

Chapter Ind 51

DEFINITIONS AND STANDARDS

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Ind 51.001 Fire-resistive construction. (1) A building is of fire-resistive construction if all the walls, partitions, piers, columns, floors, ceilings, roof and stairs are built of incombustible material, except as hereinafter provided, and if all metallic structural members are protected by an incombustible fire-resistive covering, all as specified in this section.

(2) All exterior and inner court walls shall be of not less than 4-hour fire-resistive construction, as specified in section Ind 51.04, except that nonload bearing exterior walls which face streets, alleys, outer or inner courts 20 feet or more in width may be constructed of noncombustible panels of not less than 1-hour fire-resistive construction.

(a) Non-load bearing exterior walls which face streets, alleys, outer or inner courts 30 feet or more in width may be constructed of incombustible panels with no fire-resistive rating.

(3) Interior partitions shall be constructed of incombustible materials, except that dividing partitions in stores, offices, and similar places not exceeding 3,000 square feet in area, occupied by one tenant only, may be constructed of wood panels or similar light construction.

(a) Partitions entirely within apartments having a floor area of not more than 800 square feet shall be of 1-hour fire-resistive construction but such partitions may be constructed with wood studs as specified in section Ind 51.04. Doors in such partitions may be wood panel doors.

(4) Enclosures for elevator or dumbwaiter shafts, vent shafts, stairwells, waste paper chutes and other similar vertical shafts shall be of 2-hour fire-resistive construction as specified in section Ind 51.04 with all interior openings therein protected by fire-resistive doors or windows as specified in section Ind 51.047.

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(5) Structural framework shall be of structural steel or reinforced concrete. All structural steel members, not including structural members for elevators and elevator enclosures shall be thoroughly fire-protected with not less than 4-hour fire-resistive protection for columns, beams and girders and 3-hour fire-resistive protection for floors, for all buildings more than 8 stories or 85 feet in height; and with not less than 3-hour fire-resistive protection for columns, beams and girders and 2-hour fire-resistive protection for floors, for all buildings which are 8 stories or 85 feet or less in height. All such fire-resistive protection shall be as specified in section Ind 51.04.

(6) All reinforced concrete columns, beams and girders shall be thoroughly fire-protected with 4-hour fire-resistive protection, and all floors, joists and slabs shall be thoroughly fire-protected with not less than 3-hour fire-resistive protection for all buildings more than 8 stories or 85 feet in height; and with not less than 3-hour fire-resistive protection for columns, beams and girders and 2-hour fire-resistive protection for all floors, joists and slabs, for all buildings which are 8 stories or 85 feet or less in height. All such fire-resistive protection shall be as specified in section Ind 51.04.

(7) Floor construction shall consist of any approved floor system providing not less than 3-hour fire-resistive construction for all buildings more than 8 stories or 85 feet in height; and providing not less than 2-hour fire-resistive construction, for buildings which are 8 stories or 85 feet or less in height. All such fire-resistive protection shall be as specified in section Ind 51.04.

(8) Roofs shall be constructed as specified for floors, except that wood sheathing of not less than 2 inch nominal thickness may be used for buildings not more than 8 stories or 85 feet in height when all of such sheathing is more than 25 feet distant from any floor, balcony or gallery, or wood sheathing of not less than 1 inch nominal thickness may be used at any distance not exceeding 5 feet from a 2-hour fire-resistive attic floor, and when such sheathing is covered on the outside by a class "A" or equal fire-retardant roof covering, except as provided under occupancy requirements.

(9) Stairs and stair platforms shall be constructed of reinforced concrete, iron or steel. Brick, concrete, marble, tile, terrazzo or other hard incombustible materials may be used for the finish of treads and risers.

(10) Doors and windows may be of wood except as otherwise specified under occupancy requirements and in Wis. Adm. Code sections Ind 51.17, 51.19, 51.20 and 52.21.

(11) Projections from the building, including bays, oriels, and pent-houses, together with other roof structures shall be constructed of incombustible material as specified in this section.

(12) Wood may be used for finished floors and also for trim, including picture molds, chair rails, wainscoting and baseboards, if spaces between wood sleepers and wood grounds are fire-stopped with incombustible materials.

(13) Acoustical materials may be used on ceilings and on walls from a level of 6 feet above the floor provided they are attached

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directly thereto, and all spaces between wood grounds are fire-stopped with incombustible materials.

History: 1-2-56; am. (2); (2) (a); (3); (3) (a); Register, June, 1956, No. 6, eff. 7-1-56; am. (2) intro. par., (3) (a), (4), (7) and (8), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.01 Mill construction. (1) In a building of mill construction the structural frame shall consist of steel or iron which shall be fire-protected, of reinforced concrete, of masonry, or of heavy timbers, except that in buildings not exceeding one story in height the structural steel or iron may have the fire-protection omitted.

(2) Exterior and court walls shall be 2-hour fire-resistive construction as specified in section Ind 51.04, except that nonload bearing exterior walls which face streets, alleys, outer or inner courts 20 feet or more in width may be constructed of noncombustible panels of not less than 1-hour fire-resistive construction.

(a) Non-load bearing exterior walls which face streets, alleys, outer or inner courts 30 feet or more in width may be constructed of incombustible panels with no fire-resistive rating.

(3) All wood columns in the structural frame shall be directly superimposed, one above the other, and shall be provided with steel or cast iron caps, unless the floor or roof beams and girders are carried on blocks securely fastened to the columns and with the loads transmitted to the columns by metal ring or similar type connectors or by caps of otherwise suitable material. They shall not rest on wood bolsters or floor timbers. Wood bolsters may be used to support roof timbers. No wood column shall be less than 8 inches nominal in its least dimension, and no beam, girder or joist shall be less than 6 inches nominal in its least dimension nor less than 45 square inches in cross-sectional area. Where wood arches or wood trusses are used to support roof loads, the framing members shall not be less than 4 inches by 6 inches, nominal dimensions. In no case shall masonry or reinforced concrete be supported on wood construction except tile or concrete floor finishes not more than 3 inches in thickness.

(4) For structural steel or iron members, the fire-protection shall be not less than 3-hour fire-resistive protection for columns and not less than 2-hour fire-resistive protection for beams, girders and floor systems, as specified in section Ind 51.04.

(5) All reinforcement in concrete columns shall be fire-protected with not less than 3-hour fire-resistive protection, and all joists, beams, girders, slabs and steel floors with not less than 2-hour fire-resistive protection outside of all steel reinforcing as specified in section Ind 51.04.

(6) Wood floor construction shall be of tongues and grooves, or splined lumber not less than 3 inches nominal thickness, with a top layer of flooring of one inch nominal thickness laid thereon, or of solid lumber placed on edge and securely spiked together to make a floor not less than 4 inches nominal thickness.

(7) Roof construction shall be as specified for floors, except that the minimum nominal thickness shall be 2 inches. Roof coverings shall be class "A" or equal fire-retardant roofing as specified in

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section Ind 51.04 and shall be required over all combustible roof construction.

(8) Enclosures for elevator or dumbwaiter shafts, vent shafts, stairwells, wastepaper chutes, and other similar vertical shafts shall be of 2-hour fire-resistive construction as specified in section Ind 51.04, with all interior openings therein protected by fire-resistive doors as specified in section Ind 51.047.

(9) Stair construction may be of wood in buildings not exceeding 3 stories in height. In buildings 4 or more stories in height all stairs and stair construction shall be as required for fire-resistive construction specified in section Ind 51.001.

(10) Doors and windows may be of wood except as otherwise specified under occupancy requirements in this code.

History: 1-2-56; am. (2); (2) (a); Register, June, 1956, No. 6, eff. 7-1-56; r. and recr. Register, September, 1959, No. 45, eff. 10-1-59; am. (2) intro. par., (7) and (8), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.02 Ordinary construction. (1) A building is of ordinary construction if all enclosing walls are constructed entirely of non-combustible material, and the roof has a class "B" or equal fire-retardant covering as specified in section Ind 51.04.

(2) The interior structural framework shall be of steel, iron, reinforced concrete, masonry, or wood. Fire protection of steel, iron or wood structural members may be omitted, except that all members carrying masonry in buildings more than one story in height shall be fire protected with not less than one-hour protection as specified in section Ind 51.04.

(3) Floors, roof and partitions may be of wood but no joist, rafter, or stud shall be less than 2 inches in nominal thickness. In buildings of 4 stories or more in height, the lower side of all metal or wood floor or roof construction shall be protected by a ceiling of 1-hour fire-resistive construction as specified in section Ind 51.04, unless otherwise provided under the occupancy requirements.

(4) Stairs may be of steel, iron, reinforced concrete, masonry or wood, with enclosures as specified under occupancy requirements.

(5) Bays, oriels and similar projections from the walls shall be constructed of noncombustible materials as specified in this section. Penthouses and other roof structures shall be of not less than 1-hour fire-resistive construction as specified in section Ind 51.04.

(6) Roof coverings shall be class "B" or equal.

History: 1-2-56; r. and recr. Register, September, 1959, No. 45, eff. 10-1-59; am. (1), (3) and (5), and cr. (6), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.03 Frame construction. (1) A building is of frame construction if the structural parts and enclosing walls are of wood, or of wood in combination with other materials. If such enclosing walls are veneered, encased or faced with stone, brick, tile, concrete, plaster or metal, the building is also termed a frame building.

(2) Roof coverings shall be class "C" or equal.

History: 1-2-56; cr. (2), Register, February, 1971, No. 182, eff. 7-1-71.

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NOTE: Sections Ind 51.04 through Ind 51.07 are repealed effective July 1, 1971. See Special Notice section following section Ind 51.07.

Ind 51.04 Fire-resistive standards; structural members. (1) MINIMUM THICKNESS IN INCHES FOR VARIOUS FIRE-RESISTIVE MATERIALS.

**MINIMUM THICKNESS IN INCHES FOR VARIOUS
FIRE-RESISTIVE MATERIALS**

Struct. Steel Parts to be Protected	Fire Resistive Material Used	Minimum Thickness of Material in Inches for the Following Fire-Resistive Periods			
		4 Hr.	3 Hr.	2 Hr.	1 Hr.
Steel or Cast Iron Columns: All Members of Primary Trusses or Primary Girders	Concrete	2	2	1½	1
	Gunite	2	1½	1	¾
	Brick of Clay, Shale, Concrete or Sand Lime All Spaces Filled	¾	¾	2¼	2¼
	Clay Tile or Haydite or Waylite or Concrete Block or Gypsum Block or Poured Gypsum. All Spaces Filled. Metal Ties in Horizontal Joints	2 Thick- nesses 2 Inches Each	4	2	2
	Portland Cement Plaster on Metal Lath	-----	-----	1½ with ½ air space	1
	Clay Tile, End Const. have less than 26% Voids with all Spaces Filled and Metal Ties in Horizontal Joints	¾	¾	1¼ No Filling	1¼ No Filling
Webs and Flanges of Steel Beams and Secondary Girders	Concrete	2	2	1½	1
	Gunite	2	1½	1	¾
	Brick of Clay, Shale, Concrete or Sand Lime	2¼	2¼	2¼	2¼
	Clay Tile, Concrete Block, Gypsum Block or Poured Gypsum	2	2	2	2
	Metal Lath and Gypsum or Portland Cement Plaster	-----	-----	1½	1
Reinforcing Steel in Columns, Beams Girders & Trusses	Concrete	1½	1½	1½	1
Reinforcing Steel in Reinforced Concrete Joists	Concrete	1¼	1¼	1	¾
Reinforcing Steel in Reinforced Concrete Slabs	Concrete	1	1	¾	¾
Reinforcing Steel in Reinforced Concrete Slabs	Gypsum	1	1	¾	¾

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(2) CONCRETE. Concrete shall have a coarse aggregate of limestone, calcareous gravel, traprock, blast furnace slag, burnt clay, burnt shale or other coarse aggregates containing not more than 65% of siliceous material such as granite, sandstone, chert, flint or quartz.

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(3) **APPROVAL OF OTHER MATERIALS.** Other materials, assemblies and thicknesses of necessary strength and durability for the use intended and which have successfully performed under tests made by a recognized laboratory in accordance with the requirements of the "Standard Specifications for Fire Tests of Building Construction and Materials" (C19-33) of the American Society for Testing Materials, shall be accepted for specific ratings in addition to those prescribed in this section.

History: 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.05 Fire-resistive standards; walls and partitions.

