

National Technology & Development Program

Specification 5100-624: WRAP, STRUCTURE PROTECTION

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1. SCOPE

1.1. Scope.

This specification covers the requirements for structure wrap used in the protection of structures from wildland fire.

1.1.1. Interpretation.

To carry out the provisions of this document, the word "shall" is understood to be mandatory.

1.1.2. Definitions.

Nonconformity: A departure of a quality characteristic from its intended level or state that occurs with severity sufficient to cause an associated product or service not to meet a specification requirement (per ANSI/ASQ Z1.4).

2. APPLICABLE DOCUMENTS

2.1. Non-Government publications.

The following documents form a part of this document to the extent specified herein. Unless otherwise specified the issues of these documents are those in effect on the date of the invitation for bids or request for proposals. Non-Government standards and other publications normally are available from the organizations that prepare and distribute the documents. These documents also may be available in or through libraries or other informational services.

2.1.1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

Copies are available from ASTM International, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959 or <u>www.ASTM.org</u>.

- C 1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- D 774 Standard Test Method for Bursting Strength of Paper
- D 1876 Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
- D 3951 Standard Practice for Commercial Packaging
- SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System (IEEE/ASTM Standard available from ASTM)

2.1.2. AMERICAN SOCIETY FOR QUALITY (ASQ)

Unless otherwise indicated copies of ANSI/ASQ documents are available online at <u>https://asq.org</u>, or in hard copy from the American Society for Quality, P.O. Box 3005, Milwaukee, WI 53201-3005.

ANSI/ASQ Z1.4 - Sampling Procedures and Tables for Inspection by Attributes.

2.1.3. ALUMINUM ASSOCIATION

Copies are available from Aluminum Association, Publication Department, 818 Connecticut Ave. NW, Washington, DC 20006, <u>https://www.aluminum.org</u>.

Aluminum Association Standards and Data

2.2. Order of precedence.

In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1. Compliance testing.

Unless otherwise specified, the laminated cloth shall be subjected to compliance inspection and testing in accordance with 4.3. The contracting officer shall be informed in writing when a component, or component supplier changes, or manufacturing location changes, or testing source/facility changes. The Government may at any time require samples for testing when changes in materials occur.

3.1.1. ISO registration.

The manufacturer shall be registered to ISO 9001, Quality Management Systems -Requirements. The operation of the quality assurance program shall evaluate and test product production against this specification to ensure that production remains in compliance. ISO Registration shall be maintained throughout the term of any government contract.

- 3.2. Materials.
- 3.2.1. Laminates.
- 3.2.1.1. Construction of laminates.

Structure wrap uses a single laminate cloth. Each lot of laminate produced shall be traceable by a unique lot number.

3.2.1.2. Structure wrap laminate.

The laminate shall consist of 0.00125 - 0.00165 inch aluminum foil (3.2.2) and glass cloth (3.2.3).

3.2.2. Aluminum foil.

The aluminum foil shall be in accordance with SRM Alloy 1XXX series; 0.00125 - 0.00165 inch (1.25 - 1.65 mil) thick. The aluminum foil shall meet the requirements of Aluminum Association Standards and Data.

3.2.3. Glass cloth.

The glass cloth shall be woven fiberglass cloth and shall have properties listed in Table 1.

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nortion	of Clas	~ ~	lath

Properties	Units	Values
Style	-	Various
Weave	-	Plain
Fabric Finish	-	Loom Stage or Griege Goods
Minimum Pick/Inch by Yarn	-	450x51
Size (Warp)		150x30
Minimum Pick/Inch by Yarn	-	150x30
Size (Fill)		75x18
Fabric weight	Oz/sq yd	2.3 – 3.5 oz/yd2
Fabric thickness	Inches	0.004 – 0.005
Yarn	-	E glass continuous filament (EC)

Table 1 - Material Properties of Glass Cloth

3.3. Testing.

3.3.1. Peel strength.

The minimum peel or stripping strength of the laminated cloths shall be as shown in Table 2 when tested in accordance with 4.4.2.1.

