



Office of Education
and Data Management

Fall 2017
Career Development


December

Passive Fire Protection Features

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Passive Fire Protection Features
Based on the 2015 IBC




Connecticut Career Development Training
November-December 2017

Bruce E. Johnson
UL Codes and Advisory Services

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Objectives

- At the end of this presentation, you will:
 - Understand the intent and purpose behind *fire resistive construction*
 - Understand the 2015 IBC Chapter 7 code requirements, testing procedures, plan review requirements and inspection practices relating to *fire resistive construction*



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Objectives Cont.

- Understand the code requirements, testing procedures, plan review requirements and inspection practices relating to the **protection of penetrations**
- Understand the 2015 IBC Chapter 7 requirements for protecting penetrations (firestop systems)



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Objectives Cont.

- Be able to navigate UL's Product Spec™ and Installation Code Link in order to identify *listed* products and assemblies which demonstrate compliance with the requirements of the 2015 *International Building Code*.
 - *Fire resistance-rated* Building Elements
 - *Fire protection-rated* Firestop Systems



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Agenda

- A brief IBC Basics Review
- Fire-Resistance-Rated Construction
 - Definitions
 - International Building Code Requirements
 - Establishing *Fire-Resistance* Ratings
 - Permitted Changes to UL Designs



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Agenda Cont.

- Through and Membrane-Penetration Firestop Systems
- Plan Review and Inspection Process
- Methods of Showing Code Compliance
- Engineering Judgments
- Navigating the UL Directories & UL's Online Resources for Code Compliance
- Summary and Closing



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Questions / Comments



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IBC Basics

Some Fundamentals



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Use of the IBC

- *Definitions* – Chapter 2
- Occupancy Classification
- Use of Tables – Scoping Section
- Table Footnotes
- Code Exceptions
- Reference Standards
- Index and Glossary
- Identifying Changes in Code Text

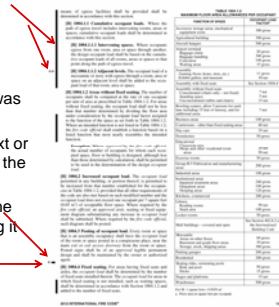


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Identifying Changes in Code Text

Margin markings:

- Vertical lines indicate new or revised text
- Arrows indicate that an entire sentence, paragraph or Section was deleted
- ★ A single asterisk indicates that text or a table has been relocated within the code
- ★★ A double asterisk indicates that the text or table immediately following it has been relocated there from elsewhere in the code

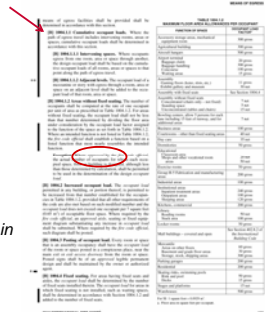


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Identifying Changes and the Responsibility of Code Development

Margin markings:

- Letters in brackets indicate the Section is maintained by another code development committee
- [B] is the Building Code Development Committee
- [M] is Mechanical Code
- *Terms set forth in Chapter 2 – Definitions are italicized*
- *If not italicized, then the definition in Chapter 2 does not impart the intended meaning*

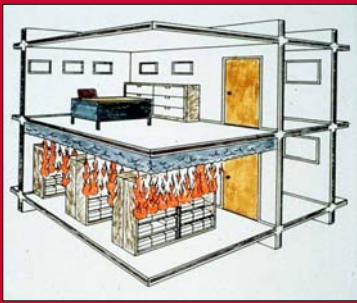


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Questions / Comments



Fire-Resistance-Rated Construction



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Passive Fire Protection

The IBC takes a systematic approach to building fire protection, including:

1. Passive Fire Protection

Fire Area = The aggregate floor area enclosed and bounded by *fire walls, fire barriers, exterior walls or horizontal assemblies* of a building.

2. Active Fire Protection

Fire Protection System = Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof.

3. Reasonable level of redundancy; inspection, testing & maintenance



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More Definitions

- *Fire-resistance* - That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use. (IBC)



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Definitions Cont.

- *Fire-resistance rating* - The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 703.3 (IBC)
 - Passage of Flames
 - Heat Transmission
 - Structural Integrity



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Definitions Cont.

- *Fire-protection rating* - The period of time that an opening protective will maintain the ability to confine a fire as determined by tests prescribed in Section 715. Ratings are stated in hours or minutes. (IBC)
 - Passage of Flames
 - Structural Integrity



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Standards Writing Organizations

American National Standards Institute (ANSI)

- ASTM International (ASTM)
- FM Global (FM)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories (UL)



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Questions / Comments



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Fire-Resistance-Rated Construction

International Building Code Requirements for Fire-Resistance-Rated Construction



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Code Requirements

- Chapters 3, 4, 5, 6, 7 and 10 of the IBC
- Chapters 3 and 4 – Defines Occupancies
- Chapter 5 – General Building Heights and Areas
 - Permitted building area based on four factors:
 - Type of construction
 - Occupancy
 - Available frontage
 - Use of sprinklers



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Code Requirements Cont.

- Section 508 – Covers mixed use considerations
- Chapter 6 – Types of Construction
 - Table 601 – Establishes hourly rating required for building elements based on Type of Construction
- Chapter 7 – Fire and Smoke Protection Features



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Code Requirements Cont.

- 703.2 – *Fire-resistance ratings* shall be determined in accordance with ASTM E 119 or UL 263
- 703.2.1 – Nonsymmetrical walls shall be tested from both faces
- 703.2.3 – Assemblies considered **unrestrained** unless registered design professional provides evidence satisfactory to AHJ that construction qualifies for restrained classification per ASTM E 119 or UL 263



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Code Requirements Cont.

- 703.3 – Methods for determining *fire resistance* shall be based on fire exposure and acceptance criteria of ASTM E 119 or UL 263



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Code Requirements Cont.

- 703.3 Cont. – Required *fire resistance* permitted to be established based on any of the following:
 1. Designs documented from *approved* sources
 2. Prescriptive requirements from Section 721
 3. Calculations in accordance with Section 722
 4. **Engineering analysis based on ASTM E 119 or UL 263**
 5. Alternative protection methods as allowed in Section 104.11
 6. **Fire-resistance designs certified by an approved agency.**



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Code Requirements Cont.

- Breaches of assemblies shall be protected in accordance with Sections 712, 713, 714, 715 and 716
- Chapter 10 – Means of Egress
 - Table 1020.1– Establishes hourly rating required for corridors based on Occupancy Group



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Fire Resistance

- Expressed as an Hourly Time Period
- Ratings range from 1/2 to 4 hours
- Containment of fire to room or floor of origin (horizontal and vertical compartmentalization)



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Questions / Comments



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Fire-Resistance-Rated Construction

Establishing
Fire-Resistance
Ratings



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Standards

- ANSI / UL 263
- ASTM E 119
- NFPA 251 (Withdrawn)



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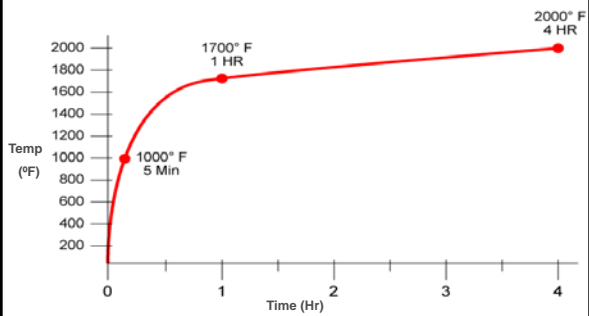
Building Components

- Columns
- Beams
- Floor/Ceilings (F/C) or Roof/Ceilings (R/C)
- Walls



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Time - Temperature Curve



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Columns

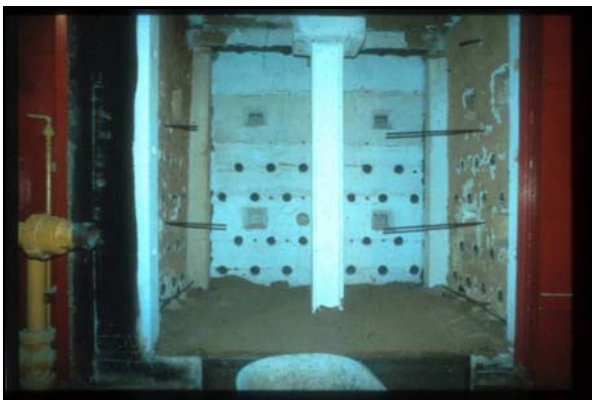
- Sample size – Minimum 9 ft
- Tested unloaded



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Conditions of Acceptance – Columns

- 1000°F / 1200°F



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Beams

- Sample size – Minimum 12 ft
- Load applied – Per design



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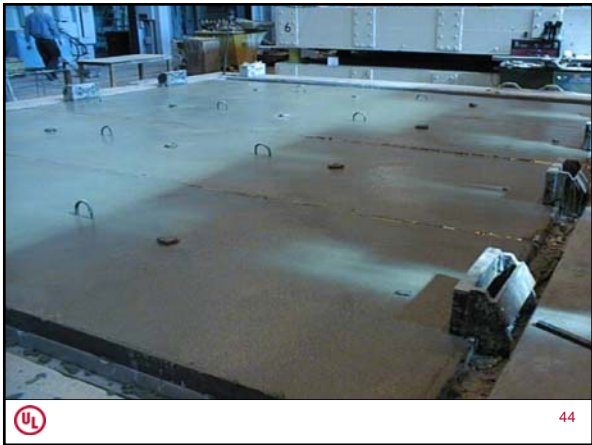


