



Low Slope Roofing Systems
The University of Wisconsin Madison
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**Built-up and polymer-modified bitumen
membrane roof systems**

presented by

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Definitions

built-up roof (BUR): A continuous, semi-flexible roof membrane consisting of multiple plies of saturated felts, coated felts, fabrics or mats assembled in place with alternate layers of bitumen and surfaced with mineral aggregate, bituminous materials, a liquid-applied coating or a granule-surfaced cap sheet.



Definitions – cont.

polymer-modified bitumen:

- (1) A bitumen modified by including one or more polymers (e.g., atactic polypropylene, styrene butadiene styrene);
- (2) Composite sheets consisting of polymer-modified bitumen often reinforced with various types of mats or films and sometimes surfaced with films, foils or mineral granules.



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Built-up roof (BUR) membrane



Photo credit: Structural Research, Inc.



4

Polymer-modified bitumen membrane



Photo credit: Structural Research, Inc.



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Built-up roof membrane roof systems

- Components
- Terminology
- Ply configurations
- Surfacing
- Flashings
- Application
- Code compliance




BUR components

- Ply sheet:
 - Organic: ASTM D226, Type I (No. 15) & II (No. 30)
 - Fiberglass: ASTM D2178, Type IV & VI
- Bitumen:
 - Asphalt: ASTM D312, Types, I, II, III & IV
 - SEBS-modified asphalt: ASTM D6152
 - Wax-modified asphalt: ASTM D8051
 - Coal tar: ASTM D450, Type I & II



This international standard was developed in accordance with internationally recognized principles on standardization established in the *Declaration of Principles for the Development of International Standards, Guides and Recommendations* issued by the *World Trade Organization Technical Barriers to Trade (TBT) Committee*.

 Designation: D312/D312M - 16a

Standard Specification for Asphalt Used in Roofing¹

This standard is issued under the fixed designation D312/D312M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript symbol (α) indicates an editorial change since the last revision or approval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers four types of asphalt intended for use in built-up roof construction, construction of some

D140/D140M Practice for Sampling Asphalt Materials
D1570 Terminology Relating to Roofing and Waterproofing
D2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene

TABLE 1 Physical Requirements of Asphalt in Roofing

Property	Type I		Type II		Type III		Type IV	
	Min	Max	Min	Max	Min	Max	Min	Max
Softening point, °C [°F]	57 [135]	66 [151]	70 [158]	80 [176]	85 [185]	96 [205]	99 [210]	107 [225]
Flash point, °C [°F]	302 [575]	...	302 [575]	...	302 [575]	...	302 [575]	...
Penetration, units:								
at 0°C [32°F]	3	...	6	...	6	...	6	...
at 25°C [77°F]	18	80	18	40	15	35	12	25
at 46°C [115°F]	90	180	...	100	...	90	...	75
Ductility at 25°C [77°F], cm	10.0	...	3.0	...	2.5	...	1.5	...
Solubility, %	99	...	99	...	99	...	99	...
EVI, °C [°F]								
At 125 cPs						221 [430]		235 [455]
At 75 cPs						243 [470]		252 [485]

D113 Test Method for Ductility of Bituminous Materials (Withdrawn 2016)²

¹ This specification is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.01 on Surfacing and Bituminous Materials for Membrane Waterproofing and Built-up Roofing. Current edition approved Dec. 15, 2016. Published December 2016. Originally approved in 1920. Last previous edition approved in 2014 as D312/D312M - 14. DOI: 10.1520/D312-16.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.


³ The last approved version of this historical standard is referenced on www.astm.org.

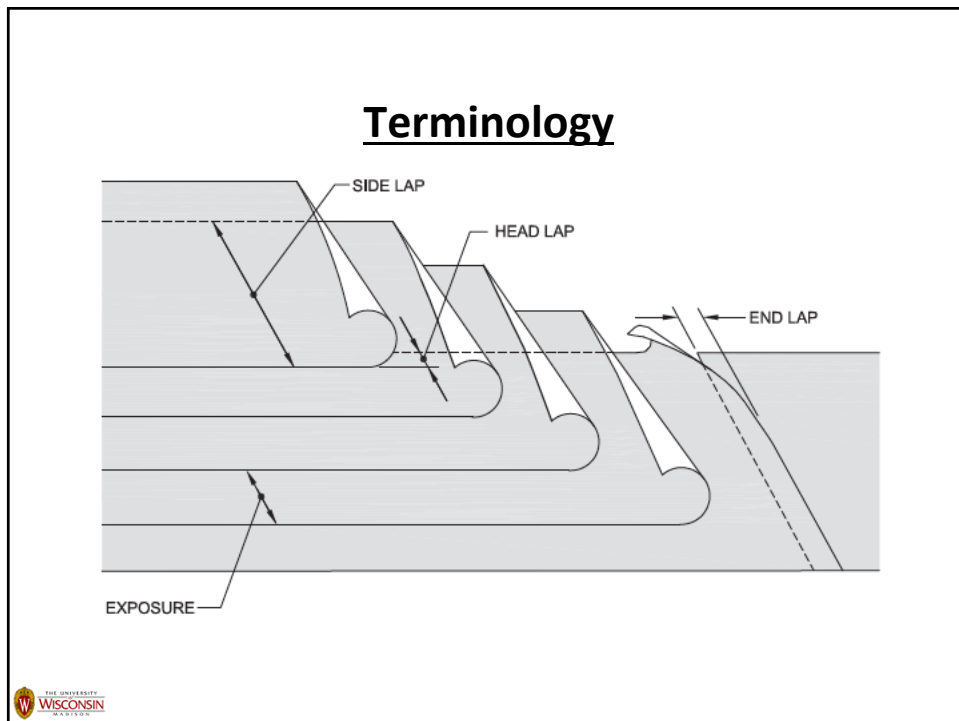
purchaser and the seller, Test Method D56/D56M shall be used as the reference method.
5.1.3 Flash Point—Test Method D92.
5.1.4 Penetration—Test Method D510M.
5.1.5 Ductility—Test Method D113.
5.1.6 Solubility—Test Method D2042 or D7553. In cases where a disagreement exists between the purchaser and the seller, Test Method D2042 shall be used as the reference method.
5.1.7 EVI—Test Method D4403/D4403M.

