

L-P-378D  
 December 8, 1972  
 \_\_\_\_\_  
 SUPERSEDING  
 Fed. Spec. L-P-378C  
 October 30, 1969

## FEDERAL SPECIFICATION

### PLASTIC SHEET AND STRIP, THIN GAUGE, POLYOLEFIN

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the requirements for thin gauge polyolefin film.

#### 1.2 Classification.

1.2.1 Types. The polyolefin film shall be furnished in the following types, as specified (see 6.2 and 6.5):

- |          |  |
|----------|--|
| Type I   | - Normal impact strength polyethylene. |
| Type II  | - High impact strength polyethylene.   |
| Type III | - Polypropylene.                       |
| Type IV  | - Heat shrinkable polyethylene.        |

1.2.2 Classes, grades and finishes. Type I, type II, type III, and type IV polyolefin film shall be furnished in the following classes, grades, and finishes, as specified (see 3.4, 6.2 and 6.5).

- |          |   |
|----------|---|
| Class 1  | - For non-food application (see 6.1.1).     |
| Class 2  | - For use in contact with food (see 6.1.1). |
| Class 3  | - Biaxially oriented.                       |
| Class 4  | - Preferentially oriented.                  |
| Grade A  | - Low slip.                                 |
| Grade B  | - Medium slip.                              |
| Grade C  | - High slip.                                |
| Finish 1 | - Untreated.                                |
| Finish 2 | - Treated.                                  |

FSC 8135

L-P-378D

## 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

### Federal Specifications:

- |           |  |
|-----------|--|
| UU-P-268  | - Paper, Kraft, Untreated, Wrapping.                                   |
| PPP-B-601 | - Boxes, Wood, Cleated-Plywood.  |
| PPP-B-636 | - Boxes, Shipping, Fiberboard.   |
| PPP-D-723 | - Drums, Fiber.  |
| PPP-T-45  | - Tape, Gummed, Paper, Reinforced and Plain, for Sealing and Securing. |
| PPP-T-60  | - Tape: Packaging, Waterproof.   |
| PPP-T-76  | - Tape, Pressure-Sensitive, Adhesive, Paper (for Carton Sealing).      |

### Federal Standards:

- Fed. Std. No. 123 - Marking for Domestic Shipment (Civil Agencies).
- Fed. Std. No. 191 - Textile Test Methods.
- Fed. Std. No. 406 - Plastics, Methods of Testing.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

L-P-378D

**Military Standards:**

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-147 - Palletized Unit Loads or 40" x 48" Pallets.

(Copies of Military Specifications and Standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

**Laws and Regulations:**

- 21 CFR - Federal Food, Drug, and Cosmetic Act, Food Additive Amendment: Paragraph 121.2501 of Subpart F.

(Application for copies should be addressed to the Department of Health, Education, and Welfare, 330 Independence Avenue, S.W., Washington, DC 20003.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply:

**American Society for Testing and Materials (ASTM) Standards:**

- D-1505 - Tentative Method of Test for Measurement of Density of Plastics by the Density-Gradient Technique.
- D-1709-67 - Impact Resistance of Polyethylene Film by the Falling Dart Method.
- E-96-66 - Water Vapor Transmission of Materials in Sheet Form.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

**National Motor Freight Traffic Association, Inc., Agent:**

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Associations, Inc., Tariff Order Section, 1616 P Street, N. W., Washington, DC 20036.)

L-P-378D

Uniform Classification Committee, Agent:

Uniform Freight Classification.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

3. REQUIREMENTS

3.1 Materials. When specified (see 6.2) that the film is intended for use in contact with food, the material shall be class 2 and shall conform to the Federal Food, Drug, and Cosmetic Act, Food Additive Amendment, Paragraph 121.2501 of Subpart F.

3.1.1 Types I, II, and IV. The material shall be flexible unsupported polyethylene film. Unless otherwise specified (see 6.2), the film shall be natural color (essentially colorless) and transparent.

3.1.2 Type III. The material shall be flexible unsupported polypropylene film. Unless otherwise specified (see 6.2), the film shall be natural color (essentially colorless).

3.2 Form. The film shall be furnished in the form of flat cut sheets or in rolls, as specified. Material in roll form shall be either single thickness or lay flat tubing, as specified (see 6.2).

3.3 Physical characteristics. The finished sheet or strip shall conform with the physical properties specified in 3.3.1 and table I. Where characteristic values vary in accordance with thickness, (impact resistance, water-vapor permeability, and tear strength), the value shall conform to that indicated for the nominal thickness value shown.

3.3.1 Thickness of sheet or strip. Sheet or strip shall be furnished in nominal thicknesses ranging from 0.0010 to 0.0090 inch, as specified (see 6.2). For thicknesses ranging from 0.0010 to 0.0014 inch a tolerance of plus or minus 25 percent shall be permitted; for thickness ranging from 0.0015 to 0.0090 inch a tolerance of plus or minus 20 percent shall be permitted when tested as specified in 4.3.9.

