

ICC-ES Evaluation Report

ESR-1649

Reissued July 1, 2011

This report is subject to renewal in two years.

www.icc-es.org | (800) 423-6587 | (562) 699-0543

A Subsidiary of the International Code Council®

**DIVISION: 07 00 00—THERMAL AND MOISTURE
PROTECTION**
Section: 07 81 00—Applied Fireproofing
REPORT HOLDER:
**ISOLATEK INTERNATIONAL
41 FURNACE STREET
STANHOPE, NEW JERSEY 07874
(973) 347-1200**
www.cafco.com
rjagnandan@isolatek.com
EVALUATION SUBJECT:

CAFCO® BLAZE-SHIELD® TYPE II, CAFCO® BLAZE-SHIELD® TYPE DC/F, CAFCO® BLAZE-SHIELD® TYPE HP, CAFCO® TYPE 300, CAFCO® TYPE 300 ES, CAFCO® TYPE 300 SB, CAFCO® TYPE 400, AND FENDOLITE® M-II SPRAYED FIRE-RESISTIVE MATERIALS; CAFCO® FIBER-PATCH TYPE P AND FENDOLITE TG (TROWEL GRADE) HAND-APPLIED FIRE-RESISTIVE MATERIALS; CAFCO® BOND-SEAL AND CAFCO® PRE-COAT TYPE PC ADHESIVES; CAFCO® QWIK-SET FIRE-RESISTIVE MATERIAL ADDITIVE/ACCELERATOR

1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2009 and 2006 *International Building Code*® (IBC)
- 1997 *Uniform Building Code*™ (UBC)

Properties evaluated:

- Fire resistance
- Physical properties
- Durability

2.0 USES
2.1 CAFCO® BLAZE-SHIELD® Type II, CAFCO BLAZE-SHIELD Type DC/F, and CAFCO BLAZE-SHIELD Type HP Sprayed Fire-resistive Materials:

2.1.1 Fire-resistance-rated Assemblies: CAFCO® BLAZE-SHIELD® Type II, CAFCO BLAZE-SHIELD Type DC/F, and CAFCO BLAZE-SHIELD Type HP sprayed materials provide fire protection for structural steel columns and beams, steel roof and floor assemblies, steel trusses, concrete pan joists, and cold-formed steel stud walls and partitions that require a fire-resistance rating. These materials are limited to interior exposures.

2.1.2 Use in Ventilation Shafts, Plenums and Elevator Shafts: BLAZE-SHIELD Type II and BLAZE-SHIELD Type HP sprayed fire-resistive materials may be installed in areas of a building, such as ventilation shafts, plenums and elevator shafts, where the maximum velocity of the air stream is 1,250 feet per minute (381 m/min), provided the in-place dry density of the materials is verified to comply with Section 3.1 of this report.

2.2 CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 Sprayed Fire-resistive Materials:

2.2.1 Fire-resistance-rated Assemblies: CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 sprayed materials provide fire protection for interior structural steel columns and beams, steel roof and floor assemblies, and steel trusses that require a fire-resistance rating. These materials are limited to interior exposures.

2.2.2 Use in Ventilation Shafts, Plenums and Elevator Shafts: CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 sprayed fire-resistive materials may be installed in areas of a building, such as ventilation shafts, plenums and elevator shafts, where the maximum velocity of the air stream is 1,250 feet per minute (381 m/min), provided the in-place dry density of the materials is verified to comply with Section 3.3 of this report.

2.3 CAFCO® Fiber-Patch Type P Fire-resistive Material:

CAFCO FIBER-PATCH Type P is hand- or trowel-applied to patch damaged CAFCO BLAZE-SHIELD Type DC/F, BLAZE-SHIELD Type II, BLAZE-SHIELD Type HP, CAFCO 300, CAFCO 300 ES, CAFCO 300 SB, and CAFCO 400 sprayed fire-resistive materials.

2.4 Fendolite® Type M-II Sprayed Fire-resistive Material and Fendolite TG Trowel-applied Fire-resistive Material:

These materials provide fire protection for structural steel columns and beams, and steel roof and floor assemblies that require a fire-resistance rating. These materials may be used for interior and exterior (exposed to the weather) applications.

2.5 CAFCO BOND-SEAL:

CAFCO BOND-SEAL is used as an adhesive coat where specifically required in this report before application of CAFCO® BLAZE-SHIELD® Type II, CAFCO BLAZE-SHIELD Type DC/F, CAFCO BLAZE-SHIELD Type HP, CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB or CAFCO Type 400 fire-resistive materials.

2.6 CAFCO PRE-COAT Type PC:

CAFCO PRE-COAT Type PC is an adhesive that is used as an adhesive coat where specifically required in this report with cellular steel floor deck units before application of CAFCO 300, CAFCO Type 300 ES, CAFCO Type 300 SB or CAFCO Type 400 fire-resistive materials.

2.7 CAFCO Qwik-Set:

CAFCO Qwik-Set may be added to CAFCO Type 300, CAFCO Type 300 ES or CAFCO Type 300 SB fire-resistive materials as a field-application aid.

3.0 DESCRIPTION

3.1 CAFCO BLAZE-SHIELD:

CAFCO BLAZE-SHIELD Type DC/F, BLAZE-SHIELD Type II, and BLAZE-SHIELD Type HP fire-resistive materials are proprietary formulations of slag wool and inorganic binders containing silicates and calcium sulfates. The BLAZE-SHIELD fire-resistive materials are noncombustible when tested in accordance with ASTM E 136 (UBC Standard 2-1), and have a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E 84 (UBC Standard 8-1).

BLAZE-SHIELD Type DC/F fire-resistive materials must have minimum average and individual in-place, dry densities of 13 and 11 pcf (208 and 176 kg/m³), respectively, for the thicknesses specified in Tables 1 through 7 of this report for a given fire-resistance rating.

BLAZE-SHIELD Type II fire-resistive material must have minimum average and individual in-place, dry densities of 13 and 11 pcf (208 and 176 kg/m³), respectively, for the thicknesses specified in Tables 1 through 7 of this report for a given fire-resistance rating. When used in ventilation shafts, plenums and elevator shafts, BLAZE-SHIELD Type II fire-resistive material must have minimum average and individual in-place, dry densities of 16 and 13 pcf (256 and 208 kg/m³), respectively.

BLAZE-SHIELD Type HP material must have minimum average and individual in-place, dry densities of 22 and 19 pcf (352 and 304 kg/m³), respectively, for the thicknesses specified in Tables 1 through 7 of this report for a given fire-resistance rating. When used in ventilation shafts, plenums and elevator shafts, BLAZE-SHIELD Type HP material must have minimum average and individual in-place, dry densities of 22 and 19 pcf (352 and 304 kg/m³), respectively.

CAFCO BLAZE-SHIELD Type DC/F, BLAZE-SHIELD Type II, and BLAZE-SHIELD Type HP fire-resistive materials are packaged in 55-pound (25 kg) bags. The shelf life of unopened bags of the material is six months provided the bags are stored on pallets (above ground or floor) in a dry location.

3.2 CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400:

CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 fire-resistive materials are proprietary formulations of inorganic aggregate and binders containing silicates, calcium sulfates and aluminates. The materials have a flame-spread index less than 25 and smoke-developed index less than 450 when tested in accordance with ASTM E 84 (UBC Standard 8-1) or UL723.

CAFCO Type 300, CAFCO Type 300 ES and CAFCO Type 300 SB materials must have minimum average and individual in-place, dry densities of 15.0 and 14.0 pcf (240 and 224 kg/m³), respectively, for the thicknesses

specified in Tables 8 through 12 of this report, with the exception of cellular deck in Table 9, for a given fire-resistance rating. Cellular deck in Table 9 requires minimum average and individual in-place densities of 17.5 and 16.0 pcf (280 and 256 kg/m³), respectively. When used in ventilation shafts, plenums and elevator shafts, CAFCO Type 300, CAFCO Type 300 ES and CAFCO Type 300 SB materials must have minimum average and individual in-place, dry densities of 15.0 and 14.0 pcf (240 and 224 kg/m³), respectively.

CAFCO Type 400 must have minimum average and individual in-place dry densities of 22.0 and 19.0 pcf (352 and 304 kg/m³), respectively, for the thicknesses specified in Tables 8 through 12 of this report for a given fire-resistance rating. When used in ventilation shafts, plenums, and elevator shafts, CAFCO Type 400 material must have minimum average and individual in-place dry densities of 22.0 and 19.0 pcf (352 and 304 kg/m³), respectively.

CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 fire-resistive materials are dry-blended products packaged in 55-pound (25-kg) bags. The shelf life of unopened bags is ten months, provided the bags are stored on pallets (above ground or floor) in a dry location.

3.3 CAFCO FIBER-PATCH Type P:

The material, consisting of a proprietary formulation of slag wool and inorganic binders containing silicates and calcium sulfates, is noncombustible when tested in accordance with ASTM E 136 (UBC Standard 2-1), and has a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E 84 (UBC Standard 8-1) or UL723. CAFCO FIBER-PATCH Type P material must have a minimum individual in-place, dry density of 17.5 pcf (280 kg/m³).

CAFCO FIBER-PATCH Type P material is packaged in 25-pound (11.3-kg) bags. The shelf life of unopened bags of the material is six months provided the bags are stored on pallets (above ground or floor) in a dry location.

3.4 Fendolite® Type M-II:

Fendolite Type M-II fire-resistive material is a proprietary formulation of portland cement and vermiculite aggregate containing calcium silicates, calcium aluminates, and aluminosilicates. The material is noncombustible when tested in accordance with ASTM E 136 (UBC Standard 2-1), and has a flame-spread index less than 25 and smoke-developed index less than 450 when tested in accordance with ASTM E 84 (UBC Standard 8-1) or UL723.

Fendolite Type M-II must have minimum average and individual dry in-place densities of 44 and 40 pcf (704 and 640 kg/m²), respectively, for the thicknesses specified in Tables 13 through 17 of this report for a given fire-resistance rating.

Fendolite Type M-II fire-resistive material is packaged in 50-pound (22.7-kg) bags. The shelf life of unopened bags of the material is 24 months, provided the bags are stored on pallets (above ground or floor) in a dry location.

3.5 CAFCO BOND-SEAL:

CAFCO BOND-SEAL is a polyvinyl acetate copolymer adhesive that is an off-white liquid, packaged in 5-gallon (19 L) containers. The shelf life of unopened containers is eight months, provided they are stored on pallets (above ground or floor) in a dry location where the temperature stays above 32°F (0°C).

3.6 CAFCO PRE-COAT Type PC:

CAFCO PRE-COAT Type PC is a grey, dry, blended fibrous powder packaged in 50-pound (22.7 kg) bags. Unopened bags of the material have a shelf life of ten months when stored on pallets (above ground or floor) in a dry location where the temperature stays above 32°F (0°C).

3.7 CAFCO Qwik-Set:

CAFCO Qwik-Set is a water-soluble, off-white, inorganic-acid-salt powder that is packaged in 50-pound (22.7 kg) bags. The shelf life of unopened bags of the material is ten months, provided they are stored on pallets (above ground or floor) in a dry location.

4.0 DESIGN, INSTALLATION, APPLICATION, AND SPECIAL INSPECTION

4.1 Design:

4.1.1 CAFCO BLAZE-SHIELD: The minimum average thicknesses of CAFCO BLAZE-SHIELD Type DC/F, BLAZE-SHIELD Type II, and BLAZE-SHIELD Type HP fire-resistive materials for each hourly fire-resistance rating are shown in Table 1 for steel columns, Table 2 for steel decks and beams of (protected) floor assemblies, Table 3 for steel beams of (unprotected) floor assemblies, Table 4 for concrete floor systems, Table 5 for steel decks and beams of (protected) roof assemblies, Table 6 for steel beams of (unprotected) roof assemblies, and Table 7 for wall assemblies.

The thickness of the fire-resistive material applied to a truss element that can be simultaneously exposed to fire on all sides must be determined on the same basis as for columns, as specified in Table 1. The thickness of the fire-resistive material applied to a truss element that directly supports floor or roof construction must be determined on the same basis as for beams and girders, as specified in Tables 2 or 3 for floor construction and in Tables 5 and 6 for roof construction.

4.1.2 CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400: The minimum average thicknesses of CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 fire-resistive materials for each hourly fire-resistance rating are shown in Table 8 for steel columns, Table 9 for steel decks and beams of (protected) floor assemblies, Table 10 for steel beams of (unprotected) floor assemblies, Table 11 for steel decks and beams of (protected) roof assemblies, and Table 12 for steel beams of (unprotected) roof assemblies.

The thickness of the fire-resistive material applied to a truss element that can be simultaneously exposed to fire on all sides must be determined on the same basis as for columns, as specified in Table 8. The thickness of the fire-resistive material applied to a truss element that directly supports floor or roof construction must be determined on the same basis as for beams and girders, as specified in Tables 9 or 10 for floor construction and in Tables 11 and 12 for roof construction.

4.1.3 Fendolite Type M-II: The minimum average thicknesses of Fendolite Type M-II fire-resistive material for each hourly fire-resistance rating are shown in Table 13 for steel columns, Table 14 for steel decks and beams of (protected) floor assemblies, Table 15 for steel beams of (unprotected) floor assemblies, Table 16 for steel decks and beams of (protected) roof assemblies, and Table 17 for steel beams of (unprotected) roof assemblies.

4.2 Installation:

4.2.1 Site Conditions: When the temperature at the building site is less than 40°F (4.4°C), the temperature of the steel substrate and its surrounding environment must be maintained at 40°F (4.4°C) or higher before, during and a minimum of 24 hours after application of sprayed fire-resistive material. Enclosures with heat must be used to maintain the required substrate and ambient temperatures during this period.

4.2.2 Surface Conditions: Surfaces that receive spray- or trowel-applied fire-resistive material and adhesive must be free of oil, grease, dirt, loose mill scale or any other condition that impairs adhesion.

4.3 Application:

4.3.1 CAFCO BLAZE-SHIELD Type DC/F, BLAZE-SHIELD Type II, and BLAZE-SHIELD Type HP Fire-resistive Materials: These materials are pneumatically conveyed in a dry state through the application machine, hose and nozzle. Water is added at the nozzle in accordance with the manufacturer's published instructions, and volume is adjusted to provide for proper spray pattern. Continuous application builds the fire-resistive material to the required thickness in either single or multiple passes. The fire-resistive material must fill all cavities between the upper beam flange and steel floor or roof units. Fire-resistive material rebound may be used for filling the cavities.

4.3.2 CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, CAFCO Type 400 Fire-resistive Materials: These materials are mixed with water in a plaster mixer at the jobsite to a uniform consistency. The mixed materials are pumped through an application machine, hose, and nozzle where air pressure is added at the nozzle to adjust the spray pattern. Continuous application builds the fire-resistive materials to the required thickness in either single or multiple passes. The fire-resistive material must fill all cavities between the upper beam flange and steel floor or roof units. Fire-resistive material rebound may be used for filling the cavities.