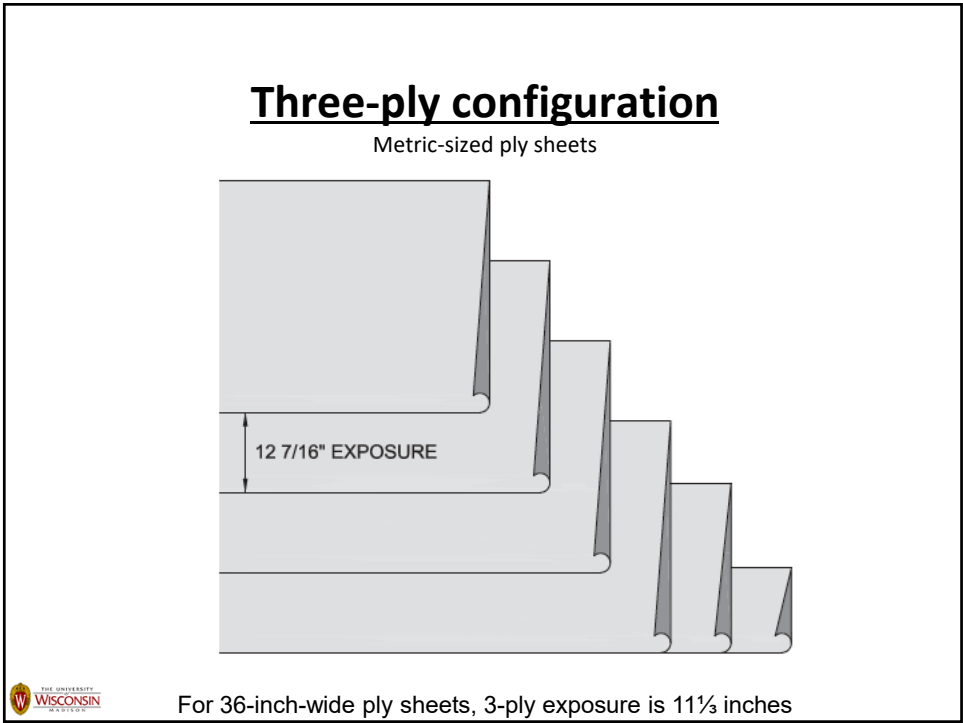
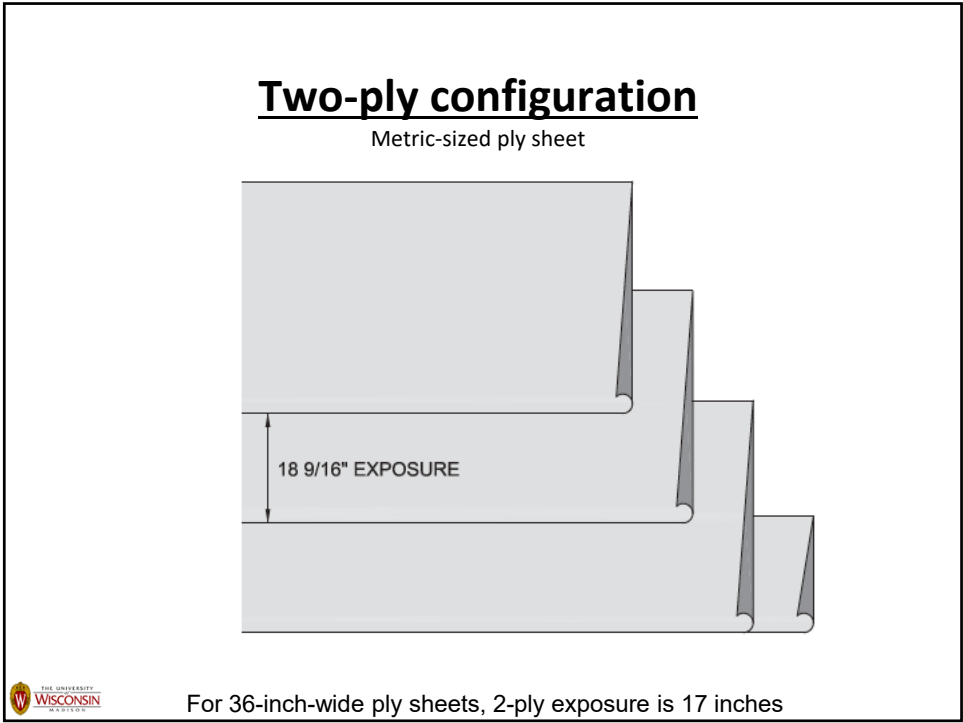
6. Inspection

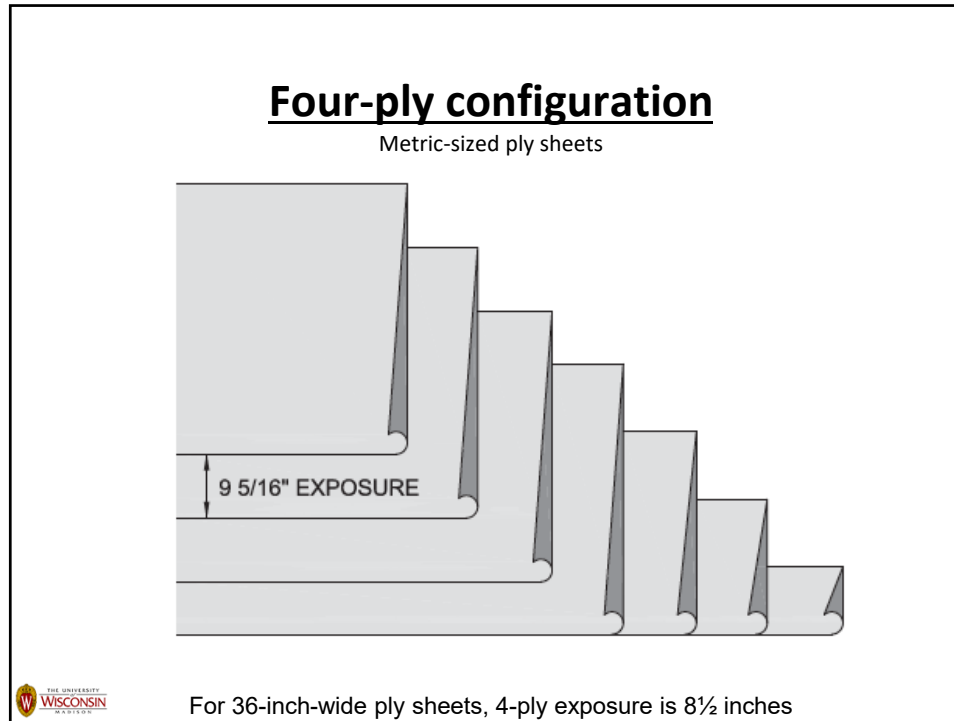
6.1 Inspection of the material shall be agreed upon between the purchaser and the seller as part of the purchase contract.

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BUR surfacings

- Flood coat and aggregate:
 - Approx. 400 lbs./sq. of aggregate in an asphalt flood coat of about 60 lbs./sq.
- Fluid-applied coatings:
 - Bituminous emulsion (black): ASTM D1227
 - Aluminum (silver): ASTM D2824
 - Acrylic (typically white): ASTM D6083
- Cap sheets:
 - Asphaltic cap sheets
 - Polymer-modified bitumen cap sheets (MB system)



Aggregate-surfaced BUR



Fluid-applied coating



Cap sheet

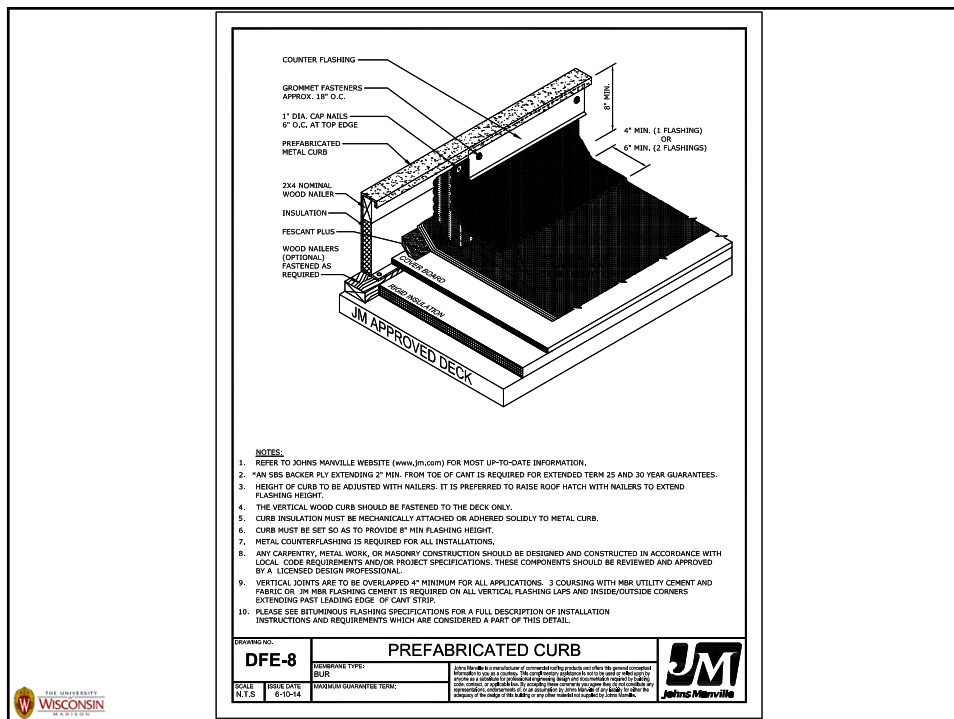
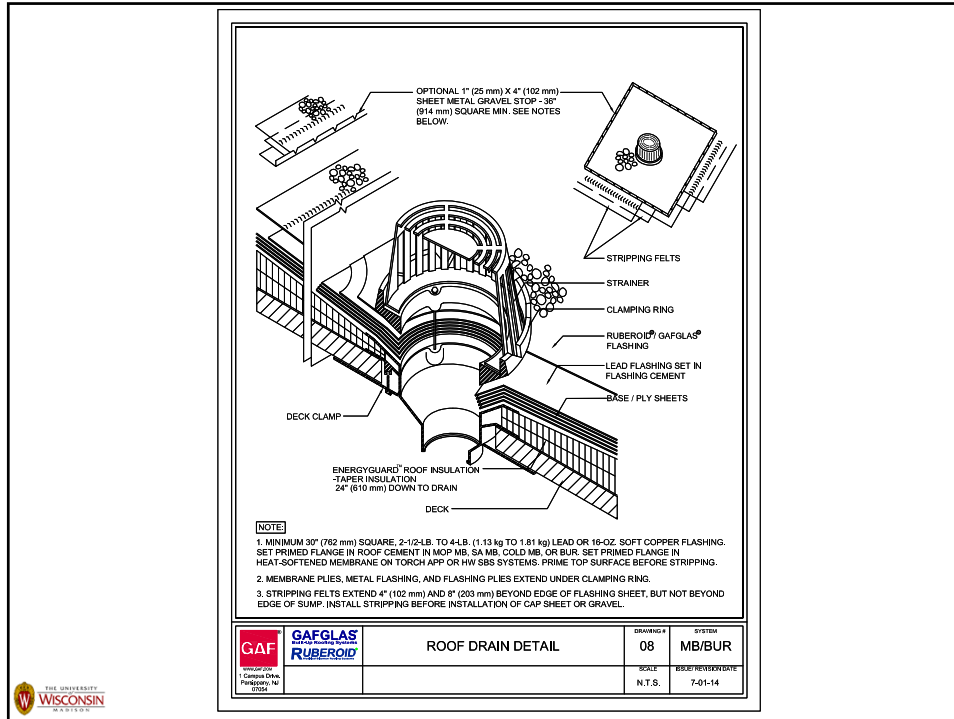


