Factory Mutual

Factory Mutual System

1 General Information

Factory Mutual's (FM) business roots extend back to 1835 with the founding of the Manufacturer's Mutual Fire Insurance Company. The company was formed by Zachariah Allen in conjunction with other Rhode Island textile mill owners in an effort to pool their resources for the purpose of reducing property loss. At the time, property loss prevention was an aberrant concept. So much so that efforts targeted at reducing risk and/or property loss were not recognized by insurance companies as deserving discounted rates.

Since then FM has progressed from a large conglomerate of individual insurance companies into an ownership group of three major insurance companies. The three insurance companies were Allendale Insurance, Arkwright and Protection Mutual Insurance. In July of 1998, the ownership group announced their intention to merge all three companies. Factory Mutual's organizations are now directed by the Factory Mutual Insurance Company (FM Insurance Company).

Factory Mutual Research Corp. (FMRC) is the nonprofit research arm for the FM Insurance Company. FMRC's research, testing and subsequent standards in the prevention of property loss due to fire and wind have promulgated modern precepts for the design and installation of Single-Ply roofing systems.

Although the roofing industry generally associates FMRC approvals with wind uplift testing and performance, their 4470 Standard for Class 1 Roof Covers is much broader in scope. The complete FMRC approval process includes examination of a product's fire resistance, wind uplift resistance, (above and below the deck), simulated hail resistance, water leakage resistance, corrosion of metal parts, and other small scale physical property testing when deemed appropriate.

2 Wind and Wind Uplift

FMRC Loss Prevention Data Sheet (LPD) 1-7, Revised September 1998, provides the following classifications of wind:

Gale. A gale refers to a common brisk wind which is not associated with a storm front. It is generally steady in velocity with sporadic gusts that can vary from 39 to 72 mph.

Squall. Squalls are generally associated with thunderstorms. They can be described as violent, turbulent and gusty. Peak gusts are typically greater than those associated with gales. Severe squalls can produce peak wind gusts up to 90 mph.

Hurricane. Hurricanes are well known for widespread damage along the Gulf and Atlantic coastal areas. Hurricanes and tropical storms receive their classifications and names from the National Weather Service. Tropical storms become hurricanes when their wind velocities reach 73 mph.

Tornado. Tornadoes have very high wind speeds (usually unmeasurable) and are extremely destructive due to the very high pressures created within the rotating vortex. Wind velocities within the vortex have been estimated from 200 to 300 mph.

Wind, regardless of its classification, is generally fluid in its movement. When an object interrupts the air flow, a turbulence is created very similar to the effect of an object placed in a stream of flowing water. As a current of air strikes the side of a building or structure, it is deflected upward, condensing the air stream as it moves up the vertical plane of the building, and mixing with the uninterrupted air flow above the horizontal plane of the building. This upward movement increases the velocity of the air current along the windward side of the building and the mixing of the air streams create localized areas of reduced pressure, or suction above the roof assembly. This reduced velocity pressure (in lbs. per sq. ft.) is proportionate to, and can be determined by, the wind velocity (in miles per hr). In other words, the higher the velocity, the greater the negative pressure.

The reduced pressure functions like a magnet toward the building's interior pressure. An atmospheric area of high pressure will attempt to equalize itself by moving toward areas of lower pressure. Consequently, the turbulence along or above the building causes the air within the building (area of higher pressure) to push upward as it tries to equalize with the air above the roof assembly (area of low pressure). Hence, we have the term "wind uplift."

Topographical Influence

In addition to specific building features like shape and height, the movement of wind is affected by the type of terrain it moves across. An open terrain provides little obstruction, promoting higher wind velocities, while a congested terrain interrupts the air flow and reduces the wind velocity.

The American Society of Civil Engineers (ASCE) characterizes the terrain or ground surface irregularities into four "Exposure Categories":

Exposure A. Large city centers with at least 50% of the buildings having a height in excess of 70 ft. Use of this category shall be limited to those areas for which terrain representative of Exposure A prevails in the upwind direction for a distance of at least 1/2 mile or 10 times the height of the building or other structure, whichever is less.

