

SAFEGUARDING TORCH-APPLIED ROOF INSTALLATIONS

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1.0 SCOPE

This data sheet recommends design considerations and precautions that should be taken during the installation of torch-applied roof (TAR) systems for new roof construction, re-roofing, or recovers.

This document does not apply to hot-air welding used to secure lap seams. For additional information on hot work management, see Data Sheet 10-3. For additional information on other issues related to building construction, alteration, and demolition operations, see Data Sheet 1-0.

1.1 Changes

October 2017. This document has been completely revised. The following major changes were made:

- A. Expanded information related to the fire watch and fire monitoring.
- B. Added guidance on training torch applicators.
- C. Made editorial changes throughout the document, including moving some information from Section 2.0 to Section 3.0.
- D. Added several definitions to Appendix A.

2.0 LOSS PREVENTION RECOMMENDATIONS

Before selecting any roof system, consider all aspects of the assembly and installation method to ensure the most appropriate assembly is chosen for a given installation. In general, torch-applied roofing is more likely to cause a fire than roof installations that use fasteners and adhesives. This is particularly true where a new roof is being installed on an existing building that already has combustible materials in the construction and occupancy. In some cases where polymer-modified roofs are to be installed in locations prone to tropical cyclones, it may be preferred to use a torch-application as an alternative to cold adhesives that require an extended cure time.

2.1 Human Element

2.1.1 Conduct pre-incident planning with the fire service. Include the building roof areas involved, access routes to the roof area, and the locations of fire hydrants. Provide a means for roof installers to communicate a fire emergency condition to the fire service and facility management, such as cell phones, two-way radios, etc. Preprogram job-specific emergency numbers into cell phones to prevent 911 calls from going to the workers' home areas.

2.1.2 Manage the torch-applied roof (TAR) installation using the FM Hot Work Permit System.

2.1.3 Install TAR systems using contractors that have been trained through the Certified Roofing Torch Applicator (CERTA) program administered through the National Roofing Contractors Association (NRCA). For additional information, see Section 3.2.

2.1.4 Follow the manufacturer's instructions for the use of torches to secure roofing membranes. Constantly move the flame from hand-held torches from side to side. If a mobile heating apparatus is used, keep it in constant motion while operating. Heat the exposed outer surface of the membrane roll until a slight sheen develops. Do not overheat the membrane as this could cause smoldering or ignition of it, which is evidenced by a slight smoke vapor.

2.1.5 Use caution when working around roof openings, penetrations, or flashings.

2.1.5.1 Do not allow the torch flame to come in direct contact with wood nailers, cant strips, or metal flashing. Use small torches to heat the underside of the membrane, keeping the membrane and torch away from these areas until just prior to securement. Use hot trowels (electric trowels or trowels heated by a torch) to run along seams at laps and flashing to soften the adhesive. Do not use a torch in areas where the flame impingement cannot be fully viewed. Do not leave open flames unattended. Use FM Approved welding pads over roof openings/vents to prevent ignition of building construction or contents. A less-desirable alternative is to use FM Approved welding blankets. If neither are available, use a stable, noncombustible cover.

2.1.5.2 Use extreme caution near penetrations such as exhaust vents as flames could ignite grease and lint accumulations. Clean such accumulations before roofing work is started.

2.1.5.3 Shut down air conditioning units and ventilating fans before torch work is started in surrounding areas.

2.1.5.4 Fill expansion joints with mineral wool or ceramic fiber with a steel insulation retainer below.

2.1.6 Use a torch stand to direct the flame upward when momentarily not in use. Close the cylinder valve to burn off propane in the line before shutting off the torch head. Shut off the gas supply whenever a propane odor (rotten egg smell) is detected.

2.1.7 Coordinate installations with all concerned parties and provide close supervision.

2.1.8 Do not use torches near gas lines, electrical wires, or ignitable liquids.

2.1.9 Use only FM Approved assemblies as detailed in RoofNav. Do not apply the torch flame to combustible substrates (such as foam plastic, kraft-faced glass fiber, wood fiber insulation or cant strips, or plastic fastener plates) when installing the membrane. Do not allow torch flames to come into contact with adhesives other than those in the TAR itself.

2.1.10 Do not install torch-applied roofing during high wind conditions (when wind speed is faster than 10 mph (4.5 m/s)).

2.1.11 Do not store other combustible materials (apart from propane cylinders; see Section 2.2.6) within 35 ft (11 m) of areas in which torches will be used. This includes, but is not limited to, stored insulation, roof covering, and solvents.