TABLE I. Physical requirements

Property	Type I	Requirements <u>1/</u>		Type III	Type IV	
		Type II	Type II		Class 3	Class 4
Density (unpigmented), g/cm <sup>3</sup> :	0.914 to 0.929	0.914 to 0.929	0.914 to 0.929	0.885 to 0.900	0.914 to 0.929	0.914 to 0.929
Density (pigmented), g/cm <sup>3</sup> :	0.914 to 0.944	0.914 to 0.944	0.914 to 0.944	0.885 to 0.915	- -	- -
Impact resistance, grams, minimum:						
	Nominal thickness, inches					
	0.0010	40	75	-	-	-
	0.0015	65	105	-	-	-
	0.0020	85	135	-	-	-
	0.0030	125	195	-	-	-
	0.0040	165	255	-	-	-
	0.0050	205	295	-	-	-
	0.0060	245	305	-	-	-
Tensile strength, pounds per square inch (p.s.i.) minimum:						
Machine direction	1700	1700	1700	4500	1700	1900
Transverse direction	1200	1200	1200	4500	1700	1700

TABLE I. Physical requirements (cont'd)

Property	Requirements <u>1/</u>				
	Type I	Type II	Type III	Type IV Class 3    Class 4	
Ultimate elongation, percent, minimum:					
Machine direction	225	225	200	225	300
Transverse direction	350	350	200	350	350
Slip (kinetic coefficient of friction), maximum:					
Grade A	0.8	0.8	-	-	-
Grade B	.5	.5	-	-	-
Grade C	.2	.2	-	-	-
o Ink adhesion (finish 2 only), percent pickoff, maximum:	10	10	10	10	10
Water-vapor permeability, maximum, g./100 sq. in. in 24 hours:					
	Nominal thickness, inches				
	0.0010	1.70	1.70	-	-
	0.0015	1.30	1.30	-	-
	0.0020	1.00	1.00	-	-
	0.0025	0.80	0.80	-	-
	0.0030	0.65	0.65	-	-
	0.0040	0.45	0.45	-	-
	0.0050	0.30	0.30	-	-
	0.0060	0.25	0.25	-	-
	0.0080	0.21	0.21	-	-

L-P-378D

TABLE I. Physical requirements (cont'd)

Property	Type I	Requirements <u>1/</u>		Type III	Type IV	
		Type II			Class 3	Class 4
Heat seal strength (breaking strength of heat sealed seams - percent of film breaking strength <u>2/</u> ), minimum:	60	60		60	60	
Film shrinkage, percent, minimum:						
Machine direction	-	-		-	30	40
Transverse direction	-	-		-	30	10
Tear strength, grams, minimum:						
7	Nominal thickness, inches	Direction				
	0.002	Machine	-	-	-	300
		Transverse	-	-	-	200
	0.003	Machine	-	-	400	300
		Transverse	-	-	225	200
	0.004	Machine	-	-	450	450
		Transverse	-	-	450	450
	0.005	Machine	-	-	500	550
		Transverse	-	-	650	450
	0.006	Machine	-	-	500	650
		Transverse	-	-	400	450
	0.008	Machine	-	-	-	800
		Transverse	-	-	-	625

L-P-378D

1/ Where no value is specified, no requirement is applicable.

2/ The breaking strength of the film shall be that used in the calculations of the film tensile strength.

L-P-378D

3.4 Finish. When specified, the film shall be treated for printing (see 1.2.2 and 6.2).

3.5 Length and width of rolls and tubing. Length and width of rolls of film and tubing shall be as specified (see 6.2). The tolerance for widths up to 30 inches shall be plus or minus 3/16 inch. For widths from 30 to 50 inches, the tolerance shall be plus or minus 3/8 inch, and for widths 50 to 60 inches, the tolerance shall be plus or minus 1/2 inch. For widths from 60 to 120 inches, the tolerance shall be plus or minus 3/4 inch. For widths greater than 120 inches, the tolerance shall be plus or minus 1/8 inch per foot of width. Each roll shall contain not more than three pieces and no piece shall be less than 10 feet in length.

3.5.1 Core size. The film shall be furnished on cores having a length equal to or up to 1 inch longer than the actual width or the folded width of the film as furnished (see 5.1.1.1 and 5.1.2.1). Unless otherwise specified (see 6.2), the inside diameter of the core shall be not less than 1-1/2 inches nor more than 6-1/4 inches.

3.6 Length and width of sheets. Unless otherwise specified, standard size trimmed sheets shall be 20  $\pm$  1/16 inches by 50  $\pm$  1/16 inches.

3.7 Workmanship. The workmanship shall be evaluated on the basis of the intended application of the material as provided in 3.7.1 and 3.7.2 (see 6.1 and 6.2).

3.7.1 Class 1, 3, and 4 applications. For class 1, 3, and 4 applications the film shall be uniform in color, texture, finish, and other physical properties and shall have no more than fifteen gels, fish eyes, unmelted material, or foreign matter per square inch. The material shall be free of holes, tears, cracks, or blisters. The edges shall be free of nicks or cuts.

