FM Approvals®

Member of the FM Global Group

Examination Standard for Heat and Smoke Vents

Class Number 4430

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for heat and smoke vents.

1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

1.2.1 This standard sets the performance requirements for heat and smoke vents under simulated laboratory conditions. This standard sets their performance requirements when exposed to various natural hazards such as simulated wind loading, the impact of simulated hail and the possible degradation effects of sunlight. The standard also examines their ability to withstand the impact effects of temporary live loads as well as to be able to operate under anticipated roof live (snow) loads. Finally, the standard validates the temperature the heat and smoke vent will operate as reported by the manufacturer.

1.2.2 This standard is not intended to be used to determine when or where heat and smoke vents are to be used or how to determine the amount of vented area needed.

1.2.3 This standard is not intended to qualify skylights.

1.2.4 This standard is intended to evaluate only those hazards investigated and is not intended to determine suitability for the end use of the product.

1.2.5 The results of tests conducted under the controlled conditions required by this standard shall not be used to describe or appraise performance under actual fire or natural hazard conditions as actual fire and natural hazard conditions vary widely.

1.2.6 This standard does not examine the product's solar optical values such as transmittance, reflectance or absorbance or other properties such as air leakage, water leakage, solar radiation, insulating properties or other properties related to the resistance of heat flow through the product due to indoor and outdoor temperature differentials.

1.3 Basis for Requirements

1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of heat and smoke vents for the purpose of obtaining certification. Heat and smoke vents having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

American National Standard Institute (ANSI)

- ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*
- ANSI/FM 4473, *Impact Resistance Testing of Rigid Roofing Materials by Impacting with*

Freezer Ice Balls

- ANSI/FM 4474, *Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures*

American Society for Testing and Materials (ASTM International)

- ASTM E108, *Standard Test Method for Fire Tests of Roof Coverings*

European Committee for Standardization (CEN)

- EN 12101-2, *Standard Practice for Smoke and Heat Control Systems – Part 2: Natural Smoke and Heat Exhaust Ventilators*

Occupational Safety and Health Administration (OSHA)

- OSHA Regulation *29 CFR 1910.23(e)(8) and 1926.501*

FM Approvals LLC (FM)

- FM 4350, *Examination Standard for Windstorm Resistant Fenestrations*

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Cracking – to break in such a way that a fine split or splits appear but the section does not come apart.

Heat & Smoke Vent – an operable opening in a roof designed to operate either automatically or manually in the event of a fire to allow heat and smoke to escape the building.

Skylight – an opening in a roof that is permanently covered with a translucent or transparent material. Skylights are generally inoperable and are provided mainly as a means of admitting light while maintaining the building envelope.

Thin Break – a flaw that is visible as a thin line or a network of fine cracks.

Deck - The structural component of the roof assembly to which the roof system is secured.

2 GENERAL INFORMATION

2.1 Product Information

2.1.1 Heat and smoke vents were originally thought to aid firefighting in unsprinklered buildings. In such cases, vents take advantage of the principle that hot air and gases tend to rise. When a fire occurs in an unsprinklered building, the smoke and gases rise until blocked. They then move radially outward in a mushrooming, deepening bank, slowly lowering to floor level and making manual firefighting difficult.

2.1.2 In a sprinklered building, this is not the case. In sprinklered buildings, the passage of hot air and smoke through the vent opening causes fresh air to enter into the building through any other available opening resulting in greater fuel consumption and potentially an increased water demand.

2.1.3 If a heat and smoke vent system is installed, it is critical to ensure they do not adversely affect the building's ability to protect its contents from external conditions such as rain, snow or wind.
The system selected must be able to withstand the design conditions presented by the building's location.

2.1.4 Heat and smoke vents are different from skylights. Heat and smoke vents can be designed to open automatically in fire situations or manually to vent smoke and hot gases. Skylights are usually inoperable and mainly provided as a means of supplementing a building's lighting.

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- general assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, piping and electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures, etc.
- the number and location of manufacturing facilities.
- all documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

2.3.1 Following authorization of an certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the heat and smoke vent system.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification examination results may further define the limits of the final certification.

3.1.2 The certification agency, at their sole discretion, may place the manufacturers of resin systems or plastics used to manufacture plastic domes and lids, under its surveillance audit program (See Section 5.2) and witness production of raw materials that are deemed to be critical to the performance of the product. Any decision to use data generated using prototypes is at the discretion of the certification agency.

