

CLASS NUMBER 4471

---

# Examination Standard for Class 1 Panel Roofs

## 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.

# TABLE OF CONTENTS

- TABLE OF CONTENTS..... 1**
- 1. INTRODUCTION ..... 1**
  - 1.1. Purpose ..... 1
  - 1.2. Scope ..... 1
  - 1.3. Basis for Requirements ..... 1
  - 1.4. Basis for certification ..... 1
  - 1.5. Basis for Continued certification ..... 1
  - 1.6. Effective Date ..... 2
  - 1.7. System of Units ..... 2
  - 1.8. Normative references..... 2
  - 1.9. Terms and Definitions ..... 2
- 2. GENERAL INFORMATION ..... 4**
  - 2.1. Product Information ..... 4
  - 2.2. Certification Application Requirements ..... 4
  - 2.3. Requirements for Samples for Examination ..... 4
  - 2.4. Recognition..... 4
- 3. GENERAL REQUIREMENTS..... 5**
  - 3.1. Review of Documentation ..... 5
  - 3.2. markings..... 5
  - 3.3. Manufacturer’s Installation and Operation Instructions ..... 5
  - 3.4. Calibration..... 5
  - 3.5. Observation of Test Sample Production ..... 5
- 4. PERFORMANCE REQUIREMENTS ..... 6**
  - 4.1. Combustibility – From Below Roof Assembly ..... 6
  - 4.2. Combustibility – From Above Roof Assembly ..... 6
  - 4.3. Wind Uplift Resistance ..... 7
  - 4.4. Foot Traffic Resistance..... 7
  - 4.5. Hail Damage Resistance ..... 7
- 5. MANUFACTURER’S REQUIREMENTS ..... 9**
  - 5.1. Demonstrated Quality Control Program..... 9
  - 5.2. Surveillance Audit ..... 9
  - 5.3. Installation Inspections..... 9
  - 5.4. Product modifications..... 10
- 6. BIBLIOGRAPHY ..... 11**

## 1. INTRODUCTION

### 1.1. PURPOSE

- 1.1.1. This standard states testing and certification requirements for Class 1 Panel Roofs. A Class 1 Panel Roof is one which meets the criteria of this standard for fire, wind, foot traffic, and hail damage resistance.
- 1.1.2. Testing and certification criteria may include 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 performance requirements for panel roofs which include all components necessary for installation of the panel roof assembly. The assembly which exhibits low fire spread below and above the panel, adequate simulated wind uplift resistance, and adequate strength and durability during the certification examination will qualify as a Class 1 assembly. To be rated as a Class 1 panel roof assembly, only Class 1 certified components may be used.
- 1.2.2. This standard applies to any component intended for use in assembling a panel roof, including metal and plastic panel roofs.
- 1.2.3. The performance of a panel roof depends in part on all components in its makeup, and on how these components interact. It is therefore necessary to evaluate the roof assembly as a whole when measuring the potential for fire spread on the underside and exterior of the roof, and/or its ability to resist wind forces.

### 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 loss control specialists was also considered.
- 1.3.2. The requirements of this standard reflect tests and practices used to examine characteristics of panel roofs for the purpose of obtaining certification.

### 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
  - 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;
- 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 agency's 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:

ANSI/IEEE/ASTM SI 10, American National Standard for Metric Practice

AISI S100, North American Specification for the Design of Cold-Formed Steel Structural Members

ASTM E108, Standard Test Methods for Fire Tests of Roof Coverings

ASTM G154, Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Materials

NFPA 276, Standard Method of Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components

ANSI FM 4474, American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures

FM 4880, Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials

FM 4451, Examination Standard for Profiled Steel Panels for Use as Decking in Class 1 Insulated Roof Construction

## 1.9. TERMS AND DEFINITIONS

For purposes of this standard, the following terms apply:

