

# FACTORY MUTUAL RESEARCH CORPORATION®

## APPROVALS

All jobs which are for FM insured buildings will be reviewed by a FM Engineer. If you have not been through the process, contact the Duro-Last@Engineering Services Department at 800-248-0280 before you submit a proposal.

### INTRODUCTION

Factory Mutual Research Corporation has successfully tested the Duro-Last Roofing System for classification as a Class 1 roof covering. The roof covering has passed tests designed to measure fire spread, hail damage, and wind uplift resistance characteristics, when installed as specified below. Evaluations of wind uplift resistance characteristics provide measurements of the ability of the roof assembly to survive air pressure loads on the rooftop that result from high wind speeds. Factory Mutual wind uplift resistance classifications are designed as I-60 to I-495. These numbers represent the pounds per square foot of upward load on the roof assembly. As an example, the I-60 rating means that the specified assembly may be able to resist uplift pressures of up to 60 lbs., depending on topography and building structure.

This roof covering is approved only when attached as tested over specific insulation, decks or existing covers. Because fire spread, wind uplift, hail damage, and weather resistance characteristics are highly dependent upon the substrate to which the roof cover is attached. The determination of the compatibility of the roof cover with other roofing components within the construction shall be the responsibility of the listed manufacturer, who shall be consulted prior to their use.

The following roof cover system is approved as designed for use over specific substrates as indicated by these five categories, unless otherwise specified:

1. Structural or insulating concretes.
2. Existing roof cover.
3. Insulation on steel roof deck.
4. Insulation over FM-approved fire treated wood.
5. FM approved wood decks.

### MEMBRANE DESCRIPTION

The 40 mil (1 mm) thick Duro-Last single-ply membrane is a non-wicking weft inserted polyester fabric encapsulated between two layers of specially formulated polyvinylchloride compound and has a system weight of .25 lbs./sq. ft. (1.22 kg/m<sup>2</sup>). The fabricated roof cover is supplied either folded or rolled in sections of up to 2,500-sq. ft. (232 m<sup>2</sup>) in area. The thermoplastic coating formulation is on file at Factory Mutual Research Corporation.

For all FM uplift design pressures, the membrane and insulation fastening must be increased at the roof perimeters and corners. The perimeter width ( $x$ ) is defined as the lesser of either 40% of the building eave height or 10% of the width of the roof area, but in no case less than 3'-0" wide. The corner is defined as ( $x$  by  $x$ ). *Note: Duro-Last's minimum requirement is a perimeter no less than 4'-0" from a perimeter edge.*

**The tab spacing in the perimeter sheets shall be no greater than 60% of the tab spacing in the field of the roof. The tab spacing in the corner sheets shall be no greater than 40% of the tab spacing in the field sheets. Call the Engineering Services Department for details. See "Figure A" on Page FM-2.**

#### For Insulation attachment:

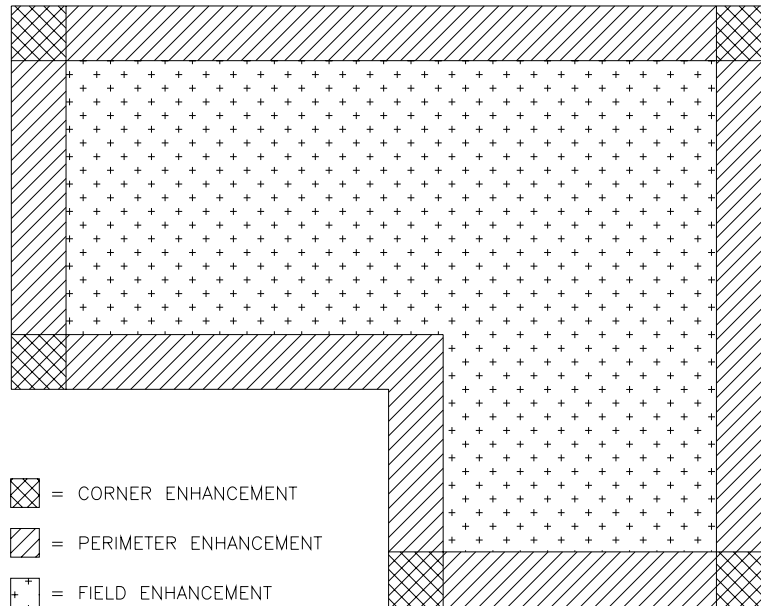
Refer to the "FM Global Loss Prevention Data Sheet 1-29" for the minimum requirements on attaching insulation. **NOTE:** In some cases, the presence of a vapor barrier will change requirements for fastening.

