NFCA 200 – Field Quality Assurance Procedure for Application of Spray-Applied Fire Resistive Materials (SFRMs)

1 Scope

The application of SFRMs requires the contractor to ensure that product is installed in accordance with Approval Agency, manufacturers, and project criteria. This document defines the type of quality assurance procedures and the frequency of the procedure that should be followed by the contractor during SFRM application.

The quality assurance procedures included in this document are:

Determining Acceptable Substrate Surface Conditions
Water Control Procedures
SFRM Wet Density
SFRM Thickness

2 Reference Documents

2.1 Following are documents referenced in this document or that reference this document.

2.1.1 NFCA 100 – "Standard Practice For The Application of Spray-Applied Fire Resistive Materials (SFRMs)"
2.1.2 ASTM E 605 – "Test Methods for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members"
2.1.3 ASTM E 736 – "Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members"
2.1.4 ASTM E 759 – "Test Method of Effect of Deflection of Sprayed Fire Resistive Materials Applied to Structural Members"
2.1.5 ASTM E 760 – "Test Method for Effect of Impact on Bonding of Sprayed Fire Resistive Materials Applied to Structural Members"

3 Determining Acceptable Substrate Surface Conditions

3.1 General: The surface of the structural substrate must be of acceptable quality to ensure adequate adhesion of the SFRM to the structure. Criteria for acceptable substrate surface include adequate substrate surface temperature, surface free of any de-bonding materials, rigidity of the substrate, and proper installation of metal lath when required. All listed criteria must be met before application of SFRM.

3.2 Substrate Surface Temperature

3.2.1 Frequency of Temperature Determination: The substrate surface temperature must be measured at the beginning of each day. The temperature must be monitored during the day to ensure compliance with temperature criteria.

3.2.2 The substrate surface temperature must not drop below 40F (4C) during the application and shall be maintained at or above 40F (4C) for 24 hours after application. Should the substrate temperature drop below 40F (4C), the application area must be heated to maintain the acceptable temperature.

3.2.3 Procedure: Substrate surface temperature must be measured with a surface-measuring thermometer with a minimum range of 0F to 100F.

3.3 Clean Substrates

3.3.3 General: Proper adhesion to the structural substrate is dependent upon the substrate being free of any materials that would interfere with SFRM adhesion. All substrates must be free of any interfering materials before application of the SFRM. Under some conditions bonding adhesives may be applied to enhance the adhesion. Field bond testing may be required to show acceptable adhesive strength.

3.3.4 Oily Deposit on Structural Substrate: Remove all oily deposits with commercial cleaners recommended by the SFRM manufacturer.

3.3.5 Loose Mill Scale, Rust or Dirt: Remove loose mill scale, rust or dirt by wire brushing or sandblasting the substrate surface.

3.3.6 Concrete Form Oils: Remove all oily deposits with commercial cleaners recommended by the SFRM manufacturer.

3.4 Coated Substrates

3.4.1 Painted or Primed Steel Structural Members: Painted or primed steel can only accept SFRM if the paint or primer has shown proven compatibility through UL testing, or a

bond test has been conducted in accordance with ASTM E 736 and meets the guidelines established by UL in the BXUV section under Coating Materials in the UL Fire Resistance Directory. Absent meeting bond test criteria, metal lath may be required to be installed in accordance with UL criteria.

3.4.2 Painted or Primed Steel Decking: Painted or primed steel can only accept SFRM if the paint or primer has shown proven compatibility through UL testing, or a bond test has been conducted in accordance with ASTM E 736 and meets the guidelines established by UL in the BXUV section under Coating Materials in the UL Fire Resistance Directory.

3.4.3 Galvanized Metal: All coatings, paint, or oil must be removed from galvanized metal using recommendations of the SFRM manufacturer. SFRM manufacturers may also require applying a adhesive to the galvanized metal to enhance SFRM adhesion.

3.5 Flexible Metal Decking

3.5.1 General: Unlimited flexible substrates will contribute to bond failure between the substrate and the SFRM. The following conditions must be determined before start of application.

3.5.2 Deck Spans of Horizontal Substrate: The vertical deflection of horizontal substrates must be limited to L/240 when a 250-pound load is placed at center span. Steel deck spans should be designed and erected in accordance with criteria set forth by the Steel Deck Institute (SDI), along with ASTM E-759 and ASTM E-760.

4 Water Control Procedures

4.1 General: Water is added to SFRMs to activate the binders used to hold together the SFRM. Therefore, controlling the quantity and pressure are two important requirements. Follow manufacturers written instructions.

4.2 Water Pressure: Application requires that potable water be used and the water pressure at the nozzle be maintained at manufacturers recommendations. A water pump when required, shall have a 35-55 gallon reservoir to maintain adequate water line pressure.

4.3 Water Ratio

4.3.1 General: The volume of water used in the mixing process to create SFRMs needs to be controlled in order to produce manufacturer recommended density. The water pump or the water meter requires calibration.

4.3.2 Frequency of Calibration: The water pump or the water meter must be calibrated on a daily basis or when equipment is moved to a new location. Water meter volume or water pump flow rate must not exceed +/- 10% of the calibration container. Equipment not

meeting this requirement must be adjusted to meet calibration criteria, repaired, or replaced before continuing installation of the SFRM.