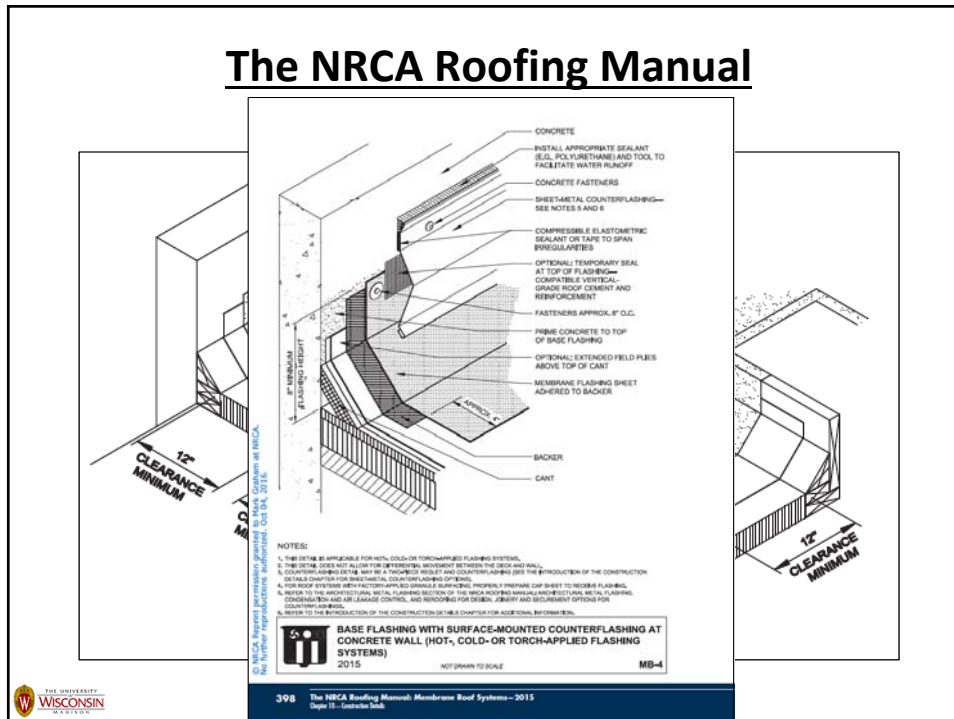
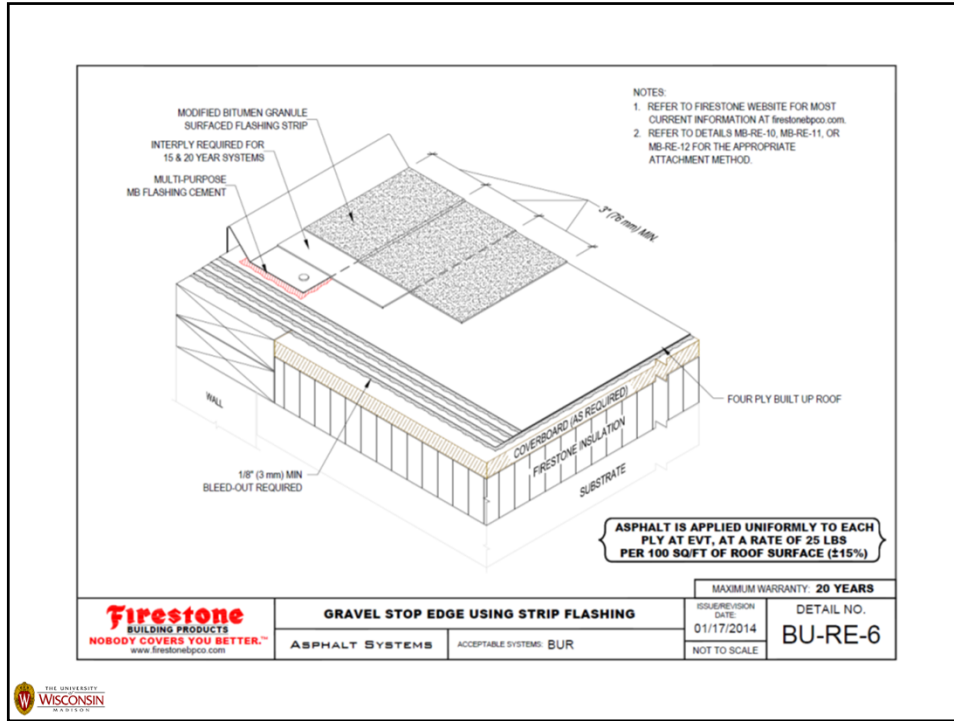
BUR flashings

Definition

flashing: Components used to weatherproof or seal roof system edges at perimeters, penetrations, walls, expansion joints, valleys, drains, and other places where the roof covering is interrupted or terminated. For example, membrane base flashing covers the edge of the field membrane, and cap flashings or counterflashings shield the upper edges of the base flashing.







Bitumen heating



Rooftop bitumen handling



Mop application



Mechanical felt-layer application



Flood coat and aggregate application



Building code compliance

International Building Code, 2015 Edition

TABLE 1507.10.2
BUILT-UP ROOFING MATERIAL STANDARDS

MATERIAL STANDARD	STANDARD
Acrylic coatings used in roofing	ASTM D 6083
Aggregate surfacing	ASTM D 1863
Asphalt adhesive used in roofing	ASTM D 3747
Asphalt cements used in roofing	ASTM D 3019; D 2822; D 4586
Asphalt-coated glass fiber base sheet	ASTM D 4601
Asphalt coatings used in roofing	ASTM D 1227; D 2823; D 2824; D 4479
Asphalt glass felt	ASTM D 2178
Asphalt primer used in roofing	ASTM D 41
Asphalt-saturated and asphalt-coated organic felt base sheet	ASTM D 2626
Asphalt-saturated organic felt (perforated)	ASTM D 226
Asphalt used in roofing	ASTM D 312
Coal-tar cements used in roofing	ASTM D 4022; D 5643
Coal-tar saturated organic felt	ASTM D 227
Coal-tar pitch used in roofing	ASTM D 450; Type I or II
Coal-tar primer used in roofing, dampproofing and waterproofing	ASTM D 43
Glass mat, coal tar	ASTM D 4990
Glass mat, venting type	ASTM D 4897
Mineral-surfaced inorganic cap sheet	ASTM D 3909
Thermoplastic fabrics used in roofing	ASTM D 5665, D 5726

1507.10 Built-up roofs. The installation of built-up roofs shall comply with the provisions of this section.

1507.10.1 Slope. Built-up roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage, except for coal-tar built-up roofs that shall have a design slope of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope).

