

TESTING APPLICATION STANDARD (TAS) 117(B)-95

TEST PROCEDURE FOR DYNAMIC PULL-THROUGH PERFORMANCE OF ROOFING MEMBRANES OVER FASTENER HEADS OR FASTENERS WITH METAL BEARING PLATES

1. Scope:

- 1.1 This protocol covers determination of the dynamic pull-through performance of roofing membrane when fastened with individual fasteners having integral or separate metal bearing plates.
- 1.2 This protocol is not applicable to plastic bearing plates. For plastic bearing plates refer to TAS 117, Appendix C.
- 1.3 The test procedures outlined herein utilize a cumulative loading procedure.
- 1.4 All testing and calculations shall be conducted by a certified testing agency and all test reports, including calculations, shall be signed and sealed by a Registered Design Professional per F.S., Section 471 or 481.

2. Referenced Documents:

- 2.1 *The Florida Building Code, Building.*
- 2.2 *Application Standards*
TAS 117(C) Test Procedure for Dynamic Pull-Off Performance of Roofing Fastener Heads or Fasteners with Bearing Plates
- 2.3 *ASTM Standards*
D 1079 Standard Definitions and Terms Relating to Roofing, Waterproofing and Bituminous Materials
E 380 Excerpts from the Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System)
- 2.4 *Norwegian Building Research Institute*
Roofing Systems With Mechanical Attachments

3. Terminology & Units:

- 3.1 Definitions—For definitions of terms in this Protocol, refer to Chapter 2 and Section 1513 of the *Florida Building Code, Building* and ASTM D 1079. Definitions from the *Florida Building Code, Building* shall take precedence.
 - 3.1.1 All references to “metal bearing plate” are interchangeable with “metal stress plate.”
 - 3.1.2 The dynamic pull-through value under cumulative loading shall be defined as the mean load capacity obtained at failure. Failure shall be defined as any of the following:
 - pull through of the fastener head or bearing plate in the membrane;
 - tearing of the membrane around the fastener head, bearing plate or fastener stem; or,
 - breakage of the fastener, fastener head or bearing plate or permanent deformation of the bearing plate in excess of 1/4 inch (6.3 mm).
- 3.2 Units—For conversion of U.S. customary units to SI units, refer to ASTM E 380.

4. Significance and Use:

- 4.1 The test procedure provides a means of determining of the dynamic pull-through performance of roofing membranes when fastened with individual fasteners having integral or separate bearing plates and exposed to cumulative loading.
- 4.2 The test procedure is acceptable for all types of roofing membranes, fasteners with integral bearing plates and fasteners with separate bearing plates.

Note: Roofing nails or cap nails are not approved for use within the high-velocity hurricane zone jurisdiction. Therefore, results from

testing membranes with these nail types shall not be utilized as design values for projects within this jurisdiction. In addition, the minimum and maximum bearing plate diameters for anchor or base sheet attachment within the high-velocity hurricane zone jurisdiction are $1\frac{5}{8}$ inches (41 mm) and 2 inches (51 mm), respectively. Therefore, results from testing membranes with bearing plates having a diameter less than $1\frac{5}{8}$ inches (41 mm) or greater than 2 inches (51 mm) shall not be utilized as design values for projects within this jurisdiction.

5. Sampling:

- 5.1 Membrane, fastener and/or bearing plate samples shall be provided directly from the respective manufacturer and shall be tested as delivered. Unless otherwise specified, 14 samples shall be tested for each variable in the test specimen (i.e., different membrane, different fastener or different bearing plate).

6. Test Method:

6.1 General:

- 6.1.1 The dynamic pull-through value is determined by subjecting the test specimen to a cumulative load until failure occurs.

