ANSI/SPRI GT-1 2016 (R2022)

Test Standard for External Gutter Systems

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Disclaimer

This standard is for use by architects, engineers, consultants, roofing contractors and owners of low slope roofing systems. This standard specifically does not address existing building drainage capacity or overflow drainage requirements and should not be used for those purposes. It is intended to provide data and guidance necessary to understand the implementation and use of retrofit roof drainage elements. Do not assume all existing buildings have code compliant drainage. SPRI, IT'S MEMBERS AND EMPLOYEES DO NOT WARRANT THAT THIS STANDARD IS PROPER AND APPLICABLE UNDER ALL CONDITIONS.

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The following editorial changes were made during the 2022 review and reaffirmation process:

- Title has been revised to **Test Standard for External Gutter Systems**—from **Test Standard for Gutter Systems**.
- Section 2.2: Added clarification of what is not included in the standard: “and drip edges or other components not part of the gutter system are not included in the scope of this standard.”
- Section 3.6 and 3.9: Definition of Leading Edge and Upper Leading Edge: clarification added
- Section 4.5: Clarification provided on Product Labeling; changed sentence to read “each component of a GT-1 tested Gutter System…” from “each section of a GT-1 Tested Gutter System…”
- Figures updated to provide clarification
- Section 5.1.1: Clarification to "testing apparatus” to “testing apparatus load gauge”
- Section 5.1.8: Added new Figure 4 and text to clarify deformation failure
- C1.0: Additional RICOWI hurricane reports included which prompted the development of this standard.
- C2.0: Explanatory text added on the use of the data generated by the GT Tests. Text added: "or specifications, whichever is greater,"
- C4.3: Commentary added to provide clarification of the minimum design pressure requirements.
- C5.1.10 and C6.1.9: Updated precision and bias statement.

1.0 Purpose (See Commentary C1.0)

This standard provides methodology for the testing of *gutters*. This standard is applicable to all material types and installation methods of low slope roofs.

2.0 Scope (See Commentary C2.0)

2.1 This standard specifies a laboratory method for static testing external *gutters*. Testing of *gutters* with a circular cross-section is not addressed in this standard.

2.2 This standard does not address water removal or the water-carrying capability of the *gutter.* Downspouts and leaders, and drip edges or other components not part of the *Gutter System* are not included in the scope of this standard.

3.0 Definitions (See Commentary C3.0)

3.1 Fastener

A device appropriate to attach the *Gutter, gutter strap* or *gutter bracket* to the building substrate. See Commentary C3.1.

3.2 Gutter

Generally U-shaped channel for collecting roof water and leading it to an *outlet*.

3.3 Gutter Bracket

A device that supports a *gutter* from underneath. See Figure 1.

3.4 Gutter Strap

A device that helps support a *gutter* from the top. See Figure 1.

3.5 Gutter System

A system consisting of *gutter*, *gutter straps*, *gutter brackets*, joints, *fasteners* and roof flange.

3.6 Leading Edge

The point on the *gutter* in cross-section furthest from the building at which the bottom of the *gutter* (typically horizontal) transitions to the face (typically more vertical). See Figure 1.

3.7 Nailer

A longitudinal wooden member attached to building structure that provides a substrate for fastening *gutters*. See Commentary C3.7.

3.8 Outlet

An opening in a *gutter* that allows water discharge.

3.9 Upper Leading Edge

The point on the *gutter* in cross-section furthest from the building at the top of the *gutter,* frequently called the lip, and where a *gutter strap* is secured. See Figure 1.