3.2 Types of Heat and Smoke Vents

3.2.1 There are two (2) categories of heat and smoke vents: automatic operating heat and smoke vents and drop-out type heat and smoke vents. All certified automatic operating heat and smoke vents shall be equipped with a heat activating device. Heat and smoke vents can be further classified based on the material used to manufacture the domes or lids – either metal or thermo plastic. The test requirements for each type of heat and smoke vent, and their material of construction, are shown in Table 1.

3.2.2 Automatic operating heat and smoke vents shall be permitted to utilize either metal or thermoplastic lids and shall be provided with a manual opening device that is accessible from floor level. Additional manual opening devices shall be permitted provided that they do not interfere with the automatic opening capabilities of the vent. Automatic heat and smoke vents that utilize a metal lid are not required to be subjected to a fire test if they are provided with a heat activating device. Automatic heat and smoke vents that utilize thermoplastic domes or lids shall be subjected to fire tests to verify that the lids will not spread flames, melt, drip or drop out prior to activation of the heat activating device.

3.2.3 Drop-out type heat and smoke vents shall be provided with a tether to prevent the dome from falling to the floor after it has dropped out of the frame. The tether shall be designed such that it allows the drop-out section to fully clear the opening and not obstruct the horizontal cross section of the open vent.

3.2.3.1 Drop out type heat and smoke vents shall be provided with a manual release device.

3.2.3.2 Motor operated automatic heat and smoke vents shall be provided with a device that disconnects the motor drive from the heat and smoke vent which will allow another type of automatic opening mechanism or manual opening mechanism to open the vent.

Table 1

Type of Test	*Automatic Type Metal Lids*	*Automatic Type Plastic Lids*	*Drop Out Type*
Wind Uplift	Yes	Yes	Yes
Wind Load	Yes	Yes	No
Live Load	Yes	Yes	Yes
Fire Test	No	Yes	Yes
Operational Test	Yes	Yes	No
Impact Test	Yes	Yes	Yes
Hail Test	Optional	Yes	Yes
Windborne Debris	Optional	Optional	Optional
Spread of Flame Test	No	Yes	Yes

3.3 Markings

3.3.1 Marking on the product shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number, size, rating, capacity, etc., as appropriate.
- when the products are provided with a safety cage, a note that the safety cage meets the requirements of OSHA Regulation 29 CFR 1910.23(e)(8) and 1926.501. or comparable international standard.

When hazard warnings are needed, the markings should be universally recognizable.

3.3.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.3.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.3.4 All markings shall be legible and durable.

3.4 Manufacturer's Installation and Operation Instructions

3.4.1 The manufacturer shall:

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.5 Calibration

3.5.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.5.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

4 PERFORMANCE REQUIREMENTS

Tests of alternate constructions may be waived if considered less hazardous than those previously tested.

4.1 Simulated Wind Uplift Resistance Test for Heat and Smoke Vents

4.1.1 Requirement

All heat and smoke vents shall be subjected to a simulated wind uplift resistance test in order to determine the product's ability to resist anticipated loads imposed by wind forces on a roof. The minimum rating shall be 60 lbs/ft^2 (2.9 kPa). Additional ratings shall be in increments of 15 lbs/ft^2 (0.75 kPa).

4.1.2 Test/Verification

Testing for wind uplift resistance shall be conducted in accordance with ANSI/FM 4474*, Test Method for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures* with the following modifications:

1) The test shall be conducted using the minimum thickness material and maximum size opening for which certification is desired.

2) Heat and smoke vents that measure < 5 x 9 ft (1.5 x 2.7 m) in size shall be permitted to be tested on the 5 x 9 ft (1.5 x 2.7 m) simulated wind uplift pressure test apparatus without limitation in wind uplift rating. Heat and smoke vents that measure > 5 x 9 ft (1.5 x 2.7 m) in size shall be tested on the 12 x 24 ft (3.7 x 7.3 m) simulated wind uplift pressure test apparatus.

4.1.3 The test sample shall be considered to meet the test criteria if:

- all fasteners, clips and other items used to secure the vent dome or lid remain fully engaged with the vent dome and do not pull through, become dislodged or disconnected;
- all fasteners, clips and other items used to secure the curb to the test frame remain fully engaged and do not pull through, become dislodged or disconnected;
- the vents do not delaminate, break, crack or develop any through openings;
- vent lids do not open or become disengaged from the mechanical devices used to secure the dome to the curb.

