



Raising the Bar on Hot Work Fabrics

A new standard aids risk management. Approved fabrics must pass a series of tests designed to measure performance in real-world hot work operations.

BY KATHIE M. LEONARD

Almost all hot work loss prevention standards call for the use of some kind of fabric cover to protect combustibles from sparks and slag within the designated 35-foot radius of welding and cutting operations. What to use as a cover, however, is not specified in existing standards, leaving management with a burdensome and costly task of researching several product specifications and running trials before making the proper choice for the job at hand. And if the next job has different requirements, another evaluation may be required.



Thanks to a new performance-based standard developed by FM Approvals, a nationally recognized testing laboratory, the job of eliminating the underbrush from such tasks just got easier. For the first time, safety professionals, material buyers, and welding supervisors have a standard they can use to match their applications to products tested in similar conditions, ensuring their choice of fabric is the best one for that job.

The new FM Approval Standard 4950, *Welding Pads, Welding Blankets and Welding Curtains for Hot Work Operations* (FM 4950), was developed in response to commercial and industrial property insurer FM Global clients' desire to develop uniform corporate policies for hot work management, including the specification of "FM Approved" products.

The standard also offers a way for fabric manufacturers to differentiate their products from those made with substandard materials and less consistent manufacturing processes. As FM 4950 is adopted by industry as part of corporate hot work policy, better risk management will be achieved, which should result in fewer insurance claims and, ultimately, lower premiums to clients. Better bottom-line results are a win for everyone involved.

What is FM Approvals?

FM Global is a major insurer, serving more than one out of every three Global 1000 companies. FM Approvals (formerly Factory Mutual Research) is an FM Global enterprise that tests and Approves more than 45,000 certified industrial and commercial products for companies worldwide. FM Approved products include building materials such as roofing, insulation, and fire protective coatings. Products that have been tested and Approved to Standard 4950 are listed under "Fire Protection Equipment." *The Approval Guide* is published quarterly and can be purchased directly from FM Global through its website, www.fmglobal.com.

After studying more than 600 hot work losses, FM Global determined almost 90 percent of the losses were due to poor hot work safety guidelines. In an effort to provide clients with some guidance in improving their hot work policies, FM Approvals took on the task of developing a performance-based standard for hot work protection fabrics, which would work hand in hand with such well-established hot work safety standards as NFPA 51B and ANSI Z49.1.

Setting a New Standard

Prior to considering the new FM 4950, it is critical to stress the importance of the NFPA 51B, Standard for Fire Prevention During Welding, Cutting and Other Hot Work, which establishes these fire-related safety precautions, two of which may include the use of fabrics:

- 1) Issuance of Hot Work Permits for each job by PAI (Permit Authorizing Individual)
- 2) PAI responsible for proper fire protection and extinguishers
- 3) Role of Fire Watch explained
- 4) Availability of Appropriate Fire Extinguishers
- 5) Combustibles to be moved outside 35-foot horizontal radius of Hot Work
- 6) Openings and cracks within 35-foot radius to be tightly covered with fire retardant or non-combustible materials
- 7) Fire-resistant tarpaulins to be suspended beneath work

Using these safety guidelines in combination with real-world applications, FM Approvals created three classes of fabrics, then developed appropriate test criteria for each classification. After two years of work, the final FM 4950 was formally introduced in 2002. Three classifications were established as follows:

- 1) **Welding pad.** Heat resistant fabric designed to be placed directly under a hot work operation such as welding or cutting. Intended for use in horizontal applications with severe exposures such as that resulting from molten substances or heavy horizontal welding. Designed to prevent the ignition of combustibles that are located adjacent to the underside of the pad.
- 2) **Welding blanket.** Heat resistant fabric designed to be placed in the vicinity of a hot work operation. Intended for use in horizontal applications with light to moderate exposures such as that from chipping, grinding, heat treating, sand blasting, and light horizontal welding. Designed to protect machinery and prevent ignition of combustibles such as wood that are located adjacent to the underside of the blanket.
- 3) **Welding curtain.** Heat resistant fabric designed to be placed in the vicinity of a hot work operation. Intended for use in vertical applications with light to moderate exposures such as that resulting from chipping, grinding, heat treating, sand blasting, and light horizontal welding. Designed to prevent sparks from escaping a confined area.

Two observations can be made about these three classifications:

First, the designations of "PAD," "BLANKET," and "CURTAIN" do not relate to whether the products are fabricated in any way. Rolls of uncut cloth as well as cut and sewn blankets and curtains can be termed as "curtains," as long as both were tested and FM Approved for vertical applications with light to moderate exposures to molten metal and sparks. It may be useful to think of the designations as LIGHT (Curtain), MEDIUM (Blanket), and HEAVY-DUTY (Pad).

Second, testing of fabric samples was done with a single layer only. Multiple layers of fabrics can enhance effectiveness when in use.