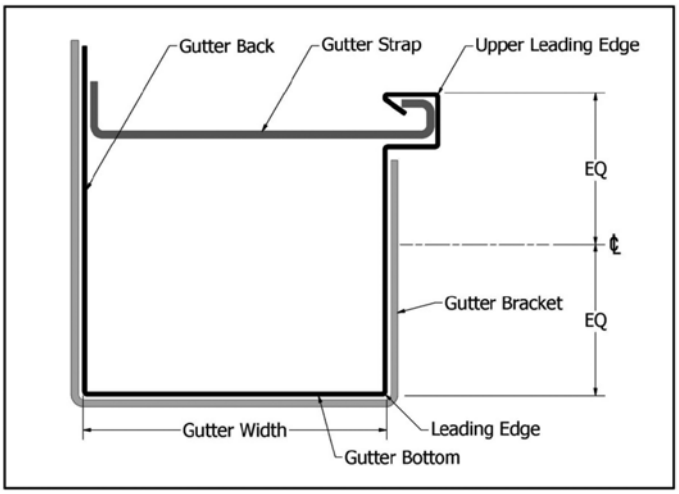

Figure 1. Gutter Components

4.0 Test Requirements (See Commentary C4.0)

The *gutter* shall be tested to withstand wind and environmental loads due to the weight of water, ice and snow.

4.1 Wind Load

Test shall demonstrate *gutter* will resist wind loads calculated per code for the project.

4.2 Water, Ice, and Snow Load

Test shall demonstrate *gutter system* will resist loads of water, ice, and snow calculated per code for the project.

4.3 Wind Resistance of Gutter Systems

The *gutter system* shall be tested using SPRI Test G-1 for resistance to outward (horizontal) loads and using SPRI Test G-2 for upward (vertical) loads. Test results shall meet or exceed design wind pressures required by the Authority Having Jurisdiction (AHJ). (See Commentary C4.3)

4.4 Securement

The *gutter system* shall be secured to a substrate, (e.g. *nailer*) that provides resistance equal to or greater than that of the *gutter* as determined by SPRI Tests G-1, G-2 and G-3.

4.5 Product Identification and Packaging

GT-1 tested *gutter systems*, shall have identification embedded in or affixed to *gutter system* components 8′-0″ or longer, stating the *gutter system* has been tested per GT-1, and packaging shall contain written documentation that identifies the components which have been tested according to the ANSI/SPRI Test Standard for *gutter systems*. Documentation, in the form of printed product literature, shall be available to the building owner or owner's representative.

5.0 SPRI Test Method G-1 & G-2

Gutter systems shall be tested in accordance with SPRI G-1, G-2 and G-3. Test G-1 measures the resistance of the *gutter system* to test forces acting outwardly (away from the building.) Test G-2 measures the resistance of the *gutter system* to test forces acting upwardly tending to lift the *gutter* off the building. Test G-3 measures the resistance of the *gutter system* to test forces acting downwardly.

5.1 Wind Load Testing

5.1.1 Apparatus

The description of the apparatus is general in nature. Any equipment capable of performing the test procedure within ±5% of measured load shall be acceptable. Calibration of test apparatus load gauge shall be verified annually by an independent third party. A schematic drawing of this apparatus is shown in Figures 2 and 3. The test apparatus shall be constructed so that the performance of individual components are unaffected by edge or end constraints on the test sample, which are not components of the installed *gutter system*.

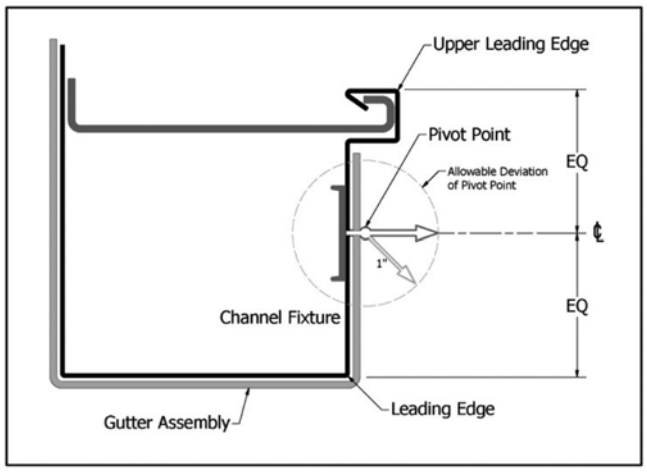

Figure 2. Test Set-Up for SPRI Test G1

5.1.2 Safety Precautions

Proper precautions shall be taken to protect the operating personnel and observers in case of any failure.