1507.10.2 Material standards. Built-up roof covering materials shall comply with the standards in Table 1507.10.2 or UL 55A.



Polymer-modified bitumen sheet membrane roof systems

- Components and manufacturing
- Application methods
- Membrane configurations
- Surfacing
- Flashings
- Code compliance



MB sheet composition

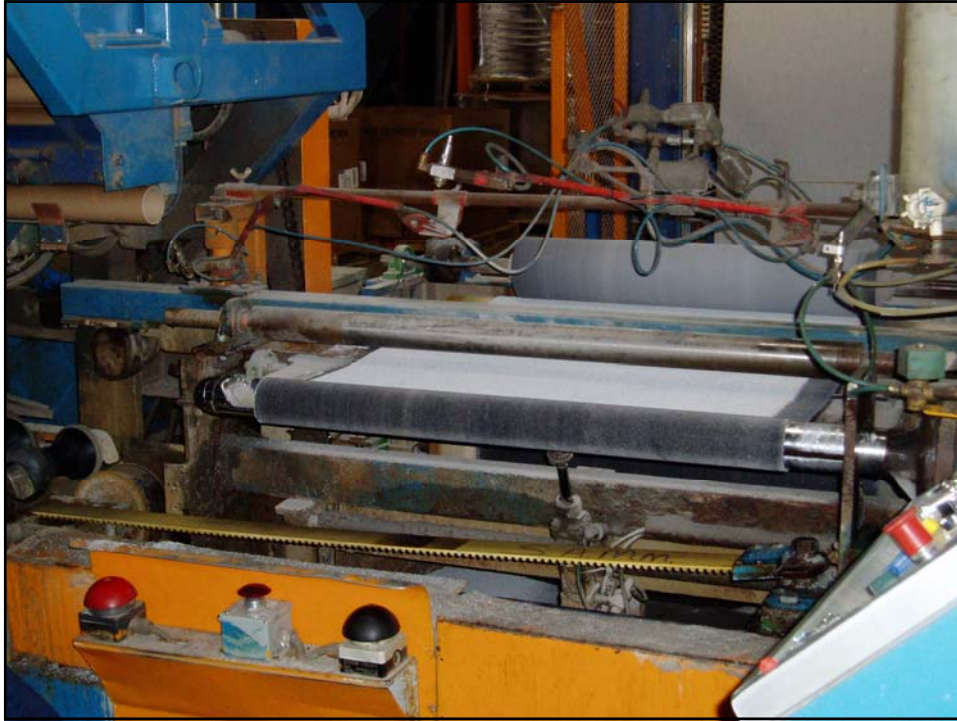
- Bitumen:
 - Atactic polypropylene (APP)
 - Styrene butadiene styrene (SBS)
- Reinforcement:
 - Fiberglass mats
 - Polyester mats
 - Combination mats
- Sheet surfacing:
 - Smooth (unsurfaced)
 - Mineral granules
 - Foil



MB sheet manufacturing







ASTM product standards

APP base sheet:

- ASTM D6509 – fiberglass

APP cap sheets:

- ASTM D6222 – polyester
- ASTM D6223 – polyester and fiberglass combo

Note: Each cap sheet also has Type I and II, and Grade G and S classifications



ASTM product standards – cont.

SBS base and cap sheets:

- ASTM D6162 – polyester and fiberglass combo.
- ASTM D6163 – fiberglass
- ASTM D6164 – polyester

Note: Each of the above cap sheets have Type I, II & III, and Grade G and S classifications

SBS cap sheet:

- ASTM D6298 – foil surface

Note: The above cap sheet has Type I & II classifications

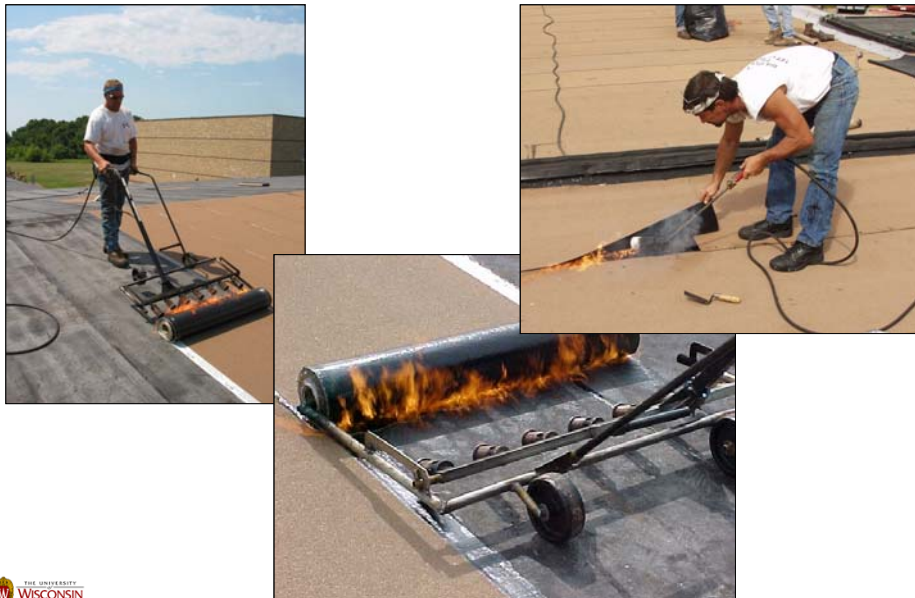


MB sheet application methods

- Torch application
- Mop application
- Cold-adhesive application
- Self-adhering application



