Standards Used in Fire-Resistance-Rated & Smoke Resistant Assemblies

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Passive Fire Protection

- Containment
- Ignition/Spread
- Structural
How does fire resistance get verified?
Scope

Fire Test Response standard for Assemblies and Elements

Specific Fire-Test conditions

Response to heat and flame under controlled conditions only

Results assess one of the many factors

Masonry to composite assemblies of structural materials

Walls & Partitions

Columns, Beams & Girders

Loadbearing & Non Load bearing

Slabs

Composite Slab & Beam Assemblies for Floors and Roofs
### Coverage

Intended to evaluate the duration in time that these building types can contain fire, retain structural integrity (or both) during a predetermined test exposure.

**Provides For**
- Walls, Partitions, floor, roof
- Transmission of Heat
- Transmission of Hot Gasses
- Measure load (Loadbearing)

**Does not Provide for**
- Performance beyond what is tested
- Other hazards like smoke, toxicity, etc.
- ‘How much’ (Passage of) smoke, etc.
- Fire behavior of joints
- Flame Spread
10. SUMMARY OF RESULTS

The non-load bearing partition system with a double layer of 12.5mm thick boards used on the unexposed face and a double layer of 12.5mm thick boards the exposed face of the test specimen has been evaluated in accordance with ASTM E119-18c.

The requirements of the standards were satisfied for:

FIRE RESISTANCE RATING

59 MINUTES

Note: The test specimen satisfied the criteria of the ASTM E119 fire endurance test for a duration of 60:00 minutes as agreed with test sponsor, but did not satisfy the criteria of the ASTM E2296 hose stream test. As such, in accordance with section 7.6 of ASTM E119, the maximum rating for a specimen that does not satisfy the criteria of the hose stream test was 59 minutes.

This report and all records of the test to which it relates may not be retained by TBWIC further than 5 years from the date of testing.

This test report is respectfully submitted by Thomas Bell-Wright International Consultants.

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**Fig. 1** Time-Temperature Curve

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Maintaining Compartmentalization
<table>
<thead>
<tr>
<th>Reaction Type</th>
<th>Effect Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intumescence</td>
<td>• To increase in volume upon exposure to heat.</td>
</tr>
<tr>
<td>Endothermic reaction</td>
<td>• To absorb heat of the exposing fire and using that to decompose the material.</td>
</tr>
<tr>
<td>Ablative reaction</td>
<td>• To resist heat transfer by using the heat of the exposing fire to erode the material.</td>
</tr>
<tr>
<td>Insulation</td>
<td>• To resist heat transfer as the result of its low thermal conductivity.</td>
</tr>
</tbody>
</table>
Test Firestop Systems

Part of the fire-resistance-rated assembly’s

Separately using the more focused testing methods
ASTM E814

Scope

Coverage

Results
Scope

Applicable: FS systems intended for use in openings in fire resistance walls & floors that are evaluated as per ASTM E119

Response to heat and flame under controlled conditions only

Firestop (Materials & Devices) are not tested in seclusion, but the firestop system/assembly is tested

Not applicable to membrane penetrations of floor-ceiling, roof-ceiling assemblies or loadbearing walls
## Coverage

### Firestop System

- Combination of Penetrating Item(s), Specific Construction that is penetrated and the materials or devices or both that seal the opening

### Membrane penetration (MP)

- A breach in one side of a floor-ceiling, roof-ceiling or wall assembly to accommodate an item installed into or passing through the assembly

### Through penetration (TP)

- A opening in both sides of a floor, **floor-ceiling** or wall assembly to accommodate an item passing through the breach.
9.2. Fire Test observation

<table>
<thead>
<tr>
<th>Time (Mins)</th>
<th>Specimen Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0'00</td>
<td>Test commences</td>
</tr>
<tr>
<td>1'14</td>
<td>Light smoke through the end of the pipe on the unexposed face.</td>
</tr>
<tr>
<td>5'19</td>
<td>Heavy smoke through the end of the pipe on the unexposed face.</td>
</tr>
<tr>
<td>11'32</td>
<td>All smoke issuance have been ceased.</td>
</tr>
<tr>
<td>20'28</td>
<td>The sealant inside the GS sleeve has started to react and started to bulge away from the furnace.</td>
</tr>
<tr>
<td>54'21</td>
<td>Smoke stains on the gypsum supporting partition at the top of the boards.</td>
</tr>
<tr>
<td>60'00</td>
<td>Specimen is stable.</td>
</tr>
<tr>
<td>90'00</td>
<td>Specimen is stable.</td>
</tr>
<tr>
<td>113'29</td>
<td>Smoke stains on the gypsum supporting partition along the vertical studs of the boards.</td>
</tr>
<tr>
<td>120'00</td>
<td>End of Fire Test as agreed with the sponsor.</td>
</tr>
</tbody>
</table>