5.1.3 Test Specimens

All *gutter straps*, *gutter brackets* and *fasteners* of the test specimen shall be identical to the standard fabricated product except that *gutter* length shall be minimum 8 ft. (2.4 m) and maximum 12 ft. (3.7 m).

5.1.4 Procedure

Separate tests shall be performed independently, pulling outward (horizontally) and upward (vertically).

SPRI Test G-1: Horizontal Test

A continuous 0.5 in. x 1 in. x 0.5 in. x 0.125 in. (12 mm x 25 mm x 12 mm x 3 mm) steel channel shall be fitted behind the face of the *gutter*. Rods, chains or cables shall be attached to the continuous steel channel on maximum 12-inch (300 mm) centers, each penetrating the *gutter* face on vertical centerline of the *gutter* face, and attached to load cells. Fixture shall be free to pivot to conform to the slope of the face where the load is applied. Care shall be taken to avoid penetration at a *gutter bracket* location. See Figure 2 and refer to Figure 1.

SPRI Test G-2: Vertical Test

If the *gutter system* does not have *gutter brackets* a continuous 0.5 in. x 1 in. x 0.5 in. x 0.125 in. (12 mm x 25 mm x 12 mm x 3 mm) steel channel shall be fitted under the base of the *gutter* assembly. If the *gutter system* does have *gutter brackets* intermittent channel sections shall be placed between the *gutter brackets* or alternate method shall be used to apply test load to *gutter* and not to *gutter brackets*. The length of the intermittent channels shall be such that the ends of the channel are 1 in. (25 mm) or less from the edges of the *gutter brackets*. Rods or cables shall be attached on maximum 12-inch (300 mm) centers to the steel channel or channels, each penetrating the *gutter* bottom, half-way between the back and the *leading edge* of the *gutter*, and attached to load cells. See Figure 3 and refer to Figure 1.

5.1.5 Gravity

Any influence from gravity that does not occur in the field shall be omitted from the test. If the test specimen is inverted, a gravity correction shall be made in the determination of the allowable superimposed loading.

5.1.6 Stabilization (See Commentary C5.1.6)

Stabilization of the test shall be when the loaded surface ceases to show movement.

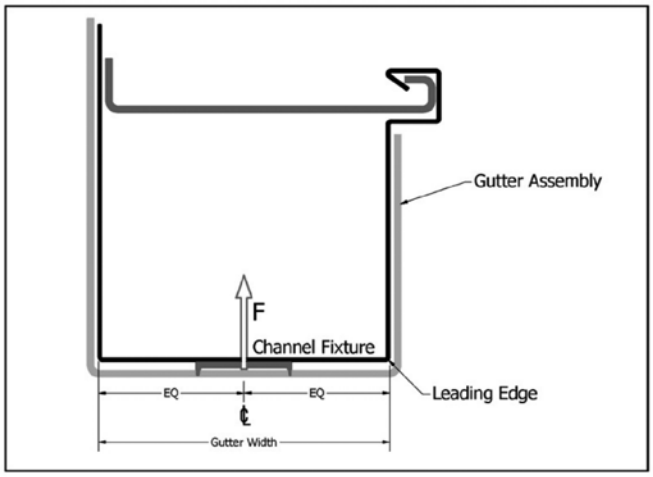

Figure 3. Test Set-Up for SPRI Test G2

5.1.7 Loading (See Commentary C5.1.7)

Loading shall be applied uniformly on the horizontal centerline of the face (G-1) or bottom (G-2) of the *gutter* on centers no greater than 12 in (300 mm). Loads shall be applied at a rate which achieves full load as described below. Loads shall be applied incrementally and held for not less than 60 seconds after stabilization has been achieved at each incremental load. Between incremental loads, the loading shall be reduced to zero until the specimen stabilizes, or for five minutes, whichever happens first. After the recovery period, initiate the next higher incremental load. Loading to the face or bottom of the *gutter system* shall be applied in increments not to exceed 15 lbs./lf. (22.3 kg/m) until approximately 60 lbs./lf. (89.2 kg/m) are obtained. Thereafter, increments of load shall not exceed 5 lbs./lf. (7.4 kg/m). Loading speed shall be such that each incremental load up to and including 60 lb./ft. (89.2 kg/m) shall be achieved in 5–60 seconds. Above 60 lbs./lf. (89.2 kg/m) incremental loading shall be achieved in 5–120 seconds.