6.2 Apparatus:

- 6.2.1 A tensile loading device which can be operated with uniform, continuous static, tensile forces.
- 6.2.2 A load cell to measure the applied load.
- 6.2.3 A deflection or deformation gauge.
- 6.2.4 A holding device:
- For test specimens which include a fastener with a bearing plate having a diameter greater than or equal to $1\frac{5}{8}$ inches (41 mm), whether the plate is integral to the fastener or not, the test specimen holding device shall consist of a 18 inch by 18 inch (457 mm by 457 mm) nail-studded metal frame (See Figure 1, attached).

- Lap fasteners shall be installed through 2 inch (50 mm) insulation and pretensioned against a 6 inch by 6 inch by $\frac{19}{32}$ inch (150 mm by 150 mm by 15 mm) plywood load-application plate. Lapped test specimens shall have the lap installed on the inside of the metal frame (see Figure 2, attached).
- For test specimens which include a roofing or cap nail, the test specimen holding device shall consist of a 5 inch (125 mm) diameter clamping ring (see Figure 3, attached). (See Note 1 in Section 4.2, herein.)

6.3 Preparation of test samples:

- 6.3.1 The fasteners shall not be prepared in any way; however, care shall be taken to insure that fasteners are mounted in the test specimen in a defined, consistent manner.
- 6.3.2 For dynamic pull-through testing of membrane over a fastener head or fastener with bearing plate, the fastener assembly sample shall be installed through the center of the test specimen.
- 6.3.3 For dynamic pull-through testing of lapped test specimens, normal pre-tension shall be applied to the fastener assembly against 2 inch (50 mm) thick polyisocyanurate insulation with a compressive strength not less than 20 psi. The lapped membrane shall be installed on the inside of the metal frame with the fastener assembly test sample installed as close as possible to the center of the test specimen.
- 6.3.4 For dynamic pull-through testing of membrane over a roofing or cap nail, the nail sample shall be installed through the center of the test specimen. (See Note 1 in Section 4.2, herein.)
- 6.3.5 Dynamic pull-through testing shall be conducted in a room with controlled temperature and hu-

midity, 73°F (23 ± 2°C) and RH 50 percent.

6.4 Procedure:

- 6.4.1 The test specimen, consisting of the membrane sample and fastener assembly sample mounted in the appropriate holding device, shall be secured in the tensile loading device in such a manner that any bending or shear loads are avoided.
- 6.4.2 The tensile loading device shall be operated at a vertical deflection rate of 2 inch per minute (50 mm/min).
- 6.4.3 Figure 4, attached shows a photograph of dynamic pull-through testing.

6.5 Statistical analysis of results:

- 6.5.1 Eliminate the “high” and “low” values recorded during the dynamic pull-through testing and calculate a mean and a standard deviation from the remaining 12 recorded values using the following equations.

$$\bar{F} = \frac{1}{12} \sum_{i=1}^{12} F_i$$

$$S_F = \sqrt{\frac{1}{11} \sum_{i=1}^{12} (F_i - \bar{F})^2} \quad \text{where,}$$

\bar{F} = mean load;

S_F = standard deviation;

F = record load; and,

i = test number

- 6.5.2 Determine the percent deviation from the mean (S'_F) using the following equation.

$$S'_F = \left(\frac{S_F}{\bar{F}} \right) \times 100$$

If the percent deviation from the mean (S'_F) is greater than 20 per-

cent, then the test results shall be considered null and void and the dynamic pull-through performance under cumulative loading shall be retested.

7. Report:

- 7.1 The final test report shall include the following relevant information:

- 7.1.1 Name and address of the testing laboratory.
- 7.1.2 Identification number of the test report.
- 7.1.3 Name and address of the organization or the person who ordered the test.
- 7.1.4 Purpose of the test.
- 7.1.5 Method of sampling and other circumstances (date and person responsible for the sampling).
- 7.1.6 Name and address of manufacturer or supplier of the tested object.
- 7.1.7 Name or other identification marks of the tested object.
- 7.1.8 Description of the tested object.
- 7.1.9 Date of supply of the tested object.
- 7.1.10 Date of the test.
- 7.1.11 Test method.
- 7.1.12 Conditioning of the test specimens, environmental data during the test (temperature, pressure, RH, etc.).
- 7.1.13 Identification of the test equipment and instruments used.
- 7.1.14 Any deviations from the test method.
- 7.1.15 Test results and statistical analysis computations.
- 7.1.16 Date and signature.

