hubless Cast-iron Soil Pipe and Fittings</td>
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<td>D 1253—14</td>
<td>Standard Test Method For Residual Chlorine in Water</td>
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<td>D 1785—15</td>
<td>Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120</td>
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<td>D 2239—12a</td>
<td>Specification for Polyethylene (PE) Plastic</td>
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<td>D 2241—15</td>
<td>Specification for Poly (Vinyl Chloride) (PVC) Pressure-rated Pipe (SDR-Series)</td>
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<td>D 2464—15</td>
<td>Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80</td>
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<td>Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40</td>
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<td>D 2467—15</td>
<td>Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80</td>
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<td>Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40</td>
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<td>D 2564—12</td>
<td>Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems</td>
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<td>D 2609—15</td>
<td>Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe</td>
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<td>D 2657—15</td>
<td>Practice for Heat Fusion-joining of Polyolefin Pipe and Fitting Waste, and Vent Pipe and Fittings</td>
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<td>D 2672—14</td>
<td>Specification for Joints for IPS PVC Pipe Using Solvent Cement</td>
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<td>D 2683—14</td>
<td>Standard Specification for Socket-type Polyethylene fittings for Outside Diameter-controlled Polyethylene Pipe and Tubing</td>
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<td>D 2729—11</td>
<td>Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings</td>
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D 2751—05 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

D 2846/D 2846M—14 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems

D 2855—15 Standard Practice for Making Solvent-cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings


D 3034—15 Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D 3035—15 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter


D 3261—15 Specification for Butt Heat Fusion Polyethylene (PE) Plastic fittings for Polyethylene (PE) Plastic Pipe and Tubing


D 4068—15 Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-containment Membrane

D 4551—12 Specification for Poly (Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-containment Membrane

E 2727—10el Standard Practice for the Assessment of Rainwater Quality 1302.8.1

F 405—13 Specification for Corrugated Polyethylene (PE) Pipe and Fittings
F 409—12 Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
F 437—15 Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
F 438—15 Specification for Socket-type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
F 441/F 441M—15 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
F 442/F 442M—13e1 Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
F 477—14 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F 493—14 Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
F 628—12e2 Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
F 656—15 Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
F 714—2013 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F 876—15a Specification for Cross-linked Polyethylene (PEX) Tubing
F 877—2011a Specification for Cross-linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems
F 891—10 Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
F 1055—15 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene Pipe and Tubing

F 1281—11 Specification for Cross-linked Polyethylene/Aluminum/ Cross-linked Polyethylene (PEX-AL-PEX) Pressure Pipe

F 1282—10 Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe

F 1412—16 Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage

F 1476—13 Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications

F 1488—14 Specification for Coextruded Composite Pipe


F 1673—10 Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems

F 1807—15 Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing

F 1866—13 Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings

F 1960—15 Specification for Cold Expansion Fittings with PEX Reinforcing Rings for use with Cross-linked Polyethylene (PEX) Tubing

F 1970—12e1 Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) OR Chlorinated Poly (Vinyl Chloride) (CPVC) Systems

F 1974—15 Specification for Metal Insert Fittings for Polyethylene/Aluminum/Polyethylene and Cross-linked Polyethylene/Aluminum/Cross-
linked Polyethylene Composite
Pressure Pipe

F 1986—01(2011) Specification for Multilayer Pipe, Type 2, Compression Fittings and Compression Joints for Hot and Cold Drinking Water Systems

F 2080—15a Specifications for Cold-expansion Fittings with Metal Compression-sleeves for Cross-linked Polyethylene (PEX) Pipe

F 2098—15 Standard specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal and Plastic Insert Fittings

F 2159—14 Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing

F 2262—09 Specification for Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene Tubing OD Controlled SDR9

F 2306/F 2306M—14e1 12" to 60" Annular Corrugated Profile-wall Polyethylene (PE) Pipe and Fittings for Gravity Flow Storm Sewer and Subsurface Drainage Applications

F 2389—15 Specification for Pressure-rated Polypropylene (PP) Piping Systems

F 2434—14 Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/ Cross-linked Polyethylene (PEX AL-PEX) Tubing

F 2735—09 Standard Specification for Plastic Insert Fittings for SDR9 Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing

F 2769—14 Polyethylene or Raised Temperature (PE-RT) Plastic Hot and Cold Water Tubing and Distribution Systems

F 2831—12 Standard Practice for Internal Non Structural
Epoxy Barrier Coating Material Used In Rehabilitation of Metallic Pressurized Piping Systems

F 2855—12
Specification Poly (Vinyl Chloride)/Aluminum/Poly (Vinyl Chloride) (CPVC/AL/CPVC) Composite Pressure Tubing

**AWS** American Welding Society
8669 NW 36 Street, #130
Doral, FL 33166

**Standard** | **Referenced** | **Title**
---|---|---
A5.8M/A5.8—2011 | Specifications for Filler Metals for Brazing and Braze Welding