9.3. Hose Stream Test observation

<table>
<thead>
<tr>
<th>Time (Mins)</th>
<th>Specimen Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0'00</td>
<td>Start of hose stream test</td>
</tr>
<tr>
<td>0'09</td>
<td>Through opening which permitted the water stream beyond the unexposed face.</td>
</tr>
<tr>
<td>0'36</td>
<td>End of Hose Stream Test (the specimen has been subjected to impact, erosion and rapid cooling effects of the hose stream for 36 seconds at 30psi, but failed the hose stream test at 10 seconds as the sealant broke off)</td>
</tr>
</tbody>
</table>

END OF ASTM E814 & ASTM E2226 TEST AS AGREED WITH THE SPONSOR
Test each perimeter joint protection with manufactured and field splices. When the technique of the manufactured splice is the same as the field splice, test only one splice.
T- Rating – Measured in Time when...

Whichever first
F- Rating – Measured in Time when...

Flame Penetration Through Perimeter Joint protection or around boundaries

Whichever first

Flames/ hot gasses Cotton Pad

F Rating
F (Flame) Rating of Firestop Systems

- Passage of Flame
- Hose Stream
T (Temperature) Rating of Firestop Systems

• Passage of Flame
• 325°F (180°C) Temperature Rise
• Hose Stream
L (Leakage) Rating (Optional, Based on UL 1479)

- Air Leakage Rate at Ambient Temperature
- Air Leakage Rate at 400°F (204°C)
W (Water) Rating (Optional, Based on UL 1479)

- Optional program, applicable to incidental water
- 3 Ft. WC (0.91 M 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
M (Movement) Rating (Optional)

- Applicable to movement of penetrating item with respect to the barrier
- Penetrating item move perpendicular and/or in plane of barrier - ASTM E3037
- After movement, fire and hose stream test
- Firestop systems - M Rating
  - Rating within plane based on percentage of the minimum annular space of the field installation
  - Rating perpendicular to barrier based on dimension
Establishing an L Rating
L (Air Leakage) Ratings

• Optional L Rating methodology added to UL 1479 in 1993
• Leakage determined at 0.3 in. WC (74.7 Pa)
• Tested at Ambient and 400°F (204°C)
• Results published in either CFM (m³/s) or CFM per sq ft (m³/s per m²)
L (Air Leakage) Ratings
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L (Air Leakage) Ratings
Test Procedure

• Incidental chamber leakage determined using blank slab
• Air leakage of test sample determined at ambient temperature
• Air leakage of test sample determine at 400°F (204°C)
• Incidental chamber leakage rechecked after cooling
• Firestop system assigned L Rating at ambient and 400°F (204°C), by subtracting incidental chamber leakage from test sample leakage
• L Ratings of firestop systems published along with F and T Ratings
Fire-Resistant Joint Systems
Forces Which Induce Movement

- Thermal
- Wind Sway
- Seismic
- Load
Test Standards / Components

- CYCLE TEST
  (Movement)
- UL 2079 & ASTM E1966
- Fire Test
  (Hourly Rating)
- Hose Stream Test
  (Impact, Temperature, Shock)
UL 2079 / ASTM E1966 - Test Standards For Building Joint Systems

**Assembly Rating**
- Evaluates both passage of fire and temperature on the non-fireside (i.e. F and T Ratings)
- Hose stream is only required for head-of-wall and wall-to-wall joints

**L Rating** (New in 2006 Code)
- The amount of air leakage through the joint system at ambient and 400°F (204°C). IBC requires an L rating of 5 cfm / lineal ft or less.

**W Rating**
- Water Leakage
Continuity Head-of-Wall Joint Systems

Test Method

1. Setup

3. When testing, the test apparatus shall be conditioned in accordance with the procedures prescribed in the test method. The test apparatus shall be set up in a manner that simulates the actual installation of the test joint system. The test apparatus shall be placed in a vertical position with the joint in the test apparatus positioned in a manner that simulates the actual installation of the test joint system.