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Conditions of Acceptance – Beams

- Support load
- 1100°F / 1300°F



47

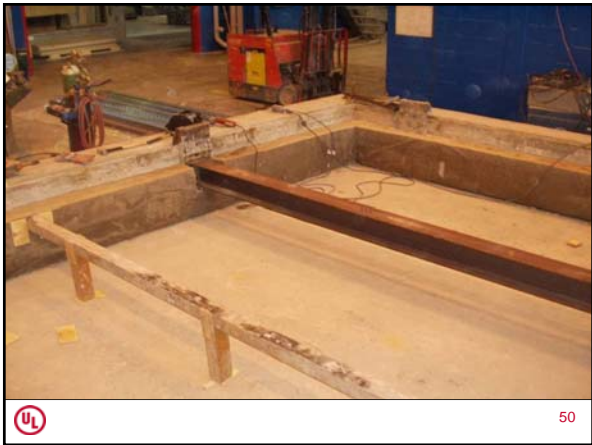
Floor/Ceiling or Roof/Ceilings

- Sample size – 180 sq ft / 12 ft
- Load applied – Per design



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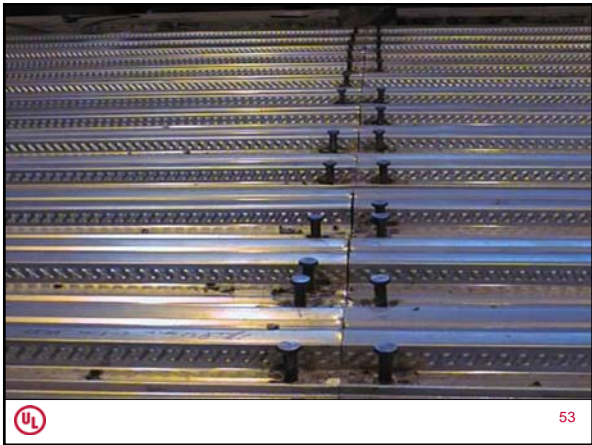








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Conditions of Acceptance
Floor/Ceilings or Roof/Ceilings

- Support load
- Flame passage
- 250°F / 325°F
- Support temperatures (beams) 1100°F / 1300°F

▶

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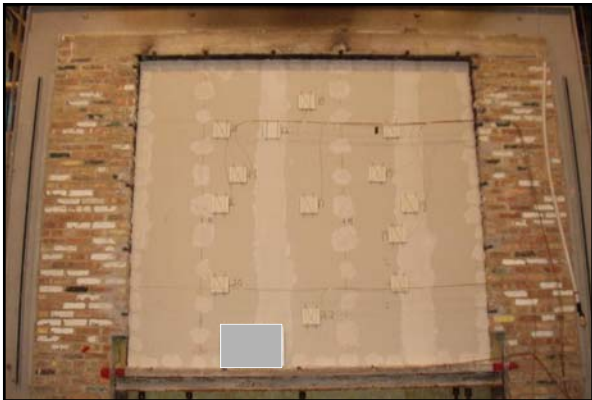


Walls

- Sample size - 100 sq ft / 9 ft
- Load applied - Per design



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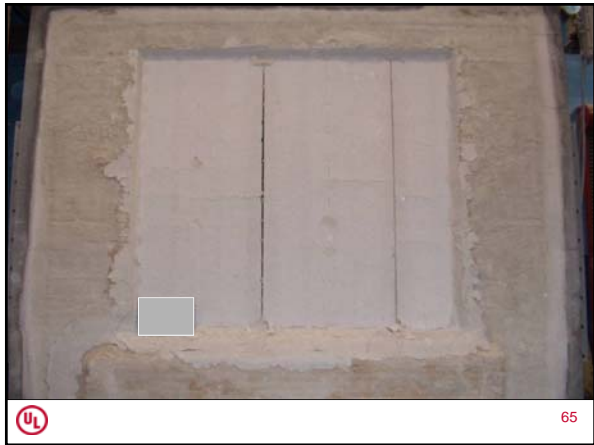


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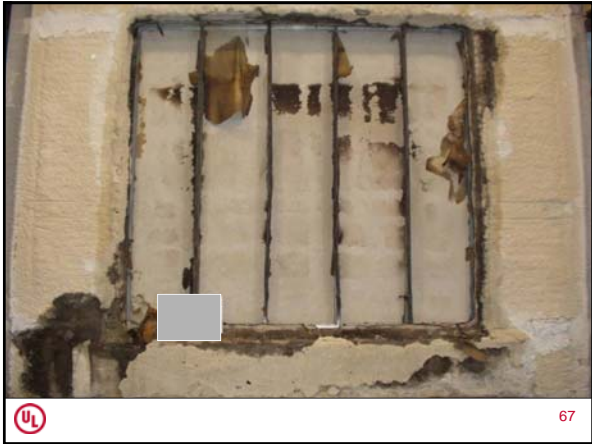


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Conditions of Acceptance – Walls

- Flame passage
- 250°F / 325°F
- Support load
- Hose stream (2 ½ minutes at 30 psi)



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Questions / Comments



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Fire-Resistance-Rated Construction

Methods of Showing Code Compliance



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Methods of Showing Compliance with the Fire Resistance Requirements of the IBC

- 703.2 – *Fire-resistance* ratings shall be determined in accordance with ASTM E 119 or UL 263
- 703.3 – Methods for determining *fire resistance* shall be based on fire exposure and acceptance criteria of ASTM E 119 or UL 263



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Methods of Showing Compliance with the Fire Resistance Requirements of the IBC

- 703.3 Cont. – Required fire resistance permitted to be established based on any of the following:
 - Designs documented from approved sources
 - Prescriptive requirements from Section 721
 - Calculations in accordance with Section 722
 - Engineering analysis based on ASTM E 119 or UL 263
 - Alternative protection methods as allowed in Section 104.11
 - Fire-resistance designs certified by an approved agency



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**Designs Documented
From Approved Sources**

- Product Directories of Nationally Recognized Testing Laboratories
 - UL - *Fire Resistance Directory, Fire Resistance Directory on CD-ROM and Online Certifications Directory*
 - Intertek – *Intertek Directories of Certified Products*
 - FM Global - *Factory Mutual Approval Guide*



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**Designs Documented
From Approved Sources Cont.**

- Gypsum Association - *Fire Resistance Design Manual*
- American Insurance Services Group, Inc. (210) 469 – 3922 - *Fire Resistance Ratings*
- BOCA - *Guidelines for Determining Fire Resistance Ratings of Building Elements*



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**Designs Documented
From Approved Sources Cont.**

- ASCE / SFPE 29 – *Standard Calculation Methods for Structural Fireproofing*
- ACI 261.1 / TMS 0216.1 – *Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies*



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Fire-Resistance Rating of Structural Members

Covered in IBC Section 704

- Comply with IBC 601 based on Construction Type
- Column and primary structural frame protection
- Secondary structural member protection (new)
 - Light-frame construction
 - Horizontal assemblies
- Truss protection



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Fire-Resistance Rating of Structural Members

Continuation of IBC Section 704 Requirements

- Attachments to structural members
- [Connections \(CT addition 704.6.1\)](#)
- Impact protection
- Exterior load-bearing structural members
- Seismic isolation systems



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Fire-Resistance Rating of Structural Members

Continuation of IBC Section 704 Requirements

- Sprayed fire-resistant materials (SFRM)
 - Application and manufacturer's instructions
 - Surface conditions
 - Primers, paints and encapsulants
 - Temperature
 - Finished condition



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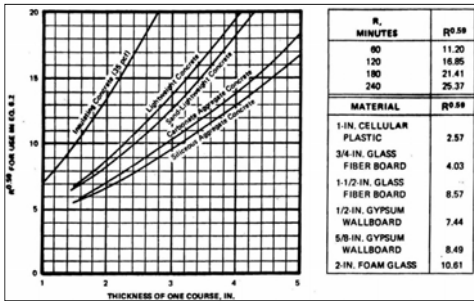
Prescriptive Fire Resistance Section 721 of the IBC

3. Bonded prestensioned reinforcement in prestressed concrete ^a	3-1.1	Carbonate, lightweight, sand-lightweight and siliceous ^d aggregate concrete	4h	3h	2½h	1½h
		Beams or girders				
		Solid slabs ^b	2	1½	1	



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Calculated Fire Resistance Section 722 of the IBC



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Engineering Analysis Based on ASTM E 119 or UL 263

- Engineering judgments
 - Product manufacturer
 - Testing laboratory
 - Fire protection engineer
 - Professional engineer



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Alternate Materials, Design and Methods of Construction and Equipment

- Allows authority having jurisdiction to accept other information to show compliance
 - Evaluation Services Reports
 - IAPMO Evaluation Services
 - ICC Evaluation Services
 - UL Evaluation Services



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Questions / Comments



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Organization Under Each Product Area

- Guide Information
- Designs, Systems or Assemblies
- Product Categories (indexed by manufacturer's names)



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Guide Information

- Equipment, materials or systems included in the Category
- Intended use, restrictions or supplemental information that apply
- Standard(s) used to evaluate products under the Category
- Listing or Classification Mark information for the Category