**AWWA** American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

**Standard** | **Referenced** | **Title**
---|---|---
C104/A21.4-13 | Cement-mortar Lining for Ductile-iron Pipe and Fittings for Water
C110/A21.10—12 | Ductile-iron and Gray-iron Fittings
C111/A21.11-12 | Rubber-gasket Joints for Ductile-iron Pressure Pipe and Fittings
C115/A21.15—11 | Flanged Ductile-iron Pipe with Ductile-iron or Gray-iron Threaded Flanges
C151/A21.51—09 | Ductile-iron Pipe, Centrifugally Cast for Water
C153—00/A21.53—11 | Ductile-iron Compact Fittings for Water Service
C500—09 | Standard for Metal-Seated Gate Valves for Water Supply Service
C504—15 | Standard for Rubber-Seated Butterfly Valves
C507—15 | Standard for Ball Valves, 6 In. Through 60 In.
C510—07  Double Check Valve Backflow Prevention Assembly
C511—07  Reduced-pressure Principle Backflow Prevention Assembly
C651—14  Disinfecting Water Mains
C652—11  Disinfection of Water-storage Facilities
C901—08  Polyethylene (PE) Pressure Pipe and Tubing 1/ inch (13 mm) Through 3 inch (76 mm) for Water Service.
C904—16  Cross-linked Polyethylene (PEX) Pressure Pipe 1/ inch (13 mm) Through 3 inch (76 mm) for Water Service
D100—11  Standard for Welded Carbon Steel Tanks for Water Storage
D115—06  Standard for Tendon Prestressed-Concrete Water Tanks
D120—09  Standard for Thermosetting Fiberglass-Reinforced Plastic Tanks

CISPI  Cast Iron Soil Pipe Institute
5959 Shallowford Road, Suite 419
Chattanooga, TN 37421

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<td>301—12</td>
<td>Specification for Hubless Cast-iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications</td>
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<td>310—12</td>
<td>Specification for Coupling for Use in Connection with Hubless Cast-iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications</td>
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CSA  CSA Group
8501 East Pleasant Valley
Cleveland, OH 44131-5516

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A257.1M—2012  Circular Concrete Culvert, Storm Drain, Sewer Pipe and Fittings
A257.2M—2012  Reinforced Circular Concrete Culvert, Storm Drain, Sewer Pipe and Fittings
A257.3M—2012  Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

ASME A112.18.1—2012/ CSA B125.1—2012  Plumbing Supply Fittings
A112.18.2—2015/ CSA B125.2—2015  Plumbing Waste Fittings
ASME A112.19.2—2013/ B45.1—2013  Ceramic Plumbing Fixtures
ASME A112.19.1—2013/ CSA B45.2—2013  Enameled Cast-iron and Enameled Steel Plumbing Fixtures
ASME A112.19.3—2008/ CSA B45.4—08(R2013)  Stainless-steel Plumbing Fixtures
ASME A112.19.5—2011/ CSA B45.15—2011  Flush Valves and Spuds for Water Closets, Urinals and Tanks
ASME A112.19.7—2012/ CSA B45.10—2012  Hydromassage Bathtub Systems
CSA B45.5—11(R2016)/ IAPMO Z124-2011(R2016)  Plastic Plumbing Fixtures
ASME A112.3.4—2013/ CSA B45.9—2013  Macerating Systems and Related Components
CSA B125.16—2011  Performance Requirements for Individual Thermostatic, Pressure Balancing and Combination Control Valves for Individual Fixture Fittings

B64.1.1—11 (2016)  Vacuum Breakers, Atmospheric Type (AVB)
B64.1.2—11 (2016)  Pressure Vacuum Breakers, (PVB)
B64.1.3—11 (2016)  Spill Resistant Pressure Vacuum Breaks (SRPVB)
B64.2—11 (2016)  Vacuum Breakers, Hose Connection Type (HCVB)
B64.2.1—11 (2016)  Vacuum Breakers, Hose Connection (HCVB) with Manual Draining Feature
B64.2.1.1—11 (2016)  Hose Connection Dual Check Vacuum Breakers, (HCDVB)
B64.2.2—11 (2016)  Vacuum Breakers, Hose Connection Type
(HCVB) with Automatic Draining Feature

B64.3—11 (2016) Backflow Preventers, Dual Check Valve Type with Atmospheric Port (DCAP)

B64.4—11 (2016) Backflow Preventers, Reduced Pressure Principle Type (RP)

B64.4.1—11 (2016) Reduced Pressure Principle for Fire Sprinklers (RPF)

B64.5—11 (2016) Double Check Backflow Preventers (DCVA)

B64.5.1—11 (2016) Double Check Valve Backflow Preventer for Fire Systems (DCVAF)