4. Before testing, the test apparatus shall be conditioned in accordance with the procedures prescribed in the test method. The test apparatus shall be set up in a manner that simulates the actual installation of the test joint system. The test apparatus shall be placed in a vertical position with the joint in the test apparatus positioned in a manner that simulates the actual installation of the test joint system.

5. After testing, the test apparatus shall be conditioned in accordance with the procedures prescribed in the test method. The test apparatus shall be set up in a manner that simulates the actual installation of the test joint system. The test apparatus shall be placed in a vertical position with the joint in the test apparatus positioned in a manner that simulates the actual installation of the test joint system.
Continuity Head-of-Wall Joint Systems Cont.

• E2837-11: Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies

• Scope – Covers rated wall intersecting bottom of non-fire-resistance-rated roof/ceiling or floor/ceiling assembly

• Testing similar to that done for Head-of-Wall Joint Systems per ASTM E1966 and UL 2079
Continuity Head-of-Wall Joint Systems Cont.

• Major differences between ASTM E2837 and UL 2079:
  • No thermocouples on roof or floor
  • As roof/floor may sag in a “real” fire, test protocol does not rigidly support the roof/floor

• Assembly Rating
  • Flame Passage
  • Temperature Rise on the Unexposed Surface of the Joint System
  • Hose Stream
Opening Protectives

• Fire Door Assemblies
  Fire Door Frames
  Fire Doors
  Hardware
  Glazing within Fire Doors

• Fire Window Assemblies
  Fire Window Frames
  Glazing
Component Approach Used for Fire Door and Fire Window Assemblies

• The UAE Fire and Life Safety Code, the IBC and NFPA 101 prescribe a component approach for testing fire door and fire window assemblies

• By referencing NFPA 80, the codes require fire door and fire window components to be Listed and Labeled

• Individual listed and labeled components are installed together in the field to form the complete opening protective

• Approval of the finished opening protective relies on Listing and Labeling of individual components with the final approval up to the Code Official
Fire Door and Shutter Assemblies

• Code Referenced Standards
  • Side-hinged or pivoted swinging doors shall be tested to UL 10C or NFPA 252 (positive pressure)
  • Tin-clad fire door assemblies shall comply with UL 10A, UL 14B, and UL 14C
  • Other types of doors shall be tested to UL 10B or NFPA 252 (neutral pressure)
• All the above standards establish a “Fire Protection Rating”
• For a Fire-Protection Rating, the fire door assembly must:
  • Prevent passage of flame through the door assembly during the fire exposure
  • Prevent a through projection of water through the door assembly during the hose stream test conducted after the full duration fire exposure
Fire Window Assemblies

• Code Referenced Standards
  • Fire Window assemblies shall be tested to UL 9 or NFPA 257 (positive pressure)
• The above standards establish a “Fire Protection Rating”
• For a Fire-Protection Rating, the fire window must:
  • Prevent passage of flame through the window assembly during the fire exposure
  • Prevent a through projection of water through the window assembly during the hose stream test conducted after the full duration fire exposure
Fire Window Assemblies

• Fire window assemblies are glazed with a fire-protection-rated glazing.
• Code limits the maximum size (individual panel size and total cumulative area) and maximum rating of fire window assemblies.
• Where required size or rating exceeds code allowance or when a fire window assembly is not permitted, a fire-resistance-rated window assembly may be utilized.
• A fire-resistance-rated window assembly meets the same requirements as any other wall assembly (ASTM E119 / UL 263).
• A fire-resistance-rated window utilizes a “non-conductive” frame and fire resistance-rated glazing.
Fire-Rated Glazing

Types of Fire-Rated Glazing

- Fire-Protection-Rated Glazing
- Fire-Resistance-Rated Glazing
Fire-Protection-Rated Glazing

- Fire-rated, thin glazing
- Traditional fire-rated material for use in fire doors and fire windows
- Allows significant radiant heat from unexposed side

- May or may not be required to meet hose stream requirements depending on application
Fire-Protection-Rated Glazing Cont.