Note: 2-fasteners shall be used to attach insulation having both dimensions no greater than 4-feet (1.2 m). 4-fasteners shall be used to attach insulation having any one dimension greater than 4-feet (1.2 m). Duro-Last® will require a minimum of 5 fasteners per board, which may exceed FM requirements.

**Example:**

If a building has a 20 ft. (6.1 m) eave height, and its dimensions are 100 ft. (30.5 m) by 200 ft. (61 m), the perimeter width would be 8 ft. (.4-times the building height which is less than .1-times the width or 10 ft.) The corner areas would be 8 ft. by 8 ft., min.

**Figure A**



**INSULATIONS FOR ROOF COVERINGS**

The following types of insulation are approved for use with the Duro-Last® roof cover when attached with Duro-Last® screws and 2-inch Poly-Plates.

1. FM approved fiberglass.
2. FM approved urethane composite board.
3. Polyisocyanurate
  - a) Iso-Shield as supplied by Dyplast, Inc.
  - b) Iso-Shield R-PLUS as supplied by Dyplast, Inc.
  - c) Isotherm-R as supplied by GAF Corporation.
  - d) Hy-Therm as supplied by Celotex Corporation.
  - e) Iso-95 Rhoflex as supplied by Firestone Building Products.
  - f) Therma-Roof Plus as supplied by R-Max, Inc.
  - g) E'NRG'Y-1 as supplied by NRG Co.
  - h) AC Foam I, II and III as supplied by Atlas Roofing Corp.
  - i) UltraGuard Gold as supplied by Johns Manville.
4. Ultra-Fold TPM or Duro-Fold may be used only if Elk VersaShield® or FR-10 is present in the assembly. See the "FM Approval Guide" for approved assemblies.

**Notes:**

- a) Recover Assemblies: The previous list of insulation types is approved 1-inch thick, max., when attached over steel or wood decks using Duro-Last® screws. The previous list of insulation types is approved 8-inch thick, max., when attached over structural concrete decks using Duro-Last® screws or concrete fasteners.
- b) New Construction: The previous list of insulation types is approved up to 8-inches thick, max., when attached over steel, wood or structural concrete decks using Duro-Last® screws or concrete fasteners. On wood decks a layer of gypsum board must be installed in the assembly.
- c) New Construction or Recover: The previous list of insulation types is approved up to 8-inches thick, max., when attached over a Tectum, gypsum or lightweight concrete using NTB fasteners with 2-inch heads.

## INSTALLATION

For the mechanically fastened system, the membrane in the field of the roof shall be mechanically fastened by the 3-inch (76 mm) wide securement tabs using Duro-Last® FM approved fasteners as described below through the FM approved insulation and into the deck. Adjoining sheets of the roof cover shall be overlapped a minimum 6-inches (150 mm) onto the previously secured section of roof cover. All fastening tabs and sheet edges shall be secured with Duro-Last® FM approved fasteners or hot-air welded to the secured edge of an adjoining sheet. Field seam welds shall be sealed with a heat-sealing apparatus forming a continuous 1.5-inch (38 mm) wide weld.