2.2 Equipment and Processes

2.2.1 Use the proper equipment to heat roofing membranes. Use torches equipped with a pilot adjustment, flame height adjustment, and 25 to 50 ft (7.6 to 15.2 m) of listed hose, pressure gauge, and regulator. Use a spark igniter to light torches. Equip torch trolleys and multiple torch head machines with listed safety valves.

2.2.2 Propane Cylinders

2.2.2.1 Tie safety caps to all propane cylinders and install them on the valves whenever cylinders are not in use. Use stable carts to transport propane cylinders. Chain tall, narrow, standing cylinders against walls or in proper carts.

2.2.2.2 Adequately size and match the propane cylinder for the torch used.

A. Do not use a torch setup designed for vapor withdrawal with a liquid withdrawal propane tank. Liquid withdrawal cylinders are preferred.

B. If frost buildup occurs on propane cylinders, shut off the valve, disconnect the hose and use a larger cylinder as the rate of vapor withdrawal is no longer adequate for operating conditions.

C. Do not place the cylinder on its side or heat with the torch flame.

D. Also see Section 3.1.

2.2.2.3 Thoroughly inspect and repair or replace equipment as needed. Inspect propane cylinders for dents. If dents larger than 1 in. (25 mm) in diameter are found, replace the cylinder. Visually inspect and check torch and cylinder connectors for leaks with a soap and water solution. Do not use an open flame to test for leaks.

2.2.2.4 Do not use leaky equipment. Check regulator adjustments and pressure gauges to ensure they are operable. Check the vent on the regulator to ensure it is not blocked. If an unstable flame occurs (i.e., one that roars loudly and tends to blow itself out), repair or replace the equipment immediately.

2.2.2.5 Do not hoist propane cylinders using their valves. Use straps placed around the cylinders.

2.2.3 Conduct a continuous fire watch over the hot work area during torch application. Conduct a post-work fire watch for at least one hour after torches have been extinguished. Ensure the fire watch includes the following activities:

A. Check all roof areas worked on for hot spots using thermal imaging, such as an infrared scanning device, and look for signs of smoldering. Where temperatures are in excess of 250°F (121°C), remove and safely discard all charred or smoldering insulation and roof covering, including materials within a 4 ft (1.2 m) radius beyond.

B. Inspect the entire top surface of the roof area worked on as well as the inside of the building for signs of fire, dripping bitumen, or smoke. Pay particular attention to areas around roof expansion joints and other roof penetrations.

2.2.3.1 After the post-work fire watch has concluded, perform fire monitoring above and below the roof surface in accordance with **one** of the following methods for at least one additional hour.

A. Have tours made on and beneath the roof work area by trained facility or contractor personnel at maximum 20-minute intervals.

B. If all work areas can be adequately viewed and exterior surfaces are properly illuminated during dark periods, use security cameras to view above and below the roof work areas at maximum 15-minute intervals to check for signs of smoke or fire.

C. Within the building, use automatic smoke detection that is monitored at a constantly attended location.

D. Use security cameras with thermal imaging capability to view the exterior surfaces of the roof work areas at maximum 30-minute intervals.

2.2.3.2 Report all "hot spots" or fires, even if extinguished, to the fire service. Smoldering may continue after extinguishment and may take place for hours before flaming begins in areas unsuspected by nonprofessionals.

2.2.3.3 If thermal imaging is not available, conduct a minimum 2-hour post-work fire watch followed by a minimum 2-hour fire monitoring period above and below the roof in accordance with Data Sheet 10-3.

2.2.4 Ensure fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating complies with Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*, and NFPA 58, *Liquefied Petroleum Gas Code*.

2.2.5 Locate all fuel containers at least 10 ft (3 m) from the burner flame or at least 2 ft (0.6 m) away when properly insulated from heat or flame.

2.2.6 Install torch-applied roof covers to ensure adequate adhesion and wind uplift resistance. Ensure the following practices are followed when it is practical and safe to do so:

A. When applying the torch, face the leading edge of the roll and pull the roll towards you. Do not walk behind the roll and push the roll as this will result in an improper angle for torch impingement and damage to the roof cover from walking on it when it is hot.

B. Pass the torch flame back and forth across the leading edge of the roll, with most of the flame impinging on the leading edge of the roll, and only slight heating of the substrate below.

C. Do not overheat the roll, such as to cause excess smoke.

D. Allow the hot bitumen to pool slightly at the leading edge of the roll and across the entire width of the sheet as it is unrolled (see Figure 1).

2.2.7 Follow guidance in DS 1-0 regarding the temporary storage of combustible roofing materials and other issues related to safety during construction and alterations.

