TESTING APPLICATION STANDARD (TAS) 131-95

STANDARD REQUIREMENTS FOR THERMOPLASTIC OLEFIN ELASTOMER BASED SHEET USED IN SINGLE-PLY ROOF MEMBRANE

1. Scope:

1.1 This Protocol covers unreinforced and reinforced thermoplastic olefin elastomer sheet made from blends of polypropylene and ethylene-propylene rubber (TPO), intended for use as a roof membrane exposed to the weather.

1.2 The test and property limits are used to characterize the membrane and are minimum values. In-place roof system design criteria, such as fire resistance, field seaming strength, material compatibility, and up-lift resistance, in situ shrinkage, among others, are factors which must be considered but are beyond the scope of this specification.

1.3 The following precautionary caveat pertains to the test methods portion only, Section 8, of this specification: This Standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.4 All testing shall be conducted by an approved testing agency, and all test reports shall be signed by an authorized signer of the testing/listing agency.

2. Referenced Documents:

2.1 *ASTM Standards*

D 412 Test Method for Rubber Properties in Tension

D 471 Test Method for Rubber Property - Effect of Liquids

D 573 Test method for Rubber-Deterioration in an Air Oven

D 624 Test Method for Rubber Property - Tear Resistance

D 751 Method of Testing Coated Fabrics

D 816 Methods of Testing Rubber Cements

D 1149 Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimens)

D 1204 Test Method for Linear Dimensional Changes of Non-rigid Thermoplastic Sheeting or Film at Elevated Temperature

D 2137 Test Method for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics

G 26 Practice for Operating Light-Exposure of Nonmetallic Materials

G 53 Practice for Operating Fluorescent UV - Condensation (QUV)

D 1822 Tensile Impact Testing

E 96 Water Vapor Permeability, Method BW

E 380 Excerpts from Use of the International System of Units (SI) (The Modernized Metric System)

2.2 *The Florida Building Code, Building*

2.3 *Application Standards*

TAS 114 Test Procedures for Roof System Assemblies in the High Velocity Hurricane Zone Jurisdiction

3. Terminology & Units:

3.1 Definitions - For definitions of terms used in this Protocol, refer to Chapter 2 and Section 1513 of the *Florida Building Code, Building* and/or the RCI Glossary of Terms. Definitions from the *Florida Building Code, Building* shall take precedence.

3.2 Units - For conversion of U.S. customary units to SI units, refer to ASTM E 380.

4. Limitations and Precautions:

4.1 This Protocol may involve hazardous materials, operations and equipment. This Protocol does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

5. Classification:

5.1 Types are used to identify the principal polymer component of the sheet.

5.1.1 Ethylene-Propylene based elastomer (TPO)

5.2 Grades indicate the mass percentage of the polymer (TPO) in relation to the total sheet:

5.2.1 Grade 1 - Greater than 95%.

5.2.2 Grade 2 - 50 to 95%.

5.3 Class describes sheet construction.

5.3.1 Class U - Unreinforced.

5.3.2 Class SR - Reinforced, internally or externally.

6. Materials and Manufacture:

6.1 The sheet shall be formulated from the appropriate polymers and other compounding ingredients. The principal polymer used in the sheet shall be one of those listed in Section 5.1.1 in accordance with the percentages listed in Sections 5.2.1 and 5.2.2.

6.2 The sheet shall be capable of being bonded to itself for making watertight field splices and repairs, and the supplier or fabricator shall recommend suitable bonding methods and materials.

7. Physical Properties:

7.1 The test shall conform to the physical requirements prescribed in Table 1 of this Protocol.

8. Dimensions and Permissible Variations:

8.1 The width and length of the sheet shall be as published and tested for physical property values. The sheet width shall be as tested for system performance in compliance with TAS 114.

8.1.1 The width and length tolerance shall be + 3%, - 0%.

8.2 The published sheet thickness tolerance shall be +15%, -10% of the specified thickness, but in no case shall the thickness be less than the minimum listed Table 1 of this Protocol.