4.3.2.1 CAFCO PRE-COAT Type PC: CAFCO PRE-COAT Type PC is applied to steel decking before application of CAFCO Type 300, Type 300 ES, Type 300 SB or Type 400 as noted in Table 9 of this report. One bag of dry material is mixed with 5.5 to 6.0 gallons (20.8 to 22.7 liters) of potable water. The mixture is sprayed at a rate sufficient to provide a minimum 70 percent coverage of deck area. CAFCO Type 300, Type 300 ES, Type 300 SB or Type 400 must be applied before the adhesive mixture dries completely.

4.3.2.2 CAFCO BOND-SEAL: CAFCO BOND-SEAL is field-mixed with potable water at a ratio of 3:1, by volume, and applied at a rate of 450 square feet per gallon (11 m²/liter). The fire-resistive material must be applied to steel surfaces before the adhesive mixture dries completely, which depends on site conditions.

4.3.2.3 CAFCO Qwik-Set: CAFCO Qwik-Set is added to CAFCO Type 300, Type 300 ES or Type 300 SB at or near the application equipment nozzle to reduce the set time of the fire-resistive materials. The solution consists of one 50-pound (22.7 kg) bag of CAFCO Qwik-Set mixed and fully dissolved in 12.5 gallons (47 L) of potable water. The solution is added to the fire-resistive material at a rate that results in a ratio of one bag of CAFCO Qwik-Set to 18 or more bags of CAFCO Type 300, Type 300 ES or Type 300 SB.

4.3.3 Fendolite Type M-II Fire-resistive Material: This material is mixed with potable water in a plaster mixer at the jobsite to a uniform consistency. The mixed material is pumped through an application machine, hose, and nozzle where air pressure is added at the nozzle to adjust the spray pattern. Continuous application builds the fire-resistive material to the required thickness in either single or multiple passes. The fire-resistive material must fill all cavities between the upper beam flange and steel floor or roof units. Fire-resistive material rebound may be used for hand-filling the cavities.

4.3.4 Fire-resistive Material Thickness: The average thickness of the sprayed fire-resistive materials applied to structural elements must not be less than the minimum average thickness specified in Tables 1 through 17 of this report. The thickness must be determined in accordance with ASTM E 605 (UBC Standard 7-6). Samples of the sprayed fire-resistive materials must be selected in accordance with Sections 1704.12.4.1 and 1704.12.4.2 of the 2009 IBC or Sections 1704.10.3.1 and 1704.10.3.2 of the 2006 IBC. Minus and positive thickness tolerance limits are as follows:

4.3.4.1 Minus Tolerance: The thickness of fire-resistive material must be corrected by applying additional material at any location where the calculated average thickness of the material is less than that listed in this report, or where an individual measured thickness reading has a minus tolerance greater than $\frac{1}{4}$ inch (6.4 mm) for thicknesses of 1 inch (25.4 mm) or greater, or greater than 25 percent of the required thicknesses for thicknesses less than 1 inch (25.4 mm).

4.3.4.2 Positive Tolerance: An individual measured thickness, exceeding the thickness specified in this report by $\frac{1}{4}$ inch (6.4 mm) or more, is recorded as the thickness specified in the table plus $\frac{1}{4}$ inch (6.4 mm).

4.3.5 Fire-resistive Material Density: The minimum average and individual in-place dry density of the sprayed fire-resistive materials must not be less than the values specified in Sections 3.1 through 3.4 of this report. Density of the sprayed fire-resistive material must be determined in accordance with ASTM E 605 (UBC Standard 7-6).

4.3.6 Fire-resistive Material Bond Strength: The cohesive/adhesive bond strength of the cured sprayed fire-resistive material applied to steel elements must be at least 150 psf (7.18 kN/m²). The cohesive/adhesive bond strength must be determined in accordance with Section 1704.12.6 of the 2009 IBC, Section 1704.10.5 of the 2006 IBC or with Section 7.605 of UBC Standard 7-6, as applicable.

4.3.7 Patching: A maximum area of 432 square inches (278 709 mm²) of a fire-resistance-rated assembly described in this report that specifies CAFCO BLAZE-SHIELD Type DC/F, Type II, or Type HP fire-resistive materials may be patched, provided the following guidelines are met:

- (a) The material used for patching is either the same material designation type as the fire-resistance material being patched or CAFCO FIBER-PATCH Type P material.
- (b) All areas to be patched must be cleaned, down to the substrate, of loose, poorly adhered material, including dirt and any other foreign material.
- (c) The patching material is keyed into the existing material surrounding the patch. The integrity of the surrounding material must be sound. The surrounding material must be pre-wetted before application of the patching material.

- (d) CAFCO BOND-SEAL adhesive is required on steel decking that does not contain concrete (roof decking) and on all cellular decks.
- (e) When the patching material is the same material designation type as the fire-resistance material being patched, the minimum individual in-place dry density, as specified in this report, and the minimum thickness of the material, as specified in the tables of this report, must be maintained.
- (f) Any clips or hangers being patched around must be totally encased in material at the point of attachment to the structural member at a thickness equal to or greater than that being applied to the structural member.

A maximum area of 144 square inches (92 903 mm²) of a fire-resistance-rated assembly described in this report that specifies CAFCO Type 300, Type 300 ES, Type 300 SB, or Type 400 fire-resistive materials may be patched, provided the guidelines (a) through (f) in Section 4.3.7 of this report are met.

A maximum area of 144 square inches (92 903 mm²) of a fire-resistance-rated assembly described in this report that specifies Fendolite Type M-II fire-resistive material may be patched, provided the material used for patching is Fendolite Type M-II, and guidelines (b) through (f) in Section 4.3.7 are met.

A maximum area of 5 square feet (0.46 m²) of a fire-resistance-rated assembly described in this report that specifies Fendolite Type M-II fire-resistive material may be patched, provided the material used for patching is Fendolite TG (Trowel Grade), and guidelines (b) through (f) in Section 4.3.7 are met.

4.3.8 Primed or Painted Surfaces: CAFCO and Fendolite fire-resistive materials may cover primed or painted wide-flange steel members, subject to the following guidelines:

- (a) Beam flange width is a maximum of 12 inches (305 mm)
- (b) Column flange width is a maximum of 16 inches (406 mm)
- (c) Beam or column web depth is a maximum of 16 inches (406 mm)
- (d) Round pipe column outer diameter or tube column width is a maximum of 12 inches (305 mm)
- (e) Bond tests of five specimens in accordance with ASTM E 736 are used to verify the bond strength of the fire-resistive material to a painted or primed steel beam or column at the jobsite. The minimum average bond strength shall be 80 percent, or a minimum individual bond strength shall be 50 percent, of the bond strength of the same fire-resistive material applied to bare, clean, $\frac{1}{8}$ -inch-thick (3.2 mm) steel plate. At a minimum, the cohesive/adhesive bond strength of the cured in-place fire-resistive material applied to primed or painted structural elements must not be less than 150 psf (7.18 kN/m²).
- (f) Where bond-strength values are less than the minimum values specified in item (e), above, for fire-resistance-rated assemblies with CAFCO BLAZE-SHIELD Type DC/F, Type II, Type HP, Type 300, Type 300 ES, Type 300 SB, or Type 400 fire-resistive materials, CAFCO BOND-SEAL adhesive must be applied to the primed or painted surfaces, and the bond-strength tests must be repeated.

- (g) Where bond-strength values are less than the minimum values specified in item (e) for fire-resistance-rated assemblies with Fendolite Type M-II fire-resistive material, an adhesive recommended by Isolatek International is applied to the primed or painted surfaces, and the bond-strength tests are repeated. Regardless of the actual cohesive/adhesive bond strength of the Fendolite Type M-II fire-resistive material, an adhesive must always be applied to steel substrates primed with an alkyd-based primer having a pH between 12.0 and 12.5 before the Fendolite Type M-II fire-resistive material is sprayed to the primed steel.

When beam or column dimensions exceed the values in items (a), (b) or (c) of Section 4.3.8, a mechanical break must be installed on the beam or column to ensure a mechanical bond of the sprayed fire-resistive material. A mechanical break consists of one or more minimum 1.7-pound-per-square-yard (0.65 kg/m²) metal lath strips, or No. 20 gage galvanized hexagonal wire lath, mechanically fastened to the flange or web, or both, either by weld, screw or powder-actuated fastener. Fasteners must be spaced a maximum of 12 inches (305 mm) on center, on each longitudinal edge of the strip, so that the clear spans do not exceed the limits established in conditions specified in items (a), (b) or (c) of Section 4.3.8. At least 25 percent of the width of the oversized flange or web must be covered by the metal lath that is a minimum of 3¹/₂ inches (89 mm) wide.

4.3.9 Protective Covering:

4.3.9.1 IBC: In areas enforcing the IBC, and where the spray-applied fire-resistive material covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire-resistive material must be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than 5 feet (1524 mm) from the finished floor in accordance with 2009 IBC Section 704.9 or 2006 IBC Section 714.4.

4.3.9.2 UBC: In areas enforcing the UBC, the fire-resistive material applied to steel columns, beams and ceilings less than 8 feet (2438 mm) above the finished floor must be protected from damage by encasement in a furred wallboard or cement-plaster/lath enclosure, or by other means approved by the code official.

4.4 Special Inspection:

Special inspections must be provided in accordance with Section 1704.12 of the 2009 IBC, Section 1704.10 of the 2006 IBC or Section 1701.4 of the UBC, as applicable.

5.0 CONDITIONS OF USE

The CAFCO® BLAZE-SHIELD® Type II, Type DC/F, and Type HP Fire-resistive Materials; CAFCO Type 300, Type 300 ES, Type 300 SB, and Type 400 Fire-resistive Materials; FENDOLITE® M-II Fire-resistive Material; CAFCO Fiber-Patch Type P and FENDOLITE TG (Trowel Grade) Hand-applied Fire-resistive Materials; CAFCO BOND-SEAL and CAFCO Pre-Coat Type PC Adhesives; and the CAFCO Qwik-Set Fire-resistive Material Additive/Accelerator described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1** Installation must comply with this report, the manufacturer's published installation instructions and the applicable code. When the manufacturer's published installation instructions differ from this report, this report governs.
- 5.2** Use of CAFCO BLAZE-SHIELD Type II, CAFCO BLAZE-SHIELD Type DC/F, CAFCO BLAZE-SHIELD Type HP, CAFCO Type 300, CAFCO Type 300 ES, CAFCO Type 300 SB, and CAFCO Type 400 fire-resistive materials is limited to interior applications.
- 5.3** Use of FENDOLITE M-II and Type TG fire-resistive materials is for interior and exterior (exposed to the weather) applications.
- 5.4** Minimum thickness and density of applied fire-resistive material must comply with this report.
- 5.5** Special inspection must be provided as set forth in Section 4.4 of this report.

6.0 EVIDENCE SUBMITTED

Data in compliance with the ICC-ES Acceptance Criteria for Spray-applied and Intumescent Mastic Coating Fire-protection Materials (AC23), dated June 2004 (editorially revised January 2008).

7.0 IDENTIFICATION

Bags and containers of the fire-resistive materials, adhesives, and fire-resistive material additive/accelerator are labeled with the company name (Isolatek International) and address, product name, storage and shelf life information, and the evaluation report number (ESR-1649).

TABLE 1—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO STEEL COLUMNS

STEEL COLUMN		W/D RATIO ¹ RANGE	A/P RATIO ²	FIRE-RESISTANCE RATING				
Structural Shape	Size			4-Hour	3-Hour	2-Hour	1-Hour	
		Minimum Average Thickness of Sprayed Fire-resistive Materials ^{3,4} (inches)						
Wide-flange Steel Columns ^{5,6}	W14×730	W/D ≥ 6.68	—	5/8	3/8	3/8	3/8	
	W14×233	2.49 ≤ W/D ≤ 6.67	—	1 3/8 (1 1/2)	1 (1 1/8)	1 1/2 (5/8)	3/8 (1/2)	
	W12×106	1.44 ≤ W/D ≤ 2.48	—	2 (2 1/4)	1 1/2 (1 5/8)	1 (1 1/8)	1 1/2 (5/8)	
	W10×49	0.83 ≤ W/D ≤ 1.45	—	2 1/8 (2 1/2)	1 3/4 (2)	1 1/4 (1 1/2)	3/4 (7/8)	
	W8×28	0.67 ≤ W/D ≤ 0.82	—	3 (3 1/2)	2 1/4 (2 5/8)	1 1/2 (1 3/4)	3/4 (7/8)	
	W6×16	0.57 ≤ W/D ≤ 0.66	—	3 1/4 (3 1/4)	2 1/2 (2 3/4)	1 5/8 (1 3/4)	3/4 (7/8)	
	W8×10	0.33 ≤ W/D ≤ 0.56	—	NR (NR)	4 (NR)	2 5/8 (3)	1 3/8 (1 1/2)	
Wide-flange Steel Column with Gypsum Wallboard Assembly (See Figure 1)	W8×28	W/D ≥ 0.67	—	2 7/8	2	1 1/4	3/4	
Steel Hollow Structural Sections (HSS) ⁷	HSS4×4×1/2	—	0.418	2 3/8	1 3/4	1 1/8	1/2	
	HSS4×4×3/8	—	0.323	3 1/4	2 3/8	1 1/4	5/8	
	HSS4×4×5/16	—	0.273	NR	2 5/8	1 5/8	5/8	
	HSS4×4×1/4	—	0.222	NR	3 1/8	2	3/4	
	HSS4×4×3/16	—	0.168	NR	NR	2 3/8	1	
Steel Pipe ⁷	Standard Weight (Std.)	12 × 0.375	—	0.36	2 7/8	2	1 1/4	1/2
		10 × 0.365	—	0.35	2 7/8	2 7/8	1 3/8	1/2
		8 × 0.322	—	0.31	3 3/8	2 3/8	1 1/2	5/8
		6 × 0.280	—	0.27	NR	2 3/4	1 3/4	3/4
		5 × 0.258	—	0.25	NR	3	1 7/8	3/4
		4 × 0.237	—	0.22	NR	3 3/8	2 1/4	7/8
		Extra Strong (X-Strong)	4 × 0.337	—	0.31	3 3/8	2 3/8	1 1/2
	Double Extra-Strong (XX-Strong)	4 × 0.674	—	0.57	1 1/8	1 3/8	7/8	3/8

For SI: 1 inch = 25.4 mm; 1 lb/sq.yd = 0.38 kg/m².

¹W/D = Weight-to-heated-perimeter ratio according to Section 721.5.1.1.3 of the IBC or Section 7.703.1 of UBC Standard 7-7, as applicable.