(1) Wall Construction	Minimum Thickness in Inches, Face to Face			
	4 Hr.	3 Hr.	2 Hr.	1 Hr.
Solid Brick, Load Bearing, Unplastered	8	8	8	8
Solid Brick, Non-Load Bearing, Unplastered	8	8	4	4
Solid Brick, Load Bearing, Plastered Two Sides	8	8	8	8
Solid Brick, Non-Load Bearing, Plastered Two Sides	8	8	4	4
Hollow Clay Tile, Load Bearing, Unplastered	12 4-Cell	12 3-Cell	8 3-Cell	8 2-Cell
Hollow Clay Tile, Non-Load Bearing, Unplastered	12 4-Cell	8 3-Cell	6 2-Cell	4 1-Cell
Hollow Clay Tile, Load Bearing, Plastered Two Sides	12 3-Cell	8 3-Cell	8 2-Cell	8 2-Cell
Hollow Clay Tile, Non-Load Bearing, Plastered Two Sides	12 3-Cell	8 3-Cell	4 1-Cell	8 1-Cell
Concrete Block, Load Bearing, Unplastered	12	12	8	8
Concrete Block, Non-Load Bearing, Unplastered	12	12	6	4
Concrete Block, Load Bearing, Plastered Two Sides	12	8	8	8
Concrete Block, Non-Load Bearing, Plastered Two Sides	12	8	4	8
Solid Plain Concrete, Load Bearing	8	8	8	6
Solid Plain Concrete, Non-Load Bearing	8	6	4	4
Solid Reinforced Concrete, Load Bearing	6	5	4	4
Solid Reinforced Concrete, Non-Load Bearing	6	5	4	3
Solid Gypsum Block, Non-Load Bearing, Unplastered	6	6	3	3
Solid Gypsum Block, Non-Load Bearing, Plastered Two Sides	6	4	3	3
Hollow Gypsum Block, Non-Load Bearing, Unplastered	8	8	4	4
Hollow Gypsum Block, Non-Load Bearing, Plastered Two Sides	8	8	4	4
Solid Cement or Gypsum Plaster on Metal Base, Non-Load Bearing	-----	-----	2	2
Hollow Partitions, Lath and Plaster shall have a minimum thickness of $\frac{5}{8}$ inch. Lath may be of metal or $\frac{3}{4}$ inch perforated gypsum. If constructed of wood studs, they shall be fire-stopped.	-----	-----	-----	5

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(2) Other materials, assemblies and thicknesses of necessary strength and durability for the use intended and which have successfully performed under tests made by a recognized laboratory in accordance with the requirements of the "Standard Specifications for Fire Tests of Building Construction and Materials" (C19-33) of the American Society for Testing Materials, shall be accepted for specific ratings in addition to those prescribed in this section.

(3) Thicknesses as established in this section shall be construed as establishing minimum requirements for fire-resistance and shall not preclude the application of other requirements of this code where considerations of strength, durability or stability require greater thicknesses.

(4) Where plaster is required in this section it shall have a minimum thickness of $\frac{1}{2}$ inch except that for hollow partitions the thickness shall be not less than $\frac{5}{8}$ inch. Either Portland cement or gypsum plaster may be used.

History: 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.06 Fire-resistive floor construction. (1) Fire-resistive floor construction shall be accepted for the following respective degrees of fire-resistive protection when constructed as specified in this section. They shall be constructed entirely of incombustible materials.

(2) **FOUR-HOUR CONSTRUCTION.** Four-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs or arches not less than 4 inches in thickness, or shall consist of hollow masonry slabs or arches not less than 4 inches in thickness with a top covering of not less than 2 inches of solid masonry, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this section. Except in the case of steel joisted construction, all reinforcing, tie rods and supporting structural members in such floors shall be protected with not less than 4-hour fire-resistive construction as specified in section Ind 51.04.

(3) **THREE-HOUR CONSTRUCTION.** Three-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs or arches not less than $2\frac{1}{2}$ inches in thickness, or shall consist of hollow masonry slabs or arches not less than 4 inches in thickness with a top covering of solid masonry not less than $1\frac{1}{2}$ inches in thickness, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this section. Except in the case of steel joisted construction all reinforcing, tie rods and supporting structural members in such floor construction shall be protected with not less than 3-hour fire-resistive construction as specified in section Ind 51.04.

(4) **TWO-HOUR CONSTRUCTION.** Two-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs or arches not less than $2\frac{1}{2}$ inches in thickness, or shall consist of hollow masonry slabs or arches not less than 3 inches in thickness with a top covering of not less than one inch of solid masonry, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this section. Except in the case of steel joisted construction all reinforcing, tie rods and

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supporting structural members in such floor construction shall be protected with not less than 2-hour fire-resistive construction as specified in section Ind 51.04.

(5) **ONE-HOUR CONSTRUCTION.** One-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs not less than 2½ inches in thickness, or shall consist of hollow masonry slabs or arches not less than 3 inches in thickness with all joints in such hollow unit construction thoroughly filled with cement or gypsum mortar, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this section, or shall consist of wood joisted construction with a double wood floor on top (the sub-floor not less than ¾ inch thick, and the total thickness of the two layers not less than 1¼ inches thick) and with a fire-resistive ceiling as tabulated in this section, securely fastened to or suspended from the under side of such joists, except that the metal lath and plaster ceiling shall not be required below the lowest floor joist over unusable space.

(6) Except in the case of steel joisted construction, all reinforcing, tie rods and supporting structural members shall be protected with not less than one-hour fire-resistive construction as specified in section Ind 51.04.

(7) **MINIMUM PROTECTION FOR METAL AND WOOD JOISTS BASED ON TIME PERIODS FOR VARIOUS INSULATING MATERIALS.**

MINIMUM PROTECTION FOR METAL AND WOOD JOISTS BASED ON TIME PERIODS FOR VARIOUS INSULATING MATERIALS

Joists to be Protected	Insulating Material	Minimum thickness of material in inches for the following fire-resistive materials			
		4 Hr.	3 Hr.	2 Hr.	1 Hr.
Ceiling protection of steel joists, where in-combustible slab not less than 2½ in. thick is placed above	Metal or wire lath and gypsum or Portland cement plaster, concrete, burned clay products or gypsum	2	1½	1	¾
	Gunitite	1½	1	¾	¾
Ceiling protection of wood joists with double floor on top	Metal or wire lath and gypsum or Portland cement plaster. ¾ in. perforated gypsum lath, ½ in. gypsum plaster, joints reinforced with 3 in. wide strips of metal lath.				¾

(8) All flat ceilings where the ceiling protection for beams, girders or flat slabs is suspended to form a free air space between the member and the protection, the protection thickness may be ½ inch less than required in the tabulation contained in this section for flat ceiling protection, but no thickness shall be less than ¾ inch minimum protection of metal and wood joists.

(9) In any reinforced concrete floor construction which includes a metal lath and cement or gypsum plastered ceiling on the under side,

not less than $\frac{3}{4}$ inch thick, the required slab thickness may be reduced $\frac{1}{2}$ inch but in no case shall be less than $2\frac{1}{2}$ inches thick.

History: 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.07 Fire retardant roof coverings. (1) Fire-retardant roof coverings have no time resistance ratings by governmental testing laboratories. The Underwriters' Laboratories in their "List of Inspected Fire Protection Equipment and Materials" classifies their degree of fire-resistance by the letters A, B and C. Class A roof coverings have the highest resistance and Class C the lowest.

(2) Roof coverings on buildings of fire-resistive and mill construction shall be not less than Class A, or equal, those on buildings of ordinary construction shall be not less than Class B, or equal, and those on frame buildings shall be not less than Class C, or equal.

(3) The department of industry, labor and human relations will accept roof coverings for different fire-resistance values as established by, and if installed according to, the requirements of the Underwriters' Laboratories.

Note: The Underwriters' Laboratories "List of Inspected Materials" is obtainable from the Fire Insurance Rating Bureau and Fire Insurance Agencies.

(4) The department of industry, labor and human relations will approve, subject to the provisions of this section, any roof covering which has developed the required fire-resistance in tests as specified in the "Standard Specifications of Fire Tests of Building Construction and Materials" (A.S.T.M. Designation C19-33) when conducted by a nationally recognized testing laboratory.

History: 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71.

SPECIAL NOTICE!

The following rules for "Fire-Resistive Standards for Materials of Construction," sections Ind 51.04 through Ind 51.048, will become effective July 1, 1971.

Fire-Resistive Standards for Materials of Construction

Ind 51.04 Scope. This section shall include standards applicable to various types of fire-resistive construction. Requirements established herein are considered minimum safety standards and will not necessarily result in the most advantageous insurance rates.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.041 Definitions. (1) **APPROVED.** Means approval granted by the department of industry, labor and human relations.

(2) **AUTOMATIC.** Automatic as applied to a fire protective device, is one which functions without human intervention and is actuated as a result of the predetermined temperature rise, rate of rise of temperature, combustion products or smoke density such as an automatic sprinkler system, automatic fire door, automatic fire shutter, or automatic fire vent.

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(3) **CEILING PROTECTION.** The fire protection membrane suspended beneath the floor or ceiling construction which, when included with the construction, develops the fire-resistive rating for the overall assembly.

(4) **COMBUSTIBLE CONSTRUCTION.** An assembly such as a wall, floor or roof having components of combustible material.

(5) **CLOSING DEVICE (FIRE DOOR).** A closing device is one which will close the door, and be adequate to latch and/or hold hinged or sliding door in a closed position.

(a) *Automatic.* An automatic closing device is one which functions without human intervention, and is actuated as a result of the pre-determined temperature rise, rate of rise of temperature, combustion products or smoke density.

(b) *Self-closing.* A self-closing device is one which will maintain the door in a closed position.

(6) **COMBUSTIBLE MATERIAL.** All materials not classified as "non-combustible" are considered combustible. This property of a material does not relate to its ability to structurally perform under fire exposure. The degree of combustibility is not defined by standard fire test procedures.

(7) **DEPARTMENT.** Means the department of industry, labor and human relations.

(8) **FIRE DOOR.** A door so constructed as to give protection against the passage of fire.

(9) **FIRE DOOR ASSEMBLY.** The assembly of fire door and its accessories, including all hardware, frames, closing devices and their anchors, so constructed as to give protection against the passage of fire.

(10) **FIRE-RESISTIVE CLASSIFICATION.** Fire-resistive classification is the time in hours during which a material or assembly continues to exhibit fire resistance under conditions of tests and performance as specified in ASTM E-119, ASTM E-152 and ASTM E-163.

(11) **FIRE-RESISTIVE RATING.** Refer to fire-resistive classification.

(12) **FIRE RESISTANCE AND FIRE-RESISTIVE MATERIAL.** Having the property to withstand fire or give protection from it. As applied to elements of building, it is characterized by the ability to confine a fire or to continue to perform a given structural function, or both.

(13) **FIRE-RESISTIVE PROTECTION.** An insulating material applied directly, attached to, or suspended from a structural assembly, to maintain the structural integrity of a member or system for the specified time rating.

(14) **FIRE-RESISTIVE PROTECTION, DIRECTLY APPLIED.** A coating material applied directly to the structural element for the purpose of fire protection.

(15) **FIRE-RETARDANT ROOF COVERINGS.** Roof coverings shall be classified on the basis of protection provided against fire originating outside the building or structure on which they have been installed.

(a) Class A roof coverings are those which are effective against severe fire exposures (meeting the three methods for fire tests of class A roof coverings (ASTM Standard E-108)) and possess no flying brand hazard.

(b) Class B roof coverings are those which are effective against moderate fire exposures (meeting the three methods for fire tests of class B roof coverings (ASTM Standard E-108)) and possess no flying brand hazard.

(c) Class C roof coverings are those which are effective against light fire exposures (meeting the three methods for fire tests of class C roof coverings (ASTM Standard E-108)) and possess no flying brand hazard.

(16) FIRE RETARDANT—TREATED WOOD. Fire-retardant wood includes lumber or plywood that has been treated with a fire-retardant chemical to provide classifications (flame-spread (FSC) and fuel contributed (FCC)) of 25 or less by ASTM method E-84, shows no progressive combustion during 30 minutes of fire exposure by this method, and is so labeled. Fire-retardant wood for decorative and interior finish purposes provides reduced flame-spread classification (FSC) by ASTM method E-84 as specified by the code for materials used in the particular applications.

(17) FIRE WINDOW ASSEMBLY. A fire window includes glass, frame, hardware and anchors constructed and glazed to give protection against the passage of flame.

(18) FLAME-SPREAD CLASSIFICATION. Flame-spread classification (FSC) is a comparative rating of the measure of flame-spread on a surface of a material or assembly as determined under conditions of tests and performance as specified in ASTM E-84.

(19) FLAME-SPREAD RATING. Refer to flame-spread classification.

(20) FUEL CONTRIBUTED CLASSIFICATION. Fuel contributed classification (FCC) is a comparative measure of the fuel contribution of a material or an assembly in the flame-spread test per ASTM E-84.