Exposure B. Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

Exposure C. Open terrain with scattered obstructions having heights generally less than 30 ft. This category includes flat open country and grasslands.

Exposure D. Flat, unobstructed areas exposed to wind flowing over open water for a distance of at least one mile. This exposure shall apply only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 ft or 10 times the height of the building or structure, whichever is greater.

FMRC uses and defines these exposure categories as ground roughness with similar definitions but has combined A with B.

Looking Back

The publication of the American National Standards Institute's ANSI A58.1 Standard in 1972 provided designers the ability to mathematically estimate the uplift forces for buildings and other structures. The approach outlined in the ANSI Standard was embraced by FM and incorporated into Factory Mutual Engineering Corp.'s 1974 publication of Loss Prevention Data Sheet (LPD) 1-7 "Wind Forces on Buildings and Other Structures." LPD 1-7 provided a series of tables that incorporated pre-determined velocity pressures into a matrix according to the building environment, height and design wind speed.

The matrix was included in LPD 1-28S "Wind Uplift Pressures on Roofs" and divided into three wind zones. Zone 1 included velocity pressures from zero to 30 psf., and Zone 2 for velocity pressures from 31 to 45 psf. In Zone 3, where pressures exceed 45 psf, special precautions were recommended. These "Wind Zones" were partitioned in accordance with I-60 and I-90 test criteria. The I "eye" as it was typically refered to is actually the Roman numeral one and refers to Class One Construction. In current literature, FMRC has changed the I to the Arabic numeral 1.

1-60 was derived from a mathematical evaluation of an 88 mph wind at an elevation of about 33 ft. above ground. This scenario would generate a negative velocity pressure of approximately 20 psf. To this, Factory Mutual adds a shape or "turbulence" factor for low slope roofs of 1.5 times the velocity pressure. (20 psf x 1.5 = 30 psf) Hence, 30 psf is the velocity pressure for the roof area. To this pressure, a standard construction safety factor of 2 is assigned for a total value of 60 psf. This became the minimum pressure which a roof assembly must withstand in order for it to be classified for 1-60 construction.

The same formula was used to establish 1-90 but began with a 110 mph wind, corresponding to a velocity pressure of 30 psf. (30 psf x 1.5 x 2 = 90) Hence, 90 psf became the minimum pressure a roof system must withstand in order for it to be classified for 1-90 construction.

Uplift Testing

FMRC testing for and the evaluation of roofing systems for wind resistance began in 1954. The test procedure involved installing a sample roof assembly into a 5 ft. x 9 ft. x 2 in. static air chamber. The perimeter of the assembly was clamped to the chamber and incremental air pressure was forced beneath the roof assembly until failure. Roof systems were classified as either 60 or 90 according to their ability to withstand 15 pound incremental increases in pressure, beginning at 30 psf, for one minute each, up to and including the passing pressures of either 60 or 90 psf.

The terms 1-60 and 1-90 do not really represent any particular wind speed by themselves nor should they be used arbitrarily. The applicability of their individual reference has to be viewed in relation to a building's environment which includes building location, building height, permeability and a given design wind velocity.

FM 60 and 90 were the prevailing design standards for Single-Ply roofing for almost 20 years. Then, at 5:00 a.m. on August 24, 1992, South Florida experienced a significant wind event. The damage associated with Hurricane Andrew prompted FM to revise the test criteria for evaluating the wind resistance and approval of roofing systems.

Going Forward

Although the incremental pressurization of the roof system outlined in the original 4470 test criteria remained the same, the size of the test frame was increased from 5′ x 9′ to 12′ x 24′. The larger test frame alleviated the contributory effects that the perimeter clamping devices may have had on the test results within the smaller test frame. The larger test frame also accommodates testing for wider row spacing and more accurately stresses the diaphragm of the decking.

In addition to modifications of the test criteria, the uplift pressures contained within the tables in LPD 1-28 were expanded to include three additional wind zones. The tables in the June 1996 publication of LPD 1-28 included a 1-120 for 46 to 60 psf; a 1-150 approval for 61 to 75 psf and a 1-180 approval for 76 to 90 psf. The tables within the most recent publication of FM LPD 1-28 "Revised January 1, 1999" still lists the Field Uplift Pressures but eliminates all reference specific to wind zones.

