



Carolinas Mid-winter Roofing Expo
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Changes in FM guidelines



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FM Approvals' revision of FM 4470

- FM 4470 provides the basis for FM's classification of roof assemblies (e.g., 1-60, 1-90)
- Previous edition dated 1992 (April 1986)
- New edition published in June 2012 with an effective date of January 1, 2013

Code requirements

IBC 2006 and previous editions

1504.3.1 Other roof systems. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single ply, through fastened metal panels and other types of membrane roof coverings shall also be tested in accordance with FM 4450, FM 4470, UL 580 or UL 1897

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Code requirements

IBC 2009 and IBC 2012

1504.3.1 Other roof systems. Roof systems with built-up, modified bitumen, fully adhered or mechanically attached single ply, through fastened metal panels and other types of membrane roof coverings shall also be tested in accordance with FM 4474, UL 580 or UL 1897

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Revisions to FM 4470

June 2012

- Adds NFPA 276
- Changes conditions of acceptance for wind uplift and hail damage resistance testing
- Adds alternative test methods for fastener corrosion resistance
- Changes to methods on how steel roof decks are evaluated
- Adds optional tests for dynamic puncture resistance, noncombustible core insulation and solar reflectance

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Revisions to FM 4470

Evaluation of steel roof decks

- Allowable stresses per AISI S100
- Deflection based upon 200 lb. point load
- Deck design based upon 0.7-mm-thick (< 22 ga.)
- Fasteners tested for “pull over” of the deck material
- Stress calcs. on decks and fastener heads; lower value controls

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STEEL DECK INSTITUTE
Position Statement

ATTACHMENT OF ROOFING MEMBRANES TO STEEL DECK

This document has been published by the Steel Deck Institute (SDI) as a position paper in response to discussions taking place in the roofing community about the screw attachment of roofing membranes to steel deck following line patterns with large spacing. The impetus for this paper is in response to testing carried out by the Special Interest Group for Dynamic Evaluation of Roofing Systems (SIDGERS) at the Institute for Research in Construction, National Research Council of Canada. The mandate of the SIDGERS joint research program is to carry out generic, pre-competitive research on the performance of flat roofing systems subjected to dynamic wind loading. The objective is to develop improved roofing systems and design methods.


The SIDGERS research is looking at roofing systems that incorporate wide membranes sheets attached to the steel deck following line patterns spaced at up to 12 ft (3.65 m). While the membrane itself has the performance characteristics to accommodate this size of tributary loading, the existing design methods for steel deck under wind uplift are typically based on the uniform application of the wind suction to the deck. The large majority of the steel roof deck used for commercial buildings in North America is profiled with 1 1/2" (38 mm) flutes, with the structural supports usually spaced between 5'-0" (1.52 m) and 6'-8" (2.03 m). Under uplift conditions, the attachment of the roofing membrane along lines with large spacing could produce localized loads that can exceed the capacity of the deck, whereas those same loads applied uniformly on the surface of the deck would be acceptable.

The strength of screwed connection between the membrane and the steel deck, as well as the strength of screwed, nailed, or welded attachment of the steel deck to the structural supports can be computed according to the North American Specification for the Design of Cold-Formed Steel Structural Members. These design values are based on the specified minimum mechanical properties (i.e. base steel thickness and yield strength) specified for the steel sheet roof deck, and should be lower than the strength determined by field-testing. The use of field-test results for properties such as the pull-out strength of a screw into a steel deck needs to recognize that the properties of the steel deck can be higher than the minimum limits required by the steel specifications. Therefore, field-testing results must be adjusted accordingly to account for the difference between the actual properties of the deck and the minimum properties of the steel according to the material specification used in design.

The screw fastening of wide roofing membranes (up to 12 ft) and the corresponding spacing of the lines of screws holding the membrane on the deck, will have a very different effect on the deck and structural supports than a membrane that is adhered over its entire surface. The screws will produce a line load along the deck instead of a uniform load of the entire deck surface. The line loads can be perpendicular or parallel to the deck flutes depending on the orientation of the membrane each condition can have different implications of the loading that is applied to the deck.