Torch-applied application



Mop application



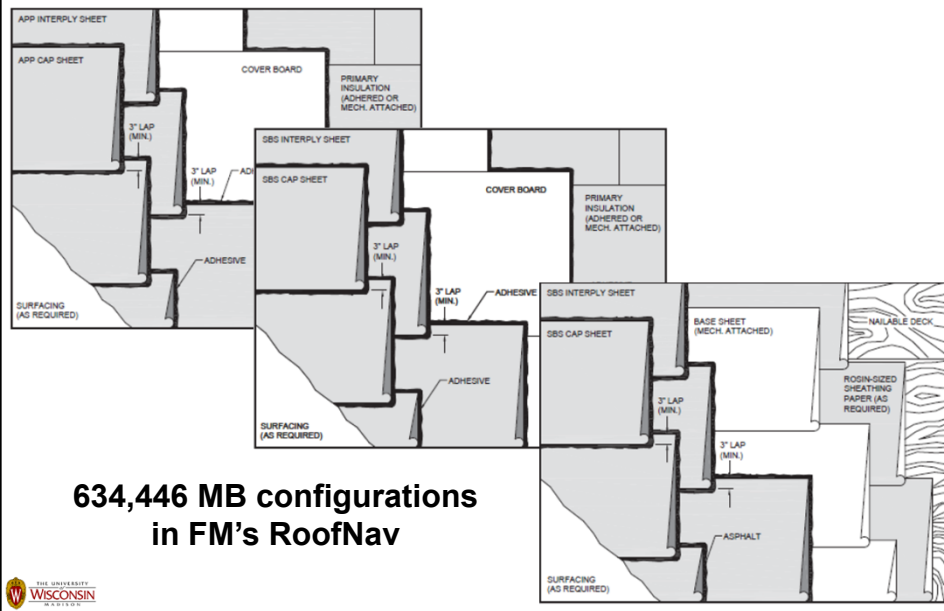
Cold-adhesive application



Self-adhering application

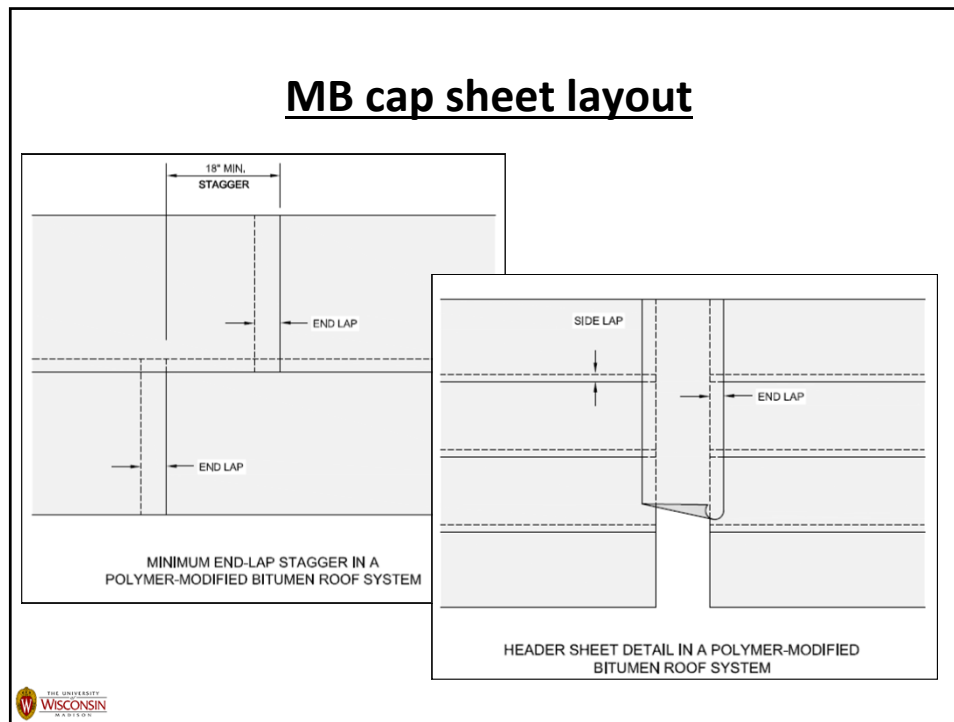


MB membrane configurations



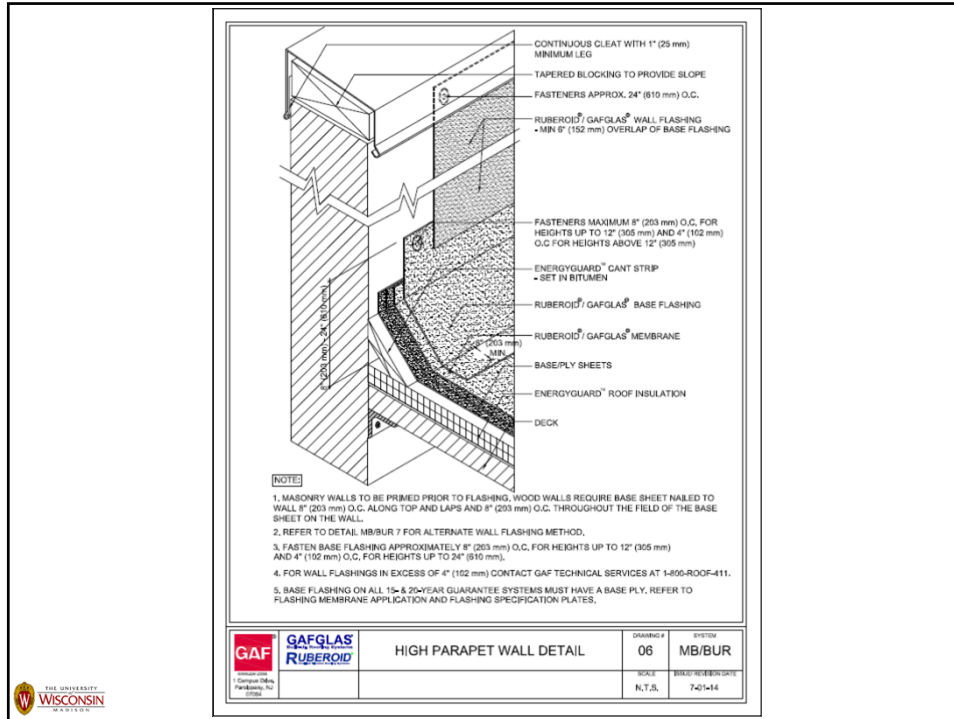
**634,446 MB configurations
in FM's RoofNav**



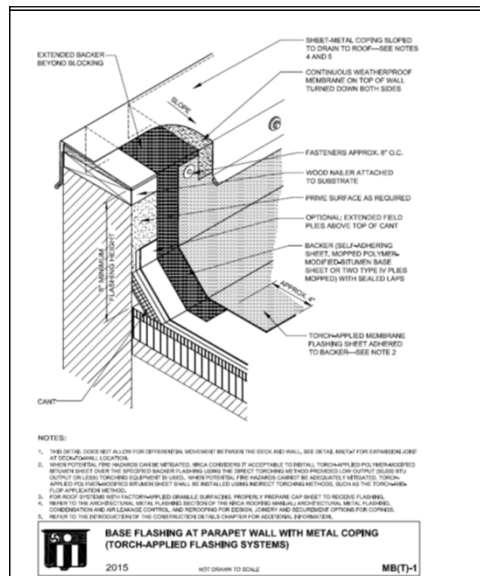


MB surfacings

- Unsurfaced (smooth or granule-surfaced sheet)
- Fluid-applied coatings:
 - Bituminous emulsion (black): ASTM D1227
 - Aluminum (silver): ASTM D2824
 - Acrylic (typically white): ASTM D6083
- Flood coat and aggregate:
 - Approx. 400 lbs./sq. of aggregate in an asphalt flood coat of about 60 lbs./sq.



The NRCA Roofing Manual



Building code compliance

International Building Code, 2015 Edition

1507.11 Modified bitumen roofing. The installation of modified bitumen roofing shall comply with the provisions of this section.

1507.11.1 Slope. Modified bitumen membrane roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage.

1507.11.2 Material standards. Modified bitumen roof coverings shall comply with CGSB 37-GP-56M, ASTM D 6162, ASTM D 6163, ASTM D 6164, ASTM D 6222, ASTM D 6223, ASTM D 6298 or ASTM D 6509.



Additional topics

- Quality control and assurance
- Test cuts and field testing
- Metal flashings
 - Design guides
 - ANSI/SPRI ES-1



Quality control and assurance during roof system application



Definitions

quality control (QC): a system for verifying and maintaining a desired level of quality in an existing product or service by careful planning, use of proper equipment, continued inspection, and corrective action as required.

Performed by the roofing contractor




Definitions – cont.

quality assurance (QA): the process of recording and reporting the installation of materials and work procedures of the installer or contractor in a roofing project for the purpose of documenting compliance or non-compliance with the contract documents on a daily basis.

If desired, is performed by the building owner or his authorized representative





Designation: D7186 - 14

Standard Practice for Quality Assurance Observation of Roof Construction and Repair¹

This standard is issued under the fixed designation D7186; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last revision. A superscript letter (s) indicates an editorial change since the last revision or approval.

1. Scope

1.1 This practice covers procedures for performing visual monitoring of roofing construction to:

1.1.1 Establish guidelines for quality assurance observation practices; and

1.1.2 Define the role and responsibilities of the quality assurance observer.

1.2 This practice pertains to quality assurance observation of roofing projects, and the report of information obtained from these observations. This practice is applicable to new construction or reworking projects involving the installation of a new roof system, the removal of existing roofing and installation of a new roof system, or encroaching an existing roof. It is also applicable to roofing projects involving repairs or scheduled maintenance to an existing roof.

1.3 This practice contains the following information:

1.3.1 The objectives of the quality assurance process;

1.3.2 The responsibilities and qualifications of the individuals involved in the observation of the roof construction or repair;

1.3.3 Identification and use of the basic tools or equipment required for the visual roof observation process; and

1.3.4 Monitoring, recording, and reporting procedures.

1.4 This practice addresses new construction or repair. This practice does not address the investigation, condition, or analysis of existing roofs.