FM is now publishing actual test results in the Approval Guide at 15 psf increments. In the past, a building evaluated as having a velocity pressure of 32 psf within the FM LPD Tables required a 1-90 system because the 32 psf fell between 30 and 45 psf. Now, the astute designer can either determine the numerical uplift pressures using the mathematical model presented in the ANSI Standard (now incorporated into the American Society of Civil Engineers ASCE 7 Standard) or use the FM Tables, apply a safety factory of 2 and select a roofing system that's tested within the limits of the quotient. In the case of a 32 psf velocity pressure, (32 x 2 = -64 psf) the applicable roof assembly would need to have met a minimum 75 psf (1-75) test threshold.

Enhancement

Uplift forces on low sloped roofs will vary across three principle areas of segmentation. A negative force coefficient is given to each of these areas to determine the design velocity pressure for each individual area. The three areas are the field (-1), perimeter (-2) and corner (-3). Approved roof assemblies are typically evaluated for exposure to wind forces in the field of the roof only. Therefore, uplift pressures enumerated in the FM tables are only applicable to the field of the roof.

Uplift pressures are considerably higher in the corners and along the roof perimeter and these areas will require design enhancement. FM defines the width of roof corners and perimeter as being either 10% of the building's lesser plan dimension (width) or 40% of the eave height, whichever is less subject to a minimum of 4 ft.

Enhancement to the securement of all components of the roof assembly are required in the perimeter and corners of the roof. Although very possible, it's not generally necessary to calculate the increased pressures in the perimeter and corner. The negative pressure coefficients of -1, -2, and -3 have been accounted for in the following prescriptive recommendations. For mechanically attached insulation, the number of fasteners per board should be increased over the FMRC-Approved field of the roof spacing by fifty percent (50%) in the roof perimeter and 75% in the roof corners.

Mechanically attached membranes also require enhancement but the increase in fastener density is not to be accomplished by increasing the number of fasteners along the laps. Instead, FM requires a reduction in the distance between the rows of fasteners. For the perimeter areas, the distance between the rows is to be less than or equal to 60% of the approved field spacing. The distance between the rows of fasteners in the corners is to be reduced to 40% of the field approval.

It would not be feasible to manufacture a two third (2/3) roll or 60% wide roll, so half-width rolls or half sheets are used to fill the designated perimeter area. When perimeter "half" sheets are incorporated into the design of the roof system along the perimeter, the fastener density is actually increased by one hundred percent (100%) while maintaining the same fastener spacing for the field membrane along the laps.

3 Fire

A focus on the combustibility of roofing systems in general was prompted by the catastrophic loss of life and property in the 1953 fire at the GM transmission plant in Livonia, Michigan. An equipment fire within the building created intense heat on the underside of the metal deck. The heat caused the bituminous vapor barrier that was applied directly to the steel deck to melt and vaporize. The volatile gases entered the building and ignited. The roof system continued to feed the fire until the 30 acres of roof collapsed.

In order to gain a better understanding of the factors that contributed to the GM fire, FM constructed a 20 ft. x 100 ft. building, dubbed the "White House." The building allowed FM to duplicate the conditions at the GM plant and literally burn it down over and over, reducing the combustibility of the assembly until a successful combination of materials and methods were found that slowed the spread of the fire to six feet in thirty minutes.

Data from the White House testing was correlated toward the development of a significantly smaller scale and economically feasible lab test that would measure heat release and fuel contribution of roofing materials.

Measurements of heat release and fuel contribution rates for materials are now determined in the FMRC Construction Materials Calorimeter. Class 1 Insulated Roof Deck Construction, "those not requiring automatic sprinkler systems in and of themselves", must meet maximum fuel contribution rates less than or equal to a 285 Btu/ft.≤/min. average measured over the thirty minute test duration.