²A/P = Cross-sectional-area-to-heated-perimeter ratio, where A is the cross-sectional area of the structural steel column in square inches and P is the inside perimeter of the fire-resistive material in inches.

³NR = Not recognized.

⁴The values shown in parentheses are the minimum thickness of sprayed fire-resistive material for wide-flange steel columns (profile shape) where the material thickness at each flange tip is reduced to 50 percent of the thickness shown in parentheses. Fire-resistive material thickness shown without parentheses must be used when the column flange tips are covered with sprayed fire-resistive material at the thickness shown.

⁵Fire-resistive protection may be applied directly to the wide-flange steel column contour (contour profile) or column boxed with minimum 1.7 lbs. per sq. yd. metal lath (box profile), except as specified for a W8×28 column assembly described in Figure 1.

⁶Thickness of sprayed fire-resistive material, T, applied to wide-flange steel columns may be calculated according to Section 721.5.1.3 of the IBC or Section 7.703.3 of UBC Standard 7-7, provided the columns have full protection at each flange tip (tabulated thicknesses shown without parentheses).

(a) When 0.32 ≤ W/D ≤ 0.55, and T ≥ 3/8 inch, the material-dependent constants C₁ and C₂ are equal to 0.95 and 0.45, respectively.

(b) When 0.56 ≤ W/D ≤ 7.0, and T ≥ 3/8 inch, the material-dependent constants C₁ and C₂ are equal to 1.01 and 0.66, respectively.

⁷Thickness of sprayed fire-resistive material applied to steel hollow section (HSS) columns and steel pipe columns may be calculated using the following equation, provided the minimum tube column size is 4×4×3/16 and the minimum pipe column size is 4×0.237-inch:

$$T = \frac{R - 0.38}{3.58(A/P)}$$

where:

- T = Thickness of sprayed fire-resistive material: 0.35" ≤ T ≤ 3.50"
- R = Fire resistance rating (hours)
- A = Cross-sectional area of the pipe or tubular column (square inches)
- P = Heated perimeter of the pipe or tubular column (inches)

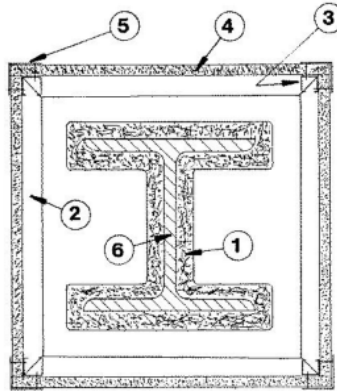


FIGURE 1—W8x28 WIDE-FLANGE STEEL COLUMN WITH GYPSUM WALLBOARD ASSEMBLY (Refer to Table 1)

- (1) Sprayed fire-resistive materials applied in one untamped coat at the thickness shown in Table 1.
- (2) Floor and ceiling C-channels, minimum $1\frac{5}{8}$ -inch deep web and $1\frac{1}{8}$ -inch long flanges, fabricated from No. 26 gage (minimum 0.017-inch base-metal thickness) steel. Attached to floor and ceiling with approved fasteners spaced maximum 12 inches on center. Minimum 1-inch clearance between C-channels and sprayed fire-resistive material.
- (3) Corner C-channels, $1\frac{5}{8}$ -inch deep web and $1\frac{5}{8}$ -inch long flanges with a $\frac{1}{4}$ inch long stiffener, fabricated from No. 24 gage (minimum 0.023-inch base-metal thickness) galvanized or painted steel. Installed vertically. Length must be from $\frac{1}{2}$ to 1 inch shorter than the column assembly height. The web may have maximum $\frac{15}{16}$ -by- $1\frac{1}{2}$ -inch rectangular holes spaced minimum 16 inches on center.
- (4) Minimum $\frac{5}{8}$ -inch-thick, Type X gypsum wallboard, attached to corner C-channels with 1-inch long, Type S bugle head, self-drilling, self-tapping steel screws spaced vertically 12 inches on center. Wallboard must be attached to horizontal C-channels at midspan.
- (5) Corner angles, $1\frac{1}{4}$ -inch long legs, fabricated from No. 28 gage (minimum 0.014-inch base-metal thickness) perforated galvanized steel. Angle legs must be attached to wallboard by crimping spaced 6 inches on center, and must be completely covered with joint compound.
- (6) Minimum W8x28 steel column, $W/D \geq 0.67$

TABLE 2—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED FLOOR ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING				
			4-Hour	3-Hour	2-Hour	1-Hour	
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)				
Floor Assembly A (with Minimum 2 1/2-inch-thick Concrete Fill)							
A1	Floor Assembly: a. Minimum 1 1/2-inch-deep steel decking ² <ul style="list-style-type: none"> • Metal deck thickness, minimum gage: fluted No. 22 gage, cellular No. 20/20 gage (minimum 0.034-inch base-metal thickness). • Maximum usage of cellular units is 1:1 blend with fluted units. b. Normal-weight or structural sand-lightweight concrete fill ³ . minimum 2 1/2-inch thick concrete fill over the top of flutes:	Top of Flute	NR	3/4	1/2	1/2	
		Bottom of Flute/Cellular	NR	1/2	3/8	3/8	
A2a	Floor Beams ^{4,5,6,7}	Supporting Normal-weight Concrete Fill	Min. W8×67 (W/D ≥ 1.60)	1 (1 1/8)	3/4 (7/8)	1/2 (5/8)	3/8 (3/8)
			Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1 1/4 (1 3/8)	1 (1)	5/8 (3/4)	3/8 (1/2)
			Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	1 1/2 (1 3/4)	1 1/4 (1 3/8)	3/4 (1)	3/8 (5/8)
			Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	2 1/4 (2 5/8)	1 3/4 (1 7/8)	1 1/8 (1 3/8)	5/8 (7/8)
A2b	Steel Joists		Steel Joist (see footnote 8)	NR	3 1/4	2 1/8	1 1/4
			Steel Joist (see footnote 9)	NR	NR	1 1/2	1 1/2
			Steel Joist (see footnote 10)	NR	NR	2 1/8	1 ⁽¹¹⁾
A3a	Floor Beams ^{4,5,6}	Supporting Structural Sand- Lightweight Concrete Fill	Min. W8×67 (W/D ≥ 1.60)	1 1/2	1	5/8	3/8
			Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1 3/4	1 1/4	7/8	1/2
			Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	2 1/4	1 5/8	1	1/2
			Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	3 1/4	2 1/4	1 1/2	3/4
A3b	Steel Joists		Steel Joist (see footnote 8)	NR	3 1/4	2 1/8	1 1/4
			Steel Joist (see footnote 9)	NR	NR	2	2
			Steel Joist (see footnote 10)	NR	NR	2 1/4	1 1/8 ⁽¹¹⁾
A4	Standard Trench Header: 36-inch wide, maximum	Top of Flute ¹²	NR	1 3/8	1 3/8	1 1/8	
		Bottom of Flute/Cellular ¹²	NR	1 1/8	1 1/8	7/8	
	Bottomless Trench Header ^{2,13,14} : 36-inch wide, maximum	Top of Flute ¹²	NR	2 1/4	1 3/4	1 1/4	
		Bottom of Flute/Cellular ¹²	NR	2 1/8	1 5/8	1	
A5a	Electric Inserts ^{15,16} : Installed in decks supporting normal-weight concrete, where the concrete is not removed from deck valleys and the insert is on top	(See footnote 17)	NR	5/8	1/2	3/8	
A5b	Electric Inserts ^{15,16} : Installed in decks supporting light-weight concrete, where the concrete is not removed from the deck valleys and the insert is on top	(See footnote 17)	NR	1	3/4	5/8	
A6a	Electric Inserts ¹⁸ : Installed in decks supporting normal-weight concrete, where the inserts penetrate the sides of the deck cells without concrete in the valleys between the cells under the inserts	(See footnote 17)	NR	1 1/4	7/8	5/8	
A6b	Electric Inserts ¹⁸ : Installed in decks supporting light-weight concrete, where the inserts penetrate the sides of the deck cells without concrete in the valleys between the cells under the inserts	(See footnote 17)	NR	1 1/2	1 1/8	5/8	

TABLE 2—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED FLOOR ASSEMBLIES (Continued)

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING			
			4-Hour	3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)			
A7a	Electric Inserts with Internal Modification ¹⁸ . Installed in decks supporting normal-weight concrete, where the inserts penetrate the sides of the deck cells without concrete in the valleys between the cells under the inserts	(See footnote 17)	NR	3/4	1/2	3/8
A7b	Electric Inserts with Internal Modification ¹⁸ . Installed in decks supporting light-weight concrete, where the inserts penetrate the sides of the deck cells without concrete in the valleys between the cells under the inserts	(See footnote 17)	NR	NR	3/4	1/2
Floor Assembly B (with Minimum 2-inch-thick Concrete Fill)						
B1	Floor Assembly: a. Minimum 2-inch-deep steel decking. Metal deck thickness, minimum gage: fluted No. 22 gage (minimum 0.028-inch base-metal thickness), cellular Nos. 20/20 gage (minimum 0.034-inch base-metal thickness) ² b. Normal-weight or structural sand-lightweight concrete fill ³ . Minimum 2-inch thick concrete fill over the top of flutes.	Top of Flute	NR	1 1/4	3/4	5/8
		Bottom of Flute/Cellular	NR	1 1/8	3/4	5/8
B2	Floor Beams ^{4,5,6} Supporting Normal-weight Concrete Fill	Min. W8×67 (W/D ≥ 1.60)	NR	7/8	5/8	3/8
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	NR	1	3/4	3/8
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	NR	1 1/4	1	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	NR	1 7/8	1 1/2	3/4
B3	Floor Beams ^{4,5,6} Supporting Structural Sand-Lightweight Concrete Fill	Min. W8×67 (W/D ≥ 1.60)	NR	7/8	5/8	3/8
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	NR	1 1/8	3/4	3/8
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	NR	1 3/8	1	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	NR	2	1 1/2	3/4
B4a	Standard Trench Header: 36-inch wide, maximum (2-inch wide steel deck flutes)	Top of Flute ¹²	NR	NR	1 1/8	7/8
		Bottom of Flute/Cellular ¹²	NR	NR	7/8	3/4
B4b	Standard Trench Header: 36-inch wide, maximum (3-inch wide steel deck flutes)	Top of Flute ¹²	NR	NR	7/8	5/8
		Bottom of Flute/Cellular ¹²	NR	NR	3/4	5/8
B4c	Bottomless Trench Header ^{13,14} : 36-inch wide, maximum	Top of Flute ¹²	NR	2 1/2	1 3/4	1 1/4
		Bottom of Flute/Cellular ¹²	NR	2 3/8	1 5/8	1
B5a	Electric Inserts ¹⁵ . Installed in decks supporting normal-weight concrete, where inserts penetrate sides of deck cells without concrete in valleys between cells under inserts	(See footnote 17)	NR	NR	3/4	5/8
B5b	Electric Inserts ¹⁸ . Installed in decks supporting normal-weight concrete, where inserts contain internal modifications and penetrate side of deck cells without concrete in valleys between cells under inserts	(See footnote 17)	NR	NR	3/4	5/8

For **SI**: 1 inch = 25.4 mm; 1 psi = 6.89 kPa; 1 lb/sq.yd = 0.38 kg/m²; 1ft² = 0.092m²; 1 pcf = 16.018 Kg/m³.

¹NR = not recognized.

²BOND-SEAL adhesive must be applied to Nos. 20/20 gage (minimum 0.034-inch base-metal thickness) cellular and No. 22 gage (minimum 0.028-inch base-metal thickness) fluted steel decks that are 36 inches wide or larger, and to bottomless trench headers before application of sprayed fire-resistive material. The adhesive is optional for heavier gage units.

³Normal-weight concrete: Minimum 3,000 psi compressive strength, minimum unit weight of 147 pcf, and either carbonate or siliceous aggregates. Light-weight Concrete: Minimum 3,000 psi compressive strength, and minimum unit weight of 110 pcf. Concrete must encapsulate minimum 6×6–W1.4×W1.4 welded-wire fabric.

⁴W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁵Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is 3/8 inch.

⁶Sprayed fire-resistive material must be applied directly to either the beam contour or a boxed beam formed with minimum 3.4 lb/sq. yd. expanded steel lath attached in an approved manner.

⁷The values in parentheses are the minimum thickness of sprayed fire-resistive material on the beam when the thickness on the lower flange tip is reduced by 50 percent of the thickness shown in parentheses. The values shown without parentheses are the minimum sprayed fire-resistive material on the beam when the flange tips are covered with sprayed fire-resistive material at the thickness shown.

TABLE 2—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED FLOOR ASSEMBLIES (continued)

- ⁸Steel Joist Description: Top chord must be two angles, minimum 1 1/2"×1 1/2"×0.156"; bottom chord must be two round bars, minimum 0.675" diameter; end reaction bearing plates must be two angles, minimum 2"×2"×0.192"; minimum 4 15/16" long; and web members must be round bars, minimum 0.774" diameter, with a second web member at each end consisting of 0.654" diameter round bar.
- ⁹Steel Joist Description: Top chord must be two angles, minimum total area of 1.26 sq. in.; bottom chord must be two angles, minimum total area of 1.07 sq. in.; and web members must be round bars, minimum area of 0.31 sq. in.
- ¹⁰Steel Joist Description: Minimum linear weight must be 4.9 lbs/ft. and a minimum joist depth must be 8 inches. Steel joist top chord must be two angles, minimum 1 1/4"×1 1/4"×0.127"; bottom chord must be two round bars, minimum 0.566" diameter, or two angles, minimum 1"×1"×0.125"; end reaction bearing plates must be two angles, minimum 1 1/2"×2"×0.188"; minimum 5 1/16" long; and web members must be round bars, minimum 0.565-inch diameter.
- ¹¹When bottom chords are angles, the fire-resistive material thickness must be increased by 1/4 inch on the bottom chords only.
- ¹²Sprayed fire-resistive material thickness under all trench headers must extend minimum 4 inches beyond each side of the trench header.
- ¹³Minimum metal thickness of bottomless trench headers must be No. 20 gage (minimum 0.034-inch base-metal thickness) for fluted decks and Nos. 20/18 gage (minimum 0.034-inch/0.045-inch base-metal thickness) or Nos. 20/20 gage (minimum 0.034-inch base-metal thickness) for cellular decks.
- ¹⁴The flat portion of Nos. 20/20 gage (minimum 0.034-inch base-metal thickness) cellular steel floor units with bottomless trench headers must have welded steel studs with discs under the trench header. The studs must be No. 12 gage galvanized steel wire attached to 1 3/16-inch-diameter No. 28 gage (minimum 0.014-inch base-metal thickness) galvanized steel discs, installed in rows spaced maximum 22 inches o. c. parallel to the trench. An average of one stud per 236 sq. in. of cellular floor units beneath the trench must be provided, with 24 inches between studs, and 4 inches between studs and trench edge. Stud and discs are not required where 20/18 or heavier gage steel is used.
- ¹⁵Minimum Insert spacing must be 30 in. o. c. along cellular steel floor units, and 18 in. o. c. in the transverse direction with not more than one insert for each 6 sq. ft. of floor area. Active inserts do not exceed more than one for each 12 sq. ft.
- ¹⁶Unused electrical inserts must be packed with a mineral wool block and covered with concrete or sand cement grout.
- ¹⁷Fire-resistive material thickness must extend the entire width and length of cellular units between supports and extend 12 inches past the insert edges.
- ¹⁸Maximum of one insert for each 7 1/2 sq. ft. of floor, with not less than 25 1/2 inches between inserts.