4.2 Simulated Wind Load Resistance for Heat and Smoke Vents

4.2.1 Requirement

All automatically operated heat and smoke vents shall be examined for resistance to closing when subject to a simulated wind load.

4.2.2 Test/Verification

Testing for wind load resistance shall be conducted using the maximum area size vent lid for which certification is desired. One (1) test shall be conducted, with the vent lid in the open position, to simulate a wind loading that would cause the vent to close after it has been activated and has reached the open position.

The Heat and Smoke Vent Wind Load Test Apparatus is a steel frame arranged to apply a horizontal load to the lid of the test sample and consists of a steel base upon which the sample is secured in place. Opposite the sample location is a pulley attached to the base via a steel post. With the lid in the open position, a rope or steel cable is tied around or secured to the horizontal center line of the lid parallel to the long dimension and the free end of the rope or cable is placed over the pulley. A steel weight tray weighing 5 lbs (2.3 kg) with a threaded rod and removable pad eye at the end is secured to the steel cable or rope and loaded with steel plates varying in weight ranging from 5 lbs to 30 lbs (2.3 kg to 13.6 kg). The applied pressure during the test shall be 5 lbs/ft^2 (0.25 kPa).

4.2.3 The test sample shall be considered to meet the test criteria if the vent lid remains within 10° of the fully open position during the sixty (60) second test.

4.3 Simulated Live Load Test for Heat and Smoke Vents

4.3.1 Requirement

All heat and smoke vents shall be examined to demonstrate that the vent lids can withstand an applied live load. Automatic opening heat and smoke vents shall also demonstrate their ability to attain the fully open position when subjected to an applied live load. The minimum live load shall be 10 lbs/ft^2 (0.5 kPa). Certification shall be granted to greater live loads in multiples of 5 lbs/ft^2 (0.25 kPa).

4.3.2 Test/Verification

All automatic operating vents shall have each combination of size or number of springs, dampers or other opening mechanisms subjected to a simulated live load test using the largest size dome for which the combination is to be certified.

4.3.2.1 This simulated live load test consists of two different test methods:

Test Method A is used to assess heat and smoke vents ability to withstand the maximum sustained live load for which it is rated without having any deleterious affects on the vent. All heat and smoke vent designs shall be subjected to Test Method A. As an alternative and at the sole discretion of the certification agency, vents constructed completely of metal shall be permitted to be qualified using engineering calculations.

Test Method B is used to assess the ability of an automatic operating heat and smoke vent to attain the open position while it's being subjected to the maximum live load for which it is rated. As such, only automatic operating heat and smoke vents shall be subjected to Test Method B.

4.3.3 One (1) test shall be conducted using the minimum thickness dome material and maximum size opening for which certification is desired.

Test Method A – All Vents

The live load shall consist of bags of sand being placing on the lid until the desired live load is achieved. The bags shall be applied evenly over the entire area of the vent. When the vent lids are not flat or of an irregular shape, the load shall be applied as uniformly as possible to follow the contour of the vent. After placement of the sand bags, the unit shall be subjected to the test load for a minimum period of seventy-two (72) hours. The seventy-two (72) hour period shall not start until the last sand bag has been placed. The bags of sand shall be placed flat and uniformly over the entire surface of vent. The vent shall remain in place for the entire test period without developing any through openings. When the sand bags have been removed, the vents shall not suffer any permanent deformation greater than 1 in. (25 mm) from its original position.

Test Method B – Automatic Operating Vents

Steel plates shall be placed on the lid to simulate the roof live load. Each 0.25 in. (6 mm) thickness of steel plate shall be considered to represent a 10 lbs/ft^2 (0.5 kPa) live load. The centroid of the steel plates shall be centered along the centerline of the moveable portion of the vent. The plates shall be securely fastened to the vent and the vent frame shall be fastened to the floor or other supports such that it does not topple when the vent is opened. Sand bags shall be permitted to be used in place of steel plates for automatic operating heat and smoke vents that utilize non-metallic domes or lids.

When the steel plates have been fastened to the vent and the unit is ready for testing, the manual release shall be activated. The test shall be repeated five (5) times. For each test, when the manual release is activated, the vent shall attain the fully open position, ±10%, within sixty (60) seconds. No maintenance or adjustments are permitted during the series of tests.

4.3.4 As an option, an alternate test method may be utilized in place of the test noted above. Reference EN 12101-2, Smoke and Heat Control Systems – Part 2: Natural Smoke and Heat Exhaust Ventilators: *Section 4, Annex D; Test method for opening under load*.

