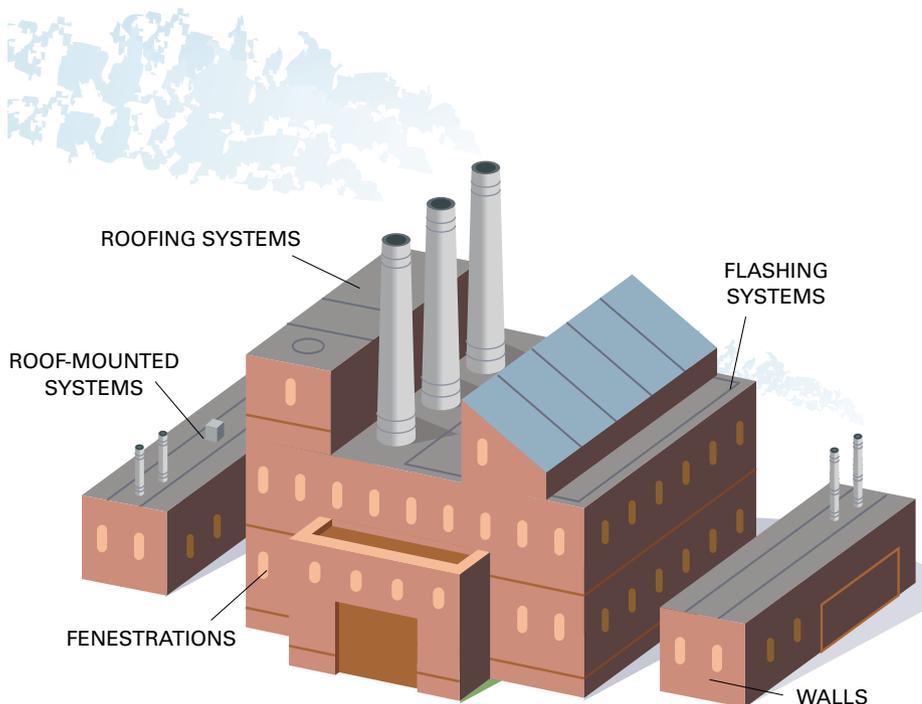


A Well-Protected Facility

FM Approvals product testing standards and FM Approved products, combined with FM Global loss prevention guidelines, gird your property against the next big event



For many property owners and managers, the beat of impending natural disasters such as hurricanes, tornadoes, tropical storms, flooding, earthquakes, winter storms and hail storms can cause sleepless nights, and for good reason! A single large-scale event can have devastating consequences that can lead to extended business interruption, lost market share, supply chain disruption, labor shortages and reduced consumer spending.

There's no denying that the frequency and value of catastrophic events due to natural hazards are on the increase from a historical perspective. While the number of geophysical disasters has remained fairly stable since the 1970s, the number of climate-related (hydrometeorological) disasters has greatly increased. This is according to the Centre

for Research on the Epidemiology of Disasters at the Université Catholique de Louvain (Brussels, Belgium).

In 2013, approximately 84 percent of all economic losses occurred outside the United States, well above the 2003-2012 average of 65 percent, according to an Aon Benfield Analytics report. In fact, the following natural disasters were considered the most costly in terms of 2013 economic losses:

- Days of record rainfall in Central Europe in May of last year, cost an estimated US\$22 billion.
- A 6.6-magnitude earthquake in Lushan, China, cost US\$14 billion.
- A total of US\$23 billion in estimated economic loss was attributed to Typhoon Haiyan that hit Southeast Asia, and

Typhoon Fitow, which struck Japan and China.

- Flooding in Alberta, Canada, and northern and southwest China cost an estimated US\$14.7 billion.

Despite these and other losses, most people continue to believe disasters won't happen to them. A survey conducted by the Wharton School of Business just before Hurricane Sandy made landfall in the Northeastern United States in the fall of 2012 found that:

- Only 16 percent of people surveyed who said they lived in a mandatory evacuation zone actually planned to evacuate;
- Only 38 percent of those surveyed who lived within a block of the ocean or a bay believed the main threat from Sandy was from flooding; and
- Just 54 percent of those surveyed had flood insurance.