1.5 This practice does not address practices of roof investigation, condition reporting, or analysis of preexisting roofs.

1.6 This practice does not pertain to quality control process or techniques performed by persons or entities representing or under contract to the roofing contractor. The quality control process is separate and distinct from the quality assurance observation process.

1.7 Assessment of safe work practices or safety monitoring procedures followed by the contractor is outside the scope of this practice.

1.8 This standard does not purport to address all of the safety concerns, if any, 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.

2. Referenced Documents

2.1 ASTM Standards:²

D1079 Terminology Relating to Roofing and Waterproofing

E631 Terminology of Building Construction

2.2 Other Documents:

The Content Documents:

Specification Literature or Roof System Installation Requirements, supplied by the applicable manufacturer, supplier, or distributor of the roof system material.

ARMA/NSCA/SPH Repair Manual for Low-Slope Membrane Roof Systems.^{3,4,5}

ARMA/NSCA Quality Control Guidelines for the Application of Built-Up Roofing.⁶


ARMA/NSCA Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing.⁷

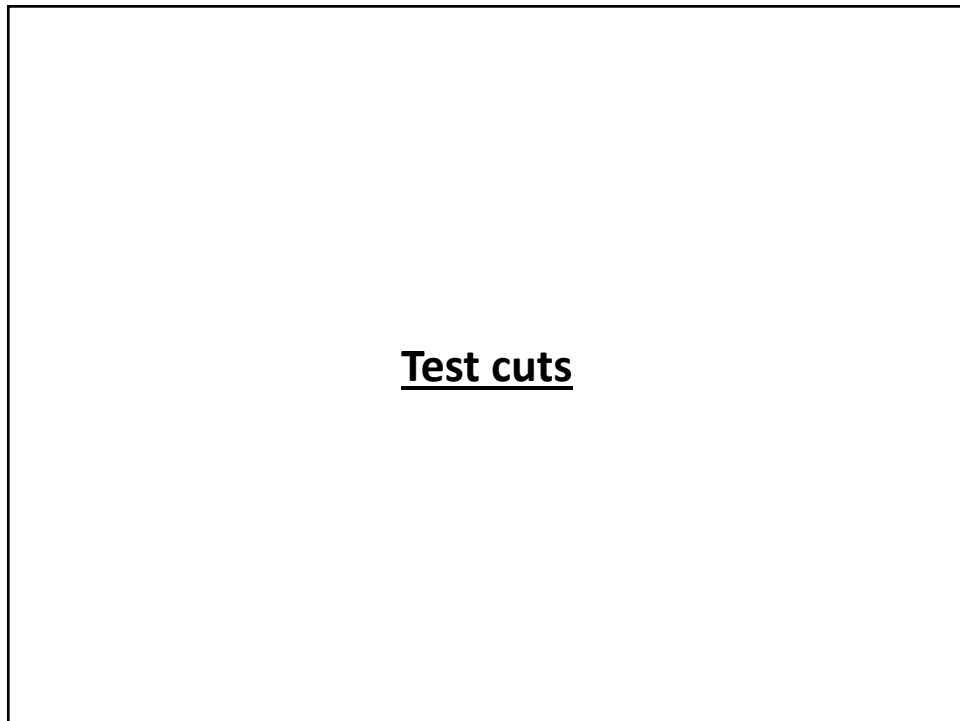
NSCA/SPH Quality Control Guidelines for the Application of Thermoset Single-Ply Roof Membranes.⁸

NSCA/SPH Quality Control Guidelines for the Application of Sprayed Polyurethane Foam Roofing.⁹

NCA Roofing Manual - Current Edition¹⁰

ASTM D7186, “Standard Practice for Quality Assurance Observation of Roof Construction and Repair”





Designation: D3617/D3617M - 17

Standard Practice for Sampling and Analysis of Built-Up Roof Systems During Application¹

This standard is based on the final designation D3617/D3617M. The number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last revision. A superscript letter indicates an editorial change since the last revision or approval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This practice is a guide for removing specimens for built-up membrane roof systems during application, but before the application of final coating and top surfacing, for determining the approximate quantities of the components and the possible presence of moisture, on dry spots between plies, in the field. Components may consist of:

- 1.1.1 Insulation, when part of the roof membrane system,
- 1.1.2 Ply of roofing felt,
- 1.1.3 Integrity layers of bituminous material, and
- 1.1.4 Top coating, if present, before any surfacing aggregate has been applied.

1.2 This practice is applicable to both 914-mm (36-in.) and 1066-mm (42-in.) wide roll rolls.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 This standard does not purport to address all of the safety concerns, if any, 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.

2. Referenced Documents

2.1 ASTM Standards:²

- D2242/D2242M Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
- D2243/D2243M Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

¹This practice is under the jurisdiction of ASTM Committee D18 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D18.02 on Building Membrane Systems.

²Some titles appear as (E), 2017. Published January 2017. Originally approved in 1977. Last previous edition approved in 2016. D3617/D3617M-16, DOI: 10.1520/D3617-16.

³The intended use of this practice is to determine the approximate quantities of components and the possible presence of moisture, on dry spots between plies, in the field. For specific precautionary information, see 6.3.2.1.

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D3274/D3274M Specification for Cold-Tar-Saturated Organic Felt Used in Roofing and Waterproofing

D3275 Standard Specification for Asphalt-Saturated Adhesive Felt Used in Roofing and Waterproofing (Withdrawn 1997)

D3741/D3741M Specification for Asphalt-Glass Felt Used in Roofing and Waterproofing

D5245/D5245M Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

D5158 Specification for Asphalt-Saturated and Coated Organic Felt Used in Roofing (Withdrawn 1997)

D5171 Specification for Asphalt-Saturated and Coated Inorganic Felt Base Sheet Used in Roofing (Withdrawn 1997)

3. Sampling

3.1 Unless otherwise specified, take at least one specimen for each separate roll, plus one for each 929 cm² (10300 ft²), take specimens at random.

3.2 If deficiencies are indicated in the membrane, additional Practice D3617/D3617M test cuts shall be taken at their locations diagonally—3 to 10 ft in each direction—from the original test cut and examined in the same manner as the original test cut was examined.

4. Test Specimens

4.1 Sweep the surface of the membrane clean where each test specimen will be taken.

4.2 For determining approximate quantities of components, cut a 300- by 300-mm (12- by 12-in.) specimen from the membrane using a template (Fig. 1).

4.2.1 If the membrane is adhered to the insulation, remove the membrane from the adhering insulation.

4.2.2 If the membrane is adhered directly to the roof deck, estimate the quantity of moisture remaining on the deck after the specimen is removed.

¹This last approved version of this historical standard is referenced on www.astm.org.

ASTM D3617, “Standard Practice for Sampling and Analysis of Built-up Roof Systems During Application”

Designation: D2829 - 07 (Reapproved 2013)

Standard Practice for Sampling and Analysis of Existing Built-Up Roof Systems¹

This standard is based on the final designation D2829. The number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last revision. A superscript letter indicates an editorial change since the last revision or approval.

1. Scope

1.1 This practice is a guide for removing test specimens from existing built-up roofing systems in the field and for determining the approximate quantities of the components of that specimen (Note 1). Components determined may be:

- 1.1.1 Insulation components when they are part of the roof membrane system,
- 1.1.2 Ply of roofing felt,
- 1.1.3 Integrity layers of bituminous material,
- 1.1.4 Top coating, and
- 1.1.5 Surfacing.

NOTE 1—This practice is for the investigation of existing roofs and is not intended for new construction projects.

1.2 This practice is applicable to both 914-mm (36-in.) and 1066-mm (42-in.) wide roll rolls.

1.3 The values stated in SI (metric) units are to be regarded as standard.

1.4 This standard does not purport to address all of the safety concerns, if any, 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. For specific precautionary information, see 6.3.2.1.

2. Referenced Documents

2.1 ASTM Standards:²

- D2242 Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
- D2243 Specification for Cold-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
- D2244 Specification for Asphalt Roll Roofing (Organic Felt)

¹This practice is under the jurisdiction of ASTM Committee D18 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D18.02 on Building Membrane Systems.