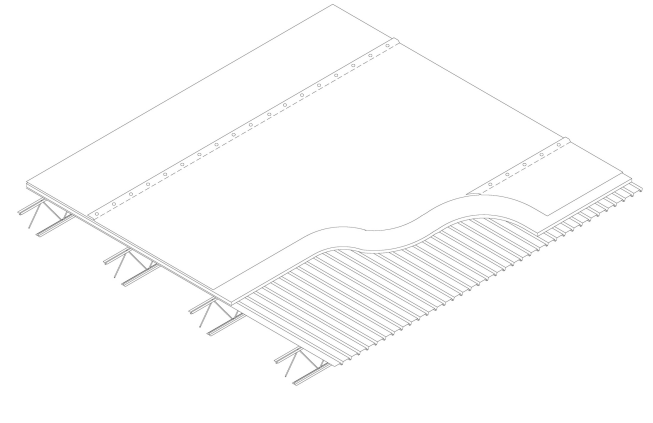
If the roofing membrane seam is perpendicular to the flutes of the deck, as illustrated in Figure 1, there are two special conditions that need to be considered.


1. if the membrane seam occurs at the mid-span of the steel deck; and
2. if the membrane seam occurs at the structural support (joists).



Mechanically-attached single-plyies

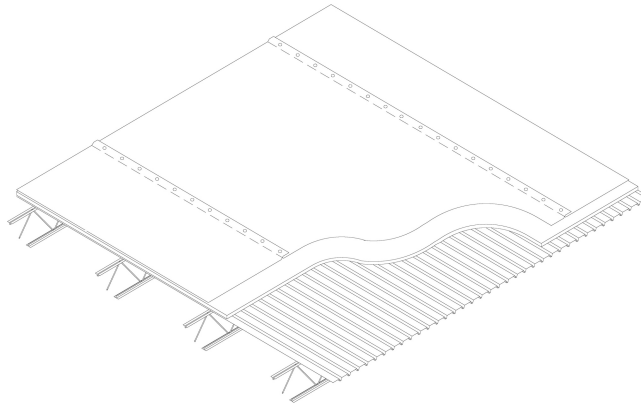
(Seams parallel to joists)





Mechanically-attached single-plyies

(Seams parallel to deck flutes)



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SDI position statement

- Membrane seams at mid-span of deck:
 - 3.8 x bending moment
- Membrane seams at joists:
 - 2 x uplift load
- Membrane seams parallel to deck flutes:
 - 12 x bending moment and shear

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SDI position statement

“...SDI does not recommend the use of roofing membranes attached to the steel deck using line patterns with large spacing unless a structural engineer has reviewed the adequacy of the steel deck and the structural supports to resist to wind uplift loads transmitted along the lines of attachment. Those lines of attachment shall only be perpendicular to the flutes of the deck.”

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Types of steel used for roof deck

- ASTM A653 (33 ksi typical)
- ASTM A611 (e.g., Grade E—80 ksi)
- ASTM A1008

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Effective date

FM 4470, Section 1.6

- Effective date is December 31, 2012
- “...Products FM Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval...”

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So, what does all this mean?

- FM has re-evaluated pre-12/31/12 classifications:
 - Reduce deck span, increase deck thickness and/or grade (33 ksi to 80 ksi) to maintain wind rating and existing RoofNav number
 - Re-evaluate assemblies, lower wind rating and create a new RoofNav number
- FM classifications likely have changed

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Deck span limitations

22 ga. wide rib deck, spanning 6 ft. with fully-adhered roof membranes:

- 33 ksi deck limited to Class 1-165
- 80 ksi deck limited to Class 1-300

Mechanically-attached roof membranes have varying ratings based upon row spacing

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An example

Sika Sarnafil Roofing Technical Bulletin #08-12, dated December 19, 2012

System description:

S327 membrane, 9'6" row spacing, attached with XP/XPN fasteners at 6" o.c. to 22 ga. steel roof deck

Pre-12/31/12 wind rating:

120 psf

New wind ratings:

- 90 psf using 80 ksi steel deck
- 90 psf using 22 ga., 33 ksi steel deck and 6' membrane row spacing

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Suggestions

- Be careful!
- Work closely with manufacturers
- For current projects, notify and seek clarification from A/E/C, GC/CMs and/or building owners.