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NUMBERING SYSTEM FOR FIRE-RATED ASSEMBLIES

Group of Construction	TYPES OF PROTECTION									
	Membrane Protection					Direct-applied Protection				
	000-099	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999
Floors, Ceilings, A or B Concrete and Cellular Steel Floor	Concrete Gird System	(Reserved)	Exposed Gird System	(Reserved)	Metal Lath	Gypsum Board	Misc.	Spray-applied Fire-resistant Material	(Reserved)	Unprotected
C - Gazing Systems	(Reserved)	(Reserved)	(Reserved)	(Reserved)	(Reserved)	(Reserved)	(Reserved)	(Reserved)	(Reserved)	Unprotected
D, E* or F** Concrete and Steel Floor Units	Concrete Gird System	(Reserved)	Exposed Gird System	Mineral and Fiber Boards	Metal Lath	Gypsum Board	Mastic and Intumescent Coatings	Spray-applied Fire-resistant Material	(Reserved)	Unprotected
G or H* Concrete and Steel Joists	Concrete Gird System	(Reserved)	Exposed Gird System	Mineral and Fiber Boards	Metal Lath	Gypsum Board	Misc.	Spray-applied Fire-resistant Material	(Reserved)	Unprotected
Non-load-bearing masonry Banner	(Reserved)	(Reserved)	(Reserved)	(Reserved)	(Reserved)	Gypsum Board	(Reserved)	(Reserved)	(Reserved)	(Reserved)
J or K Concrete	Concrete Gird System	(Reserved)	Exposed Gird System	Mineral and Fiber Boards	Metal Lath	Gypsum Board	Misc.	Spray-applied Fire-resistant Material	(Reserved)	Unprotected
L or M Wood-Joist or Combination Wood and Steel	Concrete Gird System	(Reserved)	Exposed Gird System	(Reserved)	Metal Lath	Gypsum Board	Misc.	Spray-applied Fire-resistant Material	(Reserved)	Unprotected



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Designs

- Each design contains specific construction features
- Many designs contain various options and various ratings
- Must be followed exactly for rating to apply



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Questions / Comments



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Fire Resistance-Rated Construction

Permitted
Changes to
Designs



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Guide Information

- Equipment, materials or systems included in the Category
- Intended use, restrictions or supplemental information that apply
- Standard(s) used to evaluate products under the Category
- Listing or Classification Mark information for the Category



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Fire-resistance Ratings - ANSIFUL 263, BXUV

Guide Information for Fire-resistance Ratings

Design Information Section

The Design Information Section supplements the individual published designs and is organized as follows:

I. INTRODUCTION

1. Rapid-rise Fire Test	
2. Definitions	


II. GENERAL

1. Metric Dimensions	12. Dampers
2. Loading of Test Specimens	13. Wood Structural Panels
3. Finish Ratings	14. Blanket Insulation
4. Nails and Screws	15. Sound Transmission Class (STC)
5. Interior and Exterior Applications	16. Impact Insulation Class (IIC)
6. Exposed Interior Finishes	17. Penetrations
7. Radiant Heating Cable and Panels	18. Curtain Wall/Floor Protection Systems
8. Coating Materials	19. Fire-resistant Joint Systems
9. Gypsum Board	20. Fire Doors, Frames and Hardware
10. Gypsum Board Joint Treatment (Taping)	21. Glazing, Wired Glass and Glass Blocks
11. Plaster	22. Exterior Wall Systems

III. FLOOR/CEILINGS AND ROOF/CEILINGS


1. Partitions

19. Exterior and Structural Elements (Partitions)

 91


Fasteners

- Cement coated box or cooler nails shall be used for securing gypsum board, unless otherwise specified in design
- Screws meeting ASTM C 1002 or C 954 may be substituted for nails providing head diameter and length are equal or larger than specified nail

 92

Primers with SFRM

- May be applied to primed structural elements providing:
 - Beam flange width shall not exceed 12 inch
 - Column flange width shall not exceed 16 inch
 - Web depth shall not exceed 16 inch
 - Pipe diameter or tube width shall not exceed 12 inch
 - Bond tests conducted to ASTM E 736
 - Average > 80% of uncoated steel and individual > 50% of uncoated steel, or
 - Wrap member with metal lath

 93

Concrete in Horizontal Assemblies

- Compressive strength specified may be reduced 500 psi
- Unit weight tolerance 3 pcf
- Do not substitute lightweight concrete if normal weight specified
- Do not substitute normal weight concrete if lightweight specified



94

Outlet Boxes in Ceilings

- Metallic boxes may be installed in F/C and R/C assemblies incorporating gypsum board protection providing:
 - Clearance not to exceed 1/8 in.
 - Area of each box not to exceed 16 sq in.
 - Total area of boxes not to exceed 100 sq in. per 100 sq ft of ceiling area
- Nonmetallic boxes tested and listed (CEYY)



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Steel Joists

- Specified joist is minimum depth
- Specified joist is minimum weight/foot
- K-Series Joist may often substitute for older series joists specified
- Spacing between joists may be increased to 4 ft OC providing:
 - Structural integrity of floor is maintained
 - Hanger wire spacing is not increased
- Bridging bar size is minimum



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Gypsum Board on Horizontal Assemblies

- Thickness may be increased providing fastener length is also increased
- Additional layers may be added



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Gypsum Ceiling Control Joints

- Ceiling suspended below floor assembly
- Guide describes control joints when gypsum board is parallel to wood joists
- Guide describes control joints when gypsum board is perpendicular to wood joists



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Recessed (Can) Lighting

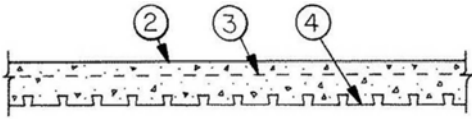
- Generic recessed luminaires not permitted unless covered in design
- Luminaires specifically tested and Listed for use in fire resistive construction covered in “Luminaires and Luminaire Assemblies Classified for Fire Resistance Category” (CDHW)



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Restrained & Unrestrained

- Designer & AHJ must determine
- Unrestrained ratings may be used for either condition



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Restrained & Unrestrained Cont.

- I. Wall Bearing:
- A. Single span and simply supported end spans of multiple bays.^a
1. Open-web steel joists or steel beams supporting concrete slab, precast units, or metal decking Unrestrained
 2. Concrete slabs, precast units, or metal decking Unrestrained
- B. Interior spans of multiple bays.
1. Open-web steel joists, steel beams, or metal decking supporting continuous concrete slab Restrained
 2. Open-web steel joists or steel beams, supporting precast units or metal decking Unrestrained
 3. Cast-in-place concrete slab systems Restrained
 4. Precast concrete where the potential thermal expansion is resisted by adjacent construction^b Restrained
- II. Steel Framing:
- A. Steel beams welded, riveted, or bolted to the framing members Restrained
- B. All types of cast-in-place floor and roof systems (such as beam-and-slabs, flat slabs, pan joists, and waffle slabs) where the floor or roof system is secured to the framing members Restrained
- C. All types of prefabricated floor or roof systems where the structural members are secured to the framing members and the potential thermal expansion of the floor or roof system is resisted by the framing system or the adjoining floor or roof construction^b Restrained



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HVAC Openings in Ceilings

- Most acoustical ceilings are tested with generic hinged blade damper
- UL Classified Ceiling Damper, Ceiling Air Diffuser or Air Terminal Unit may be substituted for generic hinged blade damper
- Duct Protection Systems A and B may also be substituted per Guide Info
- Some assemblies with gypsum board ceilings have been test with specific UL Classified Ceiling Dampers
- In assemblies with gypsum board ceilings, damper may not be utilized if not specified in design



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Blanket Insulation in Horizontal Assemblies

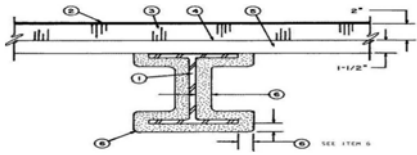
- May cause premature disruption of ceiling membrane
- For certain assemblies, fiberglass insulation can be used with additional layer of gypsum board
- Otherwise, only permitted as specified



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Beam Size

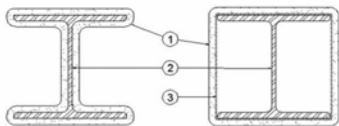
- Larger beams may be substituted without restriction
- Larger is based on W/D ratio
 - W/D = weight of unit measure divided by heated perimeter (exposed surface except top flange)
- Larger W/D yields greater fire resistance



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Column Size

- Larger columns may be substituted without restriction
- Based on W/D ratio
- Larger W/D yields greater fire resistance



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Walls & Partitions

- Rating applies when either face exposed to fire, unless otherwise noted
- Unsymmetrical walls tested from both sides
- Exterior walls may only require rating from inside face
- Load bearing rating applies to non load bearing applications



106

Walls & Partitions Cont.

- Size of studs specified is minimum
- Stud spacing specified is maximum
- Board orientation as specified in design



107

Walls & Partitions Cont.

- Metallic boxes may be installed in wall assemblies incorporating gypsum board protection providing:
 - Max 2 hr rated assemblies
 - Clearance not to exceed 1/8 in.
 - Area of each box not to exceed 16 sq in.



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Walls & Partitions Cont.