(21) NONCOMBUSTIBLE CONSTRUCTION. An assembly such as a wall, floor or roof having components of noncombustible material.

(22) NONCOMBUSTIBLE MATERIAL. A noncombustible material is one which, in the form in which it is used, meets one of the requirements 1., 2. or 3. listed below. Materials used adjacent to or in contact with heat-producing appliances, warm air ducts, plenums and chimneys shall be classified as noncombustible only on the basis of requirement 1. Noncombustible does not apply to the flame-spread characteristics of interior finish or trim materials. No material shall be classed as noncombustible building construction material which is subject to increase in combustibility or flame-spread classification (FSC) beyond the limits herein established through the effects of age, moisture or other atmospheric conditions.

1. Materials which pass the test procedure of ASTM E-136 for defining noncombustibility of elementary materials when exposed to a furnace temperature of 1,382 degrees F. for a minimum period of 5 minutes, and do not cause a temperature rise of the surface or

interior thermocouples in excess of 54 degrees F. above the furnace air temperature at the beginning of the test and which do not flame after an exposure of 30 seconds.

2. Materials having a structural base of noncombustible material as defined in paragraph 1., with a surfacing not more than $\frac{1}{8}$ inch thick which has a flame-spread classification (FSC) not greater than 50 when tested in accordance with the method of test for surface burning characteristics of building materials (ASTM E-84).

3. Materials other than defined in paragraphs 1. and 2., having a flame-spread classification (FSC) not greater than 25 without evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material in any way would not have a flame-spread classification (FSC) greater than 25 when tested in accordance with the method of test for surface burning characteristics of building materials (ASTM E-84).

(23) **RESTRAINED SUPPORT.** A flexural member where the supports and/or the adjacent construction provides complete or partial restraint against rotation of the ends of the member and/or partial restraint against horizontal displacement when subject to a gravity load and/or temperature change.

(24) **SIMPLE SUPPORT.** A flexural member where the supports and/or the adjacent construction allows free rotation of the ends of the member and horizontal displacement when subject to a gravity load and/or a temperature change.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.042 General requirements. (1) Construction details and quality of material used for these systems must be those used by the testing laboratory for the test, and/or those dictated by good construction practice.

(2) Connection of structural members. (a) The minimum fire-resistive protection of a connection shall be equal to the maximum required for the members to which it is attached.

(3) For structural components with a fire-resistive rating obtained by test with restrained ends, the supporting structure shall be designed to provide for this restraint.

(4) ASTM standard methods of test. (a) All products manufactured and tested according to ASTM standard methods prior to effective dates of standards specified in "Fire-Resistive Standards for Materials of Construction" shall be accepted unless the ASTM standard method used in the test is judged to be inadequate in comparison with the currently adopted standard method.

(5) The heat transmission requirements of ASTM E-119 (25b), with the exception of high hazard areas, penal and health care facilities and warehouses for combustible materials, may be reduced to one-half ($\frac{1}{2}$) of the hourly rating required by this code, but not less than one hour.

NOTE: For ASTM E-119 Standard adopted see Ind 51.25 (90).

(a) The fire-resistive rating for structural integrity required by this code shall be maintained where the heat transmission criteria has been reduced.

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(6) The use of fire-resistive protection implies consent by owner to maintain material in a serviceable condition. Where this protection is concealed, provisions shall be made for periodic visual inspection of the structural insulating material at each story.

NOTE: Definition of owner—see 101.01 (13), Wis. Stats.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.043 Approved rating methods. (1) Ratings of fire-resistive assemblies shall be determined by one of the following methods:

- (a) Test by approved testing laboratories (see Ind 51.044).
- (b) Typical examples as listed in this code in lieu of approved test (see Ind 51.045).
- (c) Approved method of calculation in lieu of approved test (see Ind 51.046).

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.044 Approved testing laboratories. (1) Fire rating tests conducted according to table 1 listed ASTM standards shall be acceptable if conducted by the recognized testing laboratory for referenced test.

NOTE: Other testing laboratories will be recognized as an approved agency if accepted in writing by the department.

TABLE 1

Name of Recognized Laboratories	ASTM Standard Tests					
	E-84	E-108	E-119	E-136	E-152	E-163
Forest Prod. Lab., Madison, Wis.*			X		X	
Nat'l. Bureau of St'd., Washington, D.C.			X	X		
Ohio State Univ., Columbus, Ohio			X	X	X	X
Portland Cement Assoc., Skokie, Ill.			X			
Southwest Research Inst., San Antonio, Tex.	X					
Underwriters' Lab., Inc., Chicago, Ill.	X	X	X		X	X
Underwriters' Lab., Inc., Scarborough, Ont., Canada	X	X	X	X	X	X
Univ. of Calif., Berkeley, Calif.		X	X			X

*NOTE: Reference based on research and development data. Facility is not available for conducting routine rating tests.

NOTE: For column identification and specific standards adopted, see subsections Ind 51.25 (88) thru (93).

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.045 Typical examples of Fire-Resistive Structural Components. (1) Basic design and construction for specified fire-resistive protection of structural components listed in table 2, including preferences (a) through (p), shall be acceptable.

NOTE: The following table is based on performance, interpretation of various test data and/or data from ASTM E-119 test (see table 2).

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(a) Types of concrete.

1. Type I—normal weight concrete with limestone, calcareous gravel and air-cooled slag aggregate.

2. Type II—normal weight concrete with siliceous gravel, granite or quartz aggregate containing more than 40% quartz, chert or flint. Values given for type I apply except where values are tabulated for type II.

3. Type III—lightweight aggregate with expanded slag, shale or clay aggregate. Includes sanded—lightweight concretes not over 115 lbs. per cu. ft. oven-dried density.

(b) Cover on reinforcing steel is for sides and bottoms. Where tensile reinforcing elements have different cover, the tabulated cover is the average of the minimum values of the individual elements. The cover of an individual element shall not be less than $\frac{1}{2}$ the tabulated value. Top cover to be a minimum of $\frac{3}{4}$ inch.

(c) For the heat transmission requirements of floor and roof construction, the thickness of the top slab may be reduced if non-combustible insulation is directly applied to either side of the slab and provided the U-factor is equaled or reduced.

(d) The thickness of top slab is in accordance with ASTM E-119 heat transmission requirements. For variations in thickness of top slab see section Ind 51.042 (5).

NOTE: For ASTM E-119 standard adopted see Ind 51.25 (90).

(e) Longitudinal joints between individual precast floor or roof units, or individual wall units shall be installed as tested or shall be grouted solid for the thickness required by the fire-resistive rating. Noncombustible insulation may be substituted for the grout if the U-factor is equaled or reduced providing the integrity of insulation remains as installed. The topping used in floor or roof units may be included.

(f) Type I Hollow Masonry is a masonry with calcareous or siliceous aggregate. Type II Hollow Masonry is a masonry with expanded slag, clay, shale or pumice aggregate.

(g) Equivalent thickness = $\frac{\text{Total volume minus volume of voids}}{\text{length times height}}$

(h) t_e -equivalent thickness = $\frac{\text{Total conc. area minus area of void}}{\text{width}}$

(i) Clay, shale, concrete or sand lime—with less than 25% voids or with all spaces filled.

(j) $1\frac{1}{2}$ inch space between column and masonry unit—no fill required.

(k) For restrained conditions, thickness of fire protection may be reduced if substantiated by test data or calculation method.

(l) Elements with this minimum size are recognized for heavy timber construction, acceptable for certain buildings in lieu of one hour noncombustible construction.

(m) Where combustible members are framed into a wall, the wall shall be of such thickness or be so constructed that the fire barrier between the member and the opposite face of the wall, or between adjacent members set in from opposite sides will be 93% of the equivalent thickness shown in table 2.

TYPICAL EXAMPLES OF FIRE RESISTIVE

TYPE OF CONSTRUCTION		ROW NO.	STRUCTURAL COMPONENTS	SKETCHES	
COMPONENTS WITHOUT APPLIED PROTECTION	CONCRETE CAST IN PLACE AND PRECAST	1.	COLUMNS		
		2.	GIRDERS AND BEAMS		
		3.	JOISTS & WAFFLES WITHOUT FILLERS OR PARTIAL FILLERS OF TYPE I OR II MASONRY OR CLAY TILE		
		4.	SLABS OR JOISTS & WAFFLES WITH TYPE I OR II MASONRY OR CLAY TILE FILLER		
		5.	WALLS AND PARTITIONS BR'G. & NON-BR'G.		
	CONCRETE PRECAST & CAST IN PLACE POSTENSIONED OR PRETENSIONED SIMPLE SPAN	6.	GIRDERS AND BEAMS		
		7.	JOISTS AND WAFFLES		
		8.	SINGLE TEE		
		9.	MULTI-TEE UNITS		
		10.	SOLID & CORED SLABS		
		MASONRY BEARING AND NON BEARING	11.	UNREINFORCED CONCRETE WALLS & PARTITIONS	
			12.	HOLLOW MASONRY WALLS & PARTITIONS...BLOCK TILE CORED BRICKS CAVITY WALLS	
	13.		SOLID MASONRY BRICK BLOCK...CLAY TILE WITH LESS THAN 25% VOIDS OR WITH THE CORES FILLED		
COMPONENTS WITH DIRECT APPLIED PROTECTION	STEEL	14.	COLUMNS		
		15.	GIRDERS...BEAMS...TRUSSES		
		16.	COLUMNS...BEAMS...GIRDERS... TRUSSES...JOISTS & STEEL FLOOR UNITS		

STRUCTURAL COMPONENTS, TABLE 2

INSULATING MATERIAL	DESCRIP - TION	MINIMUM REQUIREMENTS											
		4 HR.			3 HR.			2 HR.			1 HR.		
		I	II	III	I	II	III	I	II	III	I	II	III
CONCRETE TYPE I II & III (a)(b)	REINF. COVER MIN. DIM. & AREA-SQ. IN.	2	2	2	2	2	2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
CONCRETE TYPE I II & III (a)(b)(n)	REINF. COVER WIDTH (w)	2	2	2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1	1	1
CONCRETE TYPE I II & III (a)(b)(c)(d)(e)(h)(n)	REINF. COVER WIDTH WEB (w) TH. TOP SLAB (t)	1	1	1	1	1	1	3/4	3/4	3/4	3/4	3/4	3/4
CONCRETE TYPE I II & III (a)(b)(c)(d)(e)(h)(n)	REINF. COVER TOP. SLAB (t)	1	1	1	1	1	1	3/4	3/4	3/4	3/4	3/4	3/4
CONCRETE TYPE I II & III (a)(b)(e)	REINF. COVER THICKNESS (t)	1	1	1	1	1	1	3/4	3/4	3/4	3/4	3/4	3/4
CONCRETE TYPE I II & III (a)(b)(k)	AVE. COVER (w)	I 3 1/2 II 11 III 10	I 3 II 10 III 9 1/2	I 3 II 10 III 9 1/2	I 2 3/4 II 8 III 8	I 2 1/2 II 7 III 6 1/2	I 2 II 6 1/4 III 5 3/4	I 1 3/4 II 4 III 3 3/4	I 1 3/4 II 4 III 3 3/4	I 1 3/4 II 4 III 3 3/4			
CONCRETE TYPE I II & III (a)(b)(c)(d)(e)(k)	AVE. COVER AVE. WEB TH. (w) SLAB TH. (t)	2 3/4 11 6 3/4	2 3/4 10 7 5/2	2 3/4 10 7 5/2	1 3/4 9 1/2 5 3/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4		
CONCRETE TYPE I II & III (a)(b)(c)(d)(e)(k)	AVE. COVER AVE. WED TH. (w) TOP THICK'S (t)	2 3/4 8 6 3/4	2 3/4 8 7 5/2	2 3/4 8 7 5/2	1 3/4 8 5 3/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4	1 3/4 8 6 1/4		
CONCRETE TYPE I II & III (a)(b)(c)(d)(e)(k)	AVE. COVER AVE. WEB TH. (w) TOP THICK'S (t)	BY TEST OR LISTING BY APPROVED TESTING LAB.	BY TEST OR LISTING BY APPROVED TESTING LAB.	BY TEST OR LISTING BY APPROVED TESTING LAB.	2 4 4 3/4	1 3/4 4 5	1 3/4 4 5	1 3/4 4 5	1 3/4 4 5	1 3/4 4 5	1 3/4 4 5		
CONCRETE TYPE I II & III (a)(b)(c)(d)(e)(h)(k)	1 OR 1/2 AVE. COVER	6 3/4 2 1/2	7 2 1/4	5 1/2 2	5 3/4 2	6 1 3/4	4 1 3/4	5 1 1/2	3 3/4 1	3 1/4 1	3 1/2 1	2 3/4 1	
CONCRETE TYPE I II & III (a)(m)	WALL TH. (t)	6	6 1/2	5	5	5 1/2	4 1/2	4	4 1/2	4	3	3	3
MASONRY TYPE I	EQUIV. THICK'S.	6.7			5.7			4.5			3.0		
MASONRY TYPE II (f)(g)(m)	EQUIV. THICK'S.	5.7			4.8			3.8			2.6		
MASONRY TYPE I & II CLAY, SHALE, CONCRETE, SAND OR LIME (m)	WALL TH. (t)	8"			8"			8"			4"		
CONCRETE TYPE I II & III (a)(d)	THICKNESS OF (t)	I 2 II 2 1/2 III 2	I 1 1/2 II 2 III 2	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1		
SOLID MASONRY (i)	PROTECTION	3 3/4 3 3/4	3 3/4 3 3/4	3 3/4 3 3/4	2 1/4 2 1/4	2 1/4 2 1/4	2 1/4 2 1/4	2 1/4 2 1/4	2 1/4 2 1/4	2 1/4 2 1/4	2 1/4 2 1/4	2 1/4 2 1/4	
CONCRETE TYPE I II & III (d)(d)	THICKNESS OF (t) PROTECTION	I 2 II 2 1/2 III 2	I 1 1/2 II 2 III 2	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1	I 1 II 1 1/2 III 1		
SPRAYED FIBER...CEMENTITIOUS MIXTURE... INTUMESCENT PAINTS		BY TESTS...OR LISTING BY APPROVED TESTING LAB.											