Loading shall proceed as indicated above until the test specimen either fails or exceeds the required design pressure. The last sustained 60-second load without failure is the maximum test load recorded as the test value.

5.1.8 Failure (See Commentary C5.1.8)

Failure shall be either loss of securement of any component of the *gutter system* or permanent deformation of the *gutter* measured as a permanent stretching, in any direction, of the *upper leading edge* of the *gutter* by more than 25% of the distance between that edge and the back of the *gutter*. See Figure 4. When load is removed the sample shall be considered permanently deformed if the *leading edge* is greater than 0.25d from its location prior to application of first test load.

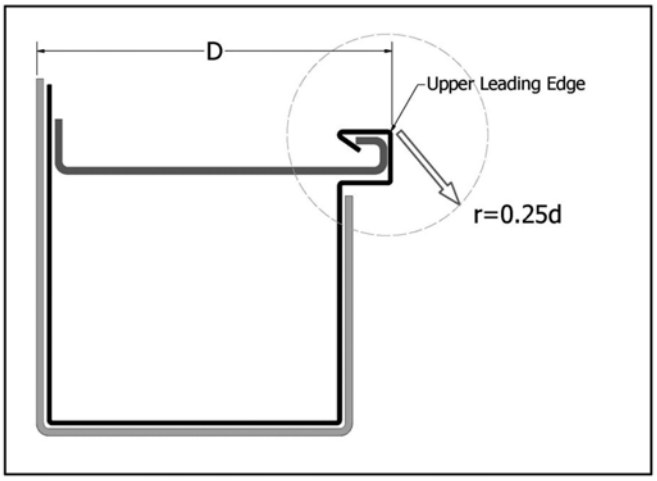

Figure 4. Deformation Failure

5.1.9 Test Results

The highest load held without failure shall be recorded and summed for a total force measurement.

For SPRI Test G-1, this total load shall be used to calculate the pressure by dividing the total force by the area of the *gutter* face:

$$\text{Pressure} = \frac{\text{Load}}{\text{Face Height} \times \text{Length}}$$

Load is in Pounds (N) and is the sum of the readings on the load cells. Height is the *gutter* face height in feet (m), and pressure is in lbf./ft.^{2}. (kPa). If test results exceed the design outward wind pressure, the *gutter system* has acceptable outward wind resistance.

For SPRI Test G-2, this total load shall be used to calculate the pressure by dividing the total load by the total width of the *gutter*:

$$\text{Pressure} = \frac{\text{Load}}{\text{Gutter Width} \times \text{Length}}$$

Gutter Width is the full *gutter* width from back to *leading edge* in feet (meter) [ft.(m)]. See Figure 3.

5.1.10 Precision and Bias (See Commentary C5.1.10)

The precision and bias of this test measure has not been determined.

6.0 SPRI Test Method G-3

Water, Ice, and Snow Load Test for *gutter*

6.1 Water, Ice, and Snow Loads

6.1.1 Apparatus

This description of the apparatus is general in nature. Any equipment capable of performing the test procedure within ±5% of measured load shall be acceptable. A schematic drawing of this apparatus is shown in Figure 5. The test apparatus shall be constructed so that the performance of individual components are unaffected by edge or end constraints on the test sample.

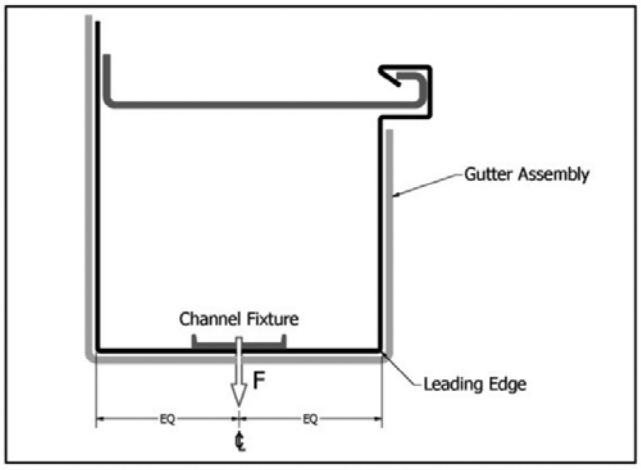

Figure 5. Test Set-Up for SPRI Test G3

6.1.2 Safety Precautions

Proper precautions shall be taken to protect the operating personnel and observers in case of any failure.