- Total area of boxes not to exceed 100 sq in. per 100 sq ft of wall surface
- Boxes on opposite sides of wall separated by min 24 in. or provided with protection (CLIV)
- Nonmetallic boxes tested and listed (CEYY)



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Permitted Changes – Summary www.ul.com/architects

Self Service Tools and Resources

Resources to help architects quickly and easily locate code compliant fire-resistance and smoke protection solutions.



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Permitted Changes – Summary www.ul.com/architects

DESIGN CRITERIA AND ALLOWABLE VARIANCES

Product category guide information can clarify construction and application requirements for the certifications and view acceptable variances allowed for the designs and systems. Click below for details.

Walls, floors, beams and columns

Firestop systems

Joint systems

Perimeter fire containment systems

Architectural services FAQs



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Questions / Comments



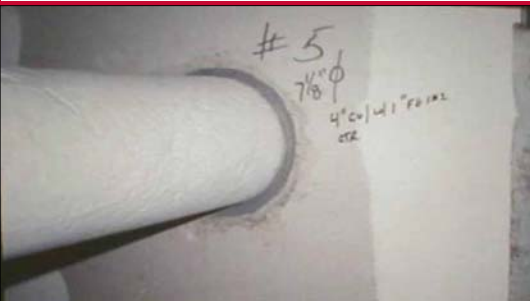
112

FIRESTOP
INSTALLATIONS



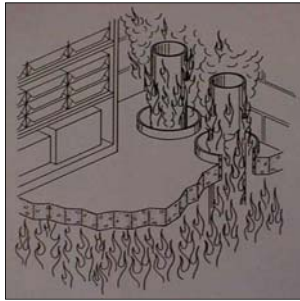
113

Through- and Membrane-Penetration
Firestop Systems



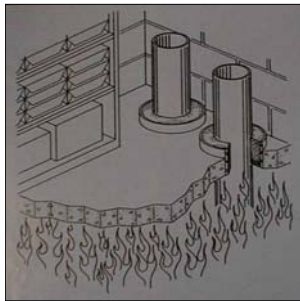
114

No Firestopping



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Proper Firestopping



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Some Definitions

• What is Firestopping?

- Firestopping (v) is the process of restoring the integrity of a fire-resistance-rated assembly at a penetration of the assembly through the use of a properly designed, installed, inspected and maintained firestop system
- Firestopping (n) is a material or device installed to resist the passage of flame and heat through penetrations (i.e. a firestop)



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Definitions Cont.

- *Membrane Penetration* – A breach in one side of a floor-ceiling, roof-ceiling or wall assembly to accommodate an item installed into or passing through the breach. (IBC)
- *Through Penetration* – A breach in both sides of a floor, floor-ceiling or wall assembly to accommodate an item passing through the breaches. (IBC)



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Definitions Cont.

- *Membrane-Penetration Firestop* – A material, device or construction installed to resist for a prescribed time period the passage of flame and heat through openings in a protective membrane in order to accommodate cables, cable trays, conduit, tubing, pipes or similar items. (IBC)



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Definitions Cont.

- *Through-Penetration Firestop System* – An assemblage consisting of a fire-resistance-rated floor, floor-ceiling, or wall assembly, one or more penetrating items passing through the breaches on both sides of the assembly and the materials or devices, or both, installed to resist the spread of fire through the assembly for a prescribed period of time. (IBC)



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Definitions Cont.

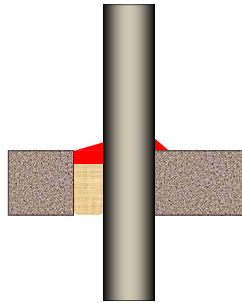
- *Firestop System* – Membrane or through-penetration firestop system. (BEJ)



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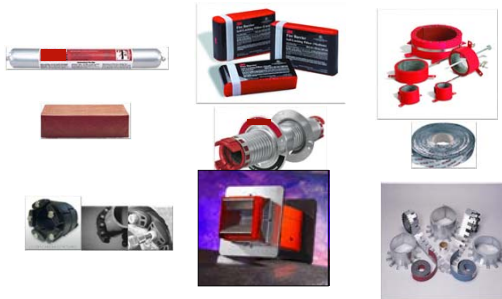
Three Elements of a Firestop System

- Floor or Wall Assembly
- Penetrating Item
- Firestopping Products



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The Right Product for the Right Application



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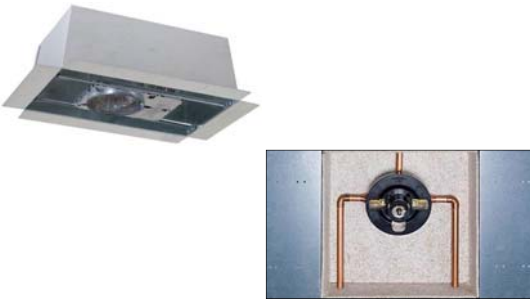
Steel Collars and Intumescent Wrap Strips

- Intumescent sealant expands and fills the void
- The collar expands to crush pipe



124

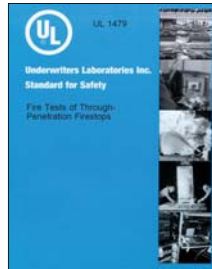
Enclosures: Valves, Controls, Speaker, Lighting



125

Firestop Systems

Standards



126

Standards

- ANSI / UL 1479
- ASTM E814



127

Ratings

- F - Flame Occurrence
- T - Heat Transmission
- L - Leakage (Optional)
- W - Water Leakage (Optional)



128

Conditions of Acceptance F Rating

- Passage of Flame
- Hose Stream
- *IBC Definition:*

F RATING. The time period that the *through-penetration firestop system* limits the spread of fire through the penetration when tested in accordance with ASTM E 814 or UL 1479.



129

Conditions of Acceptance T Rating

- Passage of Flame
- 325°F Temperature Rise
- Hose Stream
- *IBC Definition:*

T RATING. The time period that the *penetration firestop system*, including the penetrating item, limits the maximum temperature rise to 325°F (163°C) above its initial temperature through the penetration on the nonfire side when tested in accordance with ASTM E 814 or UL 1479.



130

L Rating

- Air Leakage Rate at Ambient Temperature
- Air Leakage Rate at 400°F
- *IBC Definition:*

L RATING. The air leakage rating of a *through penetration firestop system* or a fire-resistant *joint system* when tested in accordance with UL 1479 or UL 2079, respectively.



131

W Rating

- **Optional program***, applicable to incidental water
- 3 Ft WC Pressure Head / 72 Hr Exposure
- Firestop subjected to water exposure, followed by standard fire and hose stream tests
- Firestop systems assigned a W Rating

** No IBC definition or requirements*



132

Questions / Comments



133

Firestop Systems

International
Building Code
Requirements



134

Code Requirements General

- Section 714 of the 2015 IBC
 - 714.3 – Penetrations into or through *fire walls*, *fire barriers*, *smoke barrier walls* and *fire partitions* shall comply with 714.3.1 through 714.3.3. Penetrations in *smoke barrier walls* shall also comply with 714.4
 - 714.4 – Penetrations of horizontal assemblies not required to be protected by shaft enclosure shall be protected per Section 714.4.1 through 714.4.4



135

Code Requirements Wall Assemblies

- Section 714.3 of the 2015 IBC
 - 714.3.1 – Through penetrations shall be protected by one of the following:
 - As tested as part of the entire wall assembly
 - As tested to ANSI/UL 1479 / ASTM E814
 - Exceptions
 - Concrete, grout or mortar (full thickness of the wall)
 - Annular space protection material



136

Code Requirements Wall Assemblies Cont.

- 714.3.1.2 – When tested to ANSI/UL 1479 / ASTM E814, through penetrations shall have an F Rating of not less than the required rating of wall penetrated



137

Code Requirements Wall Assemblies Cont.

- 714.3.2 – Membrane penetration shall be protected as follows:
 - As specified in 714.3.1 (i.e. through penetrations)
 - Recessed fixtures shall be installed so as not to reduce the required fire resistance



138

Code Requirements Wall Assemblies Cont.

- Exceptions
 - Steel electrical boxes installed per prescriptive requirements
 - Listed electrical boxes of any material installed per listing
 - Electrical boxes of any size or type installed with tested and listed protection
 - Boxes other than electrical boxes tested and listed for such use
 - Annular space created by fire sprinklers (covered by metal escutcheon plate)
 - Steel electrical boxes exceeding 16 sq. in in area or any size exceeding prescriptive requirements protected by listed putty pads or other listed material and method installed per its listing.



139

Code Requirements Horizontal Assemblies

- Section 714.4 of the 2015 IBC
 - 714.4.1.1 – Through penetration shall be protected by one of the following:
 - As tested as part of the entire horizontal assembly
 - As tested to ANSI/UL 1479 / ASTM E814
 - Exceptions
 - Annular space protection material
 - Concrete, grout or mortar
 - Listed electrical boxes of any material installed per listing



140

Code Requirements Horizontal Assemblies Cont.