4.3.3 Flow Rate and Calibration Procedure

4.3.3.1 Chose a calibration container to be used. A 55-gallon drum or smaller container is acceptable.

4.3.3.2 Fill the calibration container with water and weigh the filled container or carefully measure the inside dimensions of the container and then calculate its volume. If the water filled container is used to determine volume, use the following formula to determine its volume.

$$\text{Container Volume (gallons)} = \frac{\text{(Weight Water Filled Container (lbs) – Empty Weight (lbs))}}{\text{8.34 lbs/gal}}$$

4.3.3.3 Water Meter Calibration: Fill the calibrated container with water flowing through the water meter. Compare the water meter reading with the calibrated volume of the container. Based on that volume difference determine the action to take in accordance with Section 4.3.2.

4.3.3.4 Water Flow Rate: Fill the calibrated container with water from the pump and using a stop watch determine the time required to fill the calibrated container. Calculate the water flow rate using the following formula.

$$\text{Water Flow Rate (Gallons per Minute)} = \frac{\text{Volume of Calibrated Container (Gallons)}}{\text{Time (Minutes)}}$$

4.3.4 Water Ratio Requirements

4.3.4.1 General: SFRMs may require a ratio of water volume to pounds of dry material to ensure proper quantity of water available for the binder and density control. Continuous mixing of material also requires control of the proper water to material ratio.

4.3.4.2 Frequency of Measurements: Control of the water ratio is critical, measure the water flow rate from the pump daily. Should the flow rate exceed +/- 5%, make the necessary equipment adjustments or repair the equipment to bring the flow rate into control.

5 SFRM Wet Density

5.1 General: Approvals of SFRMs by Underwriters Laboratories are in part based on the dry density of the SFRM used in the fire test. Frequent dry density testing in accordance with ASTM E 605 may result in many square feet of substrate not in density compliance with UL designs before corrective action is taken. In order to overcome this timing issue, a wet density procedure is provided that can be easily conducted on during application of the SFRM. SFRM manufacturers already have developed the relation between wet density and dry density for their product. Therefore establishing wet density requirements for UL listings can be accomplished.

5.2 Frequency and Accuracy: Conduct the wet density test every two (2) hours. Take the sample by spraying from the nozzle directly into the 1 liter wet density cup provided by the SFRM manufacturer. The wet density must be in the range of +/- 10% of the design value.

5.3 Wet Density Procedure: This procedure uses a plastic cup provided by the SFRM manufacturer with a known 1 liter volume. Should the plastic cup become damaged such that the 1 liter volume no longer exist, replace the cup before continuing to make wet density measurements.

5.3.1 Using a calibrated gram scale, weigh an empty, clean 1-liter plastic cup and record the container weight in grams.

5.3.2 Spray the SFRM directly from the spray nozzle into the clean 1 liter cup. Fill the cup with SFRM to above the top rim of the cup. Scrape the top surface level with the cup's rim. If an accelerator is being used with the SFRM, wait an additional period of time until the SFRM stops increasing in height above the cup's rim and then again scrape the surface level with the rim.

5.3.3 After application of the SFRM, re-weigh the filled test cup and record the weight in grams.

5.3.4 Calculate the wet density of the SFRM using the measured weights and known volume of the test cup using the following formula.

Wet Density (PCF) = (SFRM Filled Test Cup (grams) – Empty Test Cup (grams)) X 0.0624

5.4 Corrective Action: Should the wet density not be in conformance with the Accuracy requirements of Section 5.2, stop spraying and make the necessary product adjustments to bring the density into conformance. Isolate the SFRM sprayed since the last passing density test and conduct a dry density test in accordance with ASTM E 605 using the Displacement Method in Section 8.3. Should dry density fall below requirements, consult with product manufacturer for UL corrective procedure.

6 SFRM Thickness

6.1 General: The second critical property for proper application of SFRMs is the thickness of material applied to the substrate. Thickness determination is easily measured using current procedures.

6.2 Frequency and Accuracy: Make one thickness measurement every hour the structural element is being sprayed. Individual measured thickness, which exceeds the SFRM thickness specified in a listing by ¼ inch or more shall be recorded as the thickness specified in the UL listing plus ¼ inch. For thickness 1 inch or greater, the minimum allowable individual thickness shall be the UL listing thickness minus ¼ inch. For UL listing thickness less than 1 inch, the minimum allowable individual thickness shall be the listing thickness minus 25 percent. If the measurements continue not to meet the thickness requirements, corrective action is required.

6.3 Procedure: Thickness measurement shall follow the procedure in Section 8 of ASTM E 605 using the thickness gage shown in Figure 1 of the ASTM standard.

6.4 Corrective Action: Should thickness measurements fail to meet the Accuracy requirements in Section 6.2, immediately isolate the sprayed substrate since the last hourly thickness measurement, which passed the UL listing requirement. Retest the thickness of the isolated area using ASTM E- 605 procedures. Should those measurements not conform to thickness requirements, re-spray the isolated area to bring thickness into conformance. Increase the spray thickness for current applications and continue spraying the substrate.