Exterior fire resistance is evaluated according to ASTM E108 test criteria. This testing includes spread of flame, intermittent flame and burning brand which mirrors Underwriters Laboratories UL 790 testing. Ratings are classified as Class 1 (A) or 1 (B) according to the following definitions:

Class A tests are applicable to roof coverings that are effective against severe test exposure, afford a high degree of fire protection to the roof deck; do not slip from position and do not present a flying brand hazard.

Class B tests are applicable to roof coverings that are effective against moderate test exposure, afford a moderate degree of fire protection to the roof deck, do not slip from position, and do not present a flying brand hazard.

Factory Mutual Research Corp. also offers a Class 1(C) rating similar to UL, but it too has little relevance in the design and specification of Single-Ply roofing.

4 Hail

FMRC is currently classifying a roofing system's hail resistance as either Class I-SH (Severe Hail Damage Resistant) or Class I-MH (Moderate Hail Damage Resistant).

Class I-SH testing begins with a 2 in. plastic tube, suspended from a tripod 17 ft. 9 1/2 in. above the roof sample. Two samples each measuring 2 ft. x 4 ft. and one artificially weathered sample measuring 12 in. x 24 in. are evaluated. A 1 3/4 in. steel ball weighing 0.79 lb. is dropped through the tube onto the sample. This is repeated ten times for each sample on various areas of the samples. The impact energy from the steel ball is approximately 14 ft. lb. (19 J) over the impact area.

Class I-MH testing is similar but utilizes a 2 in. steel ball weighing 1.625 lb. dropped from a height of 5 ft. The impact energy from this test is reduced to 8 ft. lb. (10.8 J) over the impact area.

Test results must not show any signs of cracking, splitting, separation or rupture when examined under a 10X magnification.

5 FM Follow-Up

In addition to product testing, the manufacturer is also evaluated through an examination of the manufacturing facilities which includes an audit of the manufacturing process and quality control procedures. These audits are intended to insure consistency within the process and formulations between products tested and those actually being produced. Products conforming to all the requirements of the 4470 Standard are qualified as Class 1 roof coverings. Class 1 roof coverings are those which do not present a significant fire hazard, will withstand wind uplift forces and hail stones when installed according to approval requirements.

Once a product has been approved or classified, it must bear the FMRC Approval Mark. The mark not only identifies an approved product but it also confirms that it is manufactured under periodic FM Facilities and Procedures Audits.

6 1999 FM Approvals

The following is a list of current Seaman Corporation FiberTite FM Approvals. The approvals are always subject to additions, modification or change.

Seaman Corp., 1000 Venture Blvd. Wooster OH 44691

Roof Cover: FiberTite, FiberTite XT
Deck: Concrete, Steel, Recover
Laps: 5 in.(153mm) side and end laps, heat welded
Application: Mechanically Attached
Hail Rating: Class 1-SH
ASTM E 108: Non-combustible deck slope and classification as follows:
Wood Fiber Insulation: Class A at $1^1/2$ in 12 slope
Wood Fiber Insulation: Class B at 2 in 12 slope
All Other Insulation: Class A at 2 in 12 slope

Construction #1: Concrete, Recover, Steel. FM approved wood fiber, perlite, ACFoam Composite, Hy-Therm Composite, GAFTEMP Composite, E"NRG"Y-2 Composite, Thermaroof Composite, Fesco Foam, Fes-Core, E"NRG"Y-2, White Line, HyTec, Multi-Max, ACFoam-II, H-Shield is pre-secured to the deck. The roof cover is applied over the insulation and secured to the deck with FiberTite Magnum Stress Plates and Fasteners indicated as follows:

Lap / Spacing	Fasteners/Spacing	Classification
Open Lap / 51 in. oc	FiberTite Magnum / 24 in. oc	Meets Class 1-60
Open Lap / 51 in. oc	FiberTite Magnum / 18 in. oc	Meets Class 1-90
Open Lap / 51 in. oc	FiberTite Magnum / 12 in. oc	Meets Class 1-120
Open Lap / 105.5 in. oc	FiberTite Magnum / 12 in. oc	Meets Class 1-75
Closed Lap / 104.5 in. oc	FiberTite Magnum / 12 in. oc	Meets Class 1-105
Closed Lap / 104.5 in. oc	FiberTite Magnum / 6 in. oc	Meets Class 1-165
Closed Lap / 120 in. oc	FiberTite Magnum / 12 in. oc	Meets Class 1-90
Open Lap / 23 in. oc	FiberTite Magnum / 12 in. oc	Meets Class 1-165

Open lap includes integral "conventional" fastening tabs or over laps. Membrane laps are 5 inches with 1.5 inches weld for net row spacing of 51 inches.