- 714.4.1.2 – When tested to ANSI/UL 1479 / ASTM E814, through penetrations shall have F and T Ratings of not less than 1 hour but not less than required rating of assembly penetrated
- Exceptions
 - Penetrations contained and located within the cavity of a wall above or below the floor do not require a T Rating
 - Penetrations by floor, tub or shower drains contained and located within the concealed space of a horizontal assembly do not require a T Rating
 - Penetrations a maximum of 4" in diameter penetrating directly into metal-enclosed electrical power switchgear do not require a T Rating



141

**Code Requirements
Horizontal Assemblies Cont.**

- 714.4.2 – Membrane penetration shall be protected as follows:
 - As specified in 714.4.1.1 or 714.4.1.2 (i.e. through penetrations)
 - Recessed fixtures in floor/ceiling assemblies shall be installed so as not to reduce the required fire resistance



142

**Code Requirements
Horizontal Assemblies Cont.**

- Exceptions
 - If less than 100 sq in. per 100 sq ft, metallic penetrants may be either firestopped or fireblocked
 - Steel electrical boxes installed per prescriptive requirements
 - Electrical boxes of any size or type installed with tested and listed protection
 - Listed electrical boxes of any material installed per listing
 - Annular space created by fire sprinklers (covered by metal escutcheon plate)
 - Interruption by a double wood top plate of a wall assembly sheathed with X-Rated gypsum; provided all penetrating items through the double top plates are protected and the ceiling membrane is tight to the top plates.



143

**Code Requirements
Miscellaneous**

- 714.4.3 – Noncombustible penetrants shall not be connected to combustible penetrants beyond point of firestop system
- 714.4.4 – Penetrations in smoke barriers shall have an L Rating at ambient and 400°F
 - Max 5.0 CFM / sq ft of opening
 - Aggregate 50 CFM / 100 sq ft of barrier



144

Firestop Systems

Establishing
F and T Ratings



145

Full-Scale Wall Assembly



146

Small-Scale Wood Floor Assembly



147

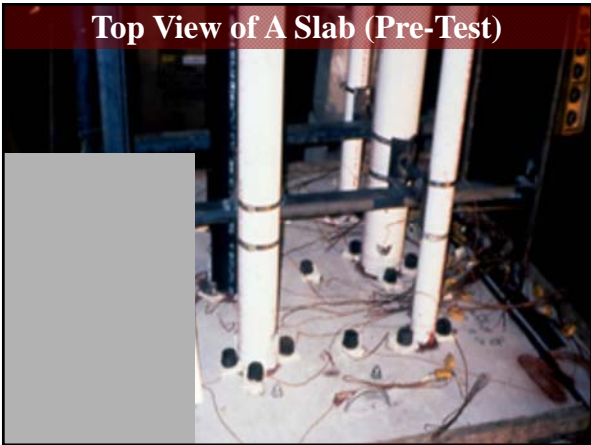
Cables Through Wood Floor



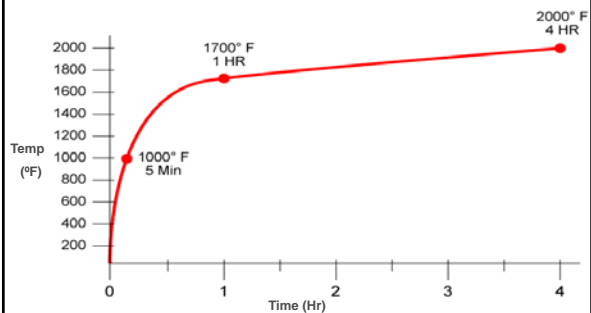
UL

148

Top View of A Slab (Pre-Test)

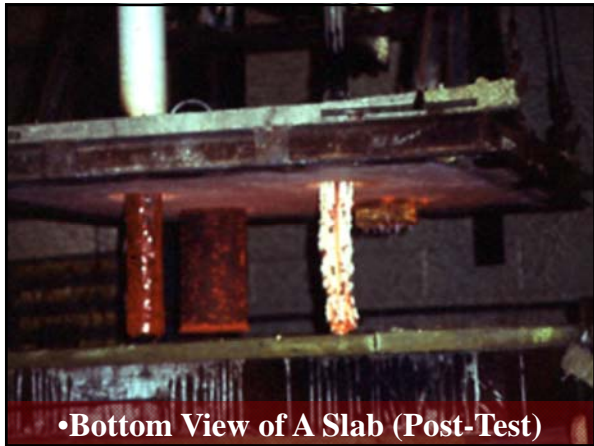


Time - Temperature Curve



UL

150







Fire-Resistance-Rated Construction

Plan Review



154

For the Architect / Contractor

Design No. U411
Rev. 26, 2012
Nonbearing Wall Rating - 2 HR.

UL Designs serve two roles:

1) Evidence of compliance

1. Floor and Ceiling Runner - (2x8 Joist) - Min. 21 #10 galv steel, 1 in. return legs, 2-1/2 in. deep (2x8) attached to floor and ceiling with fasteners 24 in. OC max.

2) A set of build-instructions

ALLSTEEL & SUPPLY PRODUCTS INC. - Type SUPREME Framing System
CALIFORNIA EXPANDED METAL PRODUCTS CO. - Vspan™ Truss
CONSOLIDATED FABRICATORS CORP. BUILDING PRODUCTS DIV. - Type SUPREME Framing System



155

For the Building Official

Design No. U411
Rev. 26, 2012
Nonbearing Wall Rating - 2 HR.

UL Designs serve two roles:

1) Evidence of compliance

1. Floor and Ceiling Runner - (2x8 Joist) - Min. 21 #10 galv steel, 1 in. return legs, 2-1/2 in. deep (2x8), attached to floor and ceiling with fasteners 24 in. OC max.

2) Document by which to inspect

ALLSTEEL & SUPPLY PRODUCTS INC. - Type SUPREME Framing System
CALIFORNIA EXPANDED METAL PRODUCTS CO. - Vspan™ Truss
CONSOLIDATED FABRICATORS CORP. BUILDING PRODUCTS DIV. - Type SUPREME Framing System



156

Plan Review

- 107.2.1 - Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code ...



157

Plan Review Cont.

- Details showing compliance with the fire-resistive requirements of the IBC shall be included on the plans and specifications
- (IPC/IMC) For buildings more than 2 stories, details showing materials and methods for protecting penetrations of pipes and mechanical systems to maintain required structural safety, fire resistance rating and fireblocking shall be included



158

Plan Review Cont

- Recommended that the UL designs (or others) be imported into the plans
- Importing designs into plans does NOT violate UL copyright requirements, provided:
 - ✓ Presented in their entirety in a non-misleading manner and without manipulation (data & drawings)
 - ✓ Include notation that they are reprinted from UL Online Certification Directory: "© 2017 UL LLC"



159

Plan Review Cont.

- Review proposed fire-resistance-rated assemblies for compliance with code
- Hourly rating requirement
 - Type of Construction
 - Details of assemblies proposed relative to actual construction
 - Consider variations identified relative to permitted substitutions stated in the UL Fire Resistance Directory



160

Plan Review Cont.

- Consider need for engineering judgments if permitted by department policy
- Consider need for special inspections as required by code and/or by department policy
- IBC 1705.17 (new) Statement of Special Inspections required in high-rise or structural risk category III or IV by an *approved agency* for:
 - ✓ Penetration firestop systems
 - ✓ Fire-resistant joint systems



161

Questions / Comments



162

Fire-Resistance-Rated Construction

Inspection Process



163

Inspection of Fire-Resistance-Rated Assemblies

- Inspections typically done by Code Official, but may be inspected by an *approved* agency or individual
- IBC 1703 requirements for *approved agency*:
 - ✓ Independence – 1703.1.1
 - ✓ Adequate equipment – 1703.1.2
 - ✓ Experienced personnel – 1703.1.3



164

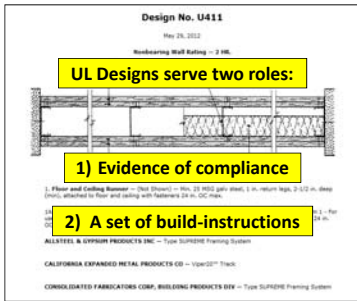
Inspection of Fire-Resistance-Rated Assemblies

- Verifies approved design is being used
- Verifies assembly is being constructed in accordance with the approved design
- May require multiple and well-timed inspections
- May require selective “destructive” inspection



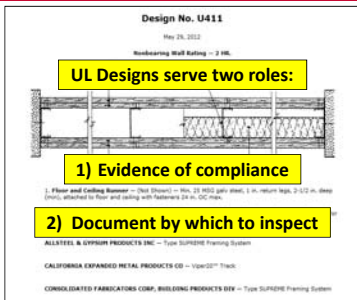
165

For the Architect / Contractor



166

For the Certified Code Official



167

Inspection of Firestop Systems

- Section 110.3.6 of the 2015 IBC:
 - Protection of joints and penetrations in *fire-resistance-rated* assemblies, *smoke barriers* and smoke partitions shall not be concealed from view until inspected and approved
- Section 1705.17 of the 2015 IBC:
 - **Special Inspections** are required for fire-resistant penetrations and joints in *high-rise buildings* and *Risk Category III or IV*



168

Pre-Construction Meeting

- Review selected designs
- Obtain engineering judgments as needed
- Establish inspection guidelines and expectations
- Establish work and inspection schedules
- Review qualifications /experience of contractors



169

Pre-Inspection

- Require construction documents that detail all fire-resistance-rated assemblies
- Obtain copies of all fire-resistance-rated designs
- Develop a plan to inspect each assembly at the appropriate times during the construction process



170

At the Inspection Site

- Have your inspection tools such as a flashlight, coring device, depth gauge, calipers, tape measure, etc.
- Review the general layout of the assembly
- Verify the building materials being utilized match those described in the approved design



171

At the Inspection Site Cont.