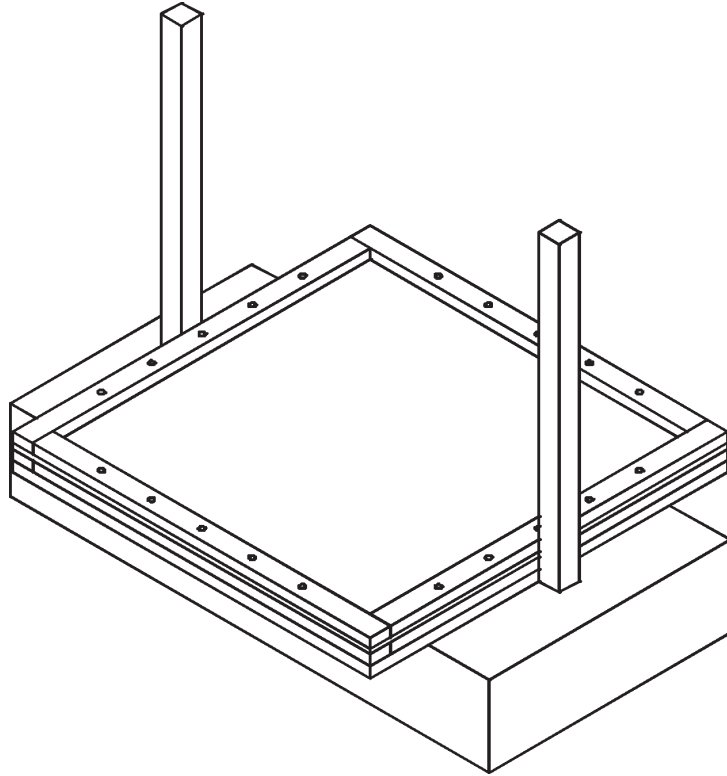


FIGURE 1
HOLDING DEVICE CONFIGURATION

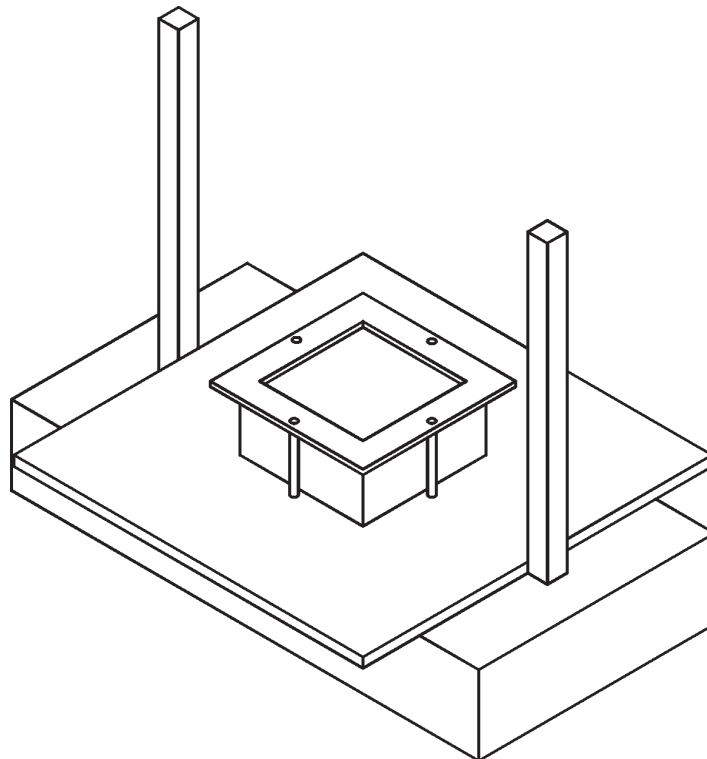
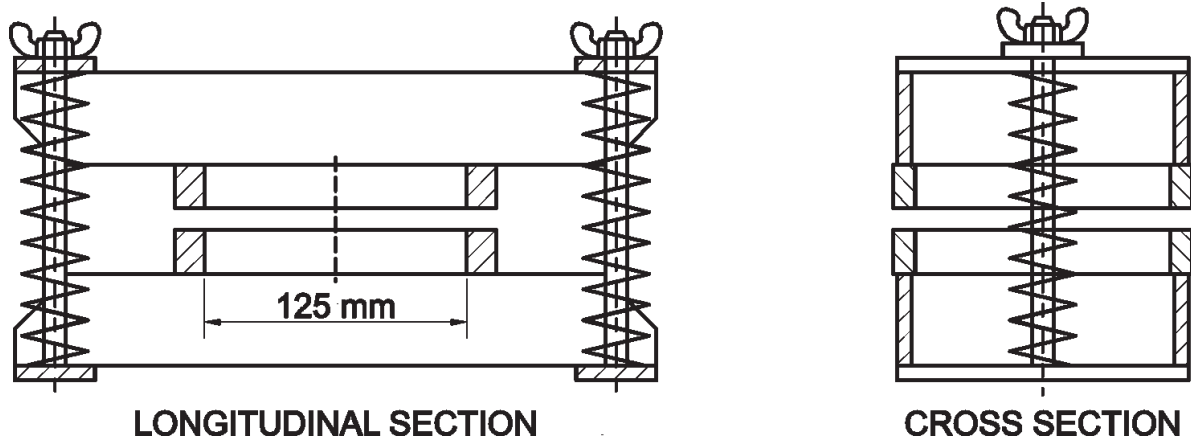


FIGURE 2
HOLDING DEVICE CONFIGURATION FOR LAPPED TEST SPECIMENS