4.4 Fire Exposure Test

4.4.1 Requirement

All heat and smoke vents that incorporate a plastic dome or lid shall be subjected to a fire exposure test to verify that the vent's lid or dome will not drop out or release prematurely and affect sprinkler activation. This shall be determined by assessing the dome's ability not to allow venting until a heat activating device has activated. The operating temperature rating of the certified heat and smoke vent shall be determined by local code requirements and manufacturer's based targeted markets.

4.4.1.1 For pop up type heat and smoke vents, a heat activated device with the maximum operating temperature rating proposed for the certified heat and smoke vent, shall be used in the fire exposure test and required as part of the certification. Upon successful completion of the test, Approval shall be granted to identical heat and smoke vents equipped with lower operating temperature ratings, at the sole descrescion of FM Approvals. Smoke detection shall not be used as the means of activation for the test. The test shall be conducted on the largest size vent for which certification is desired.

4.4.2 Test/Verification

4.4.2.1 One representative heat and smoke vent sample with lids in the closed position is secured to the sample support structure 30 in. ± 1⁄2 in. (760 mm ± 13 mm) above the floor. A thermocouple is secured to the underside of the dome/lid to monitor the temperatures during the test. In addition, a thermocouple is placed on the heat activated device to confirm that the device does not activate prior to reaching its rated operating temperature. The fuel for the fire exposure is placed in a 12 in. × 12 in. × 12 in. (300 mm × 300 mm × 300 mm) steel pan containing 1⁄2 in. (13 mm) depth of isopropyl alcohol and set in place so that the liquid surface is located 18 in. (450 mm) below the top of the test sample support structure. The fire exposure is ignited and the simulated rainfall is activated.

4.4.2.2 The test sample shall be considered to meet the test criteria if:

The dome or lid does not release or drop out of the opening until the fusible link or heat activated device has activated. If a mechanical device, cable or restraining system is used to keep the dome from venting, the device, cable or restraining system shall support the dome in such a manner that venting does not occur until the fusible link or heat activated device has activated.

A drop out type dome or lid must achieve the full open position within fifteen (15) seconds from activation. In addition, no burning or flaming particles are allowed to be dislodged from the vent and continue to burn after reaching the floor.

- For automatic opening types of vents that utilize plastic lids, the vent lid must not develop any through openings or drop-out until after the fusible link or heat activated device has activated. In addition, no burning or flaming particles are allowed to be dislodged from the vent and continue to burn after reaching the floor.

4.5 Operational Test

4.5.1 Requirement

All automatic type heat and smoke vents shall be subjected to an operation test to simulate expected service life and reliability. The operational test shall consist of cycling the vent dome through the complete open and close cycle sixty (60) times.

4.5.2 Test/Verification

The vent shall attain the fully open position within thirty (30) seconds of activation. The vent lid shall be closed and the manual release reset, if applicable. The open and close cycle shall be repeated a total of sixty (60) times. Once the test has started, no maintenance or adjustments shall be allowed other than resetting the release, if applicable.

4.6 Simulated Impact Test for Heat and Smoke Vents

4.6.1 Requirement

Heat and smoke vents shall be subjected to an impact test in order to determine the product's ability to resist anticipated live loads such as foot traffic. Vents shall be permitted to be provided with a safety cage. In this case, the use of the safety cage will be required as a condition of certification.

4.6.2 Test/Verification

4.6.2.1 The test shall be conducted on the minimum thickness of each profile for which certification is desired. The test shall be conducted at the maximum span that the particular profile and thickness are to be certified. Each test consists of two impacts. A separate sample may be used for each impact.

4.6.2.2 The impactor consists of a cylindrical canvas bag having a diameter of 12 in. (300 mm) filled with dry sand having a total assembly weight of 100 lbs (45.5 kg) ± 4 oz. (113.4 g). The bag is tied to ensure that the sand cannot escape and a ring or similar device is attached to the top of the bag to facilitate a quick release mechanism used to drop the impactor. The heat and smoke vent is secured to a suspended substrate sufficient to provide stiffness to prevent any flexibility from affecting the test results. The 1st impact is located within a 12 in. (300 mm) diameter circle located at the test sample's center point. The impactor is raised to a position such that the bottom of the impactor is 4 ft (1.2 m) above the highest surface of the test panel. The impactor is released such that it falls freely under gravity onto the surface of the test sample. The impactor shall not be removed for a period of five (5) minutes after the impact. The 2nd impact shall be located within a 12 in. (300 mm) diameter circle from the end support of the test sample.