TABLE 3—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO BEAMS OR JOISTS IN UNPROTECTED FLOOR ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING			
			4-Hour	3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)			
1	Floor Assembly: a. Minimum 1 1/2-inch-deep steel decking. Minimum No. 22 gage (minimum 0.028-inch base-metal thickness). b. Normal-weight or structural sand-lightweight concrete fill ² . c. Beam protection requires minimum 2 1/2 inches of concrete over the top flute. d. Minimum concrete fill thickness for the floor assembly rating is a separate consideration ³ .	No fire-resistive material applied to the steel deck soffit (See Figure 2).	—	—	—	—
2	Floor Beams ^{4,5,6,7,8} Supporting: • Fluted Steel Decking • Normal-weight Concrete Fill	Min. W8×67 (W/D ≥ 1.60)	1	3/4	1/2	3/8
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1 1/4	1	5/8	3/8
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	1 5/8	1 1/4	3/4	3/8
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	2 1/4	1 3/4	1 5/8	5/8
3	Steel Joists ^{8,9}	Steel Joist (See footnote 10)	NR	3 1/4	2 1/8	1 1/4
		Steel Joist (See footnote 11)	NR	NR	NR	1 ⁽¹²⁾
4	Floor Beams ^{4,5,6,7,8} Supporting: • Fluted, Cellular or Corrugated Steel Decking; or Blended Fluted/Cellular Decking. • Structural Sand-Light-weight Concrete Fill	Min. W8×67 (W/D ≥ 1.60)	1 1/2	1	5/8	3/8
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1 3/4	1 1/4	7/8	1/2
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	2 1/4	1 5/8	1	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	3 1/4	2 1/4	1 1/2	3/4
5	Steel Joists ^{8,9}	Steel Joist (See footnote 10)	NR	3 1/4	2 1/8	1 1/4
		Steel Joist (See footnote 11)	NR	NR	NR	1 1/8 ⁽¹²⁾

For SI: 1 inch = 25.4 mm. 1 lb/sq.yd. = 0.38 kg/m², 1 pcf = 16.018 Kg/m³, 1 psi = 6.89 kPa.

TABLE 3—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO BEAMS OR JOISTS IN UNPROTECTED FLOOR ASSEMBLIES (continued)

¹NR = Not recognized.

²Normal-weight concrete must have a minimum compressive strength of 3,000 psi, unit weight of 147 pcf, and either carbonate or siliceous aggregates. Structural sand-lightweight concrete must have a minimum compressive strength of 3,000 psi and a unit weight of 110 pcf. Concrete must encapsulate 6×6–W1.4×W1.4 smooth welded-wire reinforcement complying with ASTM A 185.

³Minimum concrete slab or fill thickness for the floor assembly and fire-resistive rating desired must comply with Sections 720 or 721.2.2.1 of the IBC, or Section 710.1 of the UBC or Section 7.708 of UBC Standard 7-7, as applicable, or with a current ICC-ES evaluation report.

⁴Sprayed fire-resistive material must be applied directly either to exposed beam contour or a boxed beam formed with minimum 3.4 lb/sq. yd. expanded steel lath attached in an approved manner.

⁵When sprayed fire-resistive material is applied to wide-flange steel beams described in Items 2 and 4, the required thickness of fire-resistive material applied to the lower flange tip may be reduced to one-half of the tabulated value. Refer to Figure 2.

⁶W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁷Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC and Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is $\frac{3}{8}$ inch.

⁸The fluted deck crest area above the beam or joist must be filled with the sprayed fire-resistive material.

⁹The design of the steel joists must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable, with a maximum design stress of 30 ksi.

¹⁰Steel Joist Description: Top chord must be two angles, minimum $1\frac{1}{2}$ "× $1\frac{1}{2}$ "×0.156"; bottom chord must be two round bars, minimum 0.675" diameter; end reaction bearing plates must be two angles, minimum 2"×2"×0.192"; minimum $4\frac{15}{16}$ " long; and web members must be round bars, minimum 0.774" diameter.

¹¹Steel Joist Description: Minimum linear weight must be 4.9 lbs/ft. and a minimum joist depth must be 8 inches. Steel joist top chord must be two angles, minimum $1\frac{1}{4}$ "× $1\frac{1}{4}$ "×0.127"; bottom chord must be two round bars, minimum 0.566" dia., or two angles, minimum 1"×1"×0.125"; end reaction bearing plates must be two angles, minimum $1\frac{1}{2}$ "×2"×0.188"; minimum $5\frac{1}{16}$ " long; and web members must be round bars, minimum 0.565-inch dia.

¹²When bottom chords are angles, the fire-resistive material thickness must be increased by $\frac{1}{4}$ inch on the bottom chords only.

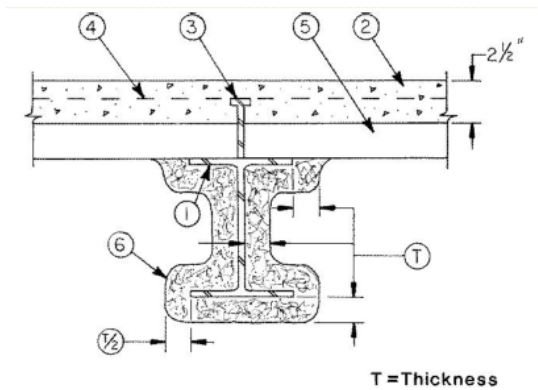


FIGURE 2—SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO BEAMS IN UNPROTECTED FLOOR ASSEMBLIES (Refer to Table 3)

- (1) Unrestrained Steel Beam or Joist.
- (2) Normal-weight or Structural Sand-lightweight Concrete.
- (3) Shear Connector (optional).
- (4) Welded Wire Fabric.
- (5) Steel Floor and Form Units ($1\frac{1}{2}$ in. deep fluted units)
- (6) Blaze-Shield Type DC/F, Type II and Type HP Sprayed Fire-resistive Materials.

TABLE 4—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO CONCRETE FLOOR SYSTEMS

ASSEMBLY			FIRE-RESISTANCE RATING			
			4-Hour	3-Hour	2-Hour	1-Hour
Assembly No.	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)			
1	Cast-in-place Concrete Slab-Joist Construction ^{1,2} : Normal-weight concrete: minimum 3,000 psi compressive strength, minimum 147 pcf unit weight. Concrete slab: Minimum 2½-inch thick; Maximum 30-inch clear span. Concrete slab must encapsulate 6×6–W2.9×W2.9 welded-wire fabric. Minimum concrete joist width: 5 inches Minimum total depth of concrete joist plus slab: 8½ inches Minimum ¾-inch concrete cover for steel reinforcement.	Slab Soffit	1¾	1¼	1¼	7/8
		Joist	1¾	5/8	5/8	0
2	Precast, Prestressed Normal-weight Concrete Construction: Single or double-stemmed joists: 4 ft. ≤ unit width ≤ 10 ft. Minimum 1½-inch precast concrete slab thickness. Concrete topping ³ (optional). Minimum 1 inch thick when used. Minimum total concrete slab (precast, or precast plus topping) thickness, t: 2-hour rated assembly: t = 2 inches 3-hour rated assembly: t = 3½ inches 4-hour rated assembly: t = 4⅝ inches	Slab Soffit	7/8	7/8	7/8	—
		Joist	1⅜	1¼	¾	—
3	Precast, Prestressed Structural Sand-lightweight Concrete Construction: Single or double-stemmed joists: 4 ft. ≤ unit width ≤ 10 ft. Minimum 1½-inch precast concrete slab thickness. Concrete topping ³ (optional). Minimum 1-inch thick when used. Minimum total concrete slab (precast, or precast plus topping) thickness, t: 2-hour rated assembly: t = 1½ inches 3-hour rated assembly: t = 2¾ inches 4-hour rated assembly: t = 4 inches	Slab Soffit	7/8	7/8	7/8	—
		Joist	1⅜	1⅛	¾	—

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa.

¹Four-hour fire-resistance-rated cast-in-place concrete assembly: Sprayed fire-resistive materials must be applied to 3/8-inch diamond-mesh expanded metal lath, mechanically fastened to the concrete construction.

²Three-, two- and one-hour fire-resistance-rated cast-in-place concrete assemblies: Sprayed fire-resistive materials must be applied directly to the contour of the concrete construction.

³Concrete topping is optional. It may be used to increase the total concrete slab thickness to the required value indicated for the hourly-rated assemblies. When topping is used, minimum 3,000 psi compressive strength concrete having a minimum 1-inch topping thickness is required.

TABLE 5—BLAZE-SHIELD TYPE DC/F, TYPE II, AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED ROOF ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
Roof Assembly A (with Polyisocyanurate Foamed Plastic Insulation Boards)					
A1	Roof Assembly ² : Minimum 1½ -inch-deep fluted steel roof deck; Minimum No. 22 gage (minimum 0.028-inch base-metal thickness). Gypsum Cover Board ³ (optional): When required, minimum 5/8-inch-thick Type X gypsum wallboard, adhered or fastened to the roof deck, placed under insulation board. Insulation Type ^{4,5} : Polyisocyanurate foam-plastic insulation board. Required minimum thickness as indicated in table. Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶ (min. 2" insulation w/ gyp. board)	NR	1¼	1/2
		Steel Deck ⁶ (min. 1" insulation w/ gyp. board)	NR	3/8	1/2
		Steel Deck ⁶ (min. 0" insulation w/ gyp. board)	NR	15/8	5/8
		Steel Deck ⁶ (min. 3" insulation)	NR	21/8	7/8
		Steel Deck ⁶ (min. 2" insulation)	NR	23/8	1
		Steel Deck ⁶ (min. 1" insulation)	NR	3¼	1¼
		Steel Deck ⁶ (min. 0" insulation)	NR	3¼	21/8

TABLE 5—BLAZE-SHIELD TYPE DC/F, TYPE II, AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED ROOF ASSEMBLIES (continued)

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
Roof Assembly A (with Polyisocyanurate Foamed Plastic Insulation Boards) (Continued)					
A2	Wide-flange Steel Beams ^{7,8} (with or without gypsum wallboard on steel roof deck)	Min. W8×28 (W/D ≥ 0.80)	1 ³ / ₈	1	5 ⁵ / ₈
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1 ¹ / ₂	1	5 ⁵ / ₈
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 ⁷ / ₈	1 ³ / ₈	7 ⁷ / ₈
A3	Steel Joists ^{9,10,11} (with or without gypsum wallboard on steel roof deck)	Min. 10K1 and mid-span bridging	NR	1 ³ / ₄	NR
		Min. 12K3 and mid-span bridging	NR	1 ³ / ₄	1 ¹ / ₈
Roof Assembly B (with Polystyrene Foamed Plastic Roof Insulation Boards)					
B1	Roof Assembly ² : Minimum 1 ¹ / ₂ -inch-deep fluted steel roof deck; Minimum No. 22 gage (minimum 0.028-inch base-metal thickness). Coverboard ³ : Minimum 5 ⁵ / ₈ -inch-thick Type X gypsum wallboard, adhered or fastened to the roof deck, placed under insulation board. Insulation Type ^{4,5} : Polystyrene insulation boards, applied in one or more layers, adhered to the wallboard coverboard. Maximum 2.5 pcf density. Total insulation thickness, <i>t</i> , is as follows: 1" ≤ <i>t</i> ≤ 8" Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶	NR	1 ¹ / ₂	5 ⁵ / ₈
B2	Wide-flange Steel Beams ^{7,8} (with gypsum wallboard on steel roof deck)	Min. W8×28 (W/D ≥ 0.80)	1 ³ / ₈	1	5 ⁵ / ₈
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1 ¹ / ₂	1	5 ⁵ / ₈
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 ⁷ / ₈	1 ³ / ₈	7 ⁷ / ₈
B3	Steel Joists ^{9,10,11} (with gypsum wallboard on steel roof deck)	Min. 10K1 and mid-span bridging	NR	1 ³ / ₄	NR
		Min. 12K3 and mid-span bridging	NR	1 ³ / ₄	1 ¹ / ₈
Roof Assembly C (with Mineral or Fiber Roof Insulation Boards)					
C1	Roof Assembly ² : Minimum 1 ¹ / ₂ -inch-deep fluted steel roof deck; Minimum No. 22 gage (minimum 0.028-inch base-metal thickness). Insulation Type ^{4,5} : Mineral or fiber boards applied in one or more layers; Total insulation thickness, <i>t</i> : 1" ≤ <i>t</i> ≤ 4 ⁷ / ₈ " Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶	NR	1 ⁷ / ₈	1
C2	Wide-flange Steel Beams ^{7,8}	Min. W8×28 (W/D ≥ 0.80)	1 ³ / ₈	1	5 ⁵ / ₈
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1 ¹ / ₂	1 ¹ / ₈	3 ³ / ₄
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 ⁷ / ₈	1 ¹ / ₂	1
C3	Steel Joists ^{9,10,11}	Min. 12K3 and mid-span bridging	NR	2 ¹ / ₄	1 ¹ / ₂

TABLE 5—BLAZE-SHIELD TYPE DC/F, TYPE II, AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED ROOF ASSEMBLIES (continued)

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
Roof Assembly D (with Fiberglass Roof Insulation Boards)					
D1	Roof Assembly ² : Minimum 1½-inch-deep fluted steel roof deck; Minimum No. 22 gage (minimum 0.028-inch base-metal thickness). Insulation Type ^{4,5} : Fiberglass insulation boards applied in one or more layers; Total insulation thickness, t : $\frac{3}{4}'' \leq t \leq 4\frac{7}{8}''$ Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶	NR	1¾	1¼
D2	Wide-flange Steel Beams ^{7,8}	Min. W8×28 (W/D ≥ 0.80)	1⅜	1¼	⅞
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1½	1⅜	⅞
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	2	1⅞	1¼
D3	Steel Joists ^{9,10,11}	Min. 12K3 and mid-span bridging	NR	2¼	1½
		Min. 10K1 and mid-span bridging	NR	NR	1½

For **SI**: 1 inch = 25.4 mm, 1 lb =/sq.yd. = 0.38 kg/m², 1 oz/sq.yd. = 0.0119 kg/m².