For SI: 1.02 mm = 0.040 inch.

FIGURE 3
HOLDING DEVICE CONFIGURATION FOR ROOFING OR CAP NAIL TESTING
(SEE NOTE IN SECTION 4.2 HEREIN)

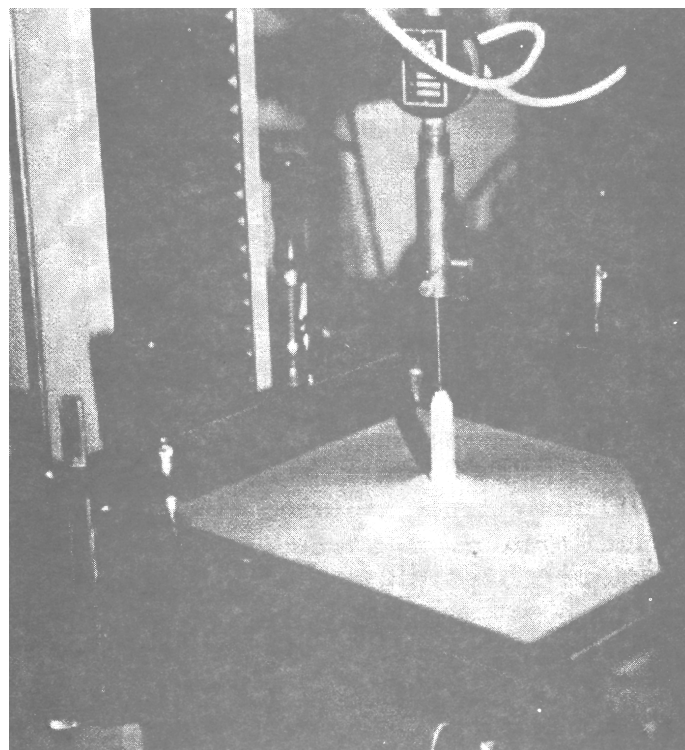


FIGURE 4
VIEW OF DYNAMIC PULL-THROUGH TESTING