4.6.2.3 The test sample(s) shall be considered to meet the test criteria if no through opening develops through which a four (4) in. (102 mm) diameter sphere can pass. The vent lid shall not become dislodged from the vent curb or drop out. When a safety cage has been provided, the safety

cage shall not come into contact with the dome or lid as a result of deflection caused by the impactor.

4.7 Simulated Hail Resistance Test Using Freezer Ice Balls

4.7.1 Requirement

All certified heat and smoke vents that utilize non-metallic domes or lids shall be subjected to a simulated hail impact test using freezer ice balls. Four (4) ratings are available: Very Severe Hail (VSH), Severe Hail+ (SH+), Severe Hail (SH) and Moderate Hail (MH). The minimum rating required for certification is MH. Each rating consists of the following specifications:

Table 1

Hail Rating	*Nominal Ice Ball Diameter, in. (mm)*	*Kinetic Energy, ft-lbs (J)*
VSH	2.0 (51)	53 – 58 (72 – 79)
SH+	2.0 (51)	26.8 – 29.5 (36.4 – 40)
SH	1.75 (44)	14.9 – 16.5 (20.3 – 22.4)
MH	1.5 (44)	7.8 – 8.6 (10.4 – 11.6J)

As an option, heat and smoke vents that utilize metal domes or lids shall be eligible to achieve a VSH rating.

4.7.2 Test/Verification

Two (2) test samples of each profile shall be subjected to either the VSH, SH+, SH or MH impact energy. One sample shall be exposed to ultra-violet (UV) light for a period of not less than one thousand (1000) hours prior to impact from the freezer ice balls. Each sample shall be impacted a minimum of ten (10) times for SH+, SH or MH impact energy and subjected to a minimum of three (3) ice ball impacts at corner, edge and center areas of the test sample for VSH impact energy. Additional impacts shall be conducted at the discretion of the certification agency, when the test sample includes changes in profile separate from the initial three (3) impact areas, such as corrugations or other points that may prove susceptible to hail damage. UV conditioning can be waived for non painted metal lids.

4.7.2.1 For VSH, impact areas shall be a minimum 6 in. (152 mm) distance apart so that the effects of each impact location are independent. The outside edge of the ice ball shall be a minimum 1/4 in. (6.4 mm) from the edge of the test sample.

4.7.3 The test samples shall be considered to meet the test criteria if:

SH+, SH and MH ratings:

- no through openings shall develop
- cracking and thin breaks shall be permitted

VSH rating:

- no through openings, cracking or thin breaks shall be permitted to develop
- no damage such as dents are permitted to develop for metal domes or lids

4.8 Windborne Debris Rating (Optional)

4.8.1 Requirement

4.8.1.1 As an option, heat and smoke vents shall be permitted to be certified for resistance to large or small windborne debris. Testing shall be conducted on the minimum thickness of each profile for which certification is desired, in accordance with *Test Procedure, Test Method for Windstorm Resistant Fenestrations*, FM Approvals LLC.

4.8.1.2 The test method offers two (2) levels of impact - Large Debris (LD) or Small Debris (SD). Products that meet the criteria of the LD impact shall be deemed to have also met the criteria for the SD impact.

4.8.1.3 The LD impact test consists of impacting a test sample with an 8 ft (2.4 m) long wooden 2 x 4 (nominal) weighing 9 lbs (4 kg) traveling at a speed of 50 ft/sec (15.25 m/s). Each sample is subjected to two (2) impacts at predetermined locations.

4.8.1.4 The SD impact test consists of impacting a test sample with a series of impacts. Each impact of the SD consists of ten (10) steel balls weighing 0.07 oz (2 g) traveling at a speed of 130 ft/sec (39.6 m/s). Each sample shall be subjected to three (3) impacts predetermined locations.

4.8.1.5 Subsequent to either large debris or small debris impact tests, the sample shall be subjected to Structural Test Method for Windstorm Resistant Fenestration Systems Exposed to Cyclic Air Pressure Differentials (Procedure A). The inward pressure level, P^{inward}, that is used during the test shall be at the discretion of the test sponsor. The tests shall be conducted such that the ratio of the outward pressure to the inward pressure ($P^{outward}$ / P^{inward}) shall be either (-1.4) or (-2.0).