3.3.2. Creep.

The adhesive bond of the laminated cloths shall have a maximum creep as specified by Table 2 when tested in accordance with 4.4.2.2.

3.3.3. Adhesive.

The adhesive shall be flexible thermoset polymeric and be safe to handle when cured.

3.3.4. Adhesive weight.

The adhesive weight range shall be 0.6 gm/ft² – 1.4 gm/ft² when tested as specified by 4.4.2.3.

3.3.5. Burst strength

The burst strength of the laminate cloths shall be as shown in Table 2 when tested in accordance with 4.4.2.4.

3.3.6. Tensile strength.

The tensile strength of the laminate cloth shall be as shown in Table 2 when tested in accordance with 4.4.2.5.

Properties	Requirements	Test Paragraph
Basis weight	38 - 48 lbs. / 1000 ft ²	-
Thickness	0.0055 – 0.008 inches	-
Burst strength	≥ 200 psi	3.3.5
Tensile Strength	 ≥ 100 lbs. / inch width machine direction (MD) ≥ 100 lbs. / inch width transverse direction (XD) 	3.3.6
Roll Dimension	54 or 60 inches x 300 ft	3.4

Table 2 – Physica	properties of	laminate cloth
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3.4. Length, width, and put-up.

Unless otherwise specified, the finished laminated cloth shall be furnished on continuous rolls, and each roll shall contain not less than 300 linear feet and with not more than three splices. Any splices will be affixed appropriately to prevent separation during handling and installation of the structure protective wrap. The finished laminated cloth shall be on a 3-inch inside diameter fiber core flush cut tube (-0/+1") with wall thicknesses great enough to prevent crushing during delivery and use. The width of each roll shall be 54 or 60 inches.

3.5. Deviations and waivers.

There shall be no deviations or waivers to the materials or construction specified herein unless authorized in writing by the Government.

3.6. Workmanship.

The finished laminated cloths shall conform to the quality and grade established by this specification. The occurrence of nonconformities shall not exceed the applicable point value or nonconformity limit.

3.7. Metric products.

Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch/pound units, provided they fall within the tolerances specified using conversion tables contained in the latest revision of IEEE/ASTM SI-10, and all other requirements of this specification are met.

4. QUALITY ASSURANCE PROVISIONS

4.1. Responsibility for inspection.

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection and test requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his/her own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1. Responsibility for compliance.

All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality

program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known nonconforming material, either indicated or actual, nor does it commit the Government to accept nonconforming material.

4.1.2. Certificate of compliance.

Where certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification (see 4.1.2.1). All certificates of compliance from the contractor shall be based on full test reports of the characteristics being certified. These test reports shall be in the possession of the contractor and available for inspection by the Government.

4.1.2.1. Certificates of compliance.

The contractor shall provide certificates of compliance for materials shown in Table 3.

Material properties of glass cloth	Physical properties of laminate cloth	Roll Properties	
Style	Basis Weight	Roll Dimensions	
Weave	Thickness		
Fabric Finish	Peel strength		
Yarn count (warp and fill)	Creep		
Fabric weight	Adhesive Weight		
Fabric thickness EC varn (warp and fill)	Burst Strength Tensile Strength		

Table 3 – Certificates of compliance

4.1.2.2. Certificates of compliance information.

The contractor shall provide the following information on or with certificates of compliance:

Product description Fabric identification or style number Specification or standard (when applicable) Manufacturer's lot number Quantity purchased Purchase source, address, and telephone number Manufacture or ship date

4.1.3. Test reports.

The contractor shall provide copies of all required test reports shown in Table 3. The test reports shall include the following information:

Manufacturer's name, address, and telephone number Lot number Testing company name, address, and telephone number Testing date Authorizing signature and title Full test result of all samples tested, except

- Peel strength average of each sample tested per lot.
- Creep pass/fail of tested samples per lot.
- Adhesive weight average of each sample tested per lot.
- Burst strength average of each sample tested per lot.
- Tensile strength lot average shall be reported

Vendor certifications shall be acceptable for Table 1 test reports.