- For board products, verify the type, manufacturer, thickness and orientation match what is described in the approved design
- Verify fastener type, size and spacing for compliance with the approved design
- For insulation products, verify the type, manufacturer, thickness and density match what is described in the approved design



172

At the Inspection Site Cont.

- Verify that the approved third party testing agency's labels are on the products, empty containers or boxes
- When necessary conduct destructive evaluations on the assemblies
- During the inspection have the contractor follow along to repair assemblies after destructive testing



173

Reference Materials

- ASTM E 736 – “Standard Test Method for Cohesion / Adhesion of Sprayed Fire Resistive Materials Applied to Structural Members”
- ASTM E 605 – “Standard Test Methods for Thickness and Density of Sprayed Fire Resistive Material Applied to Structural Members”



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Reference Materials Cont.

- Association of Wall and Ceiling Industry – *Technical Manuals 12, 12-A and 12-B*
- Gypsum Association – *Fire Resistance Design Manual*
- International Firestop Council Video – *Inspecting Firestop for Compliance*



175

Available Resources

- Fire Safe North America (FSNA) – www.firesafenorthamerica.org
- Association of Wall and Ceilings Industry (AWCI) – www.awci.org
- Gypsum Association (GA) – www.gypsum.org



176

Questions / Comments



177

Building Elements & Firestop Systems

Engineering Judgments



178

Engineering Judgments

- An Engineering Judgment is a letter or report issued by some knowledgeable party which evaluates the construction of some site-specific application which deviates from a tested design, system or assembly and concludes with a judgment of the applicable rating of that assembly
- Referred to as “Engineering Analysis” in IBC Section 703.3



179

Engineering Judgments Cont.

- Typically, an Engineering Judgment is used when a tested design, systems or assembly is unavailable
- Most often applied to fire resistive construction



180

Engineering Judgments Cont.

- Applications for an Engineering Judgment
 - Design and system concept where multiple components, some listed and some unlisted, are used to field construct the finished assembly (e.g. wall)
 - Typically products are not required to be listed by code
- Must be acceptable to the *Code Official*



181

Who Issues Engineering Judgments?

- Who issues Engineering Judgments?
 - Professional engineer
 - Fire protection engineer
 - Manufacturer
 - Testing laboratory
- Individual issuing judgment must be acceptable to the *Code Official*



182

2015 IBC References Justifying Engineering Judgments

- IBC 104.11 Alternative materials, design and methods of construction and equipment
- IBC 703.2 Fire-resistance ratings
- IBC 703.3 Alternative methods for determining fire resistance – six options are permitted



183

Important Points of an Engineering Judgment

- No guidance from the International Code Council or the various I-Codes
- No guidance from UL
- Best documents available are from the International Firestop Council (IFC) – www.firestop.org



184

IFC Guidelines

- Four Documents – *International Firestop Council (IFC)* www.firestop.org
 - Recommended *IFC* Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs)
 - Covers firestops, joint systems and grease/air duct assemblies
 - Perimeter fire barrier systems
 - Fire resistant duct enclosure systems for commercial kitchen exhaust ducts
 - Fire resistant duct enclosure systems for ventilation ducts



185

Summary of Engineering Judgments

- Emphasizes importance of tested designs
- Not a substitute for existing designs
- Should be issued only by those who know the components
- Based on sound engineering practices and knowledge of performance of the designs
- Based on interpolation of previous testing
- Issued only for a specific jobsite
- Presented in clear detail



186

Questions / Comments



187

Fire Resistive Construction

UL's Online
Search Tools



188

Fire-Resistance-Rated Construction

Navigating the
UL Directories



189

UL's Online Search Tools

- Product Spec™
- Installation Code - Code Link
- Online Certifications Directory



190



Introducing UL Product Spec™

- Responsive Web site-Right sizes to your screen size, smartphone, tablet or PC
- Works on all web connected devices regardless of platform or OS
- Includes Electrical Construction, Fire and Building Materials and Systems



191

UL Product Spec™

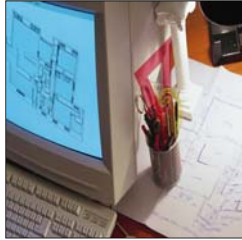
- No charge to access
- Find, specify or verify UL certified building products, fire resistance designs, through-penetrations and more
- Updated daily
- Easy to use
 - <http://www.ul.com/productspec>



192

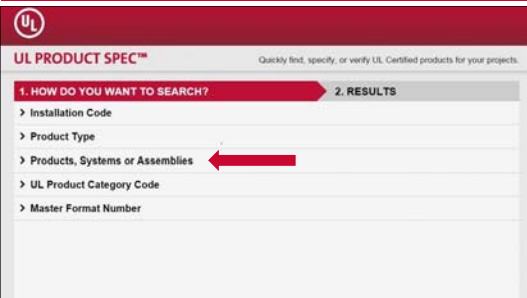
UL Product Spec™

Searching for
Information on
Fire-Resistance-
Rated Construction



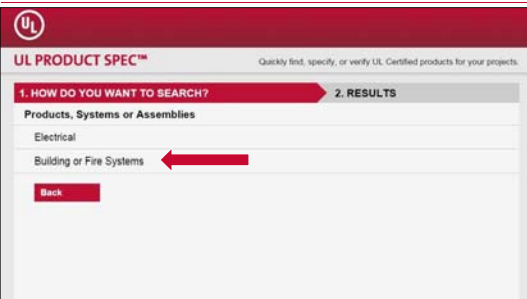
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UL Product Spec™



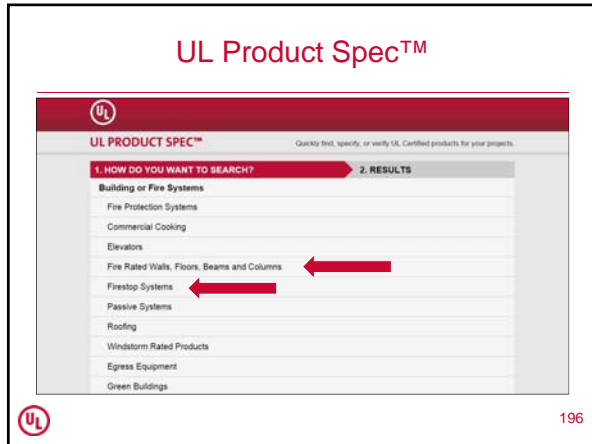
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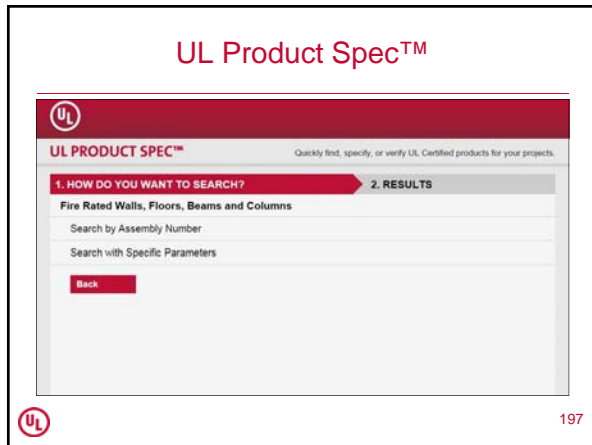


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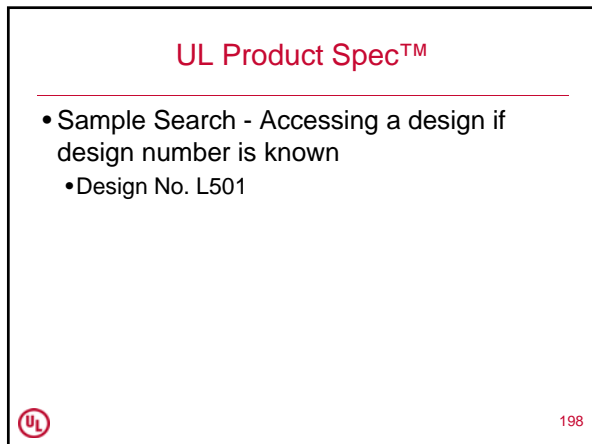


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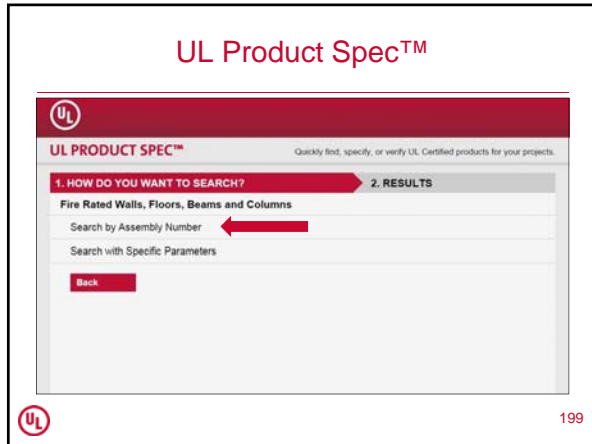