¹NR = Not recognized.

²Insulation and roof-covering materials and methods of attachment are classified by Underwriters Laboratories Inc., and are recognized by a current ICC-ES evaluation report. Where foam plastic is used, it must be recognized in an ICC-ES evaluation report for the roof-covering system.

³Gypsum wallboard, complying with ASTM C36, must be 4 ft. wide and installed perpendicular to the flutes of the steel roof deck with end joints staggered 2 ft. in adjacent rows and occurring over crests of steel roof deck.

⁴A vapor barrier may be installed.

⁵When more than one layer of insulation is used, each layer must be offset in both directions from the layer below a minimum of 6 inches.

⁶BOND-SEAL adhesive must be applied to the steel deck surfaces before application of the sprayed fire-resistive materials.

⁷W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁸Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is ⅜ inch.

⁹Use of expanded metal lath or glass-fiber fabric (scrim mesh) is optional on steel joists. When used, the expanded metal lath must weigh minimum 1.7 lb/sq yd, and the glass fiber fabric must weigh approximately 4.3 oz per sq. yd., and must be fastened to the webs of the joists in an approved manner. When metal lath is attached to the joists, both sides of the lath must be completely coated with sprayed fire-resistive materials with no minimum thickness. Glass-fiber scrim mesh is not required to be covered with sprayed fire-resistive material.

¹⁰Bridging must be coated with the same thickness of sprayed fire-resistive material as the joist. Bridging must be welded to top and bottom chords of each joist at midspan.

¹¹The design of the steel joists must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable.

TABLE 6—BLAZE-SHIELD TYPE DC/F, TYPE II AND TYPE HP SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO UNPROTECTED ROOF ASSEMBLIES WITH INSULATING CONCRETE

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
1	<p>Roof Assembly²: Fluted steel deck, vented or nonvented units:</p> <ul style="list-style-type: none"> • ¹⁵/₁₆-inch deep, minimum No. 24 gage (minimum 0.023-inch base-metal thickness), maximum clear span of 7 feet, 8 inches; or, • ¹⁵/₁₆-inch deep, minimum No. 26 gage (minimum 0.017-inch base-metal thickness), maximum clear span of 6 feet, 0 inch. <p>Insulating Concrete³: Vermiculite or cellular concrete, ¹/₈-inch-thick slurry coat⁴ between top flutes of steel deck and foam plastic insulation boards.</p> <p>Insulation Type: Polystyrene foam-plastic insulation boards, maximum 8-inch thickness, nominal 1.0 pcf density. Each insulation board is 24" x 48", and must have six 3-inch diameter holes or six 3-inch wide slots.</p> <p>Insulating Concrete^{3,5}: Vermiculite or cellular concrete, minimum 2-inch thick topping above foam-plastic insulation boards. Concrete must encapsulate 4x8-W12xW14 or 2x2-W14xW14 welded wire reinforcement (WWR) for 2-hour rated assemblies.</p> <p>Roof Covering⁶: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.</p>	No fire-resistive material is applied to the steel deck to achieve the 1-hour and 2-hour roof assembly ratings.	NR	0	0
2	Wide-flange Steel Beams ^{7,8}	Min. W6x16 (W/D ≥ 0.66)	2 ⁷ / ₈	1 ³ / ₈	5 ₈
		Min. W8x18 (0.57 ≤ W/D ≤ 0.65)	3 ¹ / ₈	1 ¹ / ₂	5 ₈
		Min. W8x10 (0.37 ≤ W/D ≤ 0.56)	3 ³ / ₄	1 ⁷ / ₈	3 ₄
3	Steel Joist ^{9,10}	Min. 10K ¹	NR	2 ³ / ₈	1
		Joist Bridging: 1 ¹ / ₄ " x 1 ¹ / ₄ " x ¹ / ₈ "	NR	1 ³ / ₄	1

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa; 1 lb/sq.yd. = 0.38 kP/m²; 1 oz = 1 oz/sq.yd. = 0.0119 kg/m².

¹NR = Not Recognized

²Insulation and roof-covering materials and methods of attachment are classified by Underwriters Laboratories Inc., and must be recognized in a current ICC-ES evaluation report.

³Vermiculite and cellular insulating concrete must be listed by Underwriters Laboratories Inc. (UL) and recognized in a current ICC-ES evaluation report. Vermiculite concrete must consist of 6 cubic feet of UL-listed vermiculite aggregate, 94 pounds of Portland cement, and 0.06 to 0.5 pounds of air entraining agent. Cellular concrete must consist of UL-listed foam concentrate mixed with water and Portland cement per manufacturer's specifications, and must have a minimum 190 psi 28-day compressive strength as determined by ASTM C 495.

⁴Two-hour rating for ¹⁵/₁₆-inch-deep deck with vermiculite concrete requires ⁵/₁₆-inch-thick slurry coat. The combined thickness of the cellular concrete slurry coat plus concrete topping is minimum 2³/₈ inches.

⁵The 4x8-W12xW14 or 2x2-W14xW14 smooth welded-wire reinforcement, complying with ASTM A 185, is required for the 2-hour fire-resistance-rated roof assembly, and is optional for the 1-hour fire-resistance-rated assembly.

⁶Single-ply roof covering and method of attachment must comply with a current ICC-ES evaluation report.

⁷W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁸Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is ³/₈ inch.

⁹The design of the steel joists must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable.

¹⁰Use of expanded metal lath or glass-fiber fabric (scrim mesh) is optional on steel joists. When used, the expanded metal lath must weigh minimum 1.7 lb/sq yd, and the glass fiber fabric must weigh approximately 4.3 oz per sq. yd., and must be fastened to the webs of the joists in an approved manner. When metal lath is attached to the joists, both sides of the lath must be completely coated with sprayed fire-resistive materials with no minimum thickness. Glass-fiber scrim mesh is not required to be covered with sprayed fire-resistive material.

TABLE 7—FIRE-RESISTANCE-RATED WALL SYSTEMS

WALL ASSEMBLY		FIRE-RESISTANCE RATING	
Assembly	Description	4-Hour	3-Hour
A	<p>Interior Nonbearing Wall:</p> <ol style="list-style-type: none"> 1. Floor runners: C-shaped, snap-in type, 1¹/₈-inch deep by minimum 4 in. wide, No. 24 gage. Fastened to concrete floor with minimum 1-inch-long approved fasteners spaced max. 24 in. on center. 2. Ceiling runners: C-shaped, 1¹/₂-inch deep by 4 in. wide, minimum No. 22 gage steel. 3. Wall Studs: C-shaped steel studs, minimum 3⁵/₈ in. wide, minimum No. 18 gage, providing a 4-inch cavity depth by means of attaching a 3³/₈-inch-high rib lath with rib siding to stud. 4. Metal lath: Diamond mesh, expanded steel 3.4 pounds per square yard, 3³/₈-inch-high rib. 5. Wall Covering Material: Plaster, scratch and brown coat, 2 cubic feet of vermiculite aggregate to 100 pounds fibered or unfibered gypsum—applied to both sides of the wall. 	<p>Fire-protection Material: Type DC/F material sprayed into wall assembly to completely fill interior wall cavity. Minimum individual and average density must be 11 pcf and 12 pcf, respectively.</p>	—
B	<p>Exterior Nonbearing Wall:</p> <ol style="list-style-type: none"> 1. Floor and ceiling runners: C-shaped, 1¹/₂-inch deep by minimum 3⁵/₈ inches wide, No. 25 gage. Attached to concrete floor with approved concrete fasteners, minimum 3¹/₄-inch long, spaced maximum 18 inches on center. 2. Metal studs: Channel-shaped, 3⁵/₈ inches wide with 1¹/₄-inch-long leg, No. 25 gage. Stud spacing not more than 16 inches on center. 3. Metal lath: Three-eighths-inch-high rib metal lath, 3.4 pounds per square yard expanded. Fastened to studs with rib side placed against stud. 4. Exterior Wall Covering: Portland cement plaster, 3¹/₄-inch-thick scratch coat consisting of 100 pounds of cement to 50 pounds lime to 5¹/₂ cubic feet of sand, and a finish coat consisting of 100 pounds of cement to 50 pounds lime to 6 cubic feet of sand. 5. Interior Wall Covering: Plaster, minimum 3¹/₄-inch thick, scratch coat of 2 cubic feet of sand to 100 pounds of gypsum plaster, and brown coat of 3 cubic feet of sand to 100 pounds of gypsum plaster. 	<p>Fire-protection Material: Type DC/F material sprayed into wall assembly to completely fill interior wall cavity. Minimum individual and average density must be 11 pcf and 12 pcf, respectively.</p>	—
C	<p>Exterior or Interior Nonbearing Wall:</p> <ol style="list-style-type: none"> 1. Floor and ceiling runners: C-shaped, 1¹/₂-inch deep by minimum 3⁵/₈ inches wide, No. 25 gage painted or galvanized steel. Attached to concrete floor with approved concrete fasteners, minimum 3¹/₄-inch long, spaced maximum 18 inches on center. 2. Metal studs: C-shaped, 3⁵/₈ inches wide with 1¹/₄-inch legs, 1¹/₄-inch long folded flange returns (stiffeners). Studs must be spaced maximum 16 inches on center. Stud length 3³/₈ inch less than assembly height. 3. Exterior Wall Covering (When an exterior wall, the following lath and cement plaster must replace the two or three layers of gypsum wallboard for the three- or four-hour fire-resistant-rated wall assemblies, respectively): <ol style="list-style-type: none"> a. Building Paper: Optional. May be used on the exterior face of the wall assembly. The paper is located between the metal studs and the metal lath. The paper is single-ply asphalt-saturated material. b. Metal Lath: 3.4 pounds per square yard expanded metal lath with 3³/₈-inch-high rib. The rib side must be installed against the steel studs and attached with No. 18 SWG wire spaced 6 inches on center. c. Portland Cement Plaster: Minimum 3¹/₄-inch-thick cement plaster, scratch coat consists of 100 pounds cement to 50 pounds lime to 5¹/₂ cubic feet of sand and a finish coat of 100 pounds cement to 50 pounds lime to 6 cubic feet of sand. 4. Interior Wall Covering: <ol style="list-style-type: none"> a. Type X gypsum wallboard, minimum 5¹/₈-inch thick, with either beveled square or tapered edges. Number of layers and method of attachment is governed by the fire-resistance rating of the wall assembly. b. Joint tape and compound: Vinyl or casein, dry or premixed joint compound must be applied in two coats to joints and screw heads. Two-inch-wide paper tape must be embedded in the first layer of compound over all joints. 5. Fire-protection Material: Type DC/F, Type II or Type HP material sprayed into wall assembly to completely fill interior wall cavity. Minimum individual and average density must be 11 pcf and 12 pcf, respectively. 	<p>Interior Wall Covering: Three layers of wallboard on each side. Two inner layers must be applied in the same manner as the three-hour rating. The outer layer may be applied vertically or horizontally and must be fastened to each stud through the two previous layers with 2¹/₄-inch-long Type S, self-drilling, self-tapping steel screws located 3³/₈ inch from the edges and spaced 8 inches on center. Joints in each wallboard layer must be staggered from the joints in the adjacent layer and on opposite sides of studs.</p>	<p>Interior Wall Covering: Two layers of wallboard on each side. The inner layer, applied vertically with joints centered over studs, must be fastened to studs with 1-inch-long, Type S, self-tapping, self-drilling, wallboard screws. The screws, located 3³/₈ inch from the edges, must be spaced 8 inches on center at the joints and 12 inches on center in the field. The outer layer must be applied vertically and is fastened to the studs (through the inner layer) using 1⁵/₈-inch-long, Type S, self-drilling, self-tapping, wallboard screws. The screws, located 3³/₈ inch from the edges, must be spaced 8 inches on center at the joints and 12 inches on center in the field. Additionally, fasteners must be spaced 8 inches on center at the runners. Joints must be staggered from the inner layer.</p>

For SI: 1 inch = 25.4 mm, 1 lbm = 0.45 kg, 1 pcf = 16.02 kg/m³, 1 lbm/sq. yd. = 0.38 kg/m², 1 cubic ft. = 0.0283 m³.

TABLE 8—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB OR CAFCO 400 SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO STEEL COLUMNS

CAFCO 400							
STEEL COLUMN		W/D RATIO ¹ RANGE	A/P RATIO ²	FIRE-RESISTANCE RATING			
Structural Shape	Size			4-Hour	3-Hour	2-Hour	1-Hour
		Minimum Average Thickness of Sprayed Fire-resistive Materials (inches)					
Wide-flange Steel Columns ^{3,4}	W14×730	W/D ≥ 6.68	—	1/2	3/8	1/4	1/4
	W14×233	2.49 ≤ W/D ≤ 6.67	—	1 1/4	7/8	1/2	1/4
	W12×106	1.46 ≤ W/D ≤ 2.48	—	1 3/4	1 1/4	7/8	3/8
	W10×49	0.83 ≤ W/D ≤ 1.45	—	2 1/8	1 5/8	1 1/8	5/8
	W8×28	0.67 ≤ W/D ≤ 0.82	—	2 3/8	1 7/8	1 1/4	5/8
	W6×16	0.57 ≤ W/D ≤ 0.66	—	2 3/8	1 7/8	1 3/8	3/4
	W8×10	0.33 ≤ W/D ≤ 0.56	—	2 3/4	2 1/8	1 5/8	1
Steel Hollow Structural Sections (HSS) ⁵	HSS4×4×1/2	—	0.418	1 7/8	1 3/8	7/8	3/8
	HSS4×4×3/8	—	0.323	2 1/8	1 5/8	1	1/2
	HSS4×4×5/16	—	0.273	2 3/8	1 3/4	1 1/8	1/2
	HSS4×4×1/4	—	0.222	2 7/8	2 1/8	1 1/2	3/4
	HSS4×4×3/16	—	0.168	2 3/4	2 1/8	1 1/2	3/4
Steel Pipe: Standard Weight (Std.) ⁵	4 × 0.237	—	0.22	2 3/4	2 1/8	1 3/8	3/4
CAFCO 300, CAFCO 300 ES or CAFCO 300 SB							
STEEL COLUMN		W/D RATIO ¹ RANGE	A/P RATIO ²	FIRE-RESISTANCE RATING			
Structural Shape	Size			4-Hour	3-Hour	2-Hour	1-Hour
		Minimum Average Thickness of Sprayed Fire-resistive Materials (inches)					
Wide-flange Steel Columns ^{3,4}	W14×730	W/D ≥ 6.68	—	1/2	3/8	1/4	1/4
	W14×233	2.49 ≤ W/D ≤ 6.67	—	1 1/8	7/8	1/2	1/4
	W12×106	1.46 ≤ W/D ≤ 2.48	—	1 3/4	1 1/4	7/8	1/4
	W10×49	0.83 ≤ W/D ≤ 1.45	—	2 1/8	1 5/8	1 1/8	1/2
	W8×28	0.67 ≤ W/D ≤ 0.82	—	2 3/8	1 7/8	1 1/4	5/8
	W6×16	0.57 ≤ W/D ≤ 0.66	—	2 3/8	1 7/8	1 3/8	5/8
	W8×10	0.33 ≤ W/D ≤ 0.56	—	2 3/4	2 1/8	1 5/8	1
Steel Hollow Structural Sections (HSS) ⁵	HSS4×4×1/2	—	0.418	1 7/8	1 3/8	7/8	3/8
	HSS4×4×3/8	—	0.323	2 1/8	1 5/8	1	1/2
	HSS4×4×5/16	—	0.273	2 3/8	1 3/4	1 1/8	1/2
	HSS4×4×1/4	—	0.222	2 7/8	2 1/8	1 1/2	3/4
	HSS4×4×3/16	—	0.168	2 3/4	2 1/8	1 1/2	3/4
	ST20x20x1 3/4	—	1.60	3/4	1/2	3/8	1/4
	ST20x20x1 1/2	—	1.39	7/8	5/8	3/8	1/4
	ST32x32x1 1/4	—	1.20	1	3/4	1/2	1/4
	ST20x20x1	—	0.95	1 1/8	7/8	1/2	1/4
ST20x20x3/4	—	0.72	1 1/2	1 1/8	3/4	3/8	
Steel Pipe: Standard Weight (Std.) ⁵	4 × 0.237	—	0.22	2 3/4	2 1/8	1 3/8	3/4

For **SI**: 1 inch = 25.4 mm; 1 lb/sq.yd. = 0.38 kg/m².