4.8.2 Test/Verification

4.8.2.1 Three (3) separate samples shall be tested per the Test Method for Windstorm Resistant Fenestration Systems Impacted by Windborne Debris for either LD or SD Impact Resistance. Following the Test Method for Windstorm Resistant Fenestration Systems Impacted by Windborne Debris, each sample shall also be subjected to the Structural Test Method for Windstorm Resistant Fenestration Systems Exposed to Cyclic Air Pressure Differentials (Procedure A).

4.8.2.2 To obtain certification for Wind Zones HM-LD and HM-SD:

For either LD Impact Resistance [Wind Zone HM-LD] or SD Impact Resistance [Wind Zone HM-SD], upon completion of the cyclic pressure test (which follows the impact test), all three (3) samples shall not develop any openings more than 5 in. (125 mm) in length or any through openings through which a 3 in. (75 mm) diameter solid sphere can freely pass.

4.8.2.3 To obtain certification for Wind Zones HM-LD(FL) and HM-SD(FL):

For either LD Impact Resistance [Wind Zone HM-LD (FL)] or SD Impact Resistance [Wind Zone HM-SD (FL)], upon completion of the cyclic pressure test (which follows the

impact test), all three (3) samples shall have no penetration of the impact protective system by the LD or SD (for the impact test) and during the cyclic test, shall not develop any openings more than 5 in. (125 mm) in length or 1⁄16 in. (1.6 mm) in width through which air can pass.

4.9 Spread of Flame Test for Heat and Smoke Vents from an Exterior Ignition Source

4.9.1 Requirement

All heat and smoke vents that incorporate plastic domes or lids shall be subjected to a fire test to evaluate their ability to limit flame spread in accordance with a modified version of ASTM E108 Class A or Class B. The Spread of Flame test shall also be used to evaluate the material's propensity to melt and drip and its ability to maintain its structural integrity. The modifications are as follows:

The width of the test samples for the Spread of Flame test shall be minimum 3 ft (0.91 m) up to a maximum of 6 ft-8 in. (2 m). Heat and smoke vents having widths less than 3 ft (0.91 m) shall be allowed and tested at the greatest width for which certification is desired. The length of the test samples shall be minimum 8 ft (2.4 m). Heat and smoke vents having lengths less than 8 ft (2.4 m) shall be allowed and tested at the greatest length for which certification is desired. Ratings available shall be Class A and Class B only. There is no Class C rating as with ASTM E108.

4.9.2 Test/Verification

Two (2) tests shall be conducted on each candidate submitted for certification. Each test with a continuous exposure period of ten (10) minutes. The samples will be tested at the maximum slope for which certification is desired. The minimum slope allowed during the testing is 0.25 in 12 (2.4°). The maximum slope allowed during the test is 5 in 12 slope (23°). The rating shall indicate the maximum slope at which the material was successfully tested and for which it is certified. The one minute timed wind speed average velocity measured on the calibrated deck shall be 1056 ft/min $\pm$ 44 ft/min (5.4 m/sec $\pm$ 0.22 m/sec) and the two minute average flame temperature shall be 1400 °F +/- 50 °F (760 °C $\pm$ 28 °C) for Class A and B testing.

4.9.3 Conditions of Acceptance for the Spread of Flame Test

Class A rating:

- each test sample shall not propagate flame more than 6 ft (1.8 m) from the flame exposed end;
- any particles that melt, drip or otherwise fall off during the test shall not be flaming or glowing upon contact with the floor.

Note: Heat and smoke vent samples that measure less than 6 ft (1.8 m) in length shall be granted a Class B rating if flames propagate the entire length of the sample provided particles that melt, drip, or otherwise fall off during the test are not flaming or glowing when making contact with the floor.

Class B rating:

- each test sample shall not propagate flame to the end of the test sample, 8 ft (2.4 m) from the flame exposed end;
- any particles that melt, drip or otherwise fall off during the test shall not be flaming or glowing upon contact with the floor.

When heat and smoke vents that incorporate a plastic dome or lid do not maintain their structural integrity, the manufacturer shall provide a screen or similar mechanism to keep the plastic dome or lid from interfering with the sprinkler's operation. In addition, a note shall be added to the certification listing to alert the end user that if a sprinkler is installed directly under such a heat and smoke vent, steps need to be taken to prevent the plastic dome or lid from interfering with the sprinkler's operation.

5 OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifiers surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility may be part of the certification agencies surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine

that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 Manufacturer's Responsibilities

The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

6 BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.