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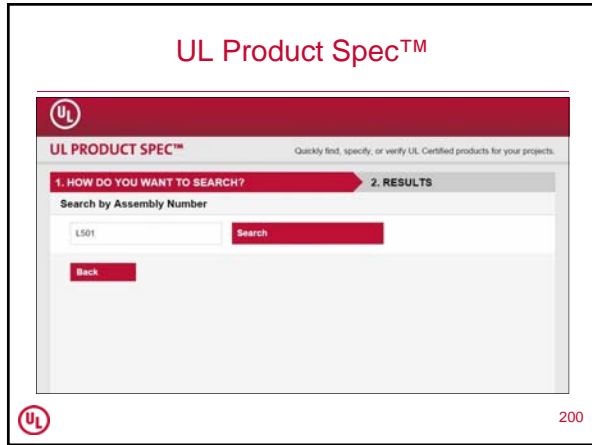
- Sample Search - Accessing a design if design number is known
 - Design No. L501



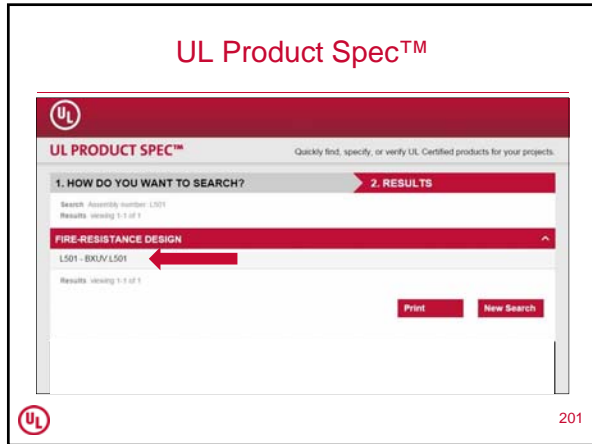
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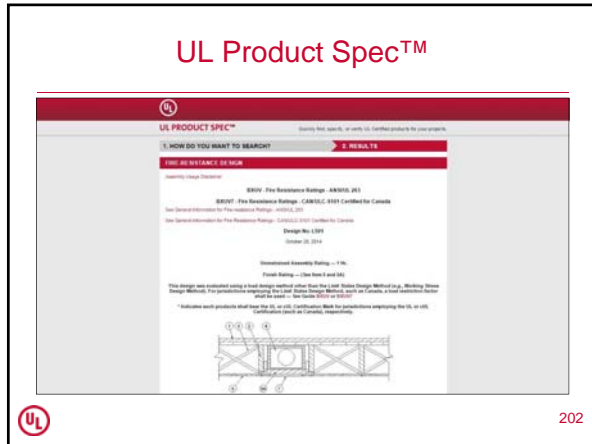
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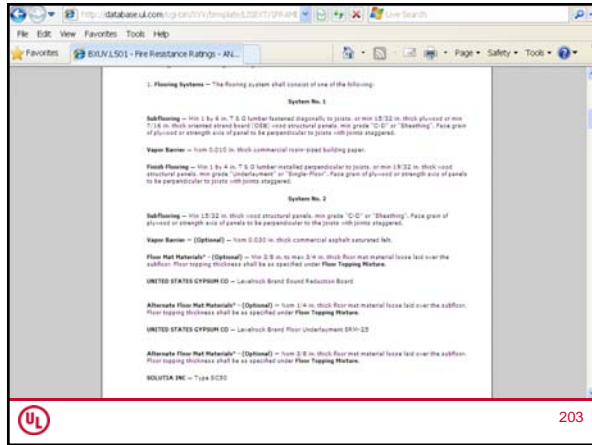
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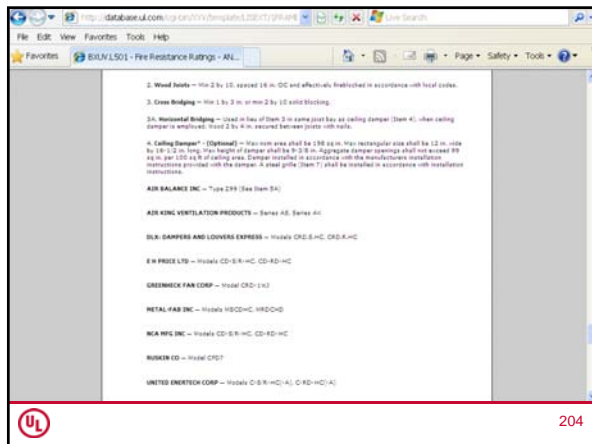
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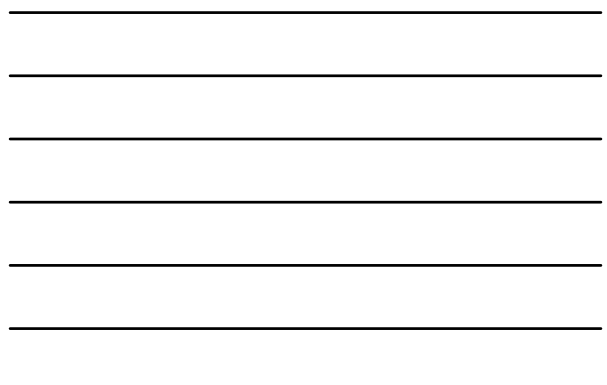
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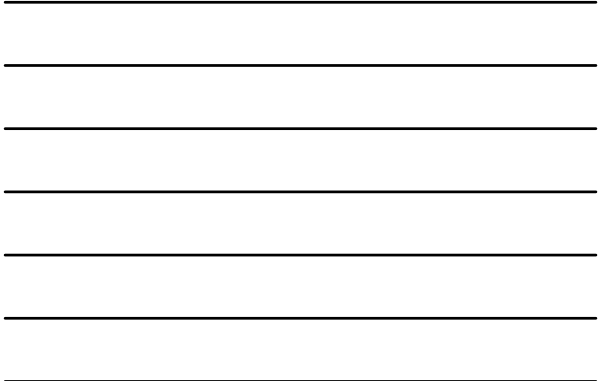
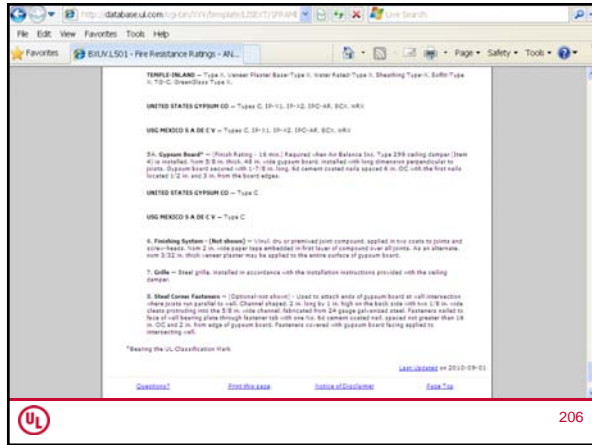
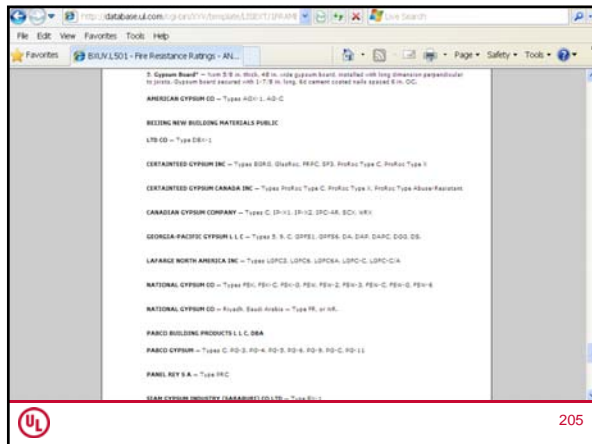


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204





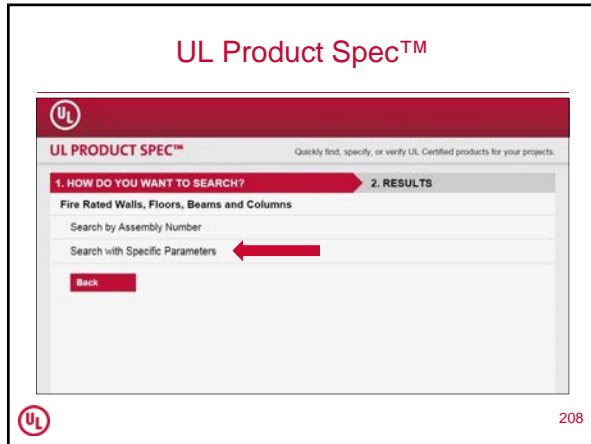
UL Product Spec™

- Sample Search - Searching for a design based on specific parameters
 - Wood stud/gypsum board wall assembly
 - 2 hour rating
 - Gypsum board supplied by the United States Gypsum Company