TABLE 1
PHYSICAL REQUIREMENTS FOR TPO ELASTOMER SHEETS

Physical Property	Grade 1 or 2 Class SR	Grade 1 or 2 Class U
Thickness (over scrim) in. (mm)	min. 0.015 (0.385)	NA
Thickness (overall) in. (mm)	min. 0.039 (1.0)	min. 0.039 (1.0)
Tensile Strength psi (MPa)	NA	min. 1740 (12.0)
Breaking Strength lbf (kN)	min. 225 (1.0)	NA
Elongation (ultimate) %	NA	min. 500
Elongation (at break) %	min. 15[1]	NA
Tensile set %	NA	max. 10
Tear Resistance lbf/in (kN/m)		min. 340 (60)
Tearing Strength lbf (N)	min. 55 (245)	NA
Brittleness Point °F(°C)	max. -49 (-45)	max. -30 (-34)
Ozone Resistance no cracks	pass	pass
After Heat Aging-(A.H.A.)		
Tensile Strength-A.H.A. psi (MPa)	NA	min. 1740 (120)
Breaking Strength-A.H.A. lbf (kN)	min. 225 (1.0)	NA
Elongation (ultimate)-A.H.A. %	NA	min. 500
Elongation (at break)-A.H.A. %	min. 15[1]	NA
Tear Resistance -A.H.A. lbf/in. (kN/m)	NA	min. 340 (60)
Linear Dimensional Change -A.H.A % Weight Change -A.H.A %	max. ± 2	max. ± 2 max. ± 2
Water Absorption mass %	max. ± 4[2]	max. ± 2
Factory Seam Strength lbf/in. (kN/m)	min. 51 (9) or Sheet Failure	min. 51 (9) or Sheet Failure
Weather Resistance no cracks or crazing	pass	pass
After Accelerated Weathering-A.A.W.		
Tensile Strength-A.A.W. psi (MPa)	report	min. 1450 (10.0)
Elongation (ultimate)-A.A.W. %	report	min. 200 %
PRFSE-A.A.W. %	report	30.00
Static Puncture Resistance	report	report
Dynamic Puncture Resistance	report	report
Tensile Impact ft•lb/in^2 (kJ/m^2)		min. 21 (44)

[1] For reinforcing fabric only.
[2] Test performed on coating elastomer only.

9. Workmanship, Finish, and Appearance:

9.1 The sheet, including factory seams, if present, shall be water tight and free of pinholes, particles of foreign matter, undisbursed raw material, or other manufacturing defects that might affect serviceability. Excessive irregularities on the sheet surface shall not be acceptable (or portion thereof), then its rejection should be negotiated between supplier and buyer.

9.2 Edges of the sheets shall be straight and flat so that they may be seamed to one another without fishmouthing.

10. Test Methods:

10.1 *Thickness (over scrim)* - Appendix A of this Protocol.

10.2 *Dimensions* - Test Method D 751

10.2.1 Testing shall be conducted after permitting the sheet to relax at 73°F (23°C) for 1 hour.

10.3 *Thickness (overall)* - Test Methods D 412 for Class U Sheet and D 751 for Class SR Sheet.

10.4 *Tensile Strength* - Test Method D 412, Die C for Class U Sheet.

10.5 *Breaking Strength* - Test Method D 751, Grab Method for Class SR Sheet.

10.6 *Elongation (ultimate)* - Test Method D 412, Die C for Class U Sheet.

10.7 *Elongation (at break)* - Test Method D 751, Grab method for Class SR Sheet.

10.8 *Tensile Set* - Test Method D 412, Method A, Die C, 50% elongation for Class U Sheet.

10.9 *Tear Resistance* - Test Method D 624, Die C for Class U Sheet.

10.10 *Tearing Strength* - Test Method D 751, Procedure B for Class SR Sheet.

10.11 *Brittleness Point* - Test Method D 746 or D 2137.

10.12 *Ozone Resistance* - Test Method D 1149.

10.12.1 Inspect at 7x magnification on specimens exposed to 1 x 10^{-5} psi (100 MPa) ozone in air at 100°F (38°C). For Class U Sheet, wrap around 3" (76.2 mm) mandrel for 166 hour exposure. For Class SR Sheets, use Procedure B.

10.13 *Heat Aging* - Test Method D 573.

10.13.1 Age sheet specimens at 240°F (115°C) for 670 hours.

10.14 *Linear Dimensional Change* - Test Method D 471.

10.14.1 Conduct test at 158°F (70°C) for 166 hours.

10.15 *Water Absorption* - Test Method D 471.

10.15.1 Conduct test at 158°F (70°C) for 166 hours.

10.16 *Factory Seam Strength* - Test Method D 816, Method B.

10.16.1 Modify procedure by cutting a 1 in. (25.4 mm) wide by 12 in. (304.8 mm) long sample across the lap seam. Place in jaws approximately 2 in. (50.8 mm) from edges of the overlap area and test at 2 in. per minute (50.8 mm/min.) claim for rehearing.