4.1.3.1. Material Inventory.

Previously approved and certified laminated materials not utilized from a prior contract period may be utilized at the initiation of a new contract period, with certifications.

4.1.4. ISO Registration.

Evidence of current ISO registration (3.1.1) shall be presented with the First Article Sample of the Structure Wrap.

- 4.2. Sample lots.
- 4.2.1. Inspection lot.

For purposes of inspection and testing, all laminates produced as a production lot for each product, shall be considered an inspection lot.

4.2.1.1. Acceptance tests.

Except where otherwise specified (4.4.2.1, 4.4.2.2, 4.4.2.3, 4.4.2.4, and 4.4.2.5) all sampling shall be in accordance with ASQ Z1.4. The sample size shall be selected in accordance with inspection level S-2 with an AQL of 10. The lot size shall be expressed in units of linear feet.

4.3. Sampling for lot acceptance, inspection and test.

Random samples of laminated cloth units shall be selected from each lot for inspection and testing, the sample sizes shall be obtained as specified in ASQ Z1.4.

4.3.1. Visual inspection.

For visual inspection, the sample size shall be selected in accordance with inspection level I of ASQ Z1.4 and sufficient rolls shall be selected at random from the lot so that by inspecting approximately 2 consecutive yards out of each roll, a total of inspected yardage equal to that required shall be obtained. A unit of laminated cloth shall be 1 linear yard of the finished material.

4.4. Inspection and tests.

4.4.1. Visual inspection.

Each sample selected according to 4.3.1 shall be visually examined for nonconformities specified in Table 4. Normal inspection distance shall be 3 feet average and samples shall be examined over a uniform light source of 250-foot candles minimum, and all areas of the laminated cloth shall be examined. Classification of nonconformities shall be in accordance with Table 4 and lot acceptance shall be based upon Acceptable Quality Levels (AQL's). The AQL's shall be 2.5 for major nonconformities and 6.5 for minor nonconformities.

Classification Examine	Nonconformity	Major	Minor
Material	Not as specified	Х	
	Length of put-up not as specified	Х	
Blisters and unlaminated areas	Greater than 1/4 square inch in size	Х	
	Less than ¼ square inch in size:		Х
	One to six occurrences		Х
	More than six occurrences	Х	
Creases or foldovers	Greater than 6 linear inches in length	Х	
	Less than 6 linear inches in length		X
	Note : Wrinkles in the laminate are acceptable as long as there is no evidence of foldovers or breaks in aluminum foil.		
Evidence of break	One to six in aluminum foil		Х
	More than six	X	

Table 4 - Classification of nonconformities

4.4.2. Tests.

Each sample of the finished laminate, selected in accordance with 4.2.1.1, shall be tested for the requirements in Table 5.

Table 5 - Test methods

Characteristic	Requirement paragraph	Test method
Peel strength	3.3.1	4.4.2.1
Creep	3.3.2	4.4.2.2
Adhesive weight	3.3.4	4.4.2.3
Burst test	3.3.5	4.4.2.4
Tensile strength test	3.3.6	4.4.2.5

4.4.2.1. Peel strength.

Test for peel strength shall be in accordance with ASTM D 1876 except the applied separation rate shall be 3 inches per minute. Samples shall be selected so that different warp and fill threads are tested with each sample. It was found during initial development of this laminate that due to the thinness of the foil; the foil would often tear before the laminate would separate. Failure of the foil (tearing) prior to failure of the bond is an acceptable result.