### FIELD MEMBRANE INSTALLATION FOR MECHANICALLY FASTENED SYSTEMS

<b>FM I-60</b>	<b>FM I-90</b>
<b>Deck types:</b> Concrete, Steel, Wood*	<b>Deck types:</b> Cementitious Wood Fiber, Gypsum
<b>Fastener types:</b> Duro-Last #14 HD, DL Concrete Screw, Olympic Fluted Nail, Tip-Top #14 HD	<b>Fastener types:</b> NTB Magnum, Auger Fastener
<b>Attachment:</b> 60" tabs fastened 18" O.C.	<b>Attachment 1:</b> 28" tabs fastened 6" O.C.
<b>FM I-60</b>	<b>FM I-105</b>
<b>Deck types:</b> Cementitious Wood Fiber, Gypsum	<b>Deck types:</b> Concrete, Steel
<b>Fastener types:</b> NTB Magnum, Auger fastener	<b>Fastener types:</b> Duro-Last #14 HD, DL Concrete Screw, Olympic Fluted Nail, Tip-Top #14 HD
<b>Attachment:</b> 60" tabs fastened 9" O.C.	<b>Attachment 1:</b> 28" tabs fastened 18" O.C.
<b>FM I-75</b>	<b>FM I-150</b>
<b>Deck types:</b> Cementitious Wood Fiber, Gypsum	<b>Deck types:</b> Concrete, Steel
<b>Fastener types:</b> NTB Magnum, Auger fastener	<b>Fastener types:</b> Duro-Last #14 HD, DL Concrete Screw, Olympic Fluted Nail, Tip-Top #14 HD
<b>Attachment:</b> 60" tabs fastened 6" O.C.	<b>Attachment 1:</b> 28" tabs fastened 18" O.C.
<b>FM I-90</b>	<b>FM I-210</b>
<b>Deck types:</b> Concrete, Steel, Wood*	<b>Deck types:</b> Concrete, Steel
<b>Fastener types:</b> Duro-Last #14 HD, DL Concrete Screw, Olympic Fluted Nail, Tip-Top #14 HD	<b>Fastener types:</b> Duro-Last #14 HD, DL Concrete Screw, Olympic Fluted Nail, Tip-Top #14 HD
<b>Attachment 1:</b> 60" tabs fastened 12" O.C.	<b>Attachment:</b> 28" tabs fastened 12" O.C.
<b>Attachment 2:</b> 28" tabs fastened 18" O.C.	<b>FM I-90</b>
<b>FM I-90</b>	<b>Deck types:</b> Cementitious Wood Fiber, Gypsum
<b>Deck types:</b> Concrete, Steel, Wood*	<b>Fastener types:</b> NTB Magnum
<b>Fastener types:</b> Duro-Last #14 HD, DL Concrete Screw, Olympic Fluted Nail, Tip-Top #14 HD	<b>Attachment:</b> 60" tabs fastened 6" O.C.
<b>Attachment:</b> 60" tabs fastened 6" O.C.	

\* Wood Decks must be FM approved.

For the fully adhered system, the membrane in the field of the roof shall be attached to approved insulations by the Duro-Last adhesives, and the insulation shall be attached using Duro-Last® FM approved fasteners or adhesives in conjunction with FM approved insulation onto the deck. Adjoining sheets of the roof cover shall be overlapped a minimum 6-inches (150 mm) onto the previously secured section of roof cover. All required fastening tabs shall be secured with Duro-Last® FM approved fasteners or hot-air welded to the secured edge of an adjoining sheet. Field seam welds shall be sealed with a heat-sealing apparatus forming a continuous 1.5-inch (38 mm) wide weld.