2.3 Protection

2.3.1 Provide at least one 10 lb (4.5 kg) multipurpose dry chemical portable extinguisher within 20 ft (6.1 m) horizontal travel distance of torch-applied roofing equipment. Use charged hose lines or additional extinguishers for roof areas greater than 10,000 ft² (929 m²).

2.3.2 Do not use TAR on tall timber structures (see Appendix A).

2.3.3 Avoid the use of TAR if other combustible construction materials are present. This includes plastic skylights, wall assemblies containing foam plastic insulation, and wood. If this is not practical, cover the exposed combustible materials with FM Approved welding pads or FM Approved welding blankets for use in hot work operations. To find such products, go to the *Approval Guide*, Fire Protection section, and click on "Miscellaneous Loss Prevention Equipment" for a drop down menu. Select "Welding Blankets for Use in Hot Work Operations" or "Welding Pads for Use in Hot Work Operations."

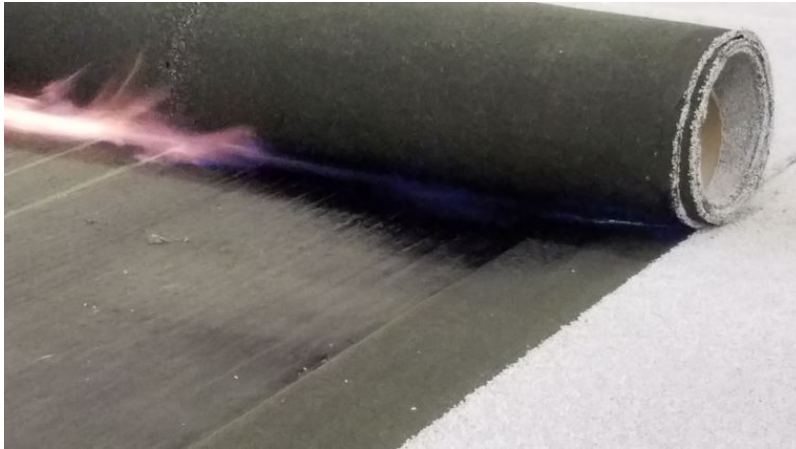


Fig. 1. Torch application of upper ply; note adhesive pooling at the leading edge of the roll

2.4 Construction and Location

2.4.1 Use only Class A exterior fire-rated FM Approved roof assemblies as specified in RoofNav. Certain types of insulations, cover boards, and plastic stress plates (as noted in Section 2.1.9) can ignite or deteriorate and therefore should not be allowed to come in direct contact with the torch.

2.4.2 Follow all applicable recommendations below before re-covering over an existing multi-ply roof. Additional details can be found in Data Sheet 1-29, *Roof Deck Securement and Above-Deck Roof Components*:

- A. Power broom and remove all gravel or slag before re-covering over existing multi-ply roofs with such surfacing. In addition, conduct a moisture survey and replace materials in wet areas.
- B. Repair blistered and broken areas before applying a torch-applied roof cover over an existing roof. If the original roof insulation was not properly mechanically fastened throughout the roof, have **one** of the following done:
 - 1. Mechanically fasten the existing roof with FM Approved fasteners driven through new insulation and/or the existing covering and into the deck. The re-roofing system can then be applied. Use fasteners with steel plates. Recess the mechanical fastener slightly into the existing covering or cover with a patch of felt before installing the new covering.
 - 2. Conduct uplift tests on the existing roof in accordance with Data Sheet 1-52, *Field Verification of Roof Uplift Resistance* (uplift tests can be waived if previously done) and mechanically fasten if tests fail. Recess the mechanical fastener slightly into the existing covering or cover with a patch of felt before installing the new covering.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General

Torch-applied roofing is a potentially hazardous construction process, and extreme caution should be exercised during installation.

Liquid propane cylinders can be of either the vapor withdrawal or liquid withdrawal type. With the vapor withdrawal type, vapor is drawn off from the top of the cylinder. Vapor withdrawal cylinders are equipped with female cylinder valves. Liquid withdrawal cylinders transfer the liquid, via a siphon tube, from the cylinder to the torch head where it is vaporized. Liquid withdrawal cylinders have male cylinder valves, which may be equipped with adapters.

Frost buildup occurs only with vapor withdrawal cylinders. This buildup can be the result of an undersized cylinder or low air temperatures. When vapor is drawn off more quickly than it is replaced, heat is absorbed

and frost buildup occurs on the outside of the cylinder. Vapor pressure then further declines. Consequently, liquid withdrawal cylinders are preferred. However, if vapor withdrawal cylinders are used, or if temperatures are low (below 20°F [-7°C]), use 40 or 100 lb (18.2 or 45.5 kg) cylinders with larger torches suitable for the type of tank it is being used with. Do not use fitting adapters that can result in excessive flame lengths.