6.1.3 Test Specimens

All *gutter straps*, *gutter brackets* and *fasteners* of the test specimen shall be identical to the standard fabricated product except that *gutter* length shall be minimum 8 ft. (2.4 m) and maximum 12 ft. (3.7 m).

6.1.4 Procedure

A continuous 0.5 in. x 1 in. x 0.5 in. x 0.125 in. (12 mm x 25 mm x 12 mm x 3 mm) steel channel shall be fitted above the bottom of the *gutter*. Rods or cables shall be attached to the continuous steel channel on maximum 12-inch (300 mm) centers, each penetrating the *gutter* bottom, half-way between the back and the *leading edge* of the *gutter*, and attached to force gauges. Care shall be taken to avoid penetration at a *gutter bracket* location.

6.1.5 Gravity

Any influence from gravity that does not occur in the field shall be omitted from the test. If the test specimen is inverted, a gravity correction shall be made in the determination of the allowable superimposed loading.

6.1.6 Loading (See Commentary C6.1.6)

Loading shall be applied uniformly on the centerline of the bottom (G-2) of the *gutter* on centers no greater than 12 in. (300 mm). Loads shall be applied at a rate which achieves full incremental load as described below. Loads shall be applied incrementally and held for not less than 60 seconds after stabilization has been achieved at each incremental load. Between incremental loads, the loading shall be reduced to zero until the specimen stabilizes, or for five minutes,

whichever happens first. After the recovery period, initiate the next higher incremental load. Loading to the bottom of the *gutter system* shall be applied in increments not to exceed 15 lbs./lf. until approximately 60 lbs./lf. are obtained. Thereafter, increments of load shall not exceed 5 lbs/lf. Loading speed shall be such that each incremental load up to and including 60 lb./ft. shall be achieved in 5–60 seconds. Above 60 lbs./lf. incremental loading shall be achieved in 5–120 seconds.

Loading shall proceed as indicated until the test specimen either fails or exceeds the required design load. The increments of load application, as detailed above, shall be applied so that a sufficient number of observations are made to determine the exact load at failure. The last sustained 60-second load without failure is the maximum test load recorded as the test value.

6.1.7 Failure (See Commentary C6.1.7)

Failure shall be either loss of securement of any component of the *gutter system* or permanent deformation of the *gutter* measured as a permanent stretching, in any direction, of the *Upper leading edge* of the *gutter* by more than 10% of the distance between that edge and the back of the *gutter*.

6.1.8 Test Results

The highest load tested shall be recorded and summed for a total force measurement. This total force shall be used to calculate unit load by dividing the force by the length of the *gutter* sample:

$$F_w = \frac{\text{Load}}{\text{Length}}$$

Force is in Pounds Force (Newtons) and is the sum of the readings on the load cells. Length is the test sample length in feet (m) and F_w is in Pounds per Foot (Newtons per Meter). If the maximum test load exceeds the design load, the *gutter system* has acceptable resistance to water, ice, and snow load.

6.1.9 Precision and Bias (See Commentary C6.1.9)

The precision and bias of this test measure has not been determined.

7.0 Test Reporting

A report shall be prepared for all GT-1 tested *gutter systems* describing the product tested and the maximum test load applied for each test method.

7.1 Product Description

Test report shall accurately describe the *gutter system* tested including: *gutter* sectional dimensions; *gutter* length; *gutter* material and gauge; *gutter strap* and *gutter bracket* material, gauge, size, and spacing; *fastener* type, material, size, and spacing.