4.4.2.2. Creep test.

The creep test shall be performed using a 50-gram weight in a dead weight, 180-degree angle peel test at a temperature of $400 \pm 5^{\circ}$ F and uncontrolled humidity. The sample shall be hung by the cloth component and the 50-gram weight shall be attached to the aluminum foil. The test chamber shall be configured such that no movement is induced into the sample due to airflow. The test strips shall be 2 inches wide, and the same length as required for the peel strength test (see 4.4.2.1). The test strips may be cut with the warp or weave (machine or X-machine) direction. Results shall be reported as "pass" or "fail."

4.4.2.3. Adhesive weight.

The adhesive weight shall be measured and documented during the manufacturing process by sampling and weighing the dried adhesive on the foil prior to bonding. Three (3) tests shall be run at the end of every master roll.

4.4.2.4. Burst strength test.

The burst test shall be in accordance with ASTM D 774. A motor drive Model A Mullen Burst Tester shall be used. The Burst Tester shall be driven by a motor speed of 1750 rpm and use a Model 305-B Mullen® Tester Diaphragm supplied by Mullen® Testers. The material shall be tested with the foil against the diaphragm. The lot average shall be reported.

4.4.2.5. Tensile strength test.

The tensile strength test shall be in accordance with ASTM C1136. Any results below the minimum specified in Table 2 shall result in a failure of the master roll.

4.4.3. Classification of nonconformities and lot acceptance.

Any sample that fails to comply with test requirements specified in 4.4.2.1, 4.4.2.2, shall be classified as a major nonconformity and lot acceptance shall be in accordance with 4.2.1.1. Any sample that fails to comply with test requirements specified in 4.4.2.3, 4.4.2.4, or 4.4.2.5 shall constitute rejection of the master roll.

5. PACKAGING

5.1. Preservation.

Preservation shall be in accordance with ASTM D 3951 and as specified herein and in the contract or purchase order.

5.2. Packaging.

Structure protection wrap shall be packaged in a roll and shipped palletized. A maximum of thirty (30) rolls shall be placed per pallet. Rolls shall be stacked a maximum of 5 high and 6 wide. Rolls shall be banded together widthwise in each row. Rolls shall be banded to the pallet with at least 3 bands. The palletized rolls shall be appropriately cradled and wrapped in clear stretch wrap. All packaging and banding shall be performed in a manner that will not damage the structure protection wrap and adequately secure the rolls for transport.

5.2.1. Packaging materials

Banding shall be polypropylene and rated to a minimum of 900 pounds breaking strength. The clear stretch wrap shall be a minimum of 0.63 mil thick. A minimum of three cradling pieces shall be used per row. Cradling material shall be of appropriate size and strength to secure the rolls.

5.2.1 Palletization

The pallets shall be either 44-inch length x 62-inch width or 48-inch width x 56-inch length, general purpose, four-way entry, flush stringer, and double-face non-reversible pallets.

5.3. Marking.

In addition to any special marking required by this specification, marking shall be in accordance with the contract or purchase order.

6. DEFINITIONS

6.1. Master roll.

A master roll is defined as large, continuous roll of material produced during the lamination process.

6.2. Finished roll.

A roll of material slit to final width and length.

7. NOTES

7.1. Intended use.

Structure protection wrap is used in wildland fire fighting to protect structures by providing a thermal barrier between the structure and an approaching flame front. The structure wrap consists of an aluminum foil laminated onto a fiberglass cloth. The foil protects the structure by reducing heat transfer to the structure from radiant heat. The fiberglass cloth provides durability to the laminated cloth and attenuates heat transfer from convective heat.

7.2. Acquisition requirements.

Acquisition documents should specify the following:

- a) Title, number, and date of the specification.
- b) Length required if other than specified.
- c) Arrangements for inspection and testing.
- d) Preservation, packing, and marking required in addition to specification requirements (see section 5).

7.3. Notice.

When Government drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever.

7.4. Preparing activity.

US Forest Service, National Technology and Development Program, 5785 Highway 10 West, Missoula, MT 59808, 406-329-3900.



Figure 1 Packaging and palletization example illustration