

Most of the possible building collapse sequences included some contribution from the floors, ranging from their ability to transfer load to their initiating the collapse by their failure. Thus, it became central to the Investigation to obtain data regarding the limits of the insulated floors in withstanding the heat from the fires. The standard test for determining the fire endurance of floor assemblies is ASTM E 119, “Standard Test Methods for Fire Tests of Building Construction and Materials.” The conduct of the test is described in Section 1.2.2 under “Fire Protection Systems.”

Accordingly, NIST contracted with Underwriters Laboratories, Inc. to conduct tests to obtain information on the fire endurance of trusses like those in the WTC towers. The objective was to understand the effects of three factors:

- **Scale of the test.** There were no established facilities capable of testing the 60 ft lengths of the long spans that were used in the towers, but there is a history of testing reduced-scale assemblies and scaling them to practical dimensions. In the Investigation’s tests, the full-scale test specimens were 35 ft long, equal to the shorter span between the core and the perimeter of the WTC towers. Their construction replicated, as closely as possible, the original short-span floors. The reduced-scale specimens were half that length and height. All assemblies were 14 ft wide. The simulation of a “maximum load condition,” as required by ASTM E 119, involved placing a combination of concrete blocks and containers filled with water on the top surface of the floor. The load on the shorter truss was double that of the longer truss to achieve the same state of stress in both trusses. Traditionally, relatively small-scale assemblies have been tested and results have been scaled to practical floor system spans.
- **SFRM thickness.** The Port Authority originally specified BLAZE-SHIELD D as the SFRM, applied to a ½ in. covering. The average measured thicknesses were found to be approximately 0.75 in. These two thicknesses of BLAZE-SHIELD D were used in the Investigation tests.
- **Test restraint conditions.** In 1971, well after the design of the towers was completed, the ASTM E 119 Standard began differentiating between thermally restrained and unrestrained floor assemblies. An unrestrained assembly is free to expand thermally and to rotate at its supports; a restrained assembly is not. It is customary in the United States to conduct standard fire tests of floor assemblies in the restrained condition. The current standard describes a means to establish unrestrained ratings for floor assemblies from restrained test results. In practice, a floor assembly such as that used in the WTC towers is neither restrained nor unrestrained but is likely somewhere in between. Testing under both restraint conditions, then, is thought to bound performance under the standard fire exposure. In addition, it provided a comparison of unrestrained ratings developed from both restrained and unrestrained test conditions.

The test plan included four tests, which varied the three factors:

Test 1: 35 ft floor, ¾ in. insulation, restrained

Test 2: 35 ft floor, ¾ in. insulation, unrestrained