²Some titles appear as (E), 2013. Published May 2013. Originally approved in 2007. Last previous edition approved in 2012. D2829 - 07, DOI: 10.1520/D2829-07E01.

³The intended use of this practice is to determine the approximate quantities of components and the possible presence of moisture, on dry spots between plies, in the field. For specific precautionary information, see 6.3.2.1.

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D3274/D3274M Specification for Cold-Tar-Saturated Organic Felt Used in Roofing and Waterproofing

D3275 Standard Specification for Asphalt-Saturated Adhesive Felt Used in Roofing and Waterproofing (Withdrawn 1997)

D3741/D3741M Specification for Asphalt-Glass Felt Used in Roofing and Waterproofing

D1079 Terminology Relating to Roofing and Waterproofing

D1278 Specification for Asphalt-Glass Felt Used in Roofing and Waterproofing

D2626 Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

D1158 Specification for Asphalt-Saturated and Coated Organic Felt Used in Roofing (Withdrawn 1997)

D5171 Practice for Sampling and Analysis of Built-Up Roof Systems During Application

D5972 Standard Specification for Venting Asphalt-Saturated and Coated Inorganic Felt Base Sheet Used in Roofing (Withdrawn 1997)

D3900 Specification for Asphalt Roll Roofing (Glass Felt) Surfaced With Mineral Granules

D4801 Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing

D4897 Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing

D4999 Specification for Cold-Tar-Glass Felt Used in Roofing and Waterproofing

3. Terminology

3.1 Definitions—For definitions of terms used in this practice, refer to Terminology D1079.


4. Securing of Specimens in the Field

4.1 Do not disturb any surfacing in the area from which a specimen is to be taken. Cut each specimen at least 300 by 300 mm (12 by 12 in.) and use the total specimen taken in the field for laboratory analysis.

4.2 The recommended practice is to use a cutting template (Fig. 1), consisting of a 300 by 300-mm (12 by 12-in.) metal box with an open bottom. Place the box over the roof area that

¹This last approved version of this historical standard is referenced on www.astm.org.

ASTM D2829, “Standard Practice for Sampling and Analysis of Existing Roof Systems”



Designation: D7636/D7636M - 11

Standard Practice for Sampling and Analysis of Modified Bitumen Roof Systems¹

The standard is based under the first designation D7636/D7636M, the number immediately following the designation indicates the year of original approval or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript symbol (s) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice is for removing specimens from existing modified bitumen roof membranes for visual assessment and evaluation for abnormalities in the membrane. The roof membrane consists of one or more plies of materials in which at least one ply is a modified bitumen (MB) sheet, and which is installed with one or more of the following methods: hot asphalt, heat welding (open flame torching or heated air), cold adhesive, or self-adhesive. The roof membrane may consist of one or more plies of the following:

1.1.1 SBS (styrene-butadiene-styrene), APP (atactic polypropylene), or other polymers, modified bitumen sheet materials.

1.1.2 An exposed modified bitumen sheet material, that is, a modified cap sheet, covering multiple layers of built-up roofing (BUR) plies.

1.1.3 Any adhesive or bitumen component used to install the roof membrane.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 ASTM Standards:²

D1079 Terminology Relating to Roofing and Waterproofing

3. Terminology

3.1 **Definitions**—For definitions of terms used in this practice, refer to Terminology D1079.

3.2 **Definitions of Terms Specific to This Standard:**

3.2.1 **Hybrid membrane system**, n—MBRMB roof membrane consisting of a modified bitumen cap sheet with one or more layers of underlying BUR.

3.2.2 **ply or sheet material**, n—a single layer of the modified bitumen roof membrane.

4. Sampling

4.1 Unless otherwise specified, for each abnormal roof area take at least one specimen from the area that exhibits an abnormality plus one "control" specimen. The control specimen should have no obvious abnormalities and should be taken in close proximity to the sampled problem area.

4.2 Additional specimens in which abnormalities are exhibited in the membrane may be taken to determine the extent of the affected area.

5. Test Specimen

5.1 As a minimum, the roof membrane specimens should be taken down to the top surface of the membrane substrate. Sampling down to the level of the roof deck may be necessary to better determine the cause and extent of any abnormality.

5.2 The recommended minimum specimen size is 305 by 305 mm [12 by 12 in.] or 100 by 1120 mm [4 by 44 in.], depending on the nature of the potential membrane problem. If the membrane is a hybrid BURMB, the 100 by 1120 mm [4 by 44 in.] specimen size, cutting across the width of the cap sheet, is recommended.

5.3 The specimen size and shape may be adjusted, once initial sampling has occurred, to adequately assess the nature of any problem.

6. Significance and Use

6.1 This practice is for removing specimens from existing modified bitumen roof membranes for visual assessment and evaluation for abnormalities in the membrane.

6.2 This practice is not intended for study under construction.

ASTM D7636, “Standard Practice for Sampling and Analysis of Modified Bitumen Roof Systems”

Test cuts are not a substitute for a proper quality assurance program


Field uplift testing

FM Global
Property Loss Prevention Data Sheets **1-52**
July 2012
Page 1 of 24

FIELD VERIFICATION OF ROOF WIND UPLIFT RESISTANCE
FM Global clients must contact the local FM Global office before beginning uplift testing or any roofing work.

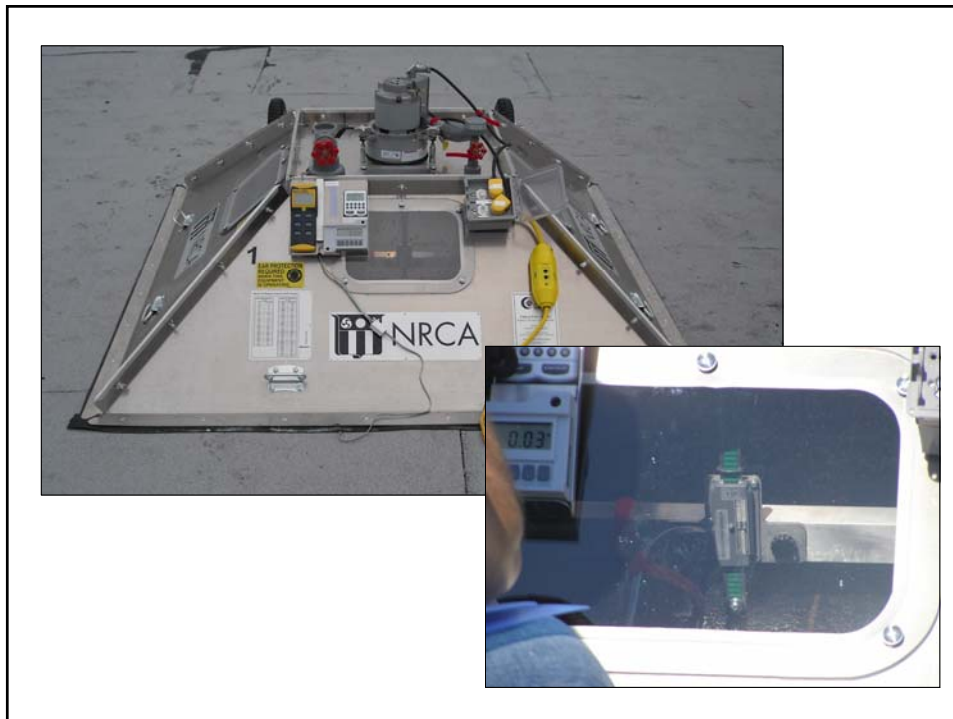
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FM 1-52, “Field verification of roof wind-uplift resistance”

ASTM E907 (withdrawn) is similar



INDUSTRY ISSUE UPDATE

NRCA Member Benefit


Field-uplift testing

ASTM E907 and FM 1-52 tests continue to be problematic

June 2015

NRCAs continue to receive a significant number of reports from building contractors, manufacturers and designers regarding the use of and problems associated with field uplift tests as post-installation quality assurance measures for membrane roof systems. NRCA has addressed these testing issues a number of times during the years, following a summary of NRCA's previous discussions, as well as updated information and recommendations.