TYPICAL EXAMPLES OF FIRE RESISTIVE ST

TYPE OF CONSTRUCTION		ROW NO.	STRUCTURAL COMPONENTS	SKETCHES	
COMPONENTS WITH SUSPENDED OR ATTACHED PROTECTION	CONC.	17.	CONCRETE JOISTS OR WAFFLE		
	STEEL FRAMING	18.	STEEL COLUMNS		
		19.	STEEL GIRDERS...BEAMS... TRUSSES...JOISTS, COLUMNS INDIVIDUALLY PROTECTED		
		20.	STEEL BEAMS, GIRDERS, TRUSSES & JOISTS... W/CEILING PROTECTION & MINIMUM 2 1/2" TH. TYPE I, II OR III CONCRETE SLAB (C) (C) (C)		
		21.	STEEL STUD PARTITION NON BEARING		
		COMBUSTIBLE CONSTRUCTION	22.	WOOD JOISTS MIN. 2" X 10", WOOD FLOOR ATTACHED CEILING	
	23.		WOOD JOISTS MIN. 2" X 10", WOOD FLOOR SUSPENDED CEILING		
	24.		WOOD STUD PARTITION MIN. 2" X 4" STUD		
					(C) HEAVY
	HEAVY TIMBER SOLID OR LAMINATED		25.	COLUMNS	
		26.	GIRDERS & BEAMS		
		27.	ARCH & TRUSS FOR ROOF ONLY		
		28.	FLOOR & ROOF DECK		

STRUCTURAL COMPONENTS, TABLE 2 (CONT.)

INSULATING MATERIAL	DESCRIP-TION	MINIMUM REQUIREMENTS			
		4 HR.	3 HR.	2 HR.	1 HR.
② ③ ④ CONCRETE TYPE I, II OR III 3/4" COVER	1/2" THICK OF SLAB	3"	2"		
VERMICULITE...GYPSUM...OR PERLITE GYPSUM ON METAL LATH	1/2" THICK OF INSULATION	1"	3/4"		
TYPE I & II MASONRY ① 1 1/2" AIR SPACE ①	THICK OF INSULATION	4" SOLID			
SPRAYED FIBRE...CEMENTITIOUS MIXTURE...LATH & PLASTER		BY TESTS...OR APPROVED TESTING LAB.		LISTING	BY
SPRAYED FIBRE...CEMENTITIOUS MIXTURE...LATH & PLASTER ACOUSTICAL TILE		BY TESTS...OR APPROVED TESTING LAB.		LISTING	BY
GYPSUM...PERLITE PLASTER ON PER- FORATED GYP. LATH...2 1/2" STUD	1" PLASTER 1" LATH			3/4" / 3/8"	1/2" / 3/8"
GYPSUM WALL BOARD...3 5/8" STUD	NO. LAYERS THICK. EACH			TWO 5/8"	ONE 5/8"
GYPSUM WALL BOARD...2-2" X 10" S- 4"-0" 9/16" PLYWOOD FLOORING	1" INSUL.				5/8"
GYP. WALL BOARD...2" X 10" S 16" 9/16" 1/2" PLYWOOD OR 1" X 6" T. & G. SUB-FLRG	1" INSUL. 1" FLOORING				5/8" 5/8" PLYWOOD OR 1" X 3" T. & G.
NON COMBUSTIBLE 2" X 10" 16" 9/16" ACOUSTICAL TILE W/5/8" PLYWOOD	1" INSUL.				5/8" 1/2" PLYWD
OR 1" X 4" T. & G. SUB FLOORING	1" FLOORING				OR 1" X 6" T. & G.
GYPSUM WALLBOARD	NO. LAYERS / TH. OF EACH			TWO 5/8"	TWO 3/8"
GYPSUM PERLITE PLASTER ON 3/8" GYPSUM LATH	1" PLASTER 1" HEX. MESH			1" PLASTER W/1" HEX. MESH	9/16"
GYPSUM & SAND PLASTER ON U.L. LISTED WIRE LATH	1"				3/4"
GYPSUM & VERMICULITE PLASTER ON METAL LATH	1"				3/4"

MBER CONSTRUCTION TABLE

WOOD ALL SPECIES	FLOOR...WIDTH/ DEPTH MIN. NOM.				8" X 8"
	ROOF...WIDTH/ DEPTH. MIN. NOM.				6" X 8"
WOOD ALL SPECIES	MIN. WIDTH X DEPTH (NOM.)				6" X 10"
WOOD ALL SPECIES	MIN. WIDTH / DEPTH EACH MEMBER				4" X 6"
WOOD ALL SPECIES	ROOF				2" T & G. OR 3" SOLID
	FLOOR				3" T. & G. + 1" T. & G. 4"

(n) Cover thickness on reinforcing steel as indicated is based on continuity of system. For simple span conditions increase cover thickness by 50%.

(p) Wire mesh reinforced and with a minimum area of 0.015 inches square per foot of length or equivalent.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.046 Calculation method. (1) The rational design of structural members for fire resistance shall be submitted to the department and shall be based on the type of span (simple or restrained), the magnitude of longitudinal restraint, accepted structural engineering principals and methods.

(a) Appropriate research data and design criteria to substantiate the method, interpreting between known information, shall accompany the above material and shall include:

1. Time—temperature relationship ASTM E-119.
2. The temperature—strength characteristics of the structural components.
3. The time—temperature characteristics of the insulating material, at temperature range designated by ASTM E-119.
4. The expansion characteristics of the materials comprising the member, at the temperature range designated by ASTM E-119.

NOTE: 1. For ASTM E-119 standard adopted see Ind 51.25 (90). ✓

2. The department will accept published research data from Portland Cement Association, American Iron & Steel Institute, and American Institute of Steel Construction, Inc.

5. The safety factor of not less than 1.0 shall be maintained at the end of the time requirement for the full design live and dead load.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.047 Openings in fire rated construction. (1) Openings in fire rated construction where permitted by other sections of the code shall satisfy the following appropriate requirements.

(a) *Fire door assemblies.* 1. Openings. Where openings are permitted in fire rated walls protected with door assemblies they shall be time rated and labeled as 3, 1½, 1, ¾ hour by an approved laboratory and tested in accordance with ASTM E-152 standard method.

NOTE: 1. For ASTM E-152 standard adopted see section Ind 51.25 (92). ✓

2. Three-hour rated doors are accepted for all openings in 3 and 4-hour fire-resistive walls. One and one-half (1½) hour rated doors are accepted for all openings in 2-hour fire-resistive interior and exterior walls. Three-quarter (¾) hour rated doors are accepted for openings in 1-hour fire-resistive walls and openings to exterior fire escapes. Door assemblies with glued solid wood core flush doors, 1¾ inches thick, quality certified as meeting National Woodwork Manufacturers Association Industry Standard IS-1-69, and in addition possessing no core voids, may be used where the occupancy sections of this code permit.

2. The door assemblies shall be installed with frame, hinges, latches, closing devices and counterweights in accordance with methods and standards approved by the department.

3. Methods of securing door frame to adjacent construction shall be illustrated on the plans submitted to the department for approval.

NOTE: The department will accept recommended practices for installation covered in "Standard for Fire Door and Windows" N.F.P.A. No. 80.

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4. The maximum swinging door clearances to frame shall be $\frac{1}{8}$ inch on sides and top and $\frac{3}{4}$ inch at bottom between sill or floor.

5. All labeled fire doors where required shall be equipped with an approved closing device.

a. Doors with self-closing device shall remain in a closed position except when in use.

NOTE: The intent was to accept normal usage of door but not permit doors with this device to be blocked open at any time.

b. Where a pilot weight is used, it shall be suspended from a chain or wire cable and shall be installed in a protective housing.

NOTE: For type of closing device permitted please refer to chapters for classes of construction and/or occupancy.

6. Adequate clearance shall be maintained to permit free operation of fire doors.

Note: 1. See section Ind 51.15 for exit door requirements.

2. Transoms, vision panels and/or louvers may be incorporated if tested in accordance with ASTM E-152 standard method.

(b) *Fire window assemblies.** 1. Openings. Where openings are permitted in fire rated walls protected with fire window assemblies they shall be time rated as $\frac{3}{4}$ hour by an approved laboratory and tested in accordance with ASTM E-163 standard method.

NOTE: For ASTM E-163 standard adopted see section Ind 51.25 (93).

2. *Size.* The fire window assembly size shall not exceed size tested. Windows combined in multiple assemblies shall be separated by approved nonbearing metal mullions.

3. *Wired Glass.* Labeled wired glass $\frac{1}{4}$ inch thick shall be installed in a fire window assembly.

***NOTE:** Fire windows have been classified for either moderate or light fire exposure. For moderate fire exposure the individual glass size is limited to 720 sq. inches. (Size limitation either 48 inch max. width or 54 inch max. height.) For light fire exposure the individual glass size is limited to 1,296 sq. inches. (Size limitation either 54 inch max. width or 54 inch max. height.) Please refer to chapters for classes of construction and/or occupancy for fire window classifications.

4. *Installation.** a. Frames shall be securely fastened to the construction and be capable of resisting all wind stresses and other stresses to which they are likely to be subjected.

b. The wired glass shall be well bedded in approved glazing compound and all exposed joints between the metal shall be struck and pointed. The clearance between the edges of the glass and metal framing shall not exceed $\frac{1}{8}$ inch.

***NOTE:** The department will accept recommended practices for installation covered in "Standard for Fire Doors and Windows" N.F.P.A. No. 80.

(c) *Glass block.* 1. *Openings.* Where openings are permitted in fire rated walls protected with glass block they shall be time rated as $\frac{3}{4}$ hour by an approved laboratory and tested in accordance with ASTM E-163 standard method.

NOTE: For ASTM E-163 standard adopted see section Ind 51.25 (93).

2. *Size of opening.* Glass blocks are suitable for openings not exceeding 120 square feet in area, with neither the width nor height exceeding 12 feet.

3. *Installation.*

NOTE: The department will accept recommended practices for installation covered in "Standard for Fire Doors and Windows" N.F.P.A. No. 80.

(d) *Labels.* 1. The label shall identify the time rating for fire door assemblies and class of fire window assemblies and glass block.

2. The label shall identify the testing laboratory, listing agency and manufacturer.

3. The label shall be securely attached and located to permit visual inspection after installation.

(e) *Miscellaneous openings.* 1. Openings around ducts, pipes, conduit or other service installations penetrating required fire-resistive rated floor, wall and roof assemblies shall be filled solidly with material of fire-resistive rating equal to the required rating of assembly penetrated.

2. Duct openings in required fire-resistive rated floor and wall assemblies shall be protected as specified under section Ind 59.69 (13).

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.048 Roof coverings. (1) Roof coverings of class A, B, C or unclassified shall be provided as specified under "Classes of Construction" or under the specific occupancy requirements.

NOTE: Brick, concrete, tile, slate, ferrous and cupreous metals and their alloys will be accepted as "Class A" roof coverings.

History: Cr. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.08 Occupancy separations. (1) When a building is used for more than one occupancy purpose, each part of the building comprising a distinct occupancy division shall be separated from any other occupancy division as provided for under the occupancy requirements of this code.

(2) Occupancy separations shall be classed as "Absolute", "Special" and "Ordinary" and shall apply to both horizontal and vertical separations.