Closed Lap includes Integral Tabs or Cover Strips, i.e., fasteners through roof cover and fastener rows covered by tabs or 6 in. cover strips. Non-secured edge of tab or both edges of cover strip heat welded to the roof cover.

**For Class 1-165, steel deck meeting ASTM Designation A611 Grade E or ASTM Designation A446 is placed over min 0.25 in. (6 mm) thick structural supports with max 6 ft. (1.8 m) o.c. deck spans. The deck is anchored to the supports with ITW Buildex Traxx/4 or Traxx/5 fasteners spaced max 6 in. (152 mm) o.c. The deck side laps are secured with Buildex Stitch Traxx/1 fasteners spaced max 30 in. (762 mm) o.c.

Construction #2: Cementitious Wood Fiber, Gypsum Re-roof. Insulation listed in Construction #1 above pre-secured to deck with fasteners approved for the specific deck type. Roof cover secured to the deck through the insulation and, if present, existing Class 1 roof assembly with FiberTite NTB Fasteners (min embedment 2 in. [51 mm]) applied along the roof cover side laps as follows:

Fastener/Max Lap

Fastener	Spacing (o.c.)	Classification
FiberTite N.T.B. with 1 in. (25 mm)	6 in. (0.15 m)	Meets Class 1-90
Head and 2 in. (51 mm)	51 in. (1.3 m)	
N.T.B. Metal Barbed Plate		
FiberTite N.T.B. with 1 in. (25 mm)	9 in. (0.22 m)	Meets Class 1-60
Head and 2 in. (51 mm)	51 in. (1.3 m)	
N.T.B. Metal Barbed Plate		

Roof Cover: FiberTite, FiberTite-XT (Without Tabs)

Deck: Concrete, Steel, Recover (max 1 in. [25 mm] additional insulation for steel or wood).

Laps: 4 in. (102 mm) side and end laps, heat welded.

Application: Fully Adhered with Seaman FTR-190 Bonding Adhesive applied at 1 gal./sq. (0.4 L/m^2) to both surfaces.

Hail Rating: Class 1-SH

ASTM E 108: Class A non-combustible deck at 2 in. 12 slope.

Construction #1: Min 1.5 in. (38.1 mm) ACFoam-II, Multi-Max FA, E"NRG"Y-2, or H-Shield secured to the deck with FiberTite #14 fasteners and plates (S or P) applied at 2 ft.^{2} (0.19 m^2) max contributory area per fastener. Meets Class 1-90.

Construction #2: Min 2.0 in. (51 mm) ACFoam-II, Multi-Max FA, E"NRG"Y-2, or H-Shield secured to the deck with FiberTite #14 fasteners and plates (S or P) applied at 4 ft.^{2} (0.37 m^2) max contributory area per fastener. Meets Class 1-90.

Roof Cover: FiberTite FB Roof Cover

Deck: Lightweight Concrete, Structural Concrete, New or Recover (see below).

Laps: 4 in. (102 mm) laps, sealed with 1.5 in. (38 mm) wide heat weld.

Application: Fully Adhered

Hail Rating: Class 1-SH

ASTM E 108: Class A non-combustible deck at 2 in 12 slope.