### FIELD MEMBRANE AND INSULATION INSTALLATION FOR FULLY ADHERED\* SYSTEMS

<b>FM I-90</b>	<b>FM I-90</b>
<b>Deck types:</b> Structural concrete, Steel, Wood*	<b>Deck types:</b> Structural concrete
<b>Ins:</b> AC Foam II or III (Min. 1.4" x 4' x 8' board)	<b>Ins:</b> AC Foam II (4' x 4' board)
<b>Attachment:</b> Duro-Last Metal Plates and fasteners at 16 Fasteners per 4 x 8 board.	<b>Attachment:</b> Ashland® Pliobond Insulation Adhesive applied in ½" ribbons spaced 12" o.c.
<b>FM I-90</b>	<b>FM I-150</b>
<b>Deck types:</b> Structural concrete, Steel, Wood*	<b>Deck types:</b> Structural concrete
<b>Ins:</b> AC Foam II or III (Min. 1.5" x 4' x 8' board)	<b>Ins:</b> AC Foam II (4' x 4' board)
<b>Attachment:</b> Duro-Last Metal Plates and fasteners at 10 Fasteners per 4 x 8 board.	<b>Attachment:</b> Asphalt applied at 20-25 lbs./sq.
<b>FM I-90</b>	<b>FM I-165</b>
<b>Deck types:</b> Structural concrete	<b>Deck types:</b> Structural concrete
<b>Ins:</b> AC Foam II (4' x 4' board)	<b>Ins:</b> AC Foam II (4' x 4' board)
<b>Attachment:</b> Asphalt applied at 20-25 lbs./sq.	<b>Attachment:</b> Ashland® Pliobond Insulation Adhesive applied in ½" ribbons spaced 12" o.c.

\* Coverage on Duro-Last WB adhesive shall be applied no less than 80 Sq. Ft. per gallon

\* Wood Decks must be FM approved and require a minimum of 1/4" Dens Deck placed loose on the deck under the insulation assembly unless noted.

## **PRECAUTIONS**

In the case of installation over steel decks (new or recover),

1. The 3-inch (76 mm) and 6-inch (152 mm) wide securement tabs shall be installed perpendicular to the flute direction on steel decks in the field of the roof. They may run parallel in perimeter enhancements, *up to class 1-90*. See "FM Global Loss Prevention Data sheet 1-29" for further information.
2. A trial fastener shall be driven to verify that the fastener is engaging the top flange of the steel deck.
3. The fastener must penetrate the steel deck 1-inch, min., from the top surface of the deck.
4. Increased fastener spacings may be required if there is a vapor barrier present within the roof system. See "FM Global Loss Prevention Data sheet 1-29" for further information.

Preparations shall be made to ready an existing roof surface prior to the application of new insulation and membrane.

1. These preparations include, but are not limited to, removal of loose gravel and repair of blisters and other openings.
2. Insulation boards shall be secured to the existing roof deck.
3. The roof membrane shall be mechanically fastened with approved fasteners through the 3-inch (76 mm) and 6-inch (152 mm) wide securement tabs, either directly through the existing roof and into the deck or through the approved insulation and existing roof and into the deck.

## **DURO-FOLD™ APPROVALS**

For attachment of the insulation, see the fastening requirements listed above.

### **8.a Roof System: Recover**

**Deck:** Steel, wood or concrete

**Class:** FM Class 1-A

**ASTM E 108:** Class A, non-combustible

**Slope:** ¼ in. per foot

**Wind Uplift:** Meets 1-60 and 1-90

**Insulation:** Duro-Fold™ (1-in. max.)

**Slip Sheet:** Atlas Energy Products "FR-10" or "FR-50".

**Membrane:** Duro-Last® (PVC), mechanically fastened.

### **13.d Roof System: New or Recover**

**Deck:** Steel, wood, or concrete covered with 5/8 in. gypsum or ½ in. Dens-Deck (optional for concrete).

**Class:** FM Class 1-A

**ASTM E 108:** Class A, non-combustible.

**Slope:** ¼ in. per foot.

**Wind Uplift:** Meets 1-60, 1-90 and 1-150.

**Air Barrier:** AMOWRAP Housewrap

**Insulation (optional):** Amofam Insulation Board

a) New Roof: 1-6 inches, max.

b) Recover: 1-inch, max.

**Slip Sheet:** Atlas Energy Products "FR-10" or "FR-50".

**Membrane:** Duro-Last® (PVC), mechanically fastened.