

# **SPECIAL Report**



NATIONAL ROOFING CONTRACTORS ASSOCIATION

## **New Factory Mutual Research Corporation Requirements For Mechanically Attached Single-Ply Roof Systems**

August 1993

Beginning July 1, 1993, to obtain Factory Mutual Research Corporation (FM) approval of most mechanically attached single-ply membrane roof systems, manufacturers are required to have their systems tested on FM's 12'x 24' (3.7 x 7.3 m) test apparatus. Previously, a 5'x 9' (1.5 x 2.7 m) test table was used. As a result of the increased test table size, **many mechanically attached systems will now require additional fasteners. And in some cases, the distance between rows of fasteners will also need to be decreased.**

The 5'x 9' test table was originally developed a few decades ago to evaluate uplift resistance of built-up membrane systems. This table and the load cycle associated with it were subsequently used to test fully adhered and mechanically attached single-ply systems, as these systems were introduced into the market. However, by the late 1980s, it was realized that the small 5'x 9' test table over-estimated the load capacity of mechanically attached single-ply systems. After a few years of research and evaluation on the 12'x 24' table, FM has now nullified most of the approvals of mechanically attached single-ply systems that were obtained on the 5'x 9' table.

The over-estimation of load capacity on the 5'x 9' apparatus was a function of the small table size and the relatively large spacing of the rows of membrane fasteners. With the small table, the clamps around the table perimeter (which attach the roof system specimen to the test bed) carry much of the applied load, thus reducing the amount of load that is carried by the fasteners. By using the 12'x 24' test bed, the influence of the perimeter clamps is eliminated in the field of the test assembly, allowing a more accurate evaluation of the ultimate static load resistance of the roof system. The load capacity influence of a 5'x 9' versus a 12'x 24' table is presented in a paper in the Proceedings of the 10th Conference on Roofing Technology (available from NRCA).

When tested on the larger test table, many roof systems will require a substantial increase in the number of fasteners (and in some cases, a decrease in the row spacing) to meet the requirements of FM 1-90. Many systems will also require an increased number of fasteners to meet 1-60.

Special Report  
FMRC  
August 1993

If an FM approved system is specified, the system is required to meet the new approval requirements. Thus the fastener spacing that is listed in the membrane manufacturer's new approval (which is available from the manufacturer or from FM) is also now required. Incidentally, this spacing is for the field of the roof -- an increased number of fasteners at the perimeters and corners is also required per FM Loss Prevention Data Sheet 1-29S.

**NRCA suggests that designers specify these new fastener spacings for projects that do not require FM approved systems, because they are based on a more realistic field simulation than the spacings derived from tests on the 5'x 9' table.**

Because of limited advanced notice to the roofing industry prior to the adoption of the new test criteria for those projects contemplated under the old criteria, but not yet constructed, NRCA suggests the specifications be revised to comply with the new criteria and the contract sum for the work be adjusted accordingly.

For FM insured buildings, it is recommended that the FM District Office responsible for the project be contacted for directions during the transition period.

### **Air Retarders**

Air retarders (air barriers) are monolithic decks, or sheets attached to the deck, which minimize the development of air pressure between the roof membrane and the deck. Some manufacturers may test assemblies that incorporate an air retarder (this information will be noted in the manufacturer's approval). Designers and contractors are cautioned that if test results from assemblies that incorporate an air retarder are used to determine fastener spacings for a project, it is imperative that the roof system being designed and constructed also incorporate an air retarder. It is recommended that criteria on air retarder design and application be obtained from the manufacturer that incorporated the retarder in the test assembly.

While air retarders can enhance the performance of a mechanically attached single-ply membrane assembly, the design and installation of the air retarder and insulation/fasteners are critical to achieve the expected performance. For further information on air retarders, refer to "Role of air retarders deserves closer scrutiny", Professional Roofing, October 1991.

Special Report  
FMRC  
August 1993

### **Dynamic Testing**

In the U.S., mechanically attached single-ply membrane roof systems are not dynamically tested (i.e. multiple cyclical load cycles). Since these systems are susceptible to significant flutter (unless they incorporate an air retarder), they may be susceptible to fatigue-induced failure. Accordingly, FM has been evaluating dynamic testing for these systems. In addition to the 12'x 24' static test, in the near future, it is anticipated that FM will also require dynamic testing for mechanically attached single-ply membrane systems.

This special report is intended to alert designers and contractors to recent changes in FM testing and approvals. Requirements related to specific assemblies offered by membrane manufacturers are available from the manufacturers.