Professional Roofing, Jan. 2013

TECH TODAY

Changes reduce some FM classifications

FM 4470 has been revised, resulting in different uplift resistance criteria

by Mark S. Graham

FM Approvals has revised its criteria for determining the uplift resistance of membrane and liquid-applied roof assemblies. Because many roofing professionals rely on FM Approval classifications when designing and specifying low-slope roof assemblies, you should be aware of the changes made and their effects on specific roof assembly classifications.

FM 4470
 FM 4470, "Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid-Applied Roof Assemblies for use in Class I and Noncombustible Roof Deck Construction," is the basis for FM Approval determination of 140, 130, 120, etc. classifications used for low-slope membrane and liquid-applied roof assemblies.

In June 2012, FM Approvals revised FM 4470; the effective date of the new standard was Dec. 31, 2012. The revision included adding NFPA 276, "Standard Method for Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components," as a minimum combustibility before the roof deck; changes to the conditions of acceptance for wind uplift and hail damage resistance testing and adding an alternative test method for determining factory's corrosion resistance.

One of the more significant changes to FM 4470 is how roof decks are evaluated. With the revised standard, roof roof decks cannot exceed the allowable stress provided for in AISI 1008, "North American Specification for the Design of Cold-Formed Steel Structural Members." The maximum allowable deflection for roof roof decks is based on a 200-pound point load; previously, a 300-pound point load was used. Also, minimum design of roof roof decks now are based on a minimum 0.7-ten-thick (slightly less than 22-gauge), 33-ksi yield strength roof. Previously, minimum 0.75-ten-thick (22-gauge) roof complying with the ASTM International specification was used for evaluation.

The method of analyzing structures of roof decks also has been revised. Deck fasteners are no longer factor "pull-out" (pull strength) of the deck material. Also, stress calculations are performed on both roof decks and fastener heads, and the lower of the two values is used as the basis for classification.

FM 4470 also now includes additional provisions allowing for optional ratings for drainage, specific resistance of roof coverings, noncombustible core for roof insulation and solar reflectance of roof surfaces.

All products used after Dec. 31, 2012, are required to meet the new standard's requirements. Products FM Approvals already approved under previous editions of FM 4470 also must comply with the current edition by the effective date or forfeit classification.

What this means
 If a specific classified assembly results in an over-covered roof roof deck, FM Approvals has, upon consultation with the manufacturer, either changed the assembly parameters to compensate for the deck over-cover or allowed the assembly's wind rating to a level where the deck no longer is over-covered. Assembly parameters likely changed include reducing the deck open end/over increasing the deck roof thickness and/or yield strength (from 33 to 30 ksi).

For assemblies where the wind rating has been reduced, the assembly's previous Roof Ndx number has been withdrawn and new RoofNdx numbers issued to meet evaluation. If you use the new version of FM 4470 for an address roof assembly applied to a 1/8-inch-thick, 22-gauge roof deck at a 4-foot maximum span, FM Approvals has indicated maximum classifications are limited to 1-105 when using a 33-ksi roof deck and 1-100 when using a 30-ksi roof deck. For non-fastened mechanically attached single-ply membrane assemblies, classifications will vary based on assembly parameters and span; however, new spacing, but generally classifications will be noticeably lower than with FM 4470's previous version.

All products tested after Dec. 31, 2012, are required to satisfy the new standard's requirements
 Proceed carefully
 Roof system designers and installers need to be aware of FM 4470's revision and its effect on assembly parameters, uplift ratings and RoofNdx numbers for membrane and liquid-applied roof assemblies using steel roof decks.

For roofing projects designed before the implementation date but that will be installed after the implementation date, classification needs to be sought regarding which version of FM 4470 applies. If the current version applies, change to the roof assembly specification may be necessary and affect a project's cost.

I encourage roof system designers and installers and roofing contractors to work closely with manufacturers when determining changes to specific assembly parameters, uplift ratings and RoofNdx numbers. ■

MARK S. GRAHAM is NRCA's executive director of technical services.

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Questions

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