7.2 G-1 Test Results

Record the maximum horizontal load in pounds per square foot that the *gutter system* resisted before failure or completion of test.

7.3 G-2 Test Results

Record the maximum vertical load in pounds per square foot that the *gutter system* resisted before failure or completion of test.

7.4 G-3 Test Results

Record the maximum vertical downward load in pounds per lineal foot that the *gutter system* resisted before failure or completion of test.

Commentary

This Commentary consists of explanatory and supplementary material designed to help in applying the requirements of the preceding Standard.

This Commentary is intended to create an understanding of the requirements through brief explanations of the reasoning employed in arriving at these requirements.

The sections of this Commentary are numbered to correspond to sections of the Standard to which they refer. Since having comments for every section of the Standard is not necessary, not all section numbers appear in this Commentary.

C1.0 Purpose

RICOWI's Hurricanes Charley and Ivan Wind Investigation Report dated March 2006, which studied the aftermath of those Fall 2004 hurricanes revealed a need for better *gutter systems*. SPRI developed this standard in response to that need.

C2.0 Scope

While the Standard is intended as a reference for designers, manufacturers, and roofing contractors, the design responsibility rests with the "designer of record."

Installation requirements include installing a system that is tested in accordance with G-1, G-2 and G-3 to resist the loads determined in accordance with the adopted codes. Testing requirements apply to the specific design of the system being installed

This standard is to determine load resistances of tested *gutter systems*. Design load calculation and application of a safety factor is not included in this standard. Load resistance determined by tests G-1, G-2, and G-3 should be greater than design load, including safety factor, required by applicable code or specifications, whichever is greater, for the building on which the *gutter system* is to be installed.

C3.0 Definitions

Terms defined in this section appear capitalized and italicized throughout this document.

C3.1 Fastener

The building substrate to which the *fastener* is attached may be any material that is structurally secure and capable of providing required pull-out and shear resistance for *fastener* used.

C3.7 Nailer

Wooden *nailers* are a common substrate to which *gutter systems* are attached; however, other substrates, e.g. metal and masonry, that are structurally secured are also acceptable attachment points for *gutters*.

C4.3 Wind Resistance of Gutters

Gutter systems must at a minimum resist the design wind pressures as required by the Authority Having Jurisdiction (AHJ); however, project specifications may call for greater wind resistance. When project specification design loads differ from the loads required by the AHJ, the *gutter* shall be tested to the greater load.

C5.1.6 Stabilization

Stabilization is necessary during loading to ensure that the specimen has reached equilibrium before recording a sustained load for a period of 60 seconds. As the specimen approaches its ultimate capacity, stabilization of the specimen will generally take longer to achieve.

C5.1.7 & C6.1.6 Loading

These test methods consist of applying loads on surfaces of a test specimen and observing deformations and the nature of any failures of principal or critical elements of the *gutter system*. Static loads are applied to simulate the dynamic loading of the members.

A recovery period between increases in incremental loading is to allow the test specimen to attempt to assume its original shape prior to applying the next load level.

The rate of sustained loading can be a critical issue when subjecting specimens to continuously

increasing load until failure is achieved. Loading rate has little meaning in these tests because these methods employ incrementally increased loads sustained for relatively long times followed by brief recovery periods. This incremental method is more stringent than continuous loading because of the requirement of holding a load for 60 seconds.

The Standard requires full-length specimens because end conditions of discreet sections of *gutter systems* can play a profound role in the failure mode of the materials. However, due to test apparatus limitations, when full length specimens exceed 12 ft.-0 (2.4 m) in a maximum test specimen length of 12 ft.-0 in (2.4 m) is permitted. Regardless of the test specimen length additional end restraints, which are not part of the installed *gutter system*, shall not be included in the test.

C5.1.8 & C6.1.7 **Failure**

Some examples of component failure that will not enable the *gutter system* to perform as designed would be:

- Full *fastener* pullout;
- Collapse of a *gutter bracket* or *gutter strap*; and
- Disengagement of any component.

C5.1.10 & C6.1.9 **Precision and Bias**

There is not enough data to determine the precision and bias of these tests.