Businesses are lax in disaster preparedness, as well. A recent survey by FM Global found that many U.S. businesses were not prepared for the severe winter of 2013-2014. The survey found that:

- 41 percent of respondents did not have an emergency plan in place to keep their businesses running in the face of extreme weather events;
- 45 percent reported that their businesses experienced financial hardship as a result of the extreme winter weather.

At FM Approvals and parent company FM Global, the core philosophy—backed by research and over 130 years of experience and extensive testing—is that the majority of losses are preventable. What began as a method to improve the risk profile of insured clients has evolved over the years into formalized and publically available loss prevention resources, including Approval Standards (FMApprovals.com), the *Approval Guide*

(an online guide to FM Approved products at approvalguide.com), RoofNav®, a web-based roofing design tool (roofnav.com) and FM Global Property Loss Prevention Data Sheets (fmglobal.com).

FM Approved loss prevention products are available worldwide from local suppliers. It should be noted that the FM APPROVED mark on products is not a replacement for local market regulatory requirements, such as the CE mark in the European Union, but indicates that a globally accepted voluntary certification mark, that adds an additional level of value and performance assurance, has been achieved.

Companies and other organizations that choose to embrace the belief that most losses are preventable are welcome to use the planning tools, performance tested products, advice and proven guidelines from

FM Approvals and FM Global to create the most highly protected facilities possible. This holistic approach to loss prevention can result in a building envelope that is highly resistant to the most common natural hazards, including windstorms, rain, hail, temperature extremes, snow, ice and windborne debris impact (see Table 1).

Engineering to create worry-free construction

What follows is a look at a “typical” industrial building and the critical components that comprise the protective shell or building envelope. In addition, we’ll consider the FM Approvals and FM Global resources available to the general public to assist in preventing loss (see Table 2). From a loss prevention perspective, the building envelope is the outer shell that protects the interior from

the elements, including excessive heat or cold, moisture, wind, hail, snow and fire. The basic building envelope consists of:

- roof assembly (i.e., decking, insulation, fastening system, membrane, flashing);
- roof-mounted systems (e.g., cooling towers, photovoltaic panels);
- walls; and
- fenestrations (i.e., windows, doors, shutters).

Roofing assemblies and roof perimeter flashing systems

Roofing assemblies are the first line of defense against the elements in the complete building envelope. Roofing assemblies must be able to protect a structure from natural hazards associated with the local environment, including rain, hail, snow, high winds, temperature extremes—even fire.

Natural Hazards	FM Approvals Resources	FM Global Resources
General	<ul style="list-style-type: none"> ■ Approval Guide, a web-based publication of FM Approvals providing information on more than 60,000 FM Approved products 	fmglobal.com/nathaz
Wind, Windborne Debris, Rain, Hail Impact, Fire	See Table 2	See Table 2, page 10
Flooding	<ul style="list-style-type: none"> ■ Approval Standard ANSI/FM2510, Flood Abatement Equipment ■ Understanding the Benefit: Flood Abatement 	<ul style="list-style-type: none"> ■ FM Global Property Loss Prevention Data Sheet 1-40, Flood ■ FM Global Property Loss Prevention Data Sheet 10-2, Emergency Response ■ Understanding the Hazard: Flood ■ Emergency Checklist: Flood ■ Flood Emergency Response Plan
Earthquake	<ul style="list-style-type: none"> ■ Approval Standard 1950, Seismic Sway Braces for Pipe, Tubing and Conduit ■ Approval Standard 7740, Firesafe Valves ■ Approval Standard 7400, Liquid and Gas Safety Shutoff Valves ■ Understanding the Benefit: Seismic Sway Bracing 	<ul style="list-style-type: none"> ■ Understanding the Hazard: <ul style="list-style-type: none"> • Earthquake Shake Damage • Fire Following Earthquake • Lack of Earthquake Bracing on Sprinkler Systems • Lack of Seismic Gas Shutoff Valves • Nisqually Earthquake ■ Earthquake Checklist ■ Protecting Your Facility from the Dangers of Earthquakes

Table 1 – FM Approvals and FM Global resources are available to help mitigate the risk posed by most common natural hazards.