Construction #1: Lightweight Concrete, New Construction. Steel form deck, min 0.029 in. (0.74 mm) thick, 1.5 in. deep Wheeling Corrugating Company BW galvanized deck is secured to min 0.25 in. (6.4 mm) thick structural supports with ITW Buildex ICH Traxx/5 screws placed at each bottom rib [6 in. (152 mm) o.c.]. Structural supports are spaced at a max of 5 ft. (1.5 m) o.c. A slurry coat of Celcore Cellular Concrete, min 36 lb./ft.^{3} (577 kg/m^3) wet cast density, is placed on the form deck filling the corrugations plus a min of 1/8 in. (3 mm) thickness above the top flange immediately followed by min 1 in. (25 mm) thick Apache Holey Board Polystyrene Insulation. The following day, min 2 in. (51 mm) thick Celcore Cellular Concrete, min 36 lb./ft.^{3} (577 kg/m^3) wet cast density, is placed. After setting to support foot traffic, Celcore PVA Curing Compound is applied at a nominal rate of 300 ft.^{2}/gal. (7.2 m^2 /L). After curing for several days, Seaman FiberTite FB membrane is fully adhered with Seaman FTR-290 single surface bonding adhesive applied at a rate of 1.0 gal/ 75 sq. ft. (0.53 L/m^2), or Seaman FTR-390 asphalt emulsion adhesive applied at a rate of 2.0 gal./sq. (0.80 L/m^2). The roof cover is immediately rolled into the adhesive with a weighted roller and the seams sealed with a minimum 1.5 in. (38 mm) wide heat weld. Meets Class 1-90.

Construction #2: Structural Concrete Deck, New or Recover Construction. New Structural concrete deck is covered with an asphaltic vapor retarder (optional). A min 1/8 in. (3 mm) thick slurry coat of Celcore Cellular Concrete, min 36 lb./ft.^{3} (577 kg/m^3) wet cast density, is placed on the deck, asphaltic vapor retarder or existing asphaltic BUR roof followed by single layer of min 1 in. (25 mm) thick Apache Holey Board Polystyrene Insulation. The remainder of the Celcore Cellular Concrete system is constructed as described in Construction #1 above. After curing for several days a roof covering is applied as described in Construction #1 above. Meets Class 1-270.

Construction #2a: Same insulation as Construction #1 or #2 is secured to a deck. A layer of Armor Board High Density, BP High Strength, ERS Redi-Deck, FM-90 Traffic Top/High Density, Fiber Top C, E, S, GAFTEMP High Density, Roof Insulation Board, High Density Fiberboard, Sturdi-Top, Fiber Base HD1, HD6, Structodek, Armor Board Regular, Esgard, Celotex Fiberboard, GAFTEMP Fiberboard, Huebert Fiberboard, Kop-R Wood Fiber, Bildrite Roof Board, Cascades Fibreboard, Cascades High Density Fibreboard, Regular Density (Grade 1) Natural Fiberboard, Regular Density (Grade 1) Impregnated Coated Fiberboard or High Density (Grade 2) Impregnated Fiberboard is placed with all joints staggered and adhered with hot asphalt applied at a nominal rate of 20-25 lb./sq. (1.0-1.2 kg/m 2). The roof cover is adhered to the insulation with hot asphalt only and the laps sealed. Meets Class 1-90.

Construction #3: Structural Concrete Deck, New or Recover Construction. Min 2 in. (51 mm) thick Celcore Cellular Concrete, min 36 lb./ft. 3 (577 kg/m 3) wet cast density, is placed on the substrates described in Construction #2 above followed by Celcore PVA Curing Compound applied as in Construction #1 above. After curing for several days a roof covering is applied as described in Construction #1 above. Meets Class 1-270.

Roof Cover: Seaman FiberTite FB Roof Cover

Substrate: Concrete, Steel, Re-cover (max 1 in. (25 mm) thick)

Laps: 4 in. (102 mm) laps, sealed with 1.5 in. (38 mm) wide heat weld.

Application: Fully Adhered with Seaman FTR-390 asphalt emulsion roof coating at an application rate of 1 gal. per 60 ft.^{2} (0.67 L/m^2) or Seaman FTR-290 solvent adhesive at an application rate of 1 gal. per 100 ft.^{2} (0.4 L/m^2) or asphalt applied at a rate of 20-25 lbs./sq. (1.0-1.2 kg/m^2).