ASTM E907/FM 1-52
There are two recognized field test methods for determining adhered membrane roof system uplift resistance: ASTM E907, "Standard Test Method for Field Uplift Testing of Adhered Membrane Roofing Systems," and FM Global Low Penetration Data Sheet 1-52 (FM 1-52), "Field Verification of Roof Wind Uplift Resistance."



An example of a test chamber used for negative-pressure uplift testing.

Both test methods are similar and provide for affixing a 4- by 8-foot down-draft chamber to a roof surface's square and applying a defined negative uplift pressure inside the chamber to the roof system's membrane surface using a vacuum pump (see photo). During the test, membrane surface deflection inside the chamber is visually measured and recorded to determine whether a roof system passes or is "suspect."

Using ASTM E907, a roof system is considered to be suspect if the deflection measured during the test is 25 mm (about 1 inch) or greater. During FM 1-52 testing, a roof system is suspect if the measured deflection is between 1/8 of an inch and 1/4 of an inch depending

on the maximum test pressure: 1 inch when a thin tapping board (over board) is used or 2 inches when a thin over-board or flexible, mechanically attached insulation is used.

If an ASTM E907 or FM 1-52 test yields a suspect result, a test can be done in the test area to determine whether field tests have occurred and the specific failure mode.

ASTM E907 and FM 1-52 differ greatly in their test cycles and maximum test pressures for determining roof system deflection and whether a roof system passes or is suspect. ASTM E907 testing is conducted in 15 pounds per square foot (psf) pressure increments up to the calculated design wind uplift pressure for the specific roof system being evaluated. FM 1-52 testing is conducted using an initial 15 pounds psf pressure followed by 7.5-pound psf increments up to a maximum test pressure of 1.25 times the design uplift pressure for the specific roof system being evaluated.

Considering maximum test loading and allowable test deflection in combination, FM 1-52 requires 75 percent higher test loads per unit area as well as 1/3 the test deflection of ASTM E907. The old FM 1-52 is a significantly more stringent test than ASTM E907.

ASTM E907 originally was published as a recognized consensus standard in 1983, and it was revised in 1996. In 2013, ASTM withdrew ASTM E907 because a consensus could not be reached regarding necessary revisions—most significantly, defining the test method's precision and how (accuracy). ASTM E907-06 still is available for use and can be obtained directly from ASTM's website, www.astm.org.

FM 1-52 is an FM Global proprietary evaluation method and not a recognized industry consensus test standard. FM 1-52's scope indicates it only is intended to confirm acceptable wind-uplift resistance on completed roof systems in hurricane-prone regions, where a partial blow-off has occurred or where inferior roof system construction is suspected or known to be present.

FM 1-52 originally was published by FM Global in October 1976. The negative-pressure uplift test was added in August 1980 and has been revised several times. The current edition is dated July 2012 and includes an option for "visual construction observation (VCO)" as an alternative to negative-pressure uplift testing. VCO provides for full-time, third-party monitoring of a roof system application to verify roof system installation in accordance with consensus documents.

NRCA "Industry Issue Update," June 2015

NRCA's experience:

- Most tests not conducted in accordance with ASTM E907 or FM 1-52.
- No correlation between field test vs. lab. results/classifications
- NRCA survey: 55% passing

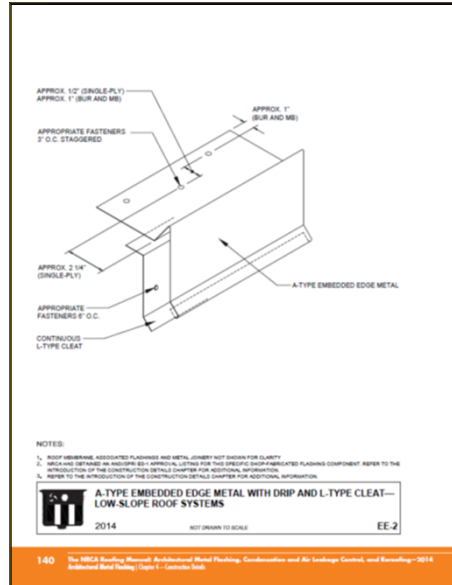
FM 1-52 or ASTM E907 are not a substitute for a proper quality assurance program


Sheet metal flashings

SMACNA Manual



The NRCA Roofing Manual





ANSI
SPRI

ANSI/SPRIFM 4435/ES-1 2017
Test Standard for Edge Systems Used with Low Slope Roofing Systems
Approved January 24, 2017

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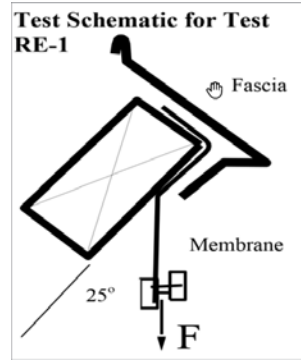
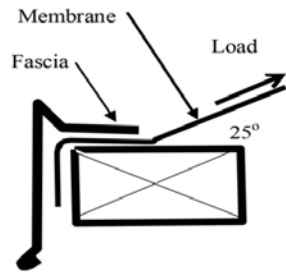
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ANSI/SPRI ES-1
www.spri.org

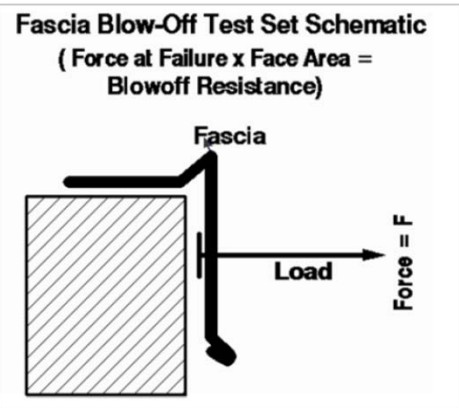
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ANSI/SPRI ES-1's RE-1 test



ANSI/SPRI ES-1's RE-2 test



ANSI/SPRI ES-1's RE-3 test

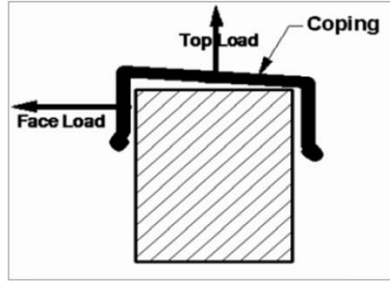


Figure RE-3.1 RE-3 Test-Face Leg Pull

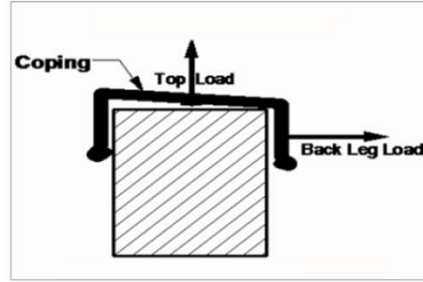
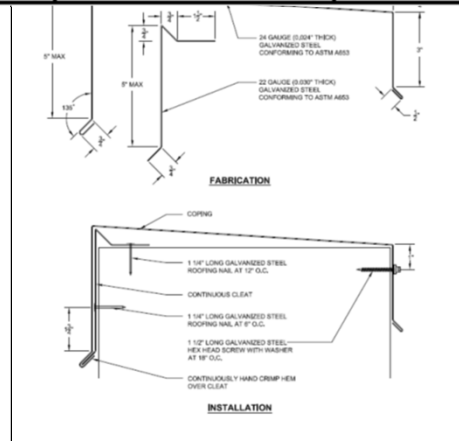


Figure RE-3.2 RE-3 Test-Back Leg Pull

NRCA's edge metal testing

www.nrca.net, Search "Shop fabricated edge metal testing"

THE NRCA ROOFING MANUAL <small>CONSTRUCTION DETAIL SM-2</small>	COPING • 24 GA. GALVANIZED STEEL • 22 GA. GALVANIZED STEEL CLEAT • CONTINUOUS FRONT FACE CLEAT AND GASKETED BACK FACE FASTENER	ANSI/SPRI ES-1 TESTED RESISTANCE		UL-4B 1/2/14
		OUTWARD 214 LBS./SQ. FT.	UPWARD 350 LBS./SQ. FT.	





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