¹W/D = Weight-to-heated-perimeter ratio according to Section 721.5.1.1.3 of the IBC or Section 7.703.1 of UBC Standard 7-7, as applicable.

²A/P = Cross-sectional-area-to-heated-perimeter ratio, where A is the cross-sectional area of the structural steel column in square inches and P is the inside perimeter of the fire-resistive material in inches.

³Fire-resistive protection may be applied directly to the wide-flange steel column contour (contour profile) or column boxed with minimum 1.7 lbs. per sq. yd. metal lath (box profile).

⁴Thickness of sprayed fire-resistive material, T, applied to wide-flange steel columns may be calculated according to Section 721.5.1.3 of the IBC and Section 7.703.3 of UBC Standard 7-7, provided the columns have full protection at each flange tip:

(a) When 0.33 ≤ W/D ≤ 2.48, and T ≥ 1/4 inch, the material-dependent constants C₁ and C₂ are equal to 75 and 32, respectively.

(b) When 2.49 ≤ W/D ≤ 6.62, and T ≥ 1/4 inch, the material-dependent constants C₁ and C₂ are equal to 75 and 15, respectively.

⁵Thickness of sprayed fire-resistive material, T, applied to steel hollow section (HSS) columns and steel pipe columns may be calculated using the following equation, provided the minimum size tube column is an HSS4×4×3/16 and the minimum size pipe column is 4×0.237 (Std.), and the minimum sprayed fire-resistive material thickness is 1/4 inch:

$$T = \frac{R}{188(A/P) + 45}$$

where:

- T = Thickness of sprayed fire-resistive material: 0.25" ≤ T ≤ 4.25"
 - R = Fire resistance rating (minutes)
 - A = Cross-sectional area of the pipe or tubular column (square inches)
 - P = Heated perimeter of the pipe or tubular column (inches)
- Allowable A/P range: 0.18 ≤ A/P ≤ 0.49

TABLE 9—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB OR CAFCO 400 SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED FLOOR ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING ¹			
			4-Hour	3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material (inches)			
1	Floor Assembly: a. Minimum 1½-inch-deep steel decking. <ul style="list-style-type: none"> • Metal deck thickness, minimum gage: fluted No. 22 gage (minimum 0.028-inch base-metal thickness), cellular Nos. 20/20 gage (minimum 0.034-inch base-metal thickness). • Cellular units may be blended 1:1 with fluted units² • CAFCO PRE-COAT Type PC must be applied to approximately 70% of the flat plate surface of cellular decking before the application of sprayed fire-resistive material. b. Normal-weight or structural sand-lightweight concrete fill ³ . Minimum 2½-inch thick concrete fill over the top of flutes	Fluted Deck (Top and Bottom Flutes)	NR	7/8	3/8	3/8
		Cellular Deck	NR	3/4	3/8	3/8
2	Steel Beams ^{4,5,6} or Joist ⁷ Supporting: a. Cellular or Blended Cellular/Fluted Steel Deck b. Normal-weight or Structural Sand-lightweight Concrete Fill, minimum 2½-inch thick.	Min. W8×67 (W/D ≥ 1.60)	1¼	7/8	5/8	3/8
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1½	1½	3/4	3/8
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	1¾	1¾	7/8	3/8
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	2 ⁵ / ₈	2	1¼	1/2
		Joist (See footnotes 7, 8, 9)	NR	2¼	1¾	5/8 ⁽⁹⁾
3	Steel Beams ^{4,5,6} or Joist ⁷ Supporting: a. All Fluted Steel Deck b. Normal-weight or Structural Sand-lightweight Concrete Fill, minimum 2½-inch thick.	Min. W8×67 (W/D ≥ 1.60)	1	3/4	1/2	3/8
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1¼	7/8	5/8	3/8
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	1½	1½	3/4	3/8
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	2¼	1 ⁵ / ₈	1	1/2
		Joist (See footnotes 7, 8, 9)	NR	2¼	1¾	5/8 ⁽⁹⁾
4a	Bottomless Trench Header ¹⁰ (Maximum 36-inch Width)	Top of Flute ¹¹	NR	2¼ ⁽¹²⁾	1¾ ⁽¹²⁾	1¾
		Bottom of Flute/Cellular ¹¹	NR	2¼ ⁽¹²⁾	1¾ ⁽¹²⁾	1 ⁵ / ₈ ⁽¹³⁾
4b	Trench Header with Intermittent Bottom ¹⁰ (Maximum 36-inch Width)	Top of Flute ¹¹	NR	NR	1¾ ^(12,14)	1¾
		Bottom of Flute/Cellular ¹¹	NR	NR	1¾ ^(12,14)	1 ⁵ / ₈ ⁽¹³⁾
5a	Electrical Inserts: Installed in Decks Supporting Normal-weight Concrete Fill	Floor Units with Inserts ¹⁵	NR	NR	1¼	1/2
5b	Electrical Inserts: Installed in Decks Supporting Light-weight Concrete Fill	Floor Units with Inserts ¹⁵	NR	NR	1¼	1/2

For SI: 1 inch = 25.4 mm, 1 Ksi = 6.89 MPa, 1 pcf = 16.018 kg/m³, 1 lbm/yd² = 542 g/m², 1 oz/yd² = 33.9 g/m².

¹NR = Not recognized.

²Blended decks must consist of alternating one cellular unit to one or more fluted units. For use with trench headers, steel decks must be minimum Nos. 20/18 gages (minimum 0.034-inch/0.045-inch base-metal thickness) cellular and No. 20 gage (minimum 0.034-inch base-metal thickness) fluted. Burlap tape must be applied to steel deck joints with bituminous adhesive.

³Normal-weight concrete must have a minimum compressive strength of 3,000 psi, minimum unit weight of 147 pcf and utilizes either carbonate or siliceous aggregates. Structural sand-lightweight concrete must have a minimum compressive strength of 3,000 psi, a minimum unit weight of 109 pcf, 4 to 7 percent entrained air, and utilizes expanded shale clay or slate aggregate by rotary kiln method. Concrete must be vibrated. Concrete must encapsulate 6×6–W1.4×W1.4 welded-wire reinforcement, complying with ASTM A 185, when steel beams are used and 6×6–W2.9×W2.9 welded-wire fabric when steel joists are used.

⁴W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁵Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC and Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is 3/8 inch.

⁶Sprayed fire-resistive material must be applied directly to either the beam contour or a boxed beam formed with minimum 3.4 lb/sq. yd. expanded steel lath attached in an approved manner.

⁷Steel Joist Description: Top chord must be two angles, minimum 1½"×1½"×0.156"; bottom chord must be two round bars, minimum 0.675" diameter or two steel angles, minimum 1"×1"×0.125"; a second web member at each end must consist of 0.654" diameter round bar. All remaining web members, including the end web members, must consist of 0.774-inch diameter round bars. Bridging angles to be protected with same material thickness of fire protection as specified for the joist. Joists must be designed in accordance with Section 2206 of the IBC for a maximum design stress of 30 ksi.

⁸The sprayed fire-resistive material must be applied to contour of the joist. Optional 1.7 lb/sq. yard 3/8-inch diamond mesh steel lath or minimum 3/32-inch coated fiberglass fabric weighing 1.9 ounces per square yard may be attached to one side of each joist. When used, the method of attachment must be sufficient to hold the mesh or fabric and sprayed fire-resistive material in place during application and curing of the material. When used, the lath must be fully covered with fire-resistive material, but with no minimum thickness requirement. Glass fiber mesh is not required to be fully covered.

⁹When the steel joist's bottom chords consist of angles, the thickness of fire resistive material on the bottom chords only must be increased by ¼ inch to achieve a 1-hour fire-resistive rating.

¹⁰Allowable loads of the steel deck must be based on noncomposite design when trench headers are used.

TABLE 9—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB OR CAFCO 400 SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED FLOOR ASSEMBLIES (continued)

¹¹The thickness of the sprayed fire-resistive material required on the underside of the trench header must extend a minimum of 4 inches beyond each side of the trench header.

¹²For two- and three-hour fire-resistive unrestrained assembly ratings, ³/₈-inch ribbed, expanded steel lath weighing 3.4 pounds per square yard must be fastened to the underside of the steel deck under the trench header in an approved manner. The width of the lath must extend a minimum of 2 inches on both sides of the trench header.

¹³For one-hour fire-resistive unrestrained assembly rating, steel studs with discs must be applied to flat plates of cellular units under a trench header. Studs must consist of No. 12 gage galvanized smooth steel wire, 1¹/₄-inch long, with one end welded to 1¹/₂-inch diameter, No. 28 gage (minimum 0.014-inch base-metal thickness) galvanized steel disc. The total number of studs must average at least one stud per 250 sq in. The ends of the studs opposite the discs must be welded to the cellular units in rows parallel with the trench header. The distance between the outer rows of the studs and the edge of the trench header must not exceed 8¹/₂ inches. The spacing between the rows must not exceed 9¹/₂-inches. The spacing between studs in each row must not exceed 12 inches.

¹⁴Two-hour fire-resistive-rated assemblies with intermittent bottom trench headers must be limited to installations with normal-weight concrete.

¹⁵Sprayed fire-resistive material must be applied the entire width and length of floor units between supports and must extend beyond the edge of inserts for a horizontal width of 12 inches.

TABLE 10—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB or CAFCO 400. SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO BEAMS IN UNPROTECTED FLOOR ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING			
			4-Hour	3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)			
1	Floor Assembly: a. Minimum 1 ¹ / ₂ -inch-deep steel fluted floor units only, minimum No. 22 gage (0.028-inch base-metal thickness). b. Normal-weight or Structural Sand-lightweight Concrete Fill ² . c. Beam protection requires minimum 2 ¹ / ₂ inches of concrete over the top flute. d. Minimum concrete fill thickness for the floor assembly rating is a separate consideration ³ .	No fire-resistive material applied to the deck soffit.	—	—	—	—
2	Steel Beams ^{4,5,6,7}	Min. W8×67 (W/D ≥ 1.60)	1	³ / ₄	¹ / ₂	³ / ₈
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	1 ¹ / ₄	⁷ / ₈	⁵ / ₈	³ / ₈
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	1 ¹ / ₂	1 ¹ / ₈	³ / ₄	³ / ₈
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	2 ¹ / ₄	1 ⁵ / ₈	1	¹ / ₂
3	Steel Joists ^{7,8}	Steel Joist (See footnotes 9,10)	NR	2 ¹ / ₄	1 ³ / ₈	⁵ / ₈ (11)

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 pcf = 16.018 kg/m³, 1 lbm/yd.² = 542 g/m², 1 oz./yd.² = 33.9 g/m².

¹NR = Not recognized.

²Normal-weight concrete must have a minimum compressive strength of 3,000 psi, minimum unit weight of 150 pcf, and either carbonate or siliceous aggregates. Structural sand-lightweight concrete must have a minimum compressive strength of 3,000 psi and a minimum unit weight of 110 pcf. Concrete must encapsulate 6×6–W1.4×W1.4 welded-wire reinforcement, complying with ASTM A 185.

³Minimum concrete slab or fill thickness for the floor assembly and fire-resistive rating desired must comply with Sections 720 or 721.2.2.1 of the IBC, or Section 710.1 of the UBC or Section 7.708 of UBC Standard 7-7, as applicable, or with a current ICC-ES evaluation report.

⁴Sprayed fire-resistive material must be applied directly either to exposed beam contour or a boxed beam formed with minimum 3.4 lb/sq. yd. expanded steel lath attached in an approved manner.

⁵W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁶Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC and Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is ³/₈ inch.

⁷The fluted deck crest area above the beam or joist must be filled with the fire-resistive material.

⁸Steel Joist Description: Top chord must be two angles, minimum 1¹/₂"×1¹/₂"×0.156"; bottom chord must be two round bars, minimum 0.675" diameter or two angles, minimum 1"×1"×0.125"; end reaction bearing plates must be two angles, minimum 2"×2"×0.192"; minimum 4¹⁵/₁₆" long; and web members must be round bars, minimum 0.774" diameter, with a second web member at each end consisting of 0.654" diameter round bar. Design stress of joists must not exceed 30,000 psi. Bridging angles to be protected with same thickness of fire-protection material as specified for the joist.

⁹Metal lath or fiberglass scrim attached to one side of the steel joist is optional. When used, the metal lath must be minimum 1.7 pounds per square yard, ³/₈-inch diamond mesh metal lath, and the fiberglass scrim mesh must be minimum ³/₃₂-inch coated fiberglass scrim mesh weighing 1.9 ounces per square yard. Both the lath or mesh must be attached to one side of steel joist in an approved manner.

¹⁰Fire-protection material must be applied to joist following joist contour. If metal lath is used, lath is to be fully covered with fire-protection material with no minimum thickness requirement. If fiberglass mesh is used, mesh is not required to be fully covered.

¹¹When bottom chords consist of angles, the thickness of the sprayed fire-resistive material on the bottom chords only must be increased by ¹/₄ inch for the 1-hour fire-resistive-rated steel joist.