(a) An absolute occupancy separation shall have no openings therein and shall have walls and floors of not less than 4-hour fire resistive construction as specified in section Ind 51.04.

(b) A special occupancy separation shall have walls and floors of not less than 3-hour fire-resistive construction as specified in section Ind 51.04. All openings in walls forming such separation shall be protected on each side thereof by self-closing fire-resistive doors as specified in section Ind 51.047, and such doors shall be kept normally closed. The total width of all openings in any such separating wall in any one story shall not exceed 25% of the length of the wall in that story and no single opening shall have an area greater than 120 square feet.

1. All openings in floors forming this type of separation shall be protected by vertical enclosures extending above and below such openings. The walls of such vertical enclosures shall be of not less than 2-hour fire-resistive construction as specified in section Ind 51.04 and all openings therein shall be protected on one side thereof by self closing 1-hour fire-resistive doors as specified in section Ind 51.047 and such doors shall be kept normally closed.

(c) An ordinary occupancy separation shall have walls and floors of not less than 1-hour fire-resistive construction as specified

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in sections Ind 51.05 and 51.06. All openings in such separations shall be protected by self-closing fire-resistive doors as specified in section Ind 51.047 and such doors shall be kept normally closed.

History: 1-2-56; r. and recr. (2) (c), Register, October, 1967, No. 142, eff. 11-1-67; am. (2) (a), (b) and (c), Register, February, 1971, No. 182, eff. 7-1-71.

rev. 8-1-71
to eff. 1-1-72
NOTE: Sections Ind 51.09 through Ind 51.11 are repealed effective July 1, 1971.

Ind 51.09 Fire-resistive doors. (1) Fire-resistive doors have no time resistance rating established by governmental agencies. It will be the policy of the department of industry, labor and human relations to approve, subject to the provisions of this section, any door given a rating by the Underwriters' Laboratories in their "Building Materials List" as class A, B, C, D and E having varying degrees of resistance, and suitable for various locations.

(2) Where fire-resistive doors are required, class A doors, or equal shall be used for all openings in 3 and 4 hour fire-resistive walls. Class B, 1½-hour fire-resistive doors, or equal shall be used for all openings in 2-hour walls. Doors for elevator shafts shall be of class B type or equal. Class C doors, or equal, shall be used in openings in corridor partitions in fire-resistive buildings and for openings in one-hour fire-resistive partitions except that wood doors of solid flush type, 1¾ inches thick may be used in such buildings which are less than 85 feet in height. Class D and E doors, or better, shall be used in outside wall openings where required for fire escapes.

(3) All required fire-resistive doors shall be equipped with a self-closing device.

History: 1-2-56; r. and recr. Register, September, 1959, No. 45, eff. 10-1-59; am. Register, December, 1962, No. 84, eff. 1-1-63; am. (2), Register, December, 1967, No. 144, eff. 1-1-68; r. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.10 Fire-resistive windows. (1) Windows shall be of a design approved by the department of industry, labor and human relations for the intended use as provided under occupancy classifications. The term "window" in this section shall include the frame, sash and all other parts of a complete assembly. Approved wire glass ¼ inch in thickness shall be used for glazing.

(2) Windows shall be limited to sizes for which effective fire-resistance has been demonstrated by actual fire test, and which in no case exceed 84 square feet in area and 12 feet in greatest dimension. Such windows may be combined in multiple assemblies when separated by approved metal mullions, which shall be considered non-bearing.

(3) Individual glass lights shall not exceed 720 square inches in area, and 54 inches in vertical and 48 inches in horizontal dimension.

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Note: It will be the policy of the department of industry, labor and human relations to approve, subject to the provisions of this section, any window bearing the inspection manifest of the Underwriters' Laboratories for the situation of installation.

History: 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.11 Glass block. (1) **USE.** Approved glass block may be used in non-load bearing panels in walls where ordinary glass will be permitted, unless specifically prohibited by occupancy requirements of this code.

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(2) **INSTALLATION.** Glass block panels shall not exceed 144 square feet in unsupported area, with a maximum height of 20 feet and a maximum width of 20 feet. The horizontal and vertical mortar joints between each block shall be composed of one part of Portland cement, one part of lime and 4 parts of sand, or its equivalent.

(a) All panels over 6 feet in width shall be supported on each side by chases, not less than 1½ inches in depth, of metal or other incombustible material.

(b) Approved continuous metal bond ties shall be provided in each horizontal mortar joint for block of nominal 12 x 12 inch size and in at least every third joint for block of smaller dimension.

(c) Provision shall be made in all panels for expansion, using approved expansion material not less than ½ inch thick for heads and lintels and not less than ¼ inch thick for jams.

History: 1-2-56; r. Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.12 Height of building. The height of a building is measured at the center line of its principal front, from the sidewalk grade (or, if setting back from the sidewalk, from the grade of the ground adjoining the building) to the highest part of the roof, if a flat roof, or to a point 2/3 of the height of the roof, if a gabled or hipped roof. If the grade of the lot or adjoining sidewalk in the rear or alongside of the building falls below the grade at the front, the height shall be measured at the center of the lowest side.

Ind 51.13 Basement; first floor; number or stories. A basement is that portion of a building whose floor level is more than 3½ feet below the average contact ground level at the exterior walls of the building. The next floor above shall be considered the first story. The number of stories of a building includes all stories except the basement.

History: 1-2-56; r. and recr. Register, February, 1971, No. 182, eff. 3-1-71.

Ind 51.14 Street; alley; court. (1) A street is any public thoroughfare 30 feet or more in width.

(2) An alley is any public thoroughfare less than 30 feet, but not less than 10 feet, in width.

(3) A court is an open, unoccupied space other than a street or alley and bounded on one or more sides by the walls of a building.

Ind 51.15 Standard exit. (1) Every door which serves as a required exit from a public passageway, stairway or building shall be a standard exit door unless exempted by the occupancy requirements of this code.

Note: For required exits see Wis. Adm. Code sections Ind 54.06, 55.10, 56.08 and 57.09.

(2) Every standard exit door shall swing outward or toward the natural means of egress (except as below). It shall be level with the floor, and shall be so hung that, when open, it will not block any part of the required width of any other doorway, passageway, stairway or fire escape. No revolving door, and no sliding door except where it opens onto a stairway enclosure or serves as a horizontal exit, shall be considered as a standard exit door.

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(3) A standard exit door shall have such fastenings or hardware that it can be opened from the inside by pushing against a single bar or plate or turning a single knob or handle.

(a) The use of a key for opening door from the inside is prohibited.

(b) The door shall not be barred, bolted or chained at any time.

(4) A standard exit doorway shall not be less than 6 feet 4 inches high by 3 feet 4 inches wide, except where especially provided under occupancy classifications and in Wis. Adm. Code section Ind 51.20. Where double doors are provided with or without mullions, the width of each single door may be reduced to 2 feet 6 inches.

(5) All exit doors, unless otherwise exempted by the occupancy requirements of this code, shall be plainly marked by a red illuminated translucent exit sign bearing the word EXIT or OUT in plain letters not less than 5 inches in height and in such other places as may be necessary to direct the occupants to exit doorways.

(6) Doors, windows or other openings which are not exits but which give the appearance of exits shall be effectively guarded.

(a) *Glass doors.* All glass doors shall be provided with a push bar or plate inside and outside. The push bar or plate shall be within 32 inches to 44 inches above the floor.

(b) *Glass walls panels.* Glass wall panels having a curb or sill less than 24 inches in height shall be protected by a horizontal bar or rail at least 1½ inches wide and located within 3 feet 6 inches to 4 feet 6 inches above the floor. The bar or rail assembly shall be capable of withstanding a lateral force of 100 pounds applied at any point.

(7) Safeguards for physically handicapped persons:

(a) Any place of employment or public building, the initial construction of which is commenced after July 1, 1970, shall be so designed and constructed as to provide reasonable means of ingress and egress by the physically handicapped with the exception of:

1. Apartment houses with less than 20 units, row houses and rooming houses;

2. Convents and monasteries;

3. Jails or other places of detention;

4. Garages, hangars and boathouses;

5. All buildings classified as hazardous occupancies;

6. Warehouses, and

7. State buildings specifically built for field service purposes such as but not limited to conservation fire towers, fish hatcheries, tree nursery buildings.

8. University residence halls at universities which have at least three residence halls for men and three residence halls for women so constructed as to allow physically handicapped persons reasonable means of ingress and egress to such buildings.

(b) The requirements of section Ind 51.15 (7) (a) may be accomplished by at least one ground or street level entrance and exit without steps.

The entrance and exit shall be by:

1. Ramps with slopes not more than one foot of rise in 12 feet coated with a nonskid surface, or

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(a) For stairways to elevated platforms, walks and runways in places of employment see Wis. Adm. Code, chapter 1, Safety.

History: 1-2-56; am. (2); (2) (a); (2) (b); Register, June, 1956, No. 6, eff. 7-1-56; r. and recr. Register, September, 1959, No. 45, eff. 10-1-59; r. (4) (b), renun. (c) to be (b), and cr. (5), Register, February, 1971, No. 182, eff. 3-1-71.

Ind 51.17 Smokeproof stair tower. (1) A smokeproof stair tower shall be an enclosed stairway which is entirely cut off from the building and which is reached by means of open balconies or platforms. The stairways, landings, platforms and balconies shall be of non-combustible material throughout. The enclosing walls shall be of not less than 4-hour fire-resistive construction, and the floors and ceilings of not less than 2-hour fire-resistive construction as specified in section Ind 51.04. ✓

(2) The doors leading from the buildings to the balconies and from the balconies to the stairways shall be fire-resistive doors, and all openings within 10 feet of any balcony shall be protected with fire-resistive windows, or fire-resistive doors as specified in section Ind 51.047. ✓

(3) Each balcony shall be open on at least one side, with a railing not less than 3'6" high on all open sides.

History: 1-2-56; am. Register, December, 1962, No. 84, eff. 1-1-63; am. (1) and (2), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.18 Interior enclosed stairway. (1) An interior enclosed stairway shall be completely enclosed with walls of not less than 2-hour fire-resistive construction as specified in section Ind 51.04, except that in ordinary or frame buildings and in mill or fire-resistive buildings not more than 3 stories in height 1-hour fire-resistive enclosures may be used. All doors opening into such enclosures shall be as specified in section Ind 51.047. ✓

(2) The enclosure shall include at each floor level a portion of such floor which will be at least as wide as the stairway; and such enclosure shall also include the passageway of the first floor level (if any) leading from the stairway to an outside door, so as to afford uninterrupted passage from the uppermost floor to such outside door without leaving the enclosure.

(3) If windows are placed in any such enclosure they shall be fixed fire-resistive windows as specified in section Ind 51.047 except in outside walls.

History: 1-2-56; am. (1) and (3), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.19 Horizontal exit. (1) A horizontal exit shall consist of one or more openings through or around an exterior wall or occupancy separation, or of one or more bridges or balconies connecting 2 buildings or parts of buildings entirely separated by occupancy separations as described in section Ind 51.08.

(2) Openings used in connection with horizontal exits shall be protected by fire-resistive doors as specified in section Ind 51.047. If swinging doors are installed in pairs, they shall be arranged to swing in opposite directions; with direction of travel indicated by signs, except that where the travel is in one direction only, both doors shall swing in that direction. Such doors shall be kept continuously

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unlocked whenever the building is occupied and be normally closed or be self-closing and equipped with fusible links.

(3) Floors in horizontal exits shall have a slope of not more than one foot in 6.

(4) All doors and windows within 10 feet of any balcony or bridge shall be fire-resistive doors or fire-resistive windows as specified in section Ind 51.047, except that if such doors or windows are in the same plane, this requirement shall apply only to those within 5 feet of the balcony or bridge.

(5) The floor on each side of a horizontal exit and all passageways leading thereto shall be kept clear and unobstructed at all times.

History: 1-2-56; am. (2) and (4), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.20 Fire escapes. (1) **LOCATION.** Every fire escape shall be so located as to lead directly to a street, alley, or open court connected with a street.

(a) Every fire escape shall be placed against a blank wall if possible. If such a location is not possible then every wall opening which is less than 6 feet distant horizontally from any tread or platform of the fire escape shall be protected by a fire-resistive door or by a fire-resistive window as specified in section Ind 51.047.

(2) **EXITS TO FIRE ESCAPES.** Every fire escape shall be accessible from a public passageway or shall be directly accessible from each occupied room. Exits to fire escapes shall be standard exit doors as specified in section Ind 51.15, except that doors to "A" fire escapes may be not less than 2 feet 6 inches wide.