<b>Heat Release Rate</b>	The Btu's released by an assembly within specific time frames. The total heat released is added over the length of the NFPA 276 test (30 minutes). The maximum or peak heat release rate is measured over a shorter period of time (either 3, 5, or 10 minutes) or as the average for the test duration.
<b>Insulation</b>	Is any of a variety of materials designed to reduce the flow of heat, either from, or into, a building.
<b>Metal Panel</b>	(1) A single metal sheet formed into a specified profile. (2) A composite assembly formed to a specified profile and consisting of an insulating core or batt material with an exterior metal skin.
<b>Permanent Deformation</b>	Any displacement of a panel or component that remains after the load has been removed. Panel deflection that can be removed by mechanical means not involving special equipment and without additional displacement shall not be considered permanent deformation.
<b>Plastic Panel</b>	(1) A single plastic sheet formed into a specified profile. (2) A composite assembly formed to a specified profile and consisting of an insulating core or batt material with an exterior plastic skin.
<b>Roof Assembly</b>	A system of interacting roof components (including the roof deck) designed to weatherproof, and normally, to insulate a building's top surface.

**Wind Uplift**

Wind-induced forces on a roof system or components in a roof system. Wind uplift generally includes a negative pressure component caused by wind being deflected around and across the surfaces of a building and a positive pressure component from air flow beneath the roof deck.

## 2. GENERAL INFORMATION

### 2.1. PRODUCT INFORMATION

The requirements of this standard shall be used to measure and describe the performance of Class 1 Panel roofs in response to exposure from heat, wind, foot traffic, and hail under controlled laboratory conditions. The results of these controlled exposures shall not be used to describe or appraise actual exposure conditions, since such conditions may vary widely. The certification examination includes fire, simulated wind uplift, and other tests as noted. A complete review of construction and applications specifications shall be conducted to assure, as far as possible, a practical and reliable installation. Inspection of the product manufacturing facility and of at least one field installation, at the discretion of the certification agency, shall be conducted to assure conformance with the required tests and specifications.

### 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, nameplate format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures;
- the number and location of manufacturing facilities;
- the number of portable roll formers and the locations where the equipment is stored and maintained;
- the formulation and specifications for the panel roofs and panel roof components shall be submitted to the certification agency for review and be kept on file on a confidential basis.

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 a certification examination, the manufacturer shall submit samples for examination and testing based on the following.

- Sample requirements will 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.

2.3.4. It is the manufacturer's responsibility to provide any necessary test fixtures or special tools, such as those which may be required to evaluate the products for certification.

### 2.4. RECOGNITION

The panel roof assembly meeting the requirements of this standard shall receive a listing in RoofNav as a Class 1-X-Y panel roof; where X indicates the Hail Damage Resistance (MH or SH) and Y indicates the Windstorm Classification (60, 75, 90, 105, 120...). However, the absence of a Hail Damage Resistance indicates SH. For example, a Class 1-120 panel roof indicates the Class 1 panel roof has a severe hail damage resistant rating and a 1-120 Windstorm Classification.

Certified panel roofs will also be listed with the minimum and maximum slopes, where such restrictions apply, and the fire classification from above deck exposures at the indicated slopes.

### **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 panel roof 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.

#### **3.2. MARKINGS**

- 3.2.1. Marking on the product or, if not possible due to size, on its packaging or label accompanying 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 hazard warnings are needed, the markings should be universally recognizable.

- 3.2.2. The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.
- 3.2.3. The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging 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.
- 3.2.4. All markings shall be legible and durable.

#### **3.3. MANUFACTURER'S INSTALLATION AND OPERATION INSTRUCTIONS**

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; and
- provide services to ensure proper installation, inspection, or maintenance for the product where it is not reasonable to expect the average user to be able to provide the installation, inspection, or maintenance.

#### **3.4. CALIBRATION**

- 3.4.1. 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.
- 3.4.2. 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.

