
By Nicholas E. Ozog, PE, Wiss, Janney, Elstner Associates, Inc.

The material characteristics of exterior wall systems are receiving detailed technical analysis as a result of the tragic Grenfell Tower fire in London last year. This article provides basic information regarding the fire tests that are available for façade components and provides the basis for inquiry when specifying an exterior wall assembly or evaluating existing installations.

Current fire testing can be separated into two groups: access-to-market and assembly. The access-to-market type of test may sometimes be referred to as an individual component test because a manufacturer may be able to use one or more relatively small-scale tests to get the product to the market.

Assembly fire tests are often on a larger scale, testing multiple components or materials together as a system, rather than individual components. They require testing a complete exterior wall envelope assembly, or the “components, including exterior wall finish materials that provides protection of the building structural member” per the International Building Code. In the present context, the assembly tests generally consider the exterior sheathing moving outward from the interior side of the building to the exterior cladding and the materials in between that form the layers for air, water and thermal control.

These assembly tests provide information about the combined components for engineers and architects when evaluating façades. The design/construction community may obtain more information about the characteristics of the assembly than by testing individual components separately if test results are made available.

Each testing approach provides useful information and insight into the products used in building construction. Accordingly, the tests may be referenced to support the requirements for a building construction permit. The testing may also be a basis for prohibiting materials in certain building construction types or circumstances.

When focusing on the exterior wall assembly, individual materials within the wall assembly are often identified as either combustible or noncombustible through ASTM E136, EN 1182 or other comparable tests. ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, is one material test in the access-to-market tests that a manufacturer could use to evaluate a façade component since it “is used to measure and describe the response of materials ... to heat and flame under controlled conditions.”

The control conditions relate to using a furnace to subject materials “to a temperature of 750°C until failure occurs or for at least 30 minutes.” Failure of the test essentially identifies the material as being combustible, based on elevated temperature measurements and recording of mass loss. The scope of this testing does not apply to “laminated or coated materials” and is not satisfactory for materials that
soften, flow, melt, intumesce or otherwise separate from the measuring thermocouple." Other access-
to-market type tests are, therefore, needed.

Another material behavior access-to-market test is ASTM E84, Standard Test Method for Surface
Burning Characteristics of Building Materials, or UL 723, commonly known as the Steiner tunnel test.
This test provides data to assist in evaluating the “relative burning behavior of the material by observing
the flame spread along the specimen” by indexed measurements of flame spread and smoke
developed. This test provides comparative information about a material’s behavior in fire when oriented
horizontally and exposed to a controlled and repeatable fire exposure. The indexed results allow for a
comparative analysis between materials and, thus, the ability of the model codes to require materials of
such indexes in particular locations.

Other tests, such as EN 13501-1 (reaction to fire classification), provide a comparative classification for
how the material reacts when exposed to a specified fire condition. The materials are ranked from “E, D,
C, B, A2, to A1,” becoming increasingly less combustible. Other tests have been developed for evaluat-
ing exterior wall assemblies that may be required, depending on the jurisdiction or property insurer involved in the project. Such tests include BS-8414 for use in the United Kingdom, and the FM Global 4880 16-foot parallel panel test (FM 16-ft PPT). Generally, these tests work to evaluate the exterior wall assembly involving combustible materials when exposed to a post-flashover fire condition. A summarized comparison of the three tests is provided in Table 1. Of note for the BS 8414 test is the use of a wood crib instead of a calibrated gas burner(s) and the presence of a return or wing wall component. The FM 4880 16ft-PPT uses two parallel panels without a simulated window opening and peak heat release as a pass/failure criterion.

When discussing combustible façades, the larger assembly tests include NFPA 285, BS 8414-1 and -2,
and FM 4880-1, and are often referenced in model codes. In these assembly tests, the materials and the
individual component construction and configuration matter. When testing metal composite material
(MCM) systems, the assembly includes “joints, seams, attachments, substrate, framing, and other
details as appropriate to a particular design.” In these circumstances, the testing should consider the
cavity space dimensions, if any, and window fenestration blocking.

NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-
Load-Bearing Wall Assemblies Containing Combustible Components, provides information about fire
propagation on façades — “exterior non-load-bearing wall assemblies and panels used as components of
curtain wall assemblies” — in “post-flashover fires of interior origin.” However, as part of the NFPA
285 revision cycle, the scope is being considered for modification by NFPA to include load-bearing
assemblies. The NFPA 285 test is conducted on an apparatus designed to represent a two-story
elevation on a building with the fire occurring on the lower story inside a room with a window opening
and is conducted for 30 minutes.

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This simplified table documents a few of the differences among the three tests and highlights potential challenges for engineers, architects, authorities having jurisdiction and manufacturers working in the global environment. Additional fire tests are used to evaluate materials within a façade that are not discussed here that may add to the complexity of any analysis. Therefore, one must understand the limitations of the respective fire tests and their specific objectives to place the particular test results in the proper context.

The continuing development of building materials and construction practices highlights the importance of understanding the adequacy of material and assembly testing. This panoply of tests remains a source of vital tools to satisfy the ongoing concern about combustible façades on buildings. The availability of test results is important to continue industry dialogue and benefit those involved in product development, design and construction, as well as life cycle management, permitting and oversight.

Nicholas E. Ozog, PE is with Wiss, Janney, Elstner Associates, Inc.

References


<table>
<thead>
<tr>
<th>Test</th>
<th>Test Dimension</th>
<th>Fire Source</th>
<th>Peak Heat Flux to Panels*</th>
<th>Primary Criteria (Failure Evaluation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 285</td>
<td>17.5 feet tall, 13.3 feet wide</td>
<td>Two gas burners (HRR = 1.3 MW)</td>
<td>~40 kW/m2</td>
<td>Temperature via thermocouple measurement (10 ft elevation, 1000°F)</td>
</tr>
<tr>
<td>BS-8414</td>
<td>~32 feet tall, 9 feet wide, with a 5 foot wide wing wall</td>
<td>Wood crib (HRR = 3±0.5 MW)</td>
<td>~75 kW/m2</td>
<td>Temperature via thermocouple measurement (16.4 ft elevation, 1110°F above ambient)</td>
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<tr>
<td>FM 16-ft PPT</td>
<td>16 feet tall, 3.5 feet wide</td>
<td>One gas burner (HRR = 360 kW)</td>
<td>~100 kW/m2</td>
<td>Peak HRR &gt; 1100 kW</td>
</tr>
</tbody>
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