(3) **DESIGN AND FABRICATION.** Each part of every fire escape (except counterweights for balanced stairways) shall be designed and constructed to carry a live load of 100 pounds per square foot of horizontal area over the entire fire escape. Each part of every fire escape shall be designed and constructed in accordance with the requirements of section Ind 53.16, except that the unit stresses therein specified shall be reduced by one-fourth. The minimum sections and sizes specified below shall be increased whenever necessary so that under full load the allowable unit stresses will not be exceeded.

(a) No other material than wrought iron, soft steel or medium steel shall be used for any part of a fire escape, except for weights, separators and ornaments. No bar material less than $\frac{1}{4}$ inch thick shall be used in the construction of any fire escape, except for separators, ornaments, structural shapes over 3 inches and rigidly built up treads and platforms of approved design. In the fabrication of a fire escape, all connections or joints shall be made by riveting, bolting or welding in an approved manner. All bolts or rivets, except for ornamental work, shall be not less than $\frac{3}{8}$ inch in diameter.

(4) **PLATFORMS.** Each platform on an "A" fire escape shall be at least 28 inches wide; each platform on a "B" fire escape shall be at least 3 feet 4 inches wide. Such widths shall be the clear distance between stringers, measuring at the narrowest point. Each platform shall extend at least 4 inches beyond the jambs of exit opening. The above minimum widths and lengths shall be increased, wherever necessary, so that no exit door or window will, when open, block any part

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2. By elevator or such other arrangements as may be reasonably appropriate under the circumstances and which meets with the approval of the department of industry, labor and human relations or in lieu thereof with the approval of the municipality wherein the building is located.

3. Doors having a clear opening of at least 40 inches in width and shall otherwise conform to the department of industry, labor and human relations building code.

(c) If any ground or street level entrance or exit is not so designed or constructed a sign shall be placed at such entrance or exit indicating the location of the entrance or exit available for wheel chair service.

(d) Where requirements of section Ind 51.15 (7) (a) apply, there shall be reasonable means of access from a parking lot, if any, ancillary to such buildings and reasonable means of ingress and egress to at least one floor on which the primary business of such building is located.

(e) The ramp shall be at least 4 feet in width of which not more than 4 inches on each side may be occupied by a handrail.

(f) All ramps shall have a handrail on each side.

1. Handrail shall be not less than 2 feet 6 inches in height with an intermediate rail at mid height.

(g) The floor on the inside and outside of each ramp doorway shall be level for a distance of 6 feet from the door.

(h) Every ramp shall have at least 6 feet of level clearance at the bottom.

(i) All ramps shall have a level platform at 30 feet intervals and shall have a level platform at least 6 feet in length wherever they turn.

(j) The requirements of section Ind 51.15 (7) (a) through (i) shall apply to buildings presently exempt or existing should there be a change in occupancy of such building to that of a place of employment or public building not otherwise exempt after July 1, 1970.

Note: See section Ind 52.59 for further requirements.

History: 1-2-56; am. Register, December, 1962, No. 84, eff. 1-1-63; am. (5) and cr. (7), Register, November, 1963, No. 95, eff. 12-1-63; r. and recr., Register, October, 1967, No. 142, eff. 11-1-67; am. (7) (J), Register, May, 1968, No. 149, eff. 6-1-68; r. and recr. (7), Register, December, 1970, No. 180, eff. 1-1-71; r. and recr. (3), Register, February, 1971, No. 182, eff. 3-1-71.

Ind 51.16 Stairways and elevated platforms. (1) **DEFINITION.** By a stairway is meant one or more flights of steps and the necessary platforms connecting them to form a continuous passage from one level to another within a building or structure, except as provided in subsection (3) (b).

(2) **WIDTH.** Every required exit stairway, whether enclosed or not, shall be not less than 3 feet 8 inches wide of which not more than 4 inches on each side may be occupied by a handrail. Every platform shall be at least as wide as the stairway, measuring at right angles to the direction of travel. Every straight run platform shall measure at least 3 feet in the direction of travel. Wherever a door opens onto a stairway, a platform shall be provided extending at least the full width of the door in the direction of travel. *Exception:*

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(a) In apartment buildings not more than 2 stories in height and having not more than 2 apartments on a floor and in rooming houses, hospitals, hotels and similar buildings not more than 2 stories in height and having not more than 6 living or sleeping rooms on a floor, such stairways shall not be less than 3 feet wide.

(b) If other stairways are provided in addition to those required by this code, such additional stairways need not conform to the width requirements of this code.

(3) **HANDRAILS.** All stairways and steps of more than 3 risers shall have at least one handrail. Stairways and steps 5 feet or more in width, or open on both sides, shall have a handrail on each side. Stairways and steps which are less than 5 feet in width shall have a handrail on the left hand side as one mounts the stairs and on the open side, if any.

(a) Stairways which are more than 8 feet wide shall be divided by center rails into widths not more than 8 feet nor less than 3 feet 8 inches. Rails shall be not less than 2 feet 6 inches above the nose of the treads or 3 feet 6 inches above the platform except as specified in Wis. Adm. Code section Ind 51.20. Railings on the open sides of stairways and platforms shall be provided with an intermediate member at midheight or with vertical members having a maximum spacing of 11 inches, or its equivalent in safety.

(b) Stairways on the outside of buildings and an integral part thereof, having more than 3 risers, shall have a handrail at each side, and if the stairway is more than 50 feet wide, one or more intermediate handrails shall be provided.

(c) Where an exit door leads to an outside stairway, platform or sidewalk, the level of the platform or sidewalk shall not be more than 7¼ inches below the door sill except as provided in section Ind 51.20 (4) (g).

(4) **RISERS AND TREADS.** All stairways and steps required as exits by this code shall have a uniform rise of not more than 7¼ inches and a uniform tread of not less than 9½ inches, measuring from tread to tread, and from riser to riser. No winders shall be used. There shall not be more than 18, nor less than 3 risers between platforms or between floor and platform and not more than 22 risers from floor to floor with no platform.

(a) Stairways and steps not required as exits by this code shall have a uniform rise of not more than 8 inches and a uniform tread of not less than 9 inches. If winders are used, the tread shall be at least 7 inches wide at a point one foot from the narrow end.

(b) The edges of all treads and the edges of all stairway landings shall be finished with a non-slippery surface not less than 3 inches in width.

(5) **ELEVATED PLATFORMS.** Elevated platforms, walks and runways not otherwise mentioned, which are an integral part of a building or structure, shall have railings as required by this section.

of the required width of the fire escape. Every platform shall consist of either,

(a) Flat bars on edge, not less than 1 x ¼ inch, but not less than 1¼ x ¼ inch where bolts and separators are used except that platforms and treads constructed of flat bars on edge may be made of material ⅜ inch in thickness provided the material is galvanized after fabrication. Bars shall not be spaced more than 1¼ inches, center to center.

(b) ½ inch or ⅝ inch square bars with sharp edge up, not more than 1½ inches, center to center.

(c) ⅝ inch round bars, not more than 1½ inches, center to center.

(d) Platform and treads may be solid if covered by a roof.

(e) The platform frame shall consist of not less than 2 x ⅝ inch flat bars on edge or equivalent, provided the brackets are not more than 4 feet apart. If brackets are more than 4 feet apart, the frame shall be correspondingly stronger and stiffer. Every platform wider than 30 inches, if made of square or round bars, shall have a third frame bar through the center; if made of flat bars, the platform shall have separators and bolts through the center. Frame bars shall not project more than ¼ inch above platform bars, except around the outside of platform.

(f) There shall be a platform at each story above the first, and intermediate platforms if floors are more than 18 feet apart vertically.

(g) Platforms shall not be more than 8 inches below the door sill.

(5) BRACKETS. Brackets for a 28 inch or 30 inch platform, when spaced not more than 4 feet apart, shall be made of not less than ⅝ inch square bars or 1½ x 1½ x ¼ inch angles; such bars or angles shall be larger if the platform is wider or if the brackets are farther apart. Each bracket shall be fastened at the top to the wall by a through bolt (at least ⅝ inch diameter), nut, and washer (at least 4 inch diameter). The slope of the lower bracket bar shall be not less than 30 degrees with the horizontal. The lower bar shall have a washer or shoulder to give sufficient bearing against the wall.

(a) The strength of the wall to which brackets are to be attached shall be carefully considered in determining the spacing, shape and inside connection of brackets, so that under full load the wall will not be unduly strained. Where it is necessary to install brackets adjacent to wall openings they shall be located at a suitable distance therefrom, or the wall shall be properly reinforced.

(6) STAIRWAYS. (a) Each stairway of an "A" fire escape shall be at least 24 inches wide between stringers; such stairway shall have a uniform rise of not more than 8 inches and a uniform run of not less than 8 inches.

(b) Each stairway of a "B" fire escape shall be at least 3 feet 4 inches wide between stringers; such stairway shall have a uniform rise of not more than 8 inches, and a uniform run of not less than 9 inches.

1. The rise is the vertical distance from the extreme edge of any step to the corresponding extreme edge of the next step. The run is the horizontal distance between the same points.

(c) Stairway stringers shall consist of either:

1. A 5 inch channel or larger.

2. Two angles 2 x 2 x $\frac{1}{4}$ inch or larger.
3. Two flat bars 2 x $\frac{3}{8}$ inch or larger.
4. One flat bar 6 x $\frac{1}{4}$ inch or larger.
5. If 2 angles or 2 flat bars are used, they shall be properly tied together by lattice bars, vertical as well as horizontal. If flat bars are used, every stairway of more than 10 risers shall have lateral bracing. The connection of stringers to platform, at top and bottom, shall be at least equal in strength to the stringers and shall safely carry the full live and dead loads. If stringers are carried by intermediate brackets, the stringers shall have a horizontal bearing on the brackets and shall be properly and securely connected thereto.
6. Treads shall consist of either flat or square bars, (not round), of the size and spacing specified for platforms. An "A" tread shall consist of at least 6 square bars, or 7 flat bars. A "B" tread shall consist of at least 7 square bars, or 8 flat bars. A "B" tread made of flat bars shall have separators and bolt through the center. A "B" tread made of square bars shall be trussed.
7. Treads and platforms may be solid if covered by a roof.

(7) **BALANCED STAIRWAY.** All "B" fire escapes, and all fire escapes on schools, theaters, assembly halls, hospitals, nursing homes, residential care institutions, group foster homes, and homes for the elderly either shall reach to the ground or shall have a balanced stairway reaching to the ground. "A" fire escapes which are not on schools, theaters, assembly halls, hospitals, nursing homes, residential care institutions, group foster homes and homes for the elderly may terminate in a platform at least 3 feet long, located not more than 10 feet above the ground and does not serve more than 8 persons.

(8) **RAILINGS.** A railing at least 42 inches in height and having 2 intermediate rails, uniformly spaced, measuring vertically from the floor of the platform, shall be provided on all open sides of platforms. Railings at least 36 inches in height, measuring vertically from the nose of the treads, shall be provided on the open sides of all stairways and on both sides of balanced stairways. Either a railing or a hand-rail fastened to the wall shall be provided on each side of all "B" fire escape stairways.

(a) Every railing shall have posts, not more than 5 feet apart made of not less than $1\frac{1}{2}$ x $1\frac{1}{2}$ x $\frac{1}{4}$ inch angles or tees, or $1\frac{1}{4}$ inch pipe; top rail not less than $1\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{1}{4}$ inch angle or equivalent; center rail not less than $1\frac{1}{4}$ x $\frac{1}{4}$ flat bar or equivalent. All connections shall be such as to make the railing stiff; 2 bolts ($\frac{3}{8}$ inch or larger) shall be used at the foot of each post wherever possible, or at least one $\frac{1}{2}$ inch bolt shall be used. Railing shall be continuous. No projections on the inside of the railing shall be permitted. Where a railing returns to the wall, it shall be fastened thereto with a through bolt (at least $\frac{3}{8}$ inch diameter), nut, and washer; or (in reinforced concrete) with an approved insert; or the railing shall be made equally secure with a diagonal brace extending at least 3 feet horizontally and 3 feet vertically.

(b) All outside railings which are more than 60 feet above grade shall be at least 6 feet high, measuring vertically from floor of platform or from nose of step. Such railings shall be of special design approved by the department of industry, labor and human relations,

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having not less than 4 longitudinal rails, and vertical lattice bars not more than 8 inches apart, and proper stiffening braces or brackets.

(9) **LADDER TO ROOF.** Every fire escape which extends higher than the second floor shall be provided with a ladder leading from the upper platform to the roof, unless the fire escape stairway leads to the roof. The ladder shall have stringers not less than 1½ inch pipe, or not less than 2 x ¾ inch flat bars, at least 17 inches apart in the clear. The rungs shall be not less than ½ inch square or ¾ inch round bars, 14 inches center to center. The stringers shall be securely tied together at intervals no greater than every fifth rung. The stringers of each ladder shall extend not less than 4 feet above the roof coping and return to within 2 feet of the roof, with the top rung of the ladder level with the coping.