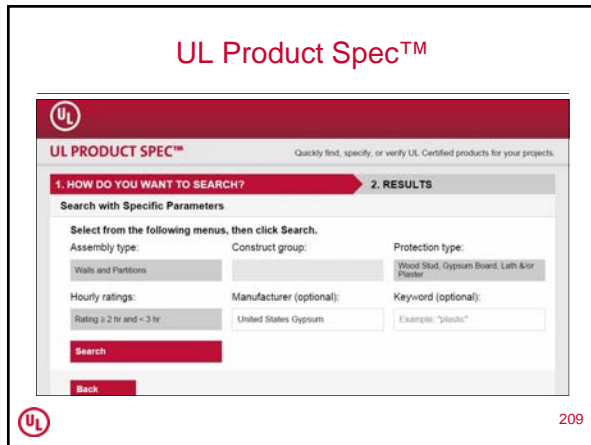
UL™ 207



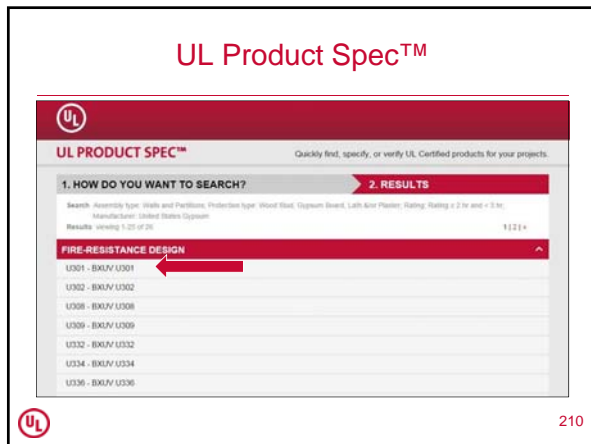
UL Product Spec™



UL Product Spec™



UL Product Spec™



UL Product Spec™



211

Guide Information

- Equipment, materials or systems included in the Category
- Intended use, restrictions or supplemental information that apply
- Standard(s) used to evaluate products under the Category
- Listing or Classification Mark information for the Category



212

Examples of Guide Information for Firestop Systems


- General Description of a Firestop System
- Standard
- Description of Ratings
- Permitted Substitutions
- Specifications of Penetrating Items
- Support of Penetrating Items
- Angle of Penetration
- Description of Numbering System



213


C-A J-1000
First Alpha Character

- C - Either Floor or Wall being Penetrated
- F - Floor being Penetrated
- W - Wall being Penetrated

 214


C-AJ-1000
Second and Third Alpha Characters

Letter	Description
A	Concrete floors with a minimum thickness less than or equal to 5 in.
B	Concrete floors with a minimum thickness greater than 5 in.
C	Framed floors
D	Steel decks in marine vessels
E	Floor-ceiling assemblies consisting of concrete with membrane protection
F - I	Not used at present time
J	Concrete or masonry walls with a minimum thickness less than or equal to 8 in.
K	Concrete or masonry walls with a minimum thickness greater than 8 in.
L	Framed wall
M	Bulkheads in marine vessels
N	Composite panel walls
O-Z	Not used at present time

 215

C-AJ-1000
Numeric Characters

Numeric Range	Description
0000 - 0999	No penetrating items
1000 - 1999	Metallic pipe, conduit or tubing
2000 - 2999	Nonmetallic pipe, conduit or tubing
3000 - 3999	Electrical cables
4000 - 4999	Cable trays with electrical
5000 - 5999	Insulated pipes
6000 - 6999	Misc. electrical penetrants such as busducts
7000 - 7999	Misc. mechanical penetrants such as air ducts
8000 - 8999	Groupings of penetrations including any combination of items listed above
9000 - 9999	Not used at present time

 216

Firestop Systems

- Each firestop system contains specific construction features
- Many firestop systems contain various options and various ratings
- Must be followed exactly for rating to apply



217

Questions / Comments



218

Search by Installation Code

- Correlates model code sections to UL product categories
- Covers many model codes and editions (IBC, IFC, NEC, etc.)
- Flexible search capabilities
- Powerful tool to locate appropriate Listings
- www.ul.com/codelink



219

Product Spec™ Installation Code

UL PRODUCT SPEC™ Quickly find, specify, or verify UL Certified products for your projects.

1. HOW DO YOU WANT TO SEARCH? 2. RESULTS

National Electrical Code	2017	2014
International Fire Code	2015	2012
NFPA 1: Fire Code	2015	2012
NFPA 101: Life Safety Code	2015	2012
International Building Code	2015	2012
International Residential Code	2015	2012
ASHRAE 189.1	2011	

UL 220

Product Spec™ Installation Code

UL PRODUCT SPEC™ Quickly find, specify, or verify UL Certified products for your projects.

1. HOW DO YOU WANT TO SEARCH? 2. RESULTS

National Electrical Code	2017	2014
International Fire Code	2015	2012
NFPA 1: Fire Code	2015	2012
NFPA 101: Life Safety Code	2015	2012
International Building Code	2015	2012

Enter one of the following search parameters:

Code Section Number:

UL Product Category Code:

Search

UL 221

Product Spec™ Installation Code

UL PRODUCT SPEC™ Quickly find, specify, or verify UL Certified products for your projects.

1. HOW DO YOU WANT TO SEARCH? 2. RESULTS

Search: Code name: International Building Code, Edition: 2015, Section number: 716.3
Results: 1-7 of 7

INSTALLATION CODE	UL PRODUCT CATEGORY & CODE
IBC 2015: 716.3	Fire-resistance-rated Glazing Materials: CCET
IBC 2015: 716.3	Glazing Materials: KCMZ
IBC 2015: 716.3.1	Fire-resistance-rated Glazing Materials: CCET
IBC 2015: 716.3.1	Glazing Materials: KCMZ
IBC 2015: 716.3.2	Glazing Materials: KCMZ
IBC 2015: 716.3.3	Fire-resistance-rated Glazing Materials: CCET
IBC 2015: 716.3.3	Glazing Materials: KCMZ

UL 222

Product Spec™ Installation Code

UL PRODUCT CATEGORY

Fire-resistance-rated Glazing Materials, CCET

Guide Information for Fire-resistance Ratings

USE

This category covers fire-resistance-rated glazing materials investigated for use in fire-resistance designs as detailed in Fire-resistance Ratings - ANSI UL 253 (D11.7). The glazing materials have been investigated for use in specified fire-resistive floor-ceiling, wall and/or partition constructions with respect to (1) construction details, (2) maximum size of individual glazing panels, and (3) for wall or partition constructions, the maximum aggregate area of glazing panels per 100 sq ft of wall area as described in the individual design illustrations. The glazing material provides the insulation properties for compliance with the temperature rise requirement of the Standard Test Method.

> Show additional information...

VIEW UL CERTIFIED PRODUCTS

[View list](#)

UL PUBLICATIONS

[Door & Window Application Guide](#)

UL STANDARDS

[UL 253 Scope](#)



223

[Print](#)

[New Search](#)

Product Spec™ Installation Code

Search: Listings: CCET

Results: viewing 1-13 of 13

COMPANY NAME AND FILE	CATEGORY NAME
AGC GLASS EUROPE SA - BENEFFE [R26570], CCET	Fire-resistance-rated Glazing Materials
GENERAL GLASS INTERNATIONAL [R25120], CCET	Fire-resistance-rated Glazing Materials
GLAS TROSCH AG FIRESWISS [R27170], CCET	Fire-resistance-rated Glazing Materials
GLASSOPOLIS [R27613], CCET	Fire-resistance-rated Glazing Materials
GREENLITE GLASS SYSTEMS INC [R38768], CCET	Fire-resistance-rated Glazing Materials
PILKINGTON DEUTSCHLAND AG [R18372], CCET	Fire-resistance-rated Glazing Materials
SAFTFIRST [R14212], CCET	Fire-resistance-rated Glazing Materials
SCHOTT TECHNICAL GLASS SOLUTIONS GMBH [R38976], CCET	Fire-resistance-rated Glazing Materials
TECHNICAL GLASS PRODUCTS [R16132], CCET	Fire-resistance-rated Glazing Materials
TECHNICAL GLASS PRODUCTS [R38726], CCET	Fire-resistance-rated Glazing Materials
TRULITE GLASS & ALUMINUM SOLUTIONS L L C [R26886], CCET	Fire-resistance-rated Glazing Materials
TRULITE GLASS & ALUMINUM SOLUTIONS L L C [R38774], CCET	Fire-resistance-rated Glazing Materials
VETROTECH SAINT-GOBAIN NORTH AMERICA INC [R22086], CCET	Fire-resistance-rated Glazing Materials



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UL PRODUCT CATEGORY

Fire-resistance-rated Glazing Materials

See General Information for Fire-resistance-rated Glazing Materials

AGC GLASS EUROPE SA - BENEFFE R26570
PARC INDUSTRIEL ZONE C
7190 BENEFFE, BELGIUM

Fire-resistance-rated glazing material. Pyrobel 60, Pyrobel 60 EG, Pyrobel 60 IGU, Pyrobel 120, Pyrobel 120 EG, Pyrobel 120 IGU for use in Wall and Partition Design Nos. U550 and U553.

Trademark and/or Tradename: "PYROBEL"

Last Updated on 2011-06-23

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

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Additional Resources
www.ul.com/architects

Architectural Services

Resources to help you quickly and easily locate code compliant fire-resistance and smoke protection solutions.

LOCATE SPECIFIC DESIGNS AND SYSTEMS

 Walls, Floors, Roofs, Beams and Columns <small>Find Designs ></small>	 Firestop Systems <small>Find Systems ></small>	 Joint Systems <small>Find Systems ></small>	 Perimeter Fire Containment Systems <small>Find Systems ></small>
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Additional Resources

- Firestop Contractors International Association www.FCIA.org
- National Fireproofing Contractors Association www.NFCA-online.org
- UL – Code Authorities Technical Library www.ul.com/codeauthorities

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Thank You for Attending!!!

Bruce E. Johnson

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