#### **3.5. OBSERVATION OF TEST SAMPLE PRODUCTION**

A representative of the certification agency may witness production of, and place an identification mark on, each panel to be evaluated at the discretion of the certification agency. If the panel roof has one or more plastic components, a representative of the certification agency may also witness the production of the plastic components at the discretion of the certification agency.



## 4. PERFORMANCE REQUIREMENTS

In order to qualify as a Class 1 panel roof assembly, each panel roof shall satisfy the following performance criteria necessary to reduce the potential for fire spread and hail damage, and to obtain satisfactory wind uplift performance.

### 4.1. COMBUSTIBILITY – FROM BELOW ROOF ASSEMBLY

#### 4.1.1. Requirement

A metal panel roof assembly which incorporates insulation in addition to the panel clip and metal panel roof (and, if applicable, including liner, thermal barrier and/or vapor retarder) and any non-metal panel roof assembly, when subjected to a fire exposure from below shall not exhibit fuel contribution rates in excess of the values in Table 1.

Additionally, there shall be no dropping of flaming particles into the furnace or uncontrolled flaming on the exterior surface of the sample.

The below deck combustibility test procedures are not required for panels that have met the requirements of FM 4880.

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

**Table 1:**

Time Interval <i>min</i>	Max Fuel Contribution Rate	
	<i>Btu/ft<sup>2</sup>/Min</i>	<i>(kW/m<sup>2</sup>)</i>
3	410	(77.6)
5	390	(73.8)
10	360	(68.1)
Avg. (30 min)	285	(54.0)

#### 4.1.2. Tests/Verification

Testing for combustibility from below shall be in accordance with NFPA 276, *Standard Method of Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components*.

### 4.2. COMBUSTIBILITY – FROM ABOVE ROOF ASSEMBLY

#### 4.2.1. Requirement

A panel roof assembly shall not exceed the specific rating coinciding with the fire exposure referenced below. Since a panel roof assembly may incorporate components (coating, caulking, insulation, facing, etc.) which may support combustion when subjected to a simulated fire exposure to the outside of the panel roof, the panel roof assembly shall meet this requirement.

The minimum classification for receiving certification shall be Class (1) C; i.e., the roof covering and substrate must be effective against a light test exposure, and “afford a light degree of fire protection to the roof deck. The panel, its coating, and substrate shall not slip from position nor present a flying brand hazard.

During the tests there shall be no flaming or burning particles blown off the test assembly and reaching the floor. For combustible panels there shall also be no burn through the panel roof. However, exposed glass reinforcement of fiber reinforced plastics shall not be considered burn through.

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

#### 4.2.2. Tests/Verification

Class A (severe exposure), Class B (moderate exposure), or Class C (light exposure) Tests in accordance with ASTM E 108 *Standard Test Methods for Fire Tests of Roof Coverings*. In addition, for the Spread of Flame tests, flame shall not be allowed to spread to more than one lateral edge of the exposed panel roof beyond 12 in. (305 mm) of the leading (flame) edge of the test sample.

Panels having a combustible bottom surface shall be subject to the spread of flame, burning brand, and intermittent flame exposure tests. Panels with a noncombustible bottom surface shall be subject to the spread of flame tests only. Systems consisting entirely of noncombustible components (e.g. galvanized steel) shall not be subject to this test and shall be considered meeting Class A at 5 in 12.

### 4.3. WIND UPLIFT RESISTANCE

#### 4.3.1. Requirement

The candidate panel roof assembly comprised of a specific combination of components shall possess adequate physical properties to resist 1) a specified minimum uplift pressure without disengagement or fracture of any component and 2) half the specified minimum uplift pressure without any permanent deformation of any component. Any separation, permanent deformation, withdrawal, or fracture within the panel roof assembly is considered a failure. The required minimum uplift pressure for the desired Windstorm Classification shall be per Table 2, in increments of 15 psf.