(10) **OTHER TYPES OF FIRE ESCAPES.** Sliding or chute fire escapes may be used, upon the approval of the department of industry, labor and human relations, in place of "A" or "B" fire escapes. Every sliding fire escape shall be provided with a ladder constructed as in subsection Ind 51.20 (9), extending from 5 feet above grade, to 4 feet above the roof coping.

History: 1-2-56; am. Register, December, 1962, No. 84, eff. 1-1-63; am. (1) (a), Register, February, 1971, No. 182, eff. 7-1-71; am. (7), Register, February, 1971, No. 182, eff. 3-1-71.

Ind 51.21 Standpipes. (1) **CLASSES OF SERVICE.** Standpipe systems are designed for 2 classes of service: (a) for use by fire departments or others trained in handling heavy streams from 2½ inch hose, and (b) for use by occupants of a building on incipient fires. These are referred to in these sections as fire departments, and first aid standpipes, respectively. The features of each system may be combined in a single equipment, if served by an automatic water supply conforming to subsection (2) (g) or (h). All threads on hose and hose connections shall be interchangeable with those of the public fire department.

(2) **FIRE DEPARTMENT STANDPIPES.** (a) Standpipes shall be provided for all buildings exceeding 60 feet in height. Required standpipes shall be installed as construction progresses, to make them available to the fire department in the topmost floor constructed.

(b) Standpipes shall be sufficient in number so that any part of every floor area can be reached within 30 feet by a nozzle attached to 100 feet of hose connected to the standpipe. When 2 or more standpipes are required, they shall be cross connected at the bottom, and equipped with individual controlling valves located not higher than the first story.

(c) Standpipes shall be protected against mechanical and fire damage, with outlets in stairway enclosures; where stairways are not enclosed, outlets shall be at inside or outside of outside walls, within one foot of a fire tower, interior stairway or fire escape. Dry standpipes shall be accessible for inspection and not concealed.

(d) No required standpipe shall be less than 4 inches in diameter, and not less than 6 inches in diameter for buildings exceeding 75 feet in height. Material shall be steel or wrought iron pipe with approved fittings, designed for a working pressure of 100 pounds in

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excess of the static pressure due to elevation. An approved 2½ inch hose valve shall be located at each story, not over 5 feet above the floor level. An approved pressure reducing device shall be installed at hose valves where the pressure would otherwise be in excess of 50 pounds. Where a standpipe is not normally under pressure, hose valves shall be equipped with a tight fitting cap on a chain and having lugs for a spanner wrench.

(e) An approved siamese connection with a check valve in each inlet shall be installed on a 4 inch pipe connecting with each standpipe system and shall be marked "To Standpipe". The elevation of the connection shall be not over 3 feet above the sidewalk or ground. An automatic drip valve shall be installed where necessary to prevent freezing. In buildings with several standpipes, more than one siamese connection may be required.

(f) Fire department standpipes need not be equipped with attached hose.

(g) Automatic water supplies will not ordinarily be required, except as provided in subsection (2) (h), or where judged necessary by reason of the high combustibility or potential hazard of the occupancy. When required, they shall be designed to provide not less than 40 pounds flowing pressure at the top outlet, with volume for two fire streams. Any of the following supplies will be acceptable:

1. Connection to city water works system when providing required minimum volume and pressure.

2. Gravity tank of not less than 3,500 gallons capacity, elevated 50 feet above the top story.

3. Pressure tank of 5,250 gallons gross capacity (3,500 gallons water capacity).

4. Automatic pump or pumps, with combined effective capacity of 500 gallons per minute.

(h) An automatic water supply from an approved fire pump shall be provided in buildings over 150 feet high, or in buildings over 10,000 square feet in area per floor and requiring a standpipe. The capacity of the pump shall be not less than 500 gallons per minute for a 4 inch standpipe, 750 gallons per minute for 2 interconnected 4 inch or single 6 inch standpipes, and 1,000 gallons per minute for larger systems.

(3) **FIRST AID STANDPIPES.** (a) Standpipes shall be provided as required in sections Ind 54.14, 55.33, and 57.21.

(b) Standpipes shall be sufficient in number so that any part of every floor area can be reached within 20 feet by a nozzle attached to not more than 75 feet of hose connected to a standpipe.

Note: Standpipe outlets should be located in occupied areas, and usually at interior columns in large area buildings. Asylums and places of detention may require special arrangements. It should be possible in all cases to direct the stream into all important enclosures, such as closets, etc.

(c) No required standpipe shall be less than 2 inches in diameter, and not less than 2½ inches in diameter for buildings 5 stories or more in height. Material shall be wrought iron or steel and pipe and fittings shall be of suitable weight for the pressure used. An approved 1½ inch hose valve shall be located in each story, not more than 5 feet above the floor level; valves of the gate type shall be

equipped with a suitable open drip connection. An approved pressure-reducing device shall be installed at hose valves where pressure would otherwise be over 50 pounds.

(d) Not more than 75 feet of hose shall be attached to each outlet. Hose shall be of unlined linen construction, 1½ inches in diameter, with a ½ inch nozzle attached, and shall be located in approved cabinets or racks.

(e) Water supply shall be automatic, and be designed for 70 gallons per minute for 30 minutes with 25 pounds flowing pressure at the top outlet. Such supply may be from city connection, gravity tank, pressure tank or pump.

Note: Data on the design of standpipe systems can be found in the Standards of the National Board of Fire Underwriters for the Installation of Standpipe and Hose Systems. The department of industry, labor and human relations will ordinarily approve any installation which is approved by the Underwriters.

Ind 51.22 Fire extinguishers. (1) Where fire extinguishers are required, they shall be of a type approved by the department of industry, labor and human relations. All fire extinguishers shall be charged in accordance with the instructions of the manufacturer.

(2) Extinguishers shall be conspicuously located where they will always be readily accessible and so distributed as to be immediately available in event of fire. They shall be hung on hangers or set on brackets or shelves so that the top of the extinguisher is not more than 5 feet above the floor.

Note: The department of industry, labor and human relations will ordinarily approve any extinguisher which bears the Underwriters' label and which is of the size, and suitable, for the hazard for which it is intended. Consult the department of industry, labor and human relations for lists of approved extinguishers.

Ind 51.23 Automatic sprinklers. (1) Required automatic sprinkler systems shall be designed and constructed in conformity with good established practice. Only materials and devices approved by the department of industry, labor and human relations may be used. Reinstallation of used sprinkler heads is prohibited, and other second-hand devices may be installed by special permission only.

(2) Where an automatic sprinkler system is required throughout a building, supply shall be from a city water main, or from a gravity or pressure tank. If the city water supply is inadequate in either pressure or volume, a tank of not less than 5,000 gallons capacity shall be provided. The bottom of a gravity tank shall be not less than 35 feet above the under side of the roof.

(3) Where automatic sprinklers are required in a basement only, the supply shall be from a city water main. Where there is no city water supply, such basement sprinklers need not be installed; but at such time as a city supply becomes available, such required basement sprinklers shall be installed.

(4) Every basement sprinkler system shall also include sprinklers in all shafts (except elevator shafts) leading to the story above.

(5) Every sprinkler system shall have a suitable audible alarm and an approved siamese connection marked "To Automatic Sprinklers", and otherwise conforming to section Ind 51.21 (2) (e).

Note: It will be the policy of the department of industry, labor and human relations to approve equipment conforming to standards of the National

Board of Fire Underwriters for Sprinkler Equipment, also materials and devices currently listed by the Underwriters' Laboratories. The commission reserves the right to order a sprinkler system in any building, regardless of height or number of persons, if the occupancy is especially hazardous.

Ind 51.24 Fire alarm systems. Interior fire alarm systems required under Wis. Adm. Code sections Ind 54.16, 56.19 and 57.22 shall be designed and constructed in conformity with the following requirements:

(1) All such alarm systems shall consist of operating stations on each floor of the building, including the basement, with bells, horns, or other approved sounding devices which are effective throughout the building. The system shall be so arranged that the operation of any one station will actuate all alarm devices connected to the system except in the case of a presignal system. Fire alarms shall be readily distinguishable from any other signalling devices used in the building. A system designed for fire alarm and paging service may be used if the design is such that fire alarm signals will have precedence over all others.

(2) Every fire alarm system shall be electrically operated or activated by non-combustible, non-toxic gas except as provided in section Ind 56.19. Electrically operated systems shall be operated on closed circuit current under constant electrical supervision, so arranged that upon a circuit opening and remaining open or in case of a ground or short circuit in the undergrounded conductor, audible trouble signals will be given instantly. Gas activated systems shall be mechanically supervised and under constant gas pressure, so arranged that in case of a pressure drop an audible trouble signal will be given instantly. Means shall be provided for testing purposes.

(3) In buildings more than 3 stories in height, coded fire alarm systems shall be provided, and the systems shall be so arranged that the code transmitted shall indicate the location and the story of the structure in which the signal originated.

Exception: (a) In apartment buildings, non-coded continuous sounding fire alarm systems under constant electrical or gas activated supervision will be approved.

(4) Operating stations shall be prominently located in an accessible position at all required exit doors and required exit stairways. Operating stations shall be of an approved type and shall be conspicuously identified. All such operating stations shall be of a type, which after being operated, will indicate that an alarm has been sent therefrom until reset by an authorized means. (Operating stations having a "Break Glass" panel will be acceptable. On coded systems having a device to permanently record the transmission of an alarm, "Open Door" type stations may be used). The fire alarm operating stations shall be mounted not less than 4 feet nor more than 5 feet above the finished floor as measured from the floor to the center of the box.

(5) All such alarm systems shall be tested at least once a week and a record of such tests shall be kept.

(6) Existing fire alarm systems that are effective in operation will be accepted if approved by the department of industry, labor and human relations.

(7) The gas for operation of non-combustible, non-toxic gas activated fire alarm systems shall be supplied from approved pressure cylinders on the premises. The cylinders shall have sufficient capacity and pressure to properly operate all sounding devices connected to the system for a period of not less than 10 minutes. Cylinders shall be removed for recharging immediately after use and shall be replaced by fully charged cylinders.

(8) Spare cylinders shall be kept on the premises at all times for immediate replacement and separate cylinders for testing shall be incorporated in the system.

(9) Tubing in connection with non-combustible, non-toxic gas activated fire alarm systems shall be installed in rigid metal conduit, flexible metal conduit, or surface metal raceways where subject to mechanical injury. Non-corrosive metallic tubing not less than 3/16" in diameter which will withstand a bursting pressure of not less than 500 pounds per square inch shall be used. The maximum length of 3/16" tubing shall not exceed 300 feet between charged cylinders. All tubing and other component parts shall be installed by skilled workmen in accordance with the provisions of this code.

Note: The following sections are taken from the Wisconsin Administrative Electrical Code.

(10) The energy for the operation of electrical fire alarm systems shall be taken from sources suited to the design of the system. Batteries on systems of less than 110 volts shall not be used.

(11) A 3-wire 120-240 volt or 120-208 volt (3 phase 4 wire) service will be accepted for supervised systems provided the operating current is secured from one ungrounded conductor and the neutral, or ungrounded conductor, and the current for operating trouble signal or signals is secured from the other ungrounded conductor and the neutral or grounded conductor.

(12) Electrical wiring in connection with fire alarm systems shall be installed in rigid metal conduit, flexible metal conduit, electrical metallic tubing or surface metal raceways. Armored cable (metal) may be used where it can be fished in hollow spaces of walls or partitions in apartments or rooming houses not over 3 stories in height. Where the wiring is subject to excessive moisture or severe mechanical injury, rigid metal conduit shall be used. The smallest size conductor to be used in any fire alarm system in a building over 3 stories in height shall be No. 14 AWG or No. 16 AWG for buildings not over 3 stories in height. The wires shall be provided with insulation suitable for use on circuits not exceeding 600 volts. Fire alarm systems shall be connected to the line inside of the main service switch or to the emergency feeder through 2 single pole breakers or switches used for no other purpose and arranged so they can be locked in the "on" position, and under the supervision of a qualified person. The breaker or switches shall be identified by a red color. Two pole breakers shall not be used.

History: 1-2-56; am. (4) (a), Register, November, 1963, No. 95, eff. 12-1-63; am. Register, August, 1964, No. 104, eff. 9-1-64.

Ind 51.25 Specifications cited in this code. The specifications of the American Society for Testing and Materials referred to in this code are listed below.