Hail Rating: Class 1-SH

ASTM E108: Class A non-combustible deck at 2 in. 12 slope (ACFoam-II, E"NRG"Y-2, or H-Shield). Class A non-combustible deck at 1 in. 12 slope (Pyrox). Class A non-combustible deck at 1 $^1/_2$ in 12 slope (Recover).

Construction #1: Min 1.5 in. (38.1 mm) ACFoam-II, Multi-Max FA, E"NRG"Y-2, or H-Shield secured to the deck with FiberTite #14 fasteners and plates (S or P) applied at 2 ft.^{2} (0.19 m^2) max contributory area per fastener. The roof cover is adhered to the insulation and the laps sealed. Meets Class 1-90.

Construction #2: Min 2.0 in. (51 mm) ACFoam-II, Multi-Max FA, E"NRG"Y-2, or H-Shield secured to the deck with FiberTite #14 fasteners and plates (S or P) applied at 4 ft.^{2} (0.37 m^2) max contributory area per fastener. The roof cover is adhered to the insulation and the laps sealed. Meets Class 1-90.

Construction #3: Roof cover is fully adhered to primed or unprimed structural concrete deck with asphalt only and the laps are sealed. Meets Class 1-210.

Construction #4: Min 1.5 in. ACFoam-II, Pyrox, Multi-Max FA, E"NRG"Y-2, or H-Shield secured to primed or unprimed structural concrete deck with Insta-Stik Roofing Adhesive. Optional $^1/_2$ in. (13 mm) thick Sturdi-Top or Structodek wood fiber or $^1/_4$ in. (6.4 mm) thick Dens Deck gypsum secured to roof insulation with Insta-Stik Roofing Adhesive. The roof cover is adhered to the insulation and the laps sealed. Meets Class 1-90.

Construction #5: Min 1.5 in. ACFoam-II secured to primed or unprimed structural concrete deck with Insta-Stik Roofing Adhesive. Optional $^1/_2$ in. (13 mm) thick Sturdi-Top or Structodek wood fiber or $^1/_4$ in. (6.4 mm) thick Dens Deck gypsum secured to roof insulation with Insta-Stik Roofing Adhesive. The roof cover is adhered to the insulation with asphalt only and the laps sealed. Meets Class 1-180.

Construction #6: Recover. The roof cover is adhered to an existing Approved, Class 1 rated Asphaltic BUR with FTR-390 or asphalt and the laps sealed. Meets wind uplift rating of the existing roof (max Class 1-90).

Construction #7: Recover. An FMRC Approved roof insulation, max 1 in. (25 mm) is adhered to an existing Approved, Class 1 rated Asphaltic BUR with asphalt. The roof cover is adhered to the insulation with FTR-390 or asphalt and the laps sealed. Meets wind uplift rating of the existing roof (max Class 1-90).

Construction #8: Structural concrete deck, New or Recover Construction.

New structural concrete deck is covered with an asphaltic vapor retarder (optional). A layer of FMRC Approved isocyanurate roof insulation, minimum of 1 1/2 in. (38 mm) thick, adhered to concrete, vapor retarder, or existing BUR with hot asphalt.

An optional second layer of FMRC Approved isocyanurate roof insulation, minimum 1 1/2 in. (38 mm) thick, adhered to the first layer of insulation with hot asphalt.

The insulation is covered with one of the following roof covers:

A. Seaman FiberTite or FiberTite-XT roof cover fully adhered to the insulation with FTR-190 adhesive applied at 1 gal./sq. (0.4 L/m^2) to both surfaces. Meets Class 1-360.

B. Seaman FiberTite-FB fleeceback roof cover fully adhered to the insulation with FTR-290 adhesive applied at 1 gal./sq. (0.4 L/m^2) to insulation surface. Meets Class 1-180.

C. Seaman FiberTite-FB fleeceback roof cover fully adhered to the insulation with FTR-390 adhesive applied at 1 gal./ 60 sq. ft. (0.67 L/m^2) or hot asphalt to insulation surface. Meets Class 1-120. For recover applications, Meets Class 1-60/1-75/1-90 per existing roof.