**Table 2:**

Windstorm Classification	Minimum Uplift Pressure <i>Psf (kPa)</i>
Class 1-60	60 (2.9)
Class 1-75	75 (3.6)
Class 1-90	90 (4.3)
Class 1-105	105 (5.0)
Class 1-120	120 (5.7)
Class 1-135	135 (6.5)
Class 1-150	150 (7.2)
Class 1-165	165 (7.9)
Class 1-180	180 (8.6)
Etc.	Etc.

#### 4.3.2. Tests/Verification

The wind uplift test procedures shall be in accordance with ANSI FM 4474, *American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures*.

Additional tests may be required, at the discretion of the certification agency, depending on design features and results of any foregoing tests.

Any test following a failure shall be acceptable only at the discretion of the certification agency and with a technical justification of the conditions or reasons for failure.

### 4.4. FOOT TRAFFIC RESISTANCE

#### 4.4.1. Requirement

The ability of the panel roof assembly to resist foot traffic shall be verified. There shall be no puncture of the panel roof and no separation or disengagement of the side or end laps.

#### 4.4.2. Tests/Verification

Testing for foot traffic resistance shall be as follows:

A 3 in. (76 mm) square steel plate with rounded corners is placed on the sample. A 200 lb (91 kg) load is imposed on the plate five times. The steel plate shall be positioned in the approximate center of the sample 1) adjacent to the panel side lap and 2) adjacent to the panel end lap, if applicable.

The specimen shall be inspected during and after the test and the condition of the roof panel side laps and end laps, if applicable, noted.

### 4.5. HAIL DAMAGE RESISTANCE

#### 4.5.1. Requirement

Class 1 panel roofs shall be able to withstand the effects of hail. Panels shall show no evidence of puncture or chipping, peeling, blistering, cracking, or crazing of the coating when examined under 10X magnification.

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

4.5.2. Tests/Verification

Testing for hail damage resistance shall be as follows. The minimum rating required for certification is Class 1-MH.

For MH (Moderate Hail) and SH (Severe Hail), two identical samples are prepared.

The first sample is unconditioned and tested as follows:

1. The sample is subjected to a minimum of ten impacts from the 1.19 lb (1 kg) steel ball. Five impacts will be on the field-fabricated seam, and a minimum of five impacts will be in the field of the sample.
2. For SH, the ball is dropped from a height of 141.5 in. (3595 mm), generating an impact energy of approximately 14 ft-lb (19 J) over the impact area of the 2 in. (51 mm) diameter steel ball.
3. For MH, the ball is dropped from a height of 81 in. (2057 mm), generating an impact energy of approximately 8 ft-lb (10.8 J) over the impact area of the 2 in. (51 mm) diameter steel ball.

The second sample is conditioned (weathered) for 1000 hours in an Ultraviolet Weathering Cabinet in accordance with ASTM G154, *Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Materials*. The sample is then subjected to impact testing as described above.

## 5. MANUFACTURER'S REQUIREMENTS

### 5.1. DEMONSTRATED QUALITY CONTROL PROGRAM

- 5.1.1. A quality assurance program is required to assure that subsequent panel roof(s) produced by the manufacturer shall present the same quality and reliability as the specific panel roof assembly(s) examined. Design quality, conformance to design, and performance are the areas of primary concern
- Design quality is determined during the examination and tests, and is documented in the certification report.
  - Continued conformance to this Standard is verified by the certifier's 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. Factory Fabricated Panel roofs
- An audit of the manufacturing facility is part of the certification investigation 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 ensure a uniform product consistent with that which was tested and certified.
- 5.2.2. Field Fabricated Panel roofs
- An inspection of the manufacturer's location where quality control of the field fabricated panel roofs occurs shall be a part of the certification investigation. Its purpose is to determine that equipment (e.g. portable roll former), procedures, and the manufacturer's quality controls are properly maintained and produce a product of the same quality as initially tested.
- 5.2.3. 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. INSTALLATION INSPECTIONS

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications. When more than one application technique is used, one or all may be inspected at the discretion of the certification agency.

#### **5.4. PRODUCT MODIFICATIONS**

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