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- (1) CLAY BUILDING BRICK. (Solid masonry units made from clay or shale.) Part 12 ASTM Designation C 62-66.
- (2) SAND-LIME BUILDING BRICK. Part 12 ASTM Designation C 73-51 (1965).
- (3) CONCRETE BUILDING BRICK. Part 12 ASTM Designation C 55-66T.
- (4) SAMPLING AND TESTING BRICK. Part 12 ASTM Designation C 67-66.
- (5) STRUCTURAL CLAY LOAD-BEARING WALL TILE. Part 12 ASTM C 34-62.
- (6) SAMPLING AND TESTING STRUCTURAL CLAY TILE. Part 12 ASTM C 112-60.
- (7) SAMPLING AND TESTING CONCRETE MASONRY UNITS. Part 12 ASTM Designation C 140-65T.
- (8) STRUCTURAL CLAY NON-LOAD-BEARING TILE. Part 12 ASTM Designation C 56-62.
- (9) STRUCTURAL CLAY FLOOR TILE. Part 12 ASTM Designation C 57-57 (1965).
- (10) PORTLAND CEMENT. Part 10 ASTM Designation C 150-66.
- (11) AIR-ENTRAINING PORTLAND CEMENT. Part 10 ASTM Designation C 175-66.
- (12) PORTLAND BLAST-FURNACE SLAG CEMENT. Part 10 ASTM Designation C 205-64T.
- (13) MASONRY CEMENT. Part 9 ASTM Designation C 91-66.
- (14) QUICKLIME FOR STRUCTURAL PURPOSES. Part 9 ASTM Designation C 5-59.
- (15) HYDRATED LIME FOR MASONRY PURPOSES. Part 9 ASTM Designation C 207-49 (1961).
- (16) AGGREGATE FOR MASONRY MORTAR. Part 10 ASTM Designation C 144-66T.
- (17) AGGREGATES FOR MASONRY GROUT. Part 10 ASTM Designation C 404-61.
- (18) PORTLAND-POZZOLAN CEMENT. Part 9 ASTM Designation C 340-66T.
- (19) CONCRETE AGGREGATES. Part 10 ASTM Designation C 33-66.
- (20) LIGHTWEIGHT AGGREGATES FOR STRUCTURAL CONCRETE. Part 10 ASTM Designation C 330-64T.
- (21) BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A15-66.
- (22) RAIL-STEEL BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 16-66.

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- (23) DEFORMED RAIL STEEL BARS FOR CONCRETE REINFORCEMENT WITH 60,000 P.S.I. MINIMUM YIELD STRENGTH. Part 4 ASTM Designation A 61-66.
- (24) AXLE-STEEL BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 160-66.
- (25) SPECIAL LARGE SIZE DEFORMED BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 408-66.
- (26) HIGH-STRENGTH DEFORMED BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT WITH 75,000 P.S.I. MINIMUM YIELD STRENGTH. Part 4 ASTM Designation A 431-66.
- (27) MINIMUM REQUIREMENTS FOR THE DEFORMATIONS OF DEFORMED STEEL BARS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 305-65.
- (28) BLEEDING OF CONCRETE. Part 10 ASTM Designation C 232-58 (1966).
- (29) FABRICATED STEEL BAR OR ROD MATS FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 184-65.
- (30) COLD-DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 82-66.
- (31) WELDED STEEL WIRE FABRIC FOR CONCRETE REINFORCEMENT. Part 4 ASTM Designation A 185-64.
- (32) UNCOATED SEVEN-WIRE STRESS-RELIEVED STRAND FOR PRESTRESSED CONCRETE. Part 4 ASTM Designation A 416-64.
- (33) UNCOATED STRESS-RELIEVED WIRE FOR PRESTRESSED CONCRETE. Part 4 ASTM Designation A 421-65.
- (34) STEEL FOR BRIDGES AND BUILDINGS. Part 4 ASTM Designation A 7-66.
- (35) STRUCTURAL STEEL. Part 4 ASTM Designation A 36-66.
- (36) FLEXURAL STRENGTH OF CONCRETE (using simple beam with third-point loading). Part 10 ASTM Designation C 78-64.
- (37) WELDED AND SEAMLESS STEEL PIPE. Part 1 ASTM Designation A 53-65.
- (38) CAST IRON AND DUCTILE IRON PRESSURE PIPE. Part 2 ASTM Designation A 377-66.
- (39) AIR-ENTRAINING ADMIXTURES FOR CONCRETE. Part 10 ASTM Designation C 260-66T.
- (40) CHEMICAL ADMIXTURES FOR CONCRETE. Part 10 ASTM Designation C 494-65T.
- (41) FLY ASH FOR USE AS AN ADMIXTURE IN PORTLAND CEMENT CONCRETE. Part 10 ASTM Designation C 350-65T.
- (42) RAW OR CALCINED NATURAL POZZOLANS FOR USE AS ADMIXTURES IN PORTLAND CEMENT CONCRETE. Part 10 ASTM Designation C 402-65T.

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- (43) METHODS AND DEFINITIONS FOR MECHANICAL TESTING OF STEEL PRODUCTS. Part 4 ASTM Designation A 370-65.
- (44) DEFORMED BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT WITH 60,000 P.S.I. MINIMUM YIELD STRENGTH. Part 4 ASTM Designation A 432-66.
- (45) MAKING AND CURING CONCRETE COMPRESSION AND FLEXURE TEST SPECIMENS IN THE FIELD. Part 10 ASTM Designation C 81-66.
- (46) COMPRESSIVE STRENGTH OF MOLDED CONCRETE CYLINDERS. Part 10 ASTM Designation C 39-66.
- (47) OBTAINING AND TESTING DRILLED CORES AND SAWED BEAMS OF CONCRETE. Part 10 ASTM Designation C 42-64.
- (48) READY-MIXED CONCRETE. Part 10 ASTM Designation C 94-65.
- (49) SAMPLING FRESH CONCRETE. Part 10 ASTM Designation C 172-54.
- (50) MAKING AND CURING CONCRETE COMPRESSION AND FLEXURE TEST SPECIMENS IN THE LABORATORY. Part 10 ASTM Designation C 192-66.
- (51) SPLITTING TENSILE STRENGTH OF MOLDED CONCRETE CYLINDERS. Part 10 ASTM Designation C 496-66.
- (52) METHODS OF MECHANICAL TESTINGS. Part 31 ASTM Designation E 6-66.
- (53) MILD STEEL COVERED ARC-WELDING ELECTRODES. Part 4 ASTM Designation A 233-64T.
- (54) RECOMMENDED PRACTICE FOR PROBABILITY SAMPLING OF MATERIALS. Part 30 ASTM Designation E 105-58.
- (55) CALCIUM CHLORIDE. Part 10 ASTM Designation D 98-59.
- (56) CHEMICAL ANALYSIS OF HYDRAULIC CEMENT. Part 9 ASTM Designation C 114-67.
- (57) FINENESS OF PORTLAND CEMENT BY THE TURBIDIMETER. Part 9 ASTM Designation C 115-58.
- (58) FINENESS OF PORTLAND CEMENT BY AIR PERMEABILITY APPARATUS. Part 9 ASTM Designation C 204-55.
- (59) COMPRESSIVE STRENGTH OF HYDRAULIC CEMENT MORTARS (using 2-in. cube specimens). Part 9 ASTM Designation C 109-64.
- (60) AUTOCLAVE EXPANSION OF PORTLAND CEMENT. Part 9 ASTM Designation C 151-66.
- (61) SPECIFIC GRAVITY OF HYDRAULIC CEMENT. Part 9 ASTM Designation C 188-44 (1958).
- (62) RESISTANCE TO ABRASION OF SMALL SIZE COARSE AGGREGATE BY USE OF THE LOS ANGELES MACHINE. Part 10 ASTM Designation C 131-66.
- (63) MATERIALS FINER THAN NO. 200 SIEVE IN MINERAL AGGREGATES BY WASHING. Part 10 ASTM Designation C 117-66.

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- (64) FRIABLE PARTICLES IN AGGREGATES. Part 10 ASTM Designation C 142-66T.
- (65) LIGHTWEIGHT PIECES IN AGGREGATES. Part 10 ASTM Designation C 123-66.
- (66) ORGANIC IMPURITIES IN SANDS FOR CONCRETE. Part 10 ASTM Designation C 40-66.
- (67) SIEVE OR SCREEN ANALYSIS OF FINE AND COARSE AGGREGATES. Part 10 ASTM Designation C 136-63.
- (68) SOUNDNESS OF AGGREGATES BY USE OF SODIUM SULFATE OR MAGNESIUM SULFATE. Part 10 ASTM Designation C 88-63.
- (69) SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE. Part 10 ASTM Designation C 127-59.
- (70) SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE. Part 10 ASTM Designation C 128-59.
- (71) SURFACE MOISTURE IN FINE AGGREGATE. Part 10 ASTM Designation C 70-66.
- (72) UNIT WEIGHT OF AGGREGATE. Part 10 ASTM Designation C 29-60.
- (73) VOIDS IN AGGREGATE FOR CONCRETE. Part 10 ASTM Designation C 30-37 (1964).
- (74) EFFECT OF ORGANIC IMPURITIES IN FINE AGGREGATE ON STRENGTH OF MORTAR. Part 10 ASTM Designation C 87-63T.
- (75) PETROGRAPHIC EXAMINATION OF AGGREGATES FOR CONCRETE. Part 10 ASTM Designation C 295-65.
- (76) POTENTIAL REACTIVITY OF AGGREGATES (CHEMICAL METHOD). Part 10 ASTM Designation C 289-66.
- (77) POTENTIAL ALKALI REACTIVITY OF CEMENT-AGGREGATE COMBINATIONS (MORTAR BAR METHOD). Part 10 ASTM Designation C 227-65.
- (78) TERMS RELATING TO CONCRETE AND CONCRETE AGGREGATES. Part 10 ASTM Designation C 125-66.
- (79) WEIGHT PER CUBIC FOOT, YIELD, AND AIR CONTENT (GRAVIMETRIC) OF CONCRETE. Part 10 ASTM Designation C 138-63.
- (80) AIR CONTENT OF FRESHLY MIXED CONCRETE BY THE VOLUMETRIC METHOD. Part 10 ASTM Designation C 173-66.
- (81) AIR CONTENT OF FRESHLY MIXED CONCRETE BY PRESSURE METHOD. Part 10 ASTM Designation C 231-62.
- (82) SLUMP OF PORTLAND CEMENT CONCRETE. Part 10 ASTM Designation C 143-66.
- (83) FLOW OF PORTLAND CEMENT CONCRETE BY USE OF THE FLOW TABLE. Part 10 ASTM Designation C 124-39 (1966).
- (84) COMPRESSIVE STRENGTH OF CONCRETE USING PORTIONS OF BEAMS BROKEN IN FLEXURE. Part 10 ASTM Designation C 116-65T.

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(85) FUNDAMENTAL TRANSVERSE, LONGITUDINAL, AND TORSIONAL FREQUENCIES OF CONCRETE SPECIMENS. Part 10 ASTM Designation C 215-60.

(86) CEMENT CONTENT OF HARDENED PORTLAND CEMENT CONCRETE. Part 10 ASTM Designation C 85-66.

(87) LENGTH CHANGE OF CEMENT MORTAR AND CONCRETE. Part 10 ASTM Designation C 157-64T.

(88) SURFACE BURNING CHARACTERISTICS OF BUILDING MATERIALS. Part 14 ASTM Designation E 84-68.

(89) FIRE TESTS OF ROOF COVERINGS. Part 14 ASTM Designation E 108-70.

(90) FIRE TESTS OF BUILDING CONSTRUCTION AND MATERIALS. Part 14 ASTM Designation E 119-69.

(91) NONCOMBUSTIBILITY OF ELEMENTARY MATERIALS. Part 14 ASTM Designation E 136-65.

(92) FIRE TESTS OF DOOR ASSEMBLIES. Part 14 ASTM Designation E 152-66.

(93) FIRE TEST OF WINDOW ASSEMBLIES. Part 14 ASTM Designation E 163-65.

Note: The above standards may be obtained for personal use from American Society of Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103. They are available for inspection in the office of the department, the secretary of state and the revisor of statutes.

History: Cr. Register, October, 1967, No. 142, eff. 11-1-67; cr. (88), (89), (90), (91), (92), and (93), Register, February, 1971, No. 182, eff. 7-1-71.

Ind 51.26 Specifications cited in this code. The specifications of the American Concrete Institute referred to in this code are listed below.

(1) Building code requirements for reinforced concrete ACI 318-63.

(2) Minimum standard requirements for precast concrete floor and roof units ACI 512-67.

(3) Minimum requirements for thin-section precast concrete construction ACI 525-63.

Note: The above standards may be obtained for personal use from American Concrete Institute, 7400 Second Boulevard, Detroit, Michigan. They are available for inspection in the office of the department, the secretary of state and the revisor of statutes.

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