All standards and other resources noted in this table are free to the general public.

Flashing and other edge securement components help seal the edge of the roof from the elements and help secure the roof membrane along the perimeter of the roof. The majority of roof covering failures resulting from windstorms involve improperly designed or constructed perimeter flashing systems.

Flashing, fascia and coping are evaluated according to Approval Standard 4435, *Edge Systems Used with Low Slope Roofing Systems*. If the flashing system fails, a sizable amount of roof covering will likely be lost. If the roof cover securement is also inadequate, the expected loss will be even greater.

The failure of a building's roof can have a devastating impact from which a business may not be able to recover. When a roof is damaged or destroyed, the building contents can be exposed to moisture and contamination, further compounding the loss.

Most property loss, including those involving the roof, can be prevented. FM Approvals is doing its part to help property owners avoid losses by continually improving Approval Standards and by helping to make it easier for designers, architects and contractors to specify and install locally available FM Approved roofing assemblies anywhere in the world.

FM Approvals is the only organization in the world that tests complete roof assemblies when subjected to multiple perils such as fire testing above and below the deck, wind-uplift testing, hail-damage testing, accelerated weathering, water leakage, foot traffic and corrosion-resistance testing of metal parts.

FM Approved roofing products and assemblies are listed in RoofNav. This web-based system is free to the public and takes the guesswork out of configuring an FM Approved roofing assembly by putting all roofing-related information, including

a ratings calculator and related installation recommendations from relevant FM Global Property Loss Prevention Data Sheets, in one place.

Roof-mounted systems

Cooling towers and photovoltaic systems are often mounted on the roofs of commercial and public buildings to save footprint space and take advantage of an elevated location. Both of these important systems are subject to the same natural hazards and fire risk as the roof itself and, as such, are covered by Approval Standards.

Cooling towers are an important heat removal system used in conjunction with chillers as part of a building's heating, ventilation and air condition system and as direct cooling system for machinery or heat generating processes in industry.

A widely held misconception is that cooling towers are inherently safe from fire hazards because water flows through them. In fact, cooling towers are not only vulnerable to fire risks, but may contain one or more combustible materials such as polyvinyl chloride, fiberglass-reinforced plastic or acrylonitrile butadiene styrene.

Cooling towers are evaluated in accordance with Approval Standard 4930, *Cooling Towers*, a comprehensive standard that covers all tower designs including single cell, multi-cell and rooftop mounted units. Under Approval Standard 4930, the cooling tower must be designed to withstand seismic and wind load stresses in accordance with FM Global Loss Prevention Data Sheet 1-6, *Cooling Towers*, as well as cyclic air pressure, windborne debris and fire resistance through full-scale fire testing.

Photovoltaic (PV) systems are becoming increasingly popular as energy costs rise and businesses and other organizations are under

pressure to control their carbon footprint. Commercial and private rooftops are viewed as an underutilized opportunity for solar power generation. However, installation of rooftop photovoltaic systems is a major undertaking that requires careful consideration and analysis in order to optimize performance without damaging the roof covering or the underlying structure, or overstressing the support structure of the roof.

Rigid PV modules are currently the most common form of solar energy system and typically require a metal rack system for roof or ground mounting. These rigid modules are evaluated by FM Approvals using Approval Standard 4478, *Rigid Photovoltaic Modules*.

Flexible PV modules can be secured directly to roofing assemblies and represent a smaller, but growing segment of the solar energy market. Flexible thin-film PV modules may be integrated with roof membranes in the factory or on location to form a complete waterproof system. Flexible PV modules are evaluated by FM Approvals using Approval Standard 4476, *Flexible Photovoltaic Modules*.

Both rigid and flexible PV modules are evaluated for combustibility from above the roof deck, wind uplift resistance, hail damage resistance, electrical safety and performance, seismic resistance, windborne debris resistance and the long-term impact of high heat absorption on roof covers.

Wall to wall

Exterior wall building panels designed with a facer that is exposed to the outdoors are subjected to a number of natural hazards such as wind, hail and hurricane-blown debris as well as fire. Exterior walls that have been compromised can pave the way for serious damage to the building structure and its contents, and result in other costly impacts such as business interruption.

