

- realistic ratings for structural assemblies made with materials that have improved elevated temperature properties (strength, modulus, creep behavior).
- b. Improved procedures and guidance to analyze and evaluate existing data from fire resistance tests of building components and assemblies for use in qualifying an untested building element.
- c. Relationships between prescriptive ratings and performance of the assembly in real fires.

*Affected National and International Standards*³¹: ASTM E 119, NFPA 251, UL 263, and ISO 834.
Model Building Codes: The standards should be adopted in model building codes by mandatory reference to, or incorporation of, the latest edition of the standard.

Recommendation 6. NIST recommends the development of criteria, test methods, and standards: (1) for the in-service performance of sprayed fire-resistive materials (SFRM, also commonly referred to as fireproofing or insulation) used to protect structural components; and (2) to ensure that these materials, as-installed, conform to conditions in tests used to establish the fire resistance rating of components, assemblies, and systems. This should include:

- Improved criteria and testing methodology for the performance and durability of SFRM (e.g., adhesion, cohesion, abrasion and impact resistance) under in-service exposure conditions (e.g., temperature, humidity, vibration, impact, with/without primer paint on steel³²) for use in acceptance and quality control. The current test method to measure the bond strength, for example, does not distinguish the cohesive strength from the tensile and shear adhesive strengths. Nor does it consider the effect of primer paint on the steel surface. Test requirements that explicitly consider the effects of abrasion, vibration, shock, and impact under normal service conditions are limited or do not exist. Also, the effects of elevated temperatures on thermal properties and bond strength are not considered in evaluating the performance and durability of SFRM.
- Inspection procedures, including measurement techniques and practical conformance criteria, for SFRM in both the building codes and fire codes for use after installation, renovation, or modification of all mechanical and electrical systems and by fire inspectors over the life of the building. Existing standards of practice (AIA MasterSpec and AWC Standard 12), often required by codes for some buildings need to be broadly applied to both new and existing buildings. These standards may require improvements to address the issues identified in this recommendation.
- Criteria for determining the effective uniform SFRM thickness—thermally equivalent to the variable thickness of the product as it actually is applied—that can be used to ensure that the product in the field conforms to the near uniform thickness conditions in the tests used to establish the fire resistance rating of the component, assembly, or system. Such criteria are needed to ensure that the as-installed SFRM will provide the intended performance.

³¹ While the WTC recommendations are focused mainly on U.S. national standards, each U.S. standard has counterpart international standards. In a recent report (ISO/TMB AGS N 46), the International Organization for Standardization (ISO), through its Advisory Group for Security (AGS), has recommended that since many of the ISO standards for the design of buildings date to the 1980s, they should be reviewed and updated to make use of the studies done by NIST on the World Trade Center disaster, the applicability of new technology for rescue from high buildings, natural disasters, etc. ISO's Technical Advisory Group 8 coordinates standards work for buildings.

³² NIST tests showed that the adhesive strength of SFRM on steel coated with primer paint was a third to half of the adhesive strength on steel that had not been coated with primer paint. The SFRM products used in the WTC towers were applied to steel components coated with primer paint.