TABLE 11—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB OR CAFCO 400 SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED ROOF ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
Item	Description	Fire-resistive Material Applied to:	3-Hour	2-Hour	1-Hour
			Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
Roof Assembly A (Insulation Boards Applied over Gypsum Wallboard)					
A1	Roof Assembly ² : a. Minimum 1½-inch-deep fluted steel roof deck units, Minimum No. 22 gage (0.034-inch base-metal thickness). b. Vapor Retarder (Optional): Vinyl film or paper scrim vapor barrier, loose-laid or adhered to metal roof deck ³ . c. Cover Board ⁴ : Minimum 5/8-inch-thick Type X gypsum wallboard placed under the insulation board. d. Insulation Type ⁵ : • Polyisocyanurate Board: Minimum size of 36 by 48 inches. Minimum 1-inch thickness. Unlimited maximum thickness. • Mineral and Fiber Board: Minimum 1-inch thick for 1-hour rating. Minimum 2-inch thick for 2-hour rating. Unlimited maximum thickness. • Polystyrene Board: Minimum 1-inch thick. Unlimited maximum thickness. Maximum 2.5 pcf density. e. Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶	NR	1 1/8	1/2
A2	Steel Beams ^{7,8}	Min. W8×28 (W/D ≥ 0.80)	1 1/8	3/4	1/2
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1 1/4	7/8	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 5/8	1 1/8	5/8
A3	Steel Joists ⁹	Min. 10K1 Joist and Mid-span Bridging ¹⁰ (w/ or w/o scrim or lath) ¹¹	1 5/8	1 1/4	3/4
Roof Assembly B (Insulation Boards Applied Directly Over Steel Deck)					
B1	Roof Assembly ² : a. Minimum 1½-inch-deep fluted steel roof deck, minimum No. 22 gage (0.028-inch base-metal thickness). b. Vapor Retarder (Optional): Vinyl film or paper scrim vapor barrier, loose-laid or adhered to metal roof deck ³ . c. Insulation Type ⁵ : • Fiberglass Board: Minimum 3/4-inch thick for 1-hour rating. Minimum 1 3/4-inch thick for 2-hour rating. Maximum 4 7/8-inch thickness. • Mineral and Fiberboard: Minimum 2-inch thickness when single-ply membrane is used. Minimum 1-inch thickness when bituminous roof covering is used. Unlimited maximum thickness. d. Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶	NR	1 1/2	7/8
B2	Steel Beams ^{7,8}	Min. W8×28 (W/D ≥ 0.80)	NR	3/4	1/2
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	NR	7/8	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	NR	1 1/8	5/8
B3	Steel Joists ⁹	Min. 10K1 Joist and Mid-span Bridging ¹⁰ (w/ or w/o scrim or lath) ¹¹	NR	1 1/4	3/4

TABLE 11—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB OR CAFCO 400 SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO PROTECTED ROOF ASSEMBLIES (continued)

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
Roof Assembly C (Insulation Boards Applied Directly Over Steel Deck)					
C1	Roof Assembly ² : a. Minimum 1½-inch-deep fluted steel roof deck, minimum No. 22 gage (0.028-inch base-metal thickness). b. Vapor Retarder (Optional): Vinyl film or paper scrim vapor barrier, loose-laid or adhered to metal roof deck ³ . c. Insulation Type ⁵ : Polyisocyanurate Board: Minimum size of 36 by 48 inches. Minimum 2-inch thickness. Unlimited maximum thickness. d. Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Steel Deck ⁶	1 ⁷ / ₈	1 ⁷ / ₈ 1/2	7/8
C2	Steel Beams ^{7,8}	Min. W8×28 (W/D ≥ 0.80)	1 ¹ / ₈	7/8	1/2
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1 ¹ / ₄	7/8	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 ⁵ / ₈	1 ¹ / ₄	3/4
C3	Steel Joists ⁹	Min. 10K1 Joist and Mid-span Bridging ¹⁰ (w/ or w/o scrim or lath) ¹¹	1 ⁵ / ₈	1 ¹ / ₄	3/4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 lbm/ft.² = 4.882 kg/m², 1 pcf = 16.018 kg/m³, 1 lb./yd.² = 0.38 kg/m², 1 pound = 0.454 kg, 1 psi = 6.89 kPa.

¹NR = Not recognized.

²Insulation and roof-covering materials and methods of attachment are classified by Underwriters Laboratories Inc., and are recognized by a current ICC-ES evaluation report. Where foam plastic is used, it must be recognized in an ICC-ES evaluation report for the roof-covering system. The attachment of the vapor retarder, gypsum wallboard, insulation, and roof covering to resist wind uplift must be in accordance with the evaluation report for the roof covering assembly. Use of adhesives, asphalt or coal tar pitch, or mechanical fasteners does not adversely affect the tabulated fire-resistance ratings, provided the following limitations are met:

- Optional adhesive may be applied between crests of steel roof deck and gypsum wallboard, between gypsum wallboard and vapor retarder, between vapor retarder and first layer of insulation, and between layers of insulation. Applied in ½-inch-wide ribbons, 6 inches on center at 0.4 gal./100 sq. feet.
- Optional asphalt or coal tar pitch may be used to attach first layer of roof insulation to vapor retarder and each additional layer of roof insulation, applied at a maximum rate of 25 lb./sq. ft.
- Optional mechanical screw-type fasteners with metal washers designed for the purpose may be used to attach one or more layers of insulation to steel roof deck.

³When used, the vapor retarder must be overlapped approximately 2 inches on adjacent sheets.

⁴Gypsum wallboard, complying with ASTM C36, must have a minimum weight of 2.2 psf, and must be installed perpendicular to steel roof deck with adhesive, hot asphalt, or laid loosely. End joints must be staggered 2 feet in adjacent rows and occurring over crests of steel roof deck. Wallboard may be 2- or 4-foot wide.

⁵When more than one layer of insulation is used, each layer must be offset in both directions from the layer below a minimum of 6 inches.

⁶BOND-SEAL adhesive must be applied to the steel deck surfaces before application of the sprayed fire-resistive materials.

⁷W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁸Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is 3/8 inch.

⁹The design of the steel joists must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable. The 1-hour fire-resistance-rated steel joists described in Assembly A must be designed for a maximum tensile stress of 26,000 psi. All other steel joists must be designed for a maximum tensile stress of 30,000 psi. Bridging must consist of 1¼" × 1¼" × 1/8" (minimum) steel angles welded to top and bottom chords of each joist. The number and spacing of bridging angles must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable.

¹⁰Bridging must be coated with the same thickness of sprayed fire-resistive material as the joist.

¹¹Expanded metal lath or glass-fiber scrim (nonmetallic mesh) is optional. The fire-resistive material must be applied to joist contours. When metal lath or nonmetallic mesh is attached to the joists to catch overspray during application of the fire-resistive material to the steel joist contour, the metal lath must be covered with the fire-resistive material, but with no minimum thickness requirements. Glass-fiber scrim mesh is not required to be covered with sprayed fire-resistive material.

TABLE 12—CAFCO 300, CAFCO 300 ES, CAFCO 300 SB OR CAFCO 400 SPRAYED FIRE-RESISTIVE MATERIALS APPLIED TO UNPROTECTED ROOF ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)		
1	<p>Roof Assembly²:</p> <p>a. Fluted steel deck units, vented or nonvented units:</p> <ul style="list-style-type: none"> Minimum $1\frac{5}{16}$-inch deep, minimum No. 24 gage (0.023-inch base-metal thickness), maximum clear span of 7 feet, 8 inches; or, Minimum $1\frac{5}{16}$-inch deep, minimum No. 26 gage (0.017-inch base-metal thickness), maximum clear span of 6 feet, 0 inch. <p>b. Vermiculite Concrete, Perlite Concrete, or Cellular Concrete³:</p> <ul style="list-style-type: none"> Concrete slurry coat thickness must comply with footnote 4. Minimum 2-inch thick concrete topping above foam-plastic insulation boards. Combined thickness of cellular concrete slurry coat and topping must be minimum $2\frac{3}{8}$ inches. Concrete must encapsulate 4×8–W12×W14 WWR or 2×2–W14×W14 smooth WWR (Welded Wire Reinforcement) for the 2-hour rated assembly. <p>c. Insulation: Polystyrene foam-plastic insulation boards, maximum 8-inch thickness, nominal 1.0 pcf density for roof decks with perlite or cellular concrete, and nominal 2.5 pcf density for roof decks with vermiculite concrete. Each insulation board is 24" × 48", and must have six 3-inch diameter holes or slots symmetrically placed.</p> <p>d. Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.</p>	No fire-resistive material is applied to the steel deck soffit to achieve the 1-hour and 2-hour roof assembly fire-resistance ratings.	NR	0	0
2	Steel Beams ^{5,6}	Min. W8×28 (W/D ≥ 0.80)	$1\frac{5}{8}$	1	$\frac{1}{2}$
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	$1\frac{3}{4}$	$1\frac{1}{8}$	$\frac{1}{2}$
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	$2\frac{1}{4}$	$1\frac{1}{2}$	$\frac{5}{8}$
3	Steel Joists ^{7,8}	Min. 10K1	NR	$1\frac{7}{8}$	$1\frac{1}{8}$
		Joist Bridging: $1\frac{1}{4}$ " × $1\frac{1}{4}$ " × $\frac{1}{8}$ "	NR	$1\frac{7}{8}$	$1\frac{1}{8}$

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 MPa, 1 pcf = 16.018 kg/m³, 1 lb/yd² = 0.38 kg/m², 1 oz./yd.² = 33.9 g/m², 1 foot = 304.8 mm.

¹NR = Not recognized

²Insulation and roof-covering materials and methods of attachment are classified by Underwriters Laboratories Inc., and must be recognized in a current ICC-ES evaluation report.

³Vermiculite, perlite and cellular insulating concrete must be recognized in a current ICC-ES evaluation report and listed by UL. Vermiculite concrete is mixed with 6 cubic feet of UL-listed vermiculite aggregate to 94 pounds of portland cement and 0.06 to 0.5 pounds of air-entraining agent. Perlite concrete consists of 6 cubic feet of UL-listed perlite aggregate mixed with 94 pounds of portland cement and $1\frac{1}{2}$ pints of air-entraining agent. Cellular concrete is mixed per manufacturer's specifications in the evaluation report and has a minimum compressive strength of 190 psi.

⁴Concrete slurry coat thickness, which is measured from the top of the steel roof deck to bottom of foam plastic, must comply as follows:

- Vermiculite Concrete: Slurry coat thickness must be $\frac{1}{8}$ inch, except a slurry coat thickness of $\frac{5}{16}$ inch is required for two-hour fire-resistance-rated assemblies with $1\frac{5}{16}$ -inch-deep steel decks.
- Perlite and Cellular Concrete: Slurry coat thickness must be $\frac{1}{8}$ inch.

⁵W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁶Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is $\frac{3}{8}$ inch.

⁷The design of the steel joists must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable.

⁸Fire-resistive material must be applied to the steel joist following the joist contour. If metal lath is used, the lath must be fully covered with sprayed fire-resistive material with no minimum thickness requirement. If fiberglass mesh is used, mesh is not required to be fully covered. When used, the lath or mesh must be minimum $\frac{3}{8}$ -inch expanded steel lath or minimum $\frac{3}{32}$ -inch glass-fiber mesh weighing 1.7 lbs./sq. yd. and 1.9 oz./sq. yd., respectively. The lath or mesh is attached to one side of each joist web member.

TABLE 13—FENDOLITE® TYPE M-II SPRAYED FIRE-RESISTIVE MATERIAL APPLIED TO STEEL COLUMNS

STEEL COLUMN		W/D RATIO ¹ RANGE	A/P RATIO ²	FIRE-RESISTANCE RATING			
Structural Shape	Size			4-Hour	3-Hour	2-Hour	1-Hour
		Minimum Average Thickness of Sprayed Fire-resistive Materials (inches)					
Wide-flange Steel Columns ³	W14×730	W/D ≥ 6.68	—	1/2	1/2	3/8	3/8
	W14×233	2.49 ≤ W/D ≤ 6.67	—	1 1/4	1	5/8	3/8
	W12×106	1.46 ≤ W/D ≤ 2.48	—	1 7/8	1 3/8	1	1/2
	W10×49	0.83 ≤ W/D ≤ 1.45	—	2	1 5/8	1 1/4	5/8
	W8×28	0.67 ≤ W/D ≤ 0.82	—	2 3/8	1 7/8	1 3/8	3/4
	W6×16	0.57 ≤ W/D ≤ 0.66	—	2 3/4	2 1/8	1 3/8	3/4
	W6×12	0.43 ≤ W/D ≤ 0.56	—	2 7/8	2 1/4	1 1/2	7/8
Steel Hollow Structural Sections (HSS)	W6×9	0.33 ≤ W/D ≤ 0.42	—	3 1/8	2 3/8	1 3/4	1
	HSS8×8×5/8	—	0.546	1 3/4	1 1/4	7/8	1/2
	HSS4×4×1/2	—	0.418	2 1/8	1 5/8	1	1/2
	HSS4×4×3/8	—	0.323	2 3/8	1 3/4	1 1/8	5/8
	HSS4×4×5/16	—	0.273	2 1/2	1 7/8	1 1/4	5/8
Steel Pipe	HSS4×4×3/16	—	0.168	2 5/8	2 1/8	1 1/2	1
	Standard Weight (Std.)	4 × 0.237	—	0.22	2 7/8	2 1/8	1 1/2
	Extra Strong (X-Strong)	6 × 0.432	—	0.40	2 7/8	1 5/8	1 1/8

For SI: 1 inch = 25.4 mm; 1 lb/sq.yd. = 0.38 kg/m²

¹W/D = Weight-to-heated-perimeter ratio according to Section 721.5.1.1.3 of the IBC or Section 7.703.1 of UBC Standard 7-7, as applicable.

²A/P = Cross-sectional-area-to-heated-perimeter ratio, where A is the cross-sectional area of the structural steel column in square inches and P is the inside perimeter of the fire-resistive material in inches.

³Fire-resistive protection may be applied directly to the wide-flange steel column contour (contour profile) or column boxed with minimum 1.7 lbs. per sq. yd. metal lath (box profile).

TABLE 14—FENDOLITE® TYPE M-II SPRAYED FIRE-RESISTIVE MATERIAL APPLIED TO PROTECTED FLOOR ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
Item	Description	Fire-resistive Material Applied to:	3-Hour	2-Hour	1-Hour
			Minimum Average Thickness of Sprayed Fire-resistive Material (inches)		
1	Floor Assembly: a. All fluted, all cellular, or combination fluted/cellular steel decking: • 1 1/2-inch or 1 5/8-inch deep. • Fluted units: Minimum No. 22 gage (0.028-inch base-metal thickness), 24 inches wide. • Cellular units: Minimum Nos. 20/20 gage (0.034-inch base-metal thickness), 24 inches wide. b. Metal lath fastened to underside of steel decking ¹ . c. Normal-weight concrete ² fill, minimum 2 1/2-inch thick over top flutes of steel floor decking.	Metal Lath ³ (Fastened to Underside of Steel Decking)	5/8	5/8	5/8
2	Wide-flange Steel Beams ^{4,5,6,7}	Min. W10×60 (W/D ≥ 1.20)	3/4	5/8	3/8
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	1	3/4	1/2
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1 1/8	3/4	1/2
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 1/2	1	3/4

For SI: 1 inch = 25.4 mm, 1 lb./sq. yd. = 0.38 kg/m²; 1 psi = 6.89 Mpa; 1 pcf = 16.018 kg/m³.