Building Envelope Component	FM Approvals Resources	FM Global Resources
General	<ul style="list-style-type: none"> ■ Approval Guide, a web-based publication of FM Approvals providing information on more than 70,000 FM Approved products ■ RoofNav – free web-based roofing design tool for roofing professionals 	
Roofing Systems	<ul style="list-style-type: none"> ■ Approval Standard 4454, Lightweight Insulating Concrete for Use in Class 1 and Noncombustible Roof Deck Construction ■ Approval Standard 4470, Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction ■ Approval Standard 4471, Class 1 Panel Roofs ■ ANSI FM 4473, American National Standard for Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls ■ ANSI FM 4474, American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressure ■ Approval Standard 4475, Class 1 Steep Slope Roof Covers ■ Approval Standard 4477, Vegetative Roof Systems ■ Understanding the Benefit: Roofing ■ Understanding the Benefit: Lap Seam Roofs 	<ul style="list-style-type: none"> ■ FM Global Property Loss Prevention Data Sheets: <ul style="list-style-type: none"> • 1-9, Roof Anchorage • 1-28, Wind Design • 1-28R, Roofing Systems • 1-29, Roof Deck Securement and Above-Deck Roofing Components • 1-31, Metal Roof Systems • 1-32, Existing PVC Roof Covers • 1-33, Safeguarding Torch-Applied Roof Installations • 1-35, Green Roof Systems • 1-52, Field Verification of Roof Wind Uplift Resistance • 1-54, Roof Loads for New Construction ■ Publications: <ul style="list-style-type: none"> • Protecting Your Facility Against Major Windstorms • Severe Windstorm Checklist
Flashing Systems	<ul style="list-style-type: none"> ■ Approval Standard 4435, Edge Systems Used with Low Slope Roofing Systems 	<ul style="list-style-type: none"> ■ FM Global Property Loss Prevention Data Sheet 1-49, Perimeter Flashing
Roof-Mounted Systems	<ul style="list-style-type: none"> ■ Approval Standard 4930, Cooling Towers ■ Approval Standard 4476, Flexible Photovoltaic Modules ■ Approval Standard 4478, Rigid Photovoltaic Modules ■ Understanding the Benefit: Cooling Towers Understanding the Benefit: Photovoltaic Modules 	<ul style="list-style-type: none"> ■ FM Global Property Loss Prevention Data Sheet 1-6, Cooling Towers
Walls	<ul style="list-style-type: none"> ■ ANSI FM 4880, American National Standard for Evaluating Insulated Wall or Wall and Roof/Ceiling Assemblies, Plastic Interior Finish Materials, Plastic Exterior Building Panels, Wall/Ceiling Coating systems, Interior or Exterior Finish Systems ■ Approval Standard 4881, Class 1 Exterior Wall Systems ■ Understanding the Benefit: Insulated Panels (Exterior Building Panels) 	<ul style="list-style-type: none"> ■ FM Global Property Loss Prevention Data Sheet 1-20, Protection Against Exterior Fire Exposure
Fenestrations	<ul style="list-style-type: none"> ■ Approval Standard 4350, Windstorm Resistant Fenestrations ■ Approval Standard 4431, Skylights ■ Understanding the Benefit: Skylights 	
Earthquake	<ul style="list-style-type: none"> ■ Approval Standard 1950, Seismic Sway Braces for Pipe, Tubing and Conduit ■ Approval Standard 7740, Firesafe Valves ■ Approval Standard 7400, Liquid and Gas Safety Shutoff Valves ■ Understanding the Benefit: Seismic Sway Bracing 	<ul style="list-style-type: none"> ■ Understanding the Hazard: <ul style="list-style-type: none"> • Earthquake Shake Damage • Fire Following Earthquake • Lack of Earthquake Bracing on Sprinkler Systems • Lack of Seismic Gas Shutoff Valves • Nisqually Earthquake ■ Earthquake Checklist ■ Protecting Your Facility from the Dangers of Earthquakes

Table 2 – Building envelope components and the FM Approvals and FM Global resources available to protect them. All standards and other resources noted in this table are free to the general public and address a wide range of natural and manmade hazards, including Wind, Rain, Windborne Debris, Hail Resistance, and Fire.