Making the Grade with Lab Testing

In order to obtain FM Approval in one or more of the categories described above, fabrics must pass a series of tests spanning several months and designed to measure performance in real-world hot work operations. The scope of testing includes:

1. **Fire and Thermal Resistance.** Involves automatic oxy-acetylene cutting torch with Pad and Blanket test samples positioned 21 inches beneath the torch. Curtains are hung vertically. Seven thermocouples located below the test materials measure heat resistance. Temperature recorded by the thermocouples must not exceed 500°F (260°C). Pads and blankets are additionally tested according to a Paper Ignition Test, in which the paper is inspected for signs of burns or holes. Pads may exhibit no signs of burning of the paper, and blankets may exhibit holes smaller than 1-1/2 inch in diameter. Tests are run before and after the Accelerated Weathering Test (see #3), including the Paper Ignition Test.
2. **Charring Embrittlement Test.** Measures the durability of the fabrics following the Fire and Thermal test. Pad and Blanket specimens are bent over a 1-inch nominal diameter pipe to 90 degrees five times in two directions. The specimens are then turned over and the bending process is repeated five more times in the long and short centerlines. Specimens are inspected for cracking or formation of openings through the fabric.
3. **Accelerated Weathering Test.** Determines the effect caused by outdoor conditions—such as water and UV exposures—on the fire performance of the products. The test simulates the deterioration caused by rain, dew, and sunlight. The test specimen is exposed to these outdoor conditions for 1,000 hours—about 42 days. Once completed, fabrics are again tested for Thermal Resistance and Embrittlement as described above.

Manufacturers must agree to the conditions outlined in their agreement with FM Approvals, which also include fees for testing and travel time by FM Approvals staff.

Holding Fabric Makers' Feet to the Fire

Any company making application for FM Approval of its fabrics must pass muster. Before product testing can begin, a visit by FM Approvals to the manufacturer's facility includes a thorough review of the company's quality management system. (Companies with audited quality systems in place, such as ISO certification, will find the review easier than companies without such systems in place.)

All materials submitted for testing must be made within authorized manufacturing facilities. A complete list of components, additives, raw materials, formulas, equipment, and production requirements must be provided. Periodic audits of the manufacturers' facilities are conducted in order to maintain FM Approval of their products. Such audits are intended to assure the consistency of product quality over time. In addition, notification by the manufacturer is required before any change can be made to the product (such as a different yarn or coating formulation). Consistency of quality is essential to ongoing FM Approval.

Product labeling is closely controlled in order to assure customers they are getting only FM Approved products. Labeling includes the distinctive FM Approval certification mark on the packaging and an explanation of which level of protection the user may anticipate with the products (Pad, Blanket, Curtain), together with the definition of those terms.

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What's Been Approved So Far

Presently, 12 fabrics have been tested and granted FM Approval, with more still being evaluated as this article goes to press. Fabrics for all three levels of severity are included, and several fiber types and coatings are represented, spanning recommended operating temperatures from 225°F to 1,800°F. Here is a generic listing of the products within their welding categories (weights excluded):

- WELDING PAD: Amorphous Silica Fabric (96 percent min. silica content); Carbon/Fiberglass Composite Fabric
- WELDING BLANKET: Silicone-coated Amorphous Silica Fabric
- WELDING CURTAIN: Neoprene-coated Fiberglass Fabric; Silicone-coated Fiberglass Fabric; 100 percent Fiberglass Fabric, Heat Cleaned; 100 percent Fiberglass Fabric, Black; Amorphous Silica Fabric



Making the Short List

Using this new standard and these three classifications greatly shortens the amount of research needed about specific products, but for optimal safe performance, these three issues still must be addressed before making final choices of fabrics:

- 1) **Will work occur in open or confined space?** (If confined space is an issue, special attention to adequate ventilation during hot work must be addressed before fabric choices can be made.)
- 2) **Should outdoor conditions be considered?** (Weather-resistant coatings may be preferable to plain fabrics for such conditions.)
- 3) **Will the entire fabric be exposed to extreme heat, or just where sparks and slag land?** (Special consideration should be given to heat treat or stress relief applications.)

Beyond FM 4950

The use of FM Approved fabrics is designed to enhance good hot work policies already in place. Here are a few additional points that should be included during development or revision of a hot work management policy:

- 1) The issuance of hot work permits, fire watches, and other fire safety precautions as recommended in NFPA 51B are all essential to safe hot work operations.
- 2) FM 4950 does not address the issue of toxicity or out-gassing of materials when subjected to molten metal or other fire conditions resulting from hot work.
- 3) In order to be effective, fabrics must completely cover the surface to be protected.
- 4) Fabrics should be maintained in good shape because performance can be drastically reduced if they exhibit any of the following characteristics:
 - Discoloration • Attached slag • Rips/tears • Frayed material • Holes
- 5) The added protection gained by using multiple layers of fabric should be emphasized.

Final Considerations

FM 4950 makes the job of selecting the appropriate fabric much easier but doesn't eliminate user participation in the process. For example, even if a hot work policy calls for exclusive use of FM Approved fabric, it also should include the requirements that suppliers' product data sheets be reviewed and that samples are field tested for each application. If both outdoor and indoor work are anticipated, it may be necessary to have different products approved for each use. Additionally, if fabrics must meet additional standards such as U.S. military specifications, this information will need to be included.

This new standard for hot work fabrics represents a considerable investment of capital—both intellectual and financial—by fabric makers and by the insurance-driven testing authority, FM Approvals. That investment was made on behalf of the industrial concerns that use them. As industry incorporates the use of FM Approved hot work products into hot work policies, all of us will be working smarter and safer, thereby lessening the chance of a costly industrial fire and protecting valuable resources.

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