- Used as Opening Protectives
  - Fire Doors: 20 minutes to 3 hrs
  - Fire Windows: 20 to 90 minutes
    - Area of fire window may not exceed 25% of the area of a fire-resistance-rated wall
  - Size of individual pane shall comply with IBC and NFPA 80, and may not exceed manufacturers tested sizes
Standards

Fire-Protection-Rated Glazing

• UL 10B (Fire Door Assemblies)
• UL 10C (Fire Door Assemblies)
• NFPA 252 (Fire Door Assemblies)
• UL 9 (Window Assemblies)
• NFPA 257 (Fire Window Assemblies)
Fire-Resistance-Rated Glazing

- “Thick” glazing
- Stops fire AND radiant heat
- Classified as a “wall” rather than an opening (window)
- Meets same requirements as a gypsum or CMU wall

- When use in walls, both glass and frame must block passage of heat
Fire-Resistance-Rated Glazing Cont.

• Used in fire door assemblies when required glazing exceeds size or rating permitted for fire-protection-rated glazing
• Used in window assemblies when required glazing exceeds size or rating permitted for fire-protection-rated glazing in fire windows
Standards
Fire-Resistance-Rated Glazing
• UL 263
• ASTM E119
Leakage Rated Door Assemblies

• Required for rated corridor walls and smoke barriers
• Tested to UL 1784
• Tested as complete package of components necessary to obtain rating
• Maximum 3 cfm per sq ft (0.01524 m³/s per m²) door area at 0.1 in. WC (24.9 Pa) at ambient and 400°F (204°C)
Leakage Rated Door Assembly Under Testing
Ducts and Air Transfer Openings

- Fire Dampers
- Smoke Dampers
- Combination Fire / Smoke Dampers
- Corridor Dampers
- Ceiling Radiation Dampers
Fire Dampers

- Tested and listed to UL 555
- Rated for minimum 3 hrs when used in barrier rated 3 hrs or greater
- Rated for minimum 1-1/2 hrs when used in barrier rated less than 3 hrs
Fire Dampers Cont.

• UL 555 differentiates between static and dynamic dampers
  • Static – For use in HVAC systems designed to shutdown upon detection of fire or smoke
  • Dynamic – For use in HVAC systems designed to remain operational during a fire situation. All combination fire / smoke dampers are dynamic

• UL 555 describes many tests, including fire exposure test, hose stream test, airflow test, temperature test, duct breakaway test, corrosion protection test, durability tests, dynamic closure test, etc., etc.
Smoke Dampers

• Tested and listed to UL 555S
• Required by code to be rated for Class I or II leakage at a temperature rating of not less than 250°F (121°C)
Smoke Dampers Cont.

• UL 555S describes many tests, including leakage test, temperature test, pressure test, air velocity tests, duct breakaway test, corrosion protection test, durability tests, etc., etc.
Combination Fire and Smoke Dampers

- Tested and listed to both UL 555 and UL 555S
- Required by code to meet requirements for both a fire damper and a smoke damper
Corridor Dampers

• Section 717 of the IBC
  • Used in ceilings of exit corridors where ceiling is constructed as required for corridor walls per Section 708.4, Exception 3
  • Designed to be installed in horizontal “wall”
Corridor Dampers Cont.

• Corridor dampers shall be listed and labeled in accordance with UL 555 and UL 555S. Corridor dampers shall also demonstrate acceptable closure under air flow conditions.
  • Shall meet the rating requirements for both fire and smoke dampers
    • 1 hr fire rated
    • Leakage rating shall be Class I or II with a temperature rating of not less than 250°F (121°C)
Ceiling Radiation Dampers

• Used in fire resistive floor-ceiling and roof-ceiling assemblies where duct penetrates membrane ceiling
• Intent is to minimize heat transfer into concealed space
Ceiling radiation dampers Cont.

• Ceiling radiation dampers shall be listed and labeled, and tested in accordance with UL 555C or as part of a floor/ceiling or roof/ceiling assembly in accordance with UL 263 or ASTM E119
Ceiling Radiation Dampers Cont.

- UL 555C differentiates between static and dynamic dampers.
  - Static – For use in HVAC systems designed to shutdown upon detection of fire or smoke
  - Dynamic – For use in HVAC systems designed to remain operational during a fire situation

- UL 555C describes many tests, including fire exposure test, airflow test, temperature test, corrosion protection test, durability tests, dynamic closure test, etc., etc.
Answering Questions and Queries

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Please type your questions in the chat window

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Thanks for Attending!!!

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