While electric heating elements are used to secure seams for modified bitumen membranes, they are not recommended for the securement of the membranes to their substrates.

Additional information can be found in NFPA 51B and NFPA 241.

3.2 Training

In the United States, training for torch applicators is available through the National Roofing Contractors Association (NRCA), either through training of individual roofers or using the train-the-trainer approach. Contact information is as follows:

NRCA
10255 W. Higgins Road, Suite 600
Rosemount, IL. 60018-5607
Attn: Education Department
Tel. No. 1-847-299-9070

<http://www.nrca.net/roofing/CERTA-314>

3.3 Loss Experience

Hundreds of fires have been started by roofer's torches during the installation of torch-applied roof systems. These losses support the need to follow the recommendations in this data sheet.

4.0 REFERENCES

4.1 FM

Data Sheet 1-0, *Safeguards During Construction, Alterations and Demolition*
Data Sheet 1-29, *Roof Deck Securement and Above-Deck Roof Components*
Data Sheet 1-52, *Field Verification of Roof Uplift Resistance*
Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*
Data Sheet 10-3, *Hot Work Management*

Approval Guide, an online resource of FM Approvals

RoofNav, an online resource for roofing professionals

FM *Hot Work Permit System*

4.2 Other

National Fire Protection Association (NFPA). NFPA 51B, *Standard for Fire Prevention during Welding, Cutting and Other Hot Work*.

National Fire Protection Association (NFPA). NFPA 58, *Liquefied Petroleum Gas Code*.

National Fire Protection Association (NFPA). NFPA 241, *Standard for Safeguarding Construction, Alteration and Demolition Operations*.

APPENDIX A: GLOSSARY OF TERMS

Cross laminated timber (CLT). A prefabricated, engineered wood product consisting of not less than three layers of solid-sawn or structural composite lumber where the adjacent layers are cross-laminated and bonded with structural adhesives to form a solid wood element.

FM Approved: Products and services that have satisfied the criteria for Approval by FM Approvals. Refer to the *Approval Guide* for a complete list of products and services that are FM Approved.

Hot Work: Any temporary or routine work (operation) involving an open flame, producing hot surfaces, and/or generating sparks or molten material of sufficient energy to ignite combustible, ignitable, and/or flammable

materials. Examples of hot work operations include torch-applied roofing, pipe brazing, pipe soldering, arc and torch welding, radial-mechanical and torch cutting, grinding, and post-weld heating using a gas-fired burner or electrical resistance heater. For ignition-sensitive materials such as low-flash point ignitable liquids, flammable gas/vapor, and some combustible dusts, hot work may be expanded to include low-energy hot work ignition sources.

Listed: Products that are not FM Approved but have been tested by a nationally recognized testing laboratory to ensure they perform safely for their intended use.

Tall timber structures: Buildings that are constructed of materials including, but not limited to, CLT panels or heavy (solid) wood timber as the primary structural elements, and whose height exceeds conventional prescriptive code limitations.

Torch-applied roof systems: Polymer-modified bituminous roofing systems that use membranes adhered to the substrate below by heating the underside of the roll with a torch and melting the polymer-modified asphalt contained within it.

Welding blanket, FM Approved: A heat-resistant fabric designed to be placed in the vicinity of a hot work operation. The blanket is intended for horizontal orientation while subjected to light or moderate thermal exposures from hot work activities such as torch-applied roofing that does not result in molten metal contact (i.e., no slag exposure). The blanket is capable of resisting burn-through and thermal conduction through the blanket that may ignite combustibles on the opposite side of the blanket. A welding blanket provides less thermal protection than a welding pad.

Welding pad, FM Approved: A heat-resistant fabric designed to be placed in the vicinity of a hot work operation. The pad is intended for horizontal orientation while subjected to moderate or severe thermal exposures from hot work activities, including those that may result in molten metal contact (i.e., slag exposure). The pad is capable of resisting burn-through and thermal conduction through the pad that may ignite combustibles on the opposite side of the pad. A welding pad provides more thermal protection than a welding blanket.

APPENDIX B: DOCUMENT REVISION HISTORY

October 2017. This document has been completely revised. The following major changes were made:

- A. Expanded information related to the fire watch and fire monitoring.
- B. Added guidance on training torch applicators.
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- D. Added several definitions to Appendix A.

January 2000. This document has been reorganized to provide a consistent format.

January, 1998. Information was moved from TAB 1-29 into DS 1-33. Only editorial changes were made.

October 1988. This subject was first addressed as a Technical Advisory Bulletin filed with DS 1-29 (TAB 1-29).