10.17 *Weather Resistance* - Practice G 26

10.17.1 Xenon-Arc shall be operated to the following conditions:

Filter Type:	borosilicate inner and outer
Exposure:	0.35 W/m^2 at 340 nm
Cycle:	690 min light, 30 min. light and water spray

Black Panel Temperature:	80 ± 3°C
Relative Humidity:	50 ± 5%
Spray Water:	deionized
Specimen Rotation:	every 250 hours
Exposure Time:	4000 hours

10.17.2 Specimens for exposure shall be mounted under no strain. The recommended specimen size is 2.75 in. x 8.0 in. (70 mm x 203 mm). After exposure, remove the specimens and inspect immediately. Strain Class U specimens 10% and visually inspect for cracks and crazing under 7x magnification.

10.18 Weather Resistance - Practice G 53

10.18.1 Operate to the following conditions:

Lamp Type:	Fluorescent UVB-313 (UVB-B)
Test Cycle:	20 hours UV @ 80°C 4 hours condensate @50°C
Exposure:	2000 hours

10.19 Tensile Impact - ASTM D 1822 for Class U Sheet.

11. Inspection and Special Testing:

11.1 The manufacturer shall inspect and test his production to assure compliance of the product with this Protocol.

11.2 If the results of any tests do not conform to the requirements of this specification, retesting to determine conformity shall be performed as required by the Authority Having Jurisdiction.

12. Rejection and Resubmittal:

12.1 Failure to conform to any one of the requirements prescribed in this specification shall constitute grounds for suspension of a current Product Approval.

13. Product Marking:

13.1 The sheet shall be identified on the labeling in compliance with Section 1517 of the *Florida Building Code, Building*.

14. Certification:

14.1 Upon request of the Authority Having Jurisdiction, a manufacturer may be required to certify that the material was manufactured and tested in accordance with this Protocol. Additional testing for confirmation may be required by an approved testing agency.

15. Packaging and Package Marking:

15.1 The material shall be rolled on a substantial core and packaged in a standard commercial manner.

15.2 Shipping containers shall be marked with the name of the material, the stock and lot number.

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Appendix A

TEST PROCEDURE FOR THICKNESS MEASUREMENT OF COATING OVER CLASS SR OLEFIN ELASTOMER BASED SHEET ROOFING

1. Scope:

1.1 The procedure outlined in this Protocol Appendix provides a method for measuring the thickness of the coating over fiber backing or reinforcing fabric.

2. Measurement Method:

2.1 Principal

2.1.1 The thickness of coating material over fiber, fabric, or scrim can be observed with a standard microscope. Measurement is made with a calibrated eyepiece.

2.2 Apparatus

2.2.1 Microscope, 60x with reticule.

2.2.2 Light Source - If light source on the microscope is not adequate, a small high-intensity lamp may also be used.

2.2.3 Stage Micrometer, 0.001 in. (0.0254 mm) divisions.

2.3 Calibration Procedure

2.3.1 Place a standard reflectance stage micrometer in place of the specimen.

2.3.2 Position the reticle eyepiece and the micrometer such that the scales are superimposed. Focus the reticle by turning the eyepiece. Focus the specimen and reticle by turning the vertical adjustment knob.

2.3.3 Locate a point at which both scales line up. Count the number of micrometer divisions away. Measure to the nearest 0.0005 in. or 0.5 mil (0.0125 mm). The calibration may be optimized by increasing the number of divisions measured.

2.3.4 Repeat the calibration three times and average the results. A calibration example is given below.

2.3.5 Calibration Example

2.3.5.1 If four reticle divisions (RD) are found equal to 4.5 micrometer divisions (MD), then 1 RD = 0.001125 in. or 1.125 mils (28.6 mm) or the calibration factor.

2.4 Specimen Analysis:

2.4.1 Carefully center a sharp single edge razor or equivalent over the fiber intersections along the x-x axis.

2.4.2 Make a clean bias cut completely through the sheet.

2.4.3 Remove the razor-cut section and mount in common putty with the cut surface facing upward.

2.4.4 Observe the cut surface with the eyepiece reticle. Measure the thickness of the coating on either side of the thread intersection by counting the number of reticle divisions (to the nearest one-half division).

2.4.5 Sample three areas of the coatings and average the results.

3. Calculation and Report:

3.1 Multiply the number or reticle divisions representing the thickness of the coating by calibration factor. Report the average

results from the areas of the coating to the nearest 0.005” or 0.5 mils (12.7 mm).

4. Precision:

4.1 Precision - Measurements are accurate to ± -0.005 in. or 5.0 mils (12.7 mm) when the thickness is about 0.020 in. or 20 mils (0.5 mm).