¹Three-eighths-inch expanded metal lath, weighing 2.5 lb./sq. yd., must be fastened to the underside of the floor decking units with No. 12 by 1-inch-long self-drilling tapping screws, with high-low threads and a flat head; or with approved powder-actuated steel fasteners, having a minimum length of 1 1/4 inches and a minimum shank diameter of 0.145 inch, and 1/16-inch thick by 1/2-inch diameter steel washers. Fasteners must be spaced 12 inches on center in both directions. Fasteners must be installed only to valley portion of the floor units and must not penetrate the cell areas of the cellular floor units. Adjacent pieces of lath must be overlapped 3 inches.

²Normal-weight concrete must have a minimum compressive strength of 4,000 psi and a minimum unit weight of 150 pcf, and contain carbonate or siliceous aggregate. Concrete must encapsulate minimum 6×6–W1.4×W1.4 smooth welded-wire reinforcement complying with ASTM A 185.

³Thickness of sprayed fire-resistive material beneath floor units must be measured to face of lath.

⁴W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁵Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the sprayed fire-resistive material is 3/8 inch.

⁶Sprayed fire-resistive material must be applied directly to either the beam contour or a boxed beam formed with minimum 2.5 lb./sq. yd. expanded steel lath attached in an approved manner.

⁷voids above steel beams must be filled with fire-resistive material.

TABLE 15— FENDOLITE TYPE M-II SPRAYED FIRE-RESISTIVE MATERIAL APPLIED TO UNPROTECTED FLOOR ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING			
Item	Description	Fire-resistive Material Applied to:	4-Hour	3-Hour	2-Hour	1-Hour
			Minimum Average Thickness of Sprayed Fire-resistive Material (inches)			
1	Floor Assembly: a. 1½-inch to 3-inch deep steel decking: • Fluted or corrugated floor units, minimum No. 22 gage (0.028-inch base-metal thickness). • Cellular floor units, minimum Nos. 20/20 gage (0.034-inch base-metal thickness). b. Normal-weight or lightweight concrete fill ¹ c. Beam protection requires minimum 2½ inches of concrete over the top flute. d. Minimum concrete fill thickness for the floor assembly rating is a separate consideration ² .	No fire-resistive material applied to the deck soffit.	—	—	—	—
2	Steel Beams ^{3,4,5,6} (Supporting fluted, cellular, or combination fluted/cellular steel decking)	Min. W8×67 (W/D ≥ 1.60)	1⅛	1	¾	⅜
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	⅜	¼	⅞	⅜
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	¾	½	⅞	½
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	⅝	¼	½	¼
3	Steel Beams ^{3,4,5,6} (Supporting fluted or corrugated steel decking)	Min. W8×67 (W/D ≥ 1.60)	1	⅞	⅝	⅜
		Min. W10×60 (1.20 ≤ W/D ≤ 1.59)	¼	⅞	¾	⅜
		Min. W8×28 (0.80 ≤ W/D ≤ 1.19)	½	⅞	1	⅜
		Min. W8×10 (0.37 ≤ W/D ≤ 0.79)	¼	2	⅞	⅝

For SI: 1 inch = 25.4 mm. 1psi = 6.89 kPa; 1pcf = 16.018 Kg/m³; 1 lb/sq.yd. = 0.38 kg/m².

¹Normal-weight concrete must have a minimum compressive strength of 3,500 psi, unit weight of 147 pcf, and either carbonate or siliceous aggregates. Lightweight concrete must have a minimum compressive strength of 3,000 psi and a unit weight of 107 pcf. Concrete must encapsulate 6×6–W1.4×W1.4 smooth welded-wire reinforcement complying with ASTM A 185.

²Minimum concrete slab or fill thickness for the floor assembly and fire-resistive rating desired must comply with Sections 720 or 721.2.2.1 of the IBC, or Section 710.1 of the UBC or Section 7.708 of UBC Standard 7-7, as applicable, or with a current ICC-ES evaluation report.

³Sprayed fire-resistive material must be applied directly either to exposed beam contour or a boxed beam formed with minimum 3.4 lb/sq. yd. expanded steel lath attached in an approved manner.

⁴W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁵Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC or Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is ⅜ inch.

⁶The deck crest area above the beam must be filled with the sprayed fire-resistive material.

TABLE 16—FENDOLITE® TYPE M-II SPRAYED FIRE-RESISTIVE MATERIAL APPLIED TO PROTECTED ROOF ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING	
			2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material ¹ (inches)	
1	Roof Assembly ² : a. Minimum 1 1/2-inch-deep fluted steel roof deck; Minimum No. 22 gage (0.028-inch base-metal thickness), with 3.4 lb/sq yd metal lath attached to the underside of the steel deck ³ . b. Cover Board ⁴ (optional): When required, minimum 5/8-inch-thick Type X gypsum wallboard, adhered or fastened to the roof deck, placed under insulation board. c. Insulation Type ^{5,6} : Polyisocyanurate foam-plastic insulation board. Required minimum thickness as indicated in this table. No limit on maximum overall thickness. d. Roof Covering: Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	Metal Lath attached to Steel Deck ⁷ (min. 2-inch thick insulation w/ gyp. board)	1 1/4	5/8
		Metal Lath attached to Steel Deck ⁷ (min. 1-inch thick insulation w/ gyp. board)	1 3/8	5/8
		Metal Lath attached to Steel Deck ⁷ (min. 0-inch thick insulation w/ gyp. board)	1 5/8	3/4
		Metal Lath attached to Steel Deck ⁷ (min. 3-inch thick insulation w/ or w/o gyp. board)	2 1/8	7/8
		Metal Lath attached to Steel Deck ⁷ (min. 2-inch thick insulation w/ or w/o gyp. board)	2 3/8	1
		Metal Lath attached to Steel Deck ⁷ (min. 1-inch thick insulation w/ or w/o gyp. board)	3 1/4	1 1/4
		Metal Lath attached to Steel Deck ⁷ (min. 0-inch thick insulation w/ or w/o gyp. board)	3 1/4	2 1/8
2	Wide-flange Steel Beams ^{8,9} (with or without gypsum wallboard on steel roof deck)	Min. W8×28 (W/D ≥ 0.80)	1	5/8
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	1	3/4
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	1 3/8	1
3	Steel Joists ^{10,11,12} (with or without gypsum wallboard on steel roof deck)	Min. 10K1 and mid-span bridging	1 3/4	NR
		Min. 12K3 and mid-span bridging	1 3/4	1 1/8

For SI: 1 inch = 25.4 mm, 1 lb./sq. yd. = 0.38 kg/m³; 1 gal/100 sq.ft = 0.41 liter/m²; 1 oz./sq.yd. = 0.0119kg/m²; 1 lb/100 sqft = 0.05 kg/m².

¹NR = Not recognized.

²Insulation and roof-covering materials and methods of attachment are classified by Underwriters Laboratories Inc., and are recognized by a current ICC-ES evaluation report. Where foam plastic is used, it must be recognized in an ICC-ES evaluation report for the roof-covering system. The attachment of the vapor retarder, gypsum wallboard, insulation, and roof covering to resist wind uplift must be in accordance with the evaluation report for the roof covering assembly. Use of adhesives, asphalt or coal tar pitch, or mechanical fasteners does not adversely affect the tabulated fire-resistance ratings, provided the following limitations are met:

- Optional adhesive may be applied between crests of steel roof deck and gypsum wallboard, between gypsum wallboard and vapor retarder, between vapor retarder and first layer of insulation, and between layers of insulation. Applied in 1/2-inch-wide ribbons, 6 inches on center at 0.4 gal./100 sq. feet.
- Optional asphalt or coal tar pitch may be used to attach the vapor retarder or the first layer of roof insulation to the steel crest surfaces at a maximum rate of 15 lbs/100 sq ft. Also, optional asphalt or coal tar pitch may be used to attach the first layer of insulation to the vapor retarder and each additional layer of roof insulation, applied at a maximum rate of 25 lbs/100 sq ft.
- Optional mechanical screw-type fasteners with metal washers designed for the purpose may be used to attach one or more layers of insulation to steel roof deck.

³Three-eighths-inch expanded metal lath, weighing 3.4 lb./sq. yd., must be fastened to the underside of the steel decking units with No. 12 by 1-inch-long self-drilling tapping screws, with high-low threads, a flat head, and 1/2-inch diameter steel washers; or with approved powder-actuated steel fasteners, having a minimum length of 1 1/4 inches and a minimum shank diameter of 0.145 inch, and 1/16-inch thick by 1/2-inch diameter steel washers. Fasteners must be spaced 12 inches on center in both directions. Lath edges must overlap approximately 3 inches.

⁴Gypsum wallboard must have a minimum weight of 2.2 psf, and must be minimum 4 ft. wide and installed perpendicular to the flutes of the steel roof deck with end joints staggered 2 ft. in adjacent rows and occurring over crests of steel roof deck.

⁵A vapor barrier may be installed.

⁶Minimum insulation board size is 36 inches by 48 inches. When more than one layer of insulation is used, each layer must be offset in both directions from the layer below a minimum of 6 inches.

⁷Thickness of sprayed fire-resistive material beneath floor units must be measured to face of lath.

⁸W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁹Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC and Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is 3/8 inch.

¹⁰Use of expanded metal lath or glass-fiber fabric (scrim mesh) is optional on steel joists. When used, the expanded metal lath must weigh minimum 1.7 lb/sq yd, and the glass fiber fabric must weigh approximately 1.9 oz per sq. yd., and must be fastened to the webs of the joists in an approved manner. When metal lath is attached to the joists, both sides of the lath must be completely coated with sprayed fire-resistive materials with no minimum thickness. Glass-fiber scrim mesh is not required to be covered with sprayed fire-resistive material.

¹¹Bridging must be coated with the same thickness of sprayed fire-resistive material as the joist. Bridging must be welded to top and bottom chords of each joist at midspan.

¹²The design of the steel joists must comply with Section 2206 of the IBC or Section 2221 of the UBC, as applicable.

TABLE 17—FENDOLITE® TYPE M-II SPRAYED FIRE-RESISTIVE MATERIAL APPLIED TO UNPROTECTED ROOF ASSEMBLIES

ASSEMBLY ELEMENT			FIRE-RESISTANCE RATING		
			3-Hour	2-Hour	1-Hour
Item	Description	Fire-resistive Material Applied to:	Minimum Average Thickness of Sprayed Fire-resistive Material (inches)		
1	Roof Assembly: a. Corrugated or fluted steel deck units: $\frac{9}{16}$ -, $\frac{15}{16}$ -, $1\frac{5}{16}$ - or $1\frac{1}{2}$ -inch-deep galvanized vented or nonvented units. b. Vermiculite Concrete, Perlite Concrete, or Cellular Concrete ¹ : • Vermiculite Concrete: Beam protection requires minimum $2\frac{1}{4}$ -inch thick concrete topping above crests of steel deck units. • Perlite or Cellular Concrete: Beam protection requires minimum $2\frac{3}{4}$ -inch thick concrete topping above crests of steel deck units. • Concrete must encapsulate 4×8–W12×W14 or 2×2–W14×W14 smooth welded wire reinforcement ² . c. Minimum concrete fill thickness for fire-resistance rating of unrestrained roof assemblies is a separate consideration ³ , except as noted in footnote 3. d. Roof Covering ⁴ : Hot-mopped or cold-applied Class A, B or C bituminous roof covering; or ballasted, adhered or mechanically attached Class A, B or C single-ply roof covering.	No fire-resistive material is applied to the steel deck.	—	— ⁽³⁾	— ⁽³⁾
2	Steel Beams ^{5,6}	Min. W8×28 (W/D ≥ 0.80)	$2\frac{3}{8}$	$1\frac{1}{4}$	$\frac{5}{8}$
		Min. W6×16 (0.66 ≤ W/D ≤ 0.79)	$2\frac{5}{8}$	$1\frac{1}{2}$	$\frac{5}{8}$
		Min. W8×10 (0.37 ≤ W/D ≤ 0.65)	$3\frac{3}{8}$	$1\frac{7}{8}$	$\frac{7}{8}$

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1ft³ = 0.0283m³, 1 lb = 0.45kg.

¹Vermiculite, perlite and cellular insulating concrete must be recognized in a current ICC-ES evaluation report and listed by UL. Vermiculite concrete is mixed with 6 cubic feet of UL-listed vermiculite aggregate to 94 pounds of portland cement and 0.06 to 0.5 pounds of air-entraining agent. Perlite concrete consists of 6 cubic feet of UL-listed perlite aggregate mixed with 94 pounds of portland cement and $1\frac{1}{2}$ pints of air-entraining agent. Cellular concrete is mixed per manufacturer’s specifications in the ICC-ES evaluation report and has a minimum compressive strength of 190 psi.

²The smooth welded wire reinforcement, complying with ASTM A 185, may be omitted for the 1-hour fire-resistance rated roof assemblies when the flexural design stress of the steel decking is limited to 75 percent of its bending capacity.

³No sprayed fire-resistive material is required on the underside of the steel deck for an unrestrained roof assembly fire-resistance rating of 2 or 1 hours, provided the following conditions are met:

- Minimum $1\frac{5}{16}$ -inch deep corrugated or fluted steel decking is used, having a minimum thickness of No. 24 gage (minimum 0.023-inch base-metal thickness), and
- Minimum concrete thickness complies with item 1b in the table, and
- Maximum clear span of the steel deck units is 7 feet, 7 inches.

⁴Roof-covering materials and methods of attachment are classified by Underwriters Laboratories Inc., and must be recognized in a current ICC-ES evaluation report. Where foam plastic is used, it must comply with the requirements set forth in the ICC-ES evaluation report for the roof covering material.

⁵W/D = Weight-to-heated-perimeter ratio according to Section 721.5.2.1.1 of the IBC or Section 7.704.1.1 of UBC Standard 7-7, as applicable.

⁶Thickness of sprayed fire-resistive material applied to wide-flange steel beams may be calculated according to Section 721.5.2.2 of the IBC and Section 7.704.1.2 of UBC Standard 7-7, provided the minimum W/D ratio is 0.37 and the minimum thickness of the fire-resistive material is $\frac{3}{8}$ inch.