FM Approvals is the only organization that tests exterior wall systems for fire performance as well as their ability to withstand natural hazard events without damaging the building structure.

FM Approved exterior wall systems are tested in accordance with ANSI FM 4880-2001(R20007), *American National Standard for Evaluating Insulated Wall or Wall and Roof/Ceiling Assemblies, Plastic Interior Finish Materials, Plastic Exterior Building Panels, Wall/Ceiling Coating Systems, Interior or Exterior Finish Systems* and Approval Standard 4881, *Class 1 Exterior Wall Systems*. These standards evaluate the fire performance of a wall system, as well as natural hazard performance such as wind loading, windborne debris resistance and hail resistance.

Fenestrations

The building envelope is only as strong as its weakest link. Windows, doors, skylights, shutters and impact-resistant films—fenestrations—should not be overlooked when designing a building to withstand hurricanes, powerful windstorms, hail and windborne debris. Damage to fenestrations can lead to serious damage to the building contents and the building structure itself.

Approval Standard 4350, *Windstorm Resistant Fenestrations*, provides performance-based requirements for simulated static and cyclic wind loading, windborne debris (choice of small and/or large missile impacts) and hail resistance. FM Approvals provides customers with several windstorm zone categories, based on product performance, including the

highest category, Zone HM for hurricane-force wind with missile impact; Zone H for hurricane-force wind only; and Zone NH for non-hurricane areas.

In addition, Approval Standard 4431, *Skylights*, makes it easier for architects, specifiers and contractors to include certified products in daylighting designs. Skylights are susceptible to damage from natural hazards such as hail, wind uplift, foot traffic and debris impacts. Skylights, particularly those made from plastic, also pose a fire risk from both internal and external sources. The fire test in Approval Standard 4431 evaluates the ability of the skylight to limit flame spread, and measures the sample's propensity to melt and drip, which could adversely impact the performance of sprinklers located just below.

Flood and seismic protection

In addition, for organizations that are already located within known flood and seismic zones, FM Approved products also are available to protect the building envelope from these natural hazards (see Table 1).

For instance, FM Approved seismic sway bracing is available worldwide to protect pipe, tubing and conduit from the impact of earthquakes. This bracing can be used to secure piping systems, including automatic sprinkler systems, from potentially damaging seismic movement.

The failure of sprinkler systems is a major concern due to the likelihood of fires developing following a significant earthquake. Following the 6.9-magnitude 1995 Hanshin (Kobe) earthquake, 108 fires were reported resulting in the loss of 5,000 structures. Kobe's water distribution system sustained approximately 1,750 leaks and breaks.

FM Approved flood-abatement products are now available to help keep flood waters away from critical facilities and structures

and the interior of buildings dry. Thanks to a partnership between FM Approvals, the United States Army Corps of Engineers, and the Association of State Floodplain Managers (ASFPM), the ASFPM National Flood Barrier Testing and Certification Program offers four levels of certification for temporary perimeter flood barriers and opening barriers. The new program is based on the nationally recognized Approval Standard ANSI/FM2510, *Flood Abatement Equipment* (nationalfloodbarrier.org/).

Hard knocks lead to savings

"Hurricane Andrew in 1992 taught us some hard lessons and we had to apply changes across the board," explains Rich Ferron, operations vice president and manager of FM Approvals testing and certification services. According to Ferron, following Andrew, FM Global and FM Approvals took a fresh look at loss prevention during wind events and natural hazards in general.

"We've introduced new, stronger performance-based standards that help provide for FM Approved products that are optimized for the expected intensity of natural hazards in a given location," said Ferron. He continued, "We know we've had a significant impact because when Katrina hit in 2005, FM Global clients who followed the loss prevention recommendations, which included recommendations for FM Approved products, reduced their losses by 85 percent compared to those who didn't."

Jean-Philippe Roisin, FM Approvals manager of business development for Europe notes that "FM Approved products can help architects, designers, contractors and building owners worldwide specify performance-tested assemblies and components that can help protect a business from the natural hazards expected in their local environments." ■