B64.6—11 (2016) Dual Check Backflow Preventer Valve (DuC)

B64.7—11 (2016) Laboratory Faucet Vacuum Breakers (LFVB)


B64.10.1—11 (2016) Maintenance and Field Testing of Backflow Preventers

B79—08(R2013) Commercial and Residential Drains, and Cleanouts

B125.3—2012 Plumbing Fittings

B137.1—13 Polyethylene (PE) Pipe, Tubing and Fittings for Cold Water Pressure Services

B137.2—13 Polyvinylchloride PVC Injection-moulded Gasketed Fittings for Pressure Applications

B137.3—13 Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications

B137.5—13 Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications

B137.6—13 CPVC Pipe, Tubing and Fittings for Hot and Cold Water Distribution Systems

B137.9—13 Polyethylene/Aluminum/Polyethylene Composite Pressure Pipe Systems

B137.10—13 Cross-linked Polyethylene/Aluminum/Polyethylene Composite Pressure Pipe Systems

B137.11—13 Polypropylene (PP-R) Pipe and Fittings for Pressure Applications

B181.1—15 Acrylonitrile-butadiene-styrene ABS Drain
Waste and Vent Pipe and Pipe Fittings
Polyvinylchloride PVC and chlorinated
polyvinylchloride (CPVC)
Drain, Waste, and Vent Pipe and Pipe
Fittings

Polyolefin and Polyvinylidene Fluoride
(PVDF) Laboratory Drainage Systems

Plastic Drain and Sewer Pipe and Pipe
Fittings

PSM Type Polyvinylchloride PVC Sewer
Pipe and Fittings

Profile Polyvinylchloride PVC Sewer Pipe
and Fittings

Profile Polyethylene (PE) Sewer Pipe and
Fittings for Leak-proof Sewer Applications

Profile Polyethylene (PE) Storm Sewer and
Drainage Pipe and Fittings

Water Pressure Reducing Valves for
Domestic Water Systems

Drinking Water Treatment Units

Testing and Rating of Grease interceptors
Using Lard

Sizing, Selection, Location and Installation
of Grease Interceptors

Mechanical Couplings for Drain, Waste and
Vent Pipe and Sewer Pipe

FEMA Federal Emergency Management Agency
Federal Center Plaza 500 C Street S.W.
Washington, DC 20472

Standard
Referenced

Title


IAPMO IAPMO Group
4755 E. Philadelphia
Ontario, CA 91761
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<td>Z1001-2014</td>
<td>Prefabricated Gravity Grease Interceptors</td>
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<td>Plastic Plumbing Fixtures</td>
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**ICC** International Code Council, Inc. 500 New Jersey Ave, NW
6th Floor
Washington, DC 20001

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<td>A117.1—2009</td>
<td>Accessible and Usable Buildings and Facilities</td>
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**ISEA** International Safety Equipment Association
1901 N. Moore Street, Suite 808
Arlington, VA 22209

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<td>Emergency Eyewash and Shower Equipment</td>
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**MSS** Manufacturers Standardization Society of the Valve and Fittings
Industry, Inc. 127 Park St. NE
Vienna, VA 22180-4602

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<td>Butterfly Valves</td>
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<td>SP-70—2011</td>
<td>Gray Iron Gate Valves, Flanged and Threaded Ends</td>
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<td>SP-71—2011</td>
<td>Gray Iron Swing Check Valves, Flanged and</td>
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### Threaded Ends

SP-72—2010: Ball Valves with Flanged or Butt-Welding Ends for General Service

SP-78—2011: Cast Iron Plug Valves, Flanged and Threaded Ends

SP-80—2013: Bronze Gate, Globe, Angle and Check Valves

SP-110—2010: Ball Valves, Threaded, Socket Welded, Solder Joint, Grooved and Flared Ends

**NFPA** National Fire Protection Association

1 Batterymarch Park
Quincy, MA 02169-7471

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<td>70—17</td>
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<td>99—15</td>
<td>Health Care Facilities Code</td>
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**NSF** NSF International

789 Dixboro Road Ann Arbor, MI 48105

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| 61—2015           | Drinking Water System Components—
62—2015  Health Effects  Drinking Water Distillation Systems
350—2014  Onsite Residential and Commercial Water Reuse Treatment Systems
359—2011  Valves for Crosslinked Polyethylene (PEX) Water Distribution Tubing Systems
372—2016  Drinking Water Systems Components—Lead Content

**PDI** Plumbing and Drainage Institute
800 Turnpike Street, Suite 300
North Andover, MA 01845

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<td>Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data</td>
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<td>PDI G102- 2009</td>
<td>Testing and Certification for Grease Interceptors with Fog Sensing and Alarm Devices</td>
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**UL** UL LLC
333 Pfingsten Road
Northbrook, IL 60062-2096

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