3.7.2 Class 2 applications. For class 2 applications the film shall be uniform in color, texture, finish, and other physical properties and shall have no more than two gels, fish eyes, unmelted material, or foreign matter per square inch. The film shall be free of pinholes, holes, tears, cracks, blisters, or mottling. The edges shall be free of nicks or cuts. The material shall conform to 3.1.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his 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 the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.



L-P-378D

4.1.1 Certificate of compliance. When certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification.

4.2 Inspection. Sampling for inspection shall be performed in accordance with MIL-STD-105, except where otherwise indicated hereinafter.

4.2.1 Component and material inspection. In accordance with 4.1 above, components and materials shall be tested in accordance with all the requirements of referenced specifications, drawings, and standards unless otherwise excluded, amended, or qualified in this specification or applicable purchase documents.

4.2.2 Inspection of the end item.

4.2.2.1 Examination of the end item. The end item shall be examined in accordance with the defects set forth in the applicable subparagraphs at the inspection levels and acceptable quality levels (AQL's) set forth in 4.2.2.3. Random samples shall be drawn from each lot of the end items for examination of visual, dimensional and preparation for delivery defects. The lot shall consist of all material of one type, grade, class, finish and size submitted for inspection at one time. The lot, for purposes of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of rolls of sheets, or tubing or packages of cut sheets for examination in 4.2.2.1.1 and 4.2.2.1.2, and in units of shipping containers for examination in 4.2.2.2.

4.2.2.1.1 Examination for visual defects. The sample unit for this examination shall be one sheet or one linear yard of a roll, sheet or tubing, as applicable.

Examine

Defects

Workmanship:

Class 1, 3, and 4 applications:

Color, texture, and finish not uniform.  
Hole, tear, crack, or blister.  
More than fifteen gels, fish eyes, unmelted material, or foreign matter per square inch.  
Edge contains nick or cut.

Class 2 applications:

Color, texture, and finish not uniform.  
Pinhole, hole, tear, crack, blister, mottling.  
More than two gels, fish eyes, unmelted material, or foreign matter per square inch.  
Edge contains nick or cut.

L-P-378D

4.2.2.1.2 Examination for defects in dimensions. The sample unit for this examination shall be one sheet or one roll, as applicable.

ExamineDefects

## Roll:

When specified width is 30 inches or less	Varies from specified width by more than plus or minus 3/16 inch.
When specified width is 30 to 50 inches	Varies from specified width by more than plus or minus 3/8 inch.
When specified width is 50 to 60 inches	Varies from specified width by more than plus or minus 1/2 inch.
When specified width is 60 to 120 inches	Varies from specified width by more than plus or minus 3/4 inch.
When specified width is more than 120 inches	Varies from specified width by more than plus or minus 1 inch.
Length	Any roll less than 95 percent of specified length. Overall average length of 2 or more rolls less than 99 percent of specified length. More than 2 splices in roll. Smallest piece of film in roll less than 10 feet.

## Sheet:

Length and width	Varies from specified length and width by more than plus or minus 1/16 inch.
------------------	--

## Core:

	Core length less than width of film furnished. Core length more than 1/8 inch longer than width of film. Inside diameter of core not within specified tolerance.
--	--

4.2.2.2 Examination of preparation for delivery requirements. An examination shall be made to determine that the packaging, packing, and marking complies with the section 5 requirements. Defects shall be scored in accordance with the list below. The sample unit shall be one shipping container fully prepared for

L-P-378D

delivery except that it need not be closed. Defects for closure listed below shall be examined on shipping containers fully prepared for delivery. The lot shall be the number of shipping containers in the end item inspection lot.

<u>Examine</u>	<u>Defects</u>
Marking (exterior and interior)	Incorrect, omitted, illegible; improper size, location, sequence, or method of application.
Materials	Nonconforming as to type, class, grade, finish, style or other category of the specification. Required component missing, damaged.
Workmanship	Inadequate application of components such as: poor closure of container flaps; loose strapping. Bulged or distorted container. Improper taping or inadequate stapling. Roll not suitably restrained to prevent unwinding.
Contents	Not as specified. Width of roll greater than specified.

4.2.2.2.1 Examination for palletization (military requirements). An examination shall be made to determine that the palletization complies with the section 5 requirements. Defects shall be scored in accordance with the list below. The sample unit shall be one palletized unit load fully prepared for delivery. The lot size shall be the number of palletized unit loads in the end item inspection lot.

<u>Examine</u>	<u>Defects</u>
Finished dimension	Length, width or height exceeds specified maximum requirement.
Palletization	Not as specified. Pallet pattern not as specified. Interlocking of loads not as specified. Load not bonded with required straps as specified.
Weight	Exceeds maximum load limits.
Marking	Omitted; incorrect; illegible; of improper size, location, sequence or method of application.

L-P-378D

4.2.2.3 Inspection levels and AQL's for examinations. The inspection levels for purposes of determining the sample size and the AQL's expressed in defects per 100 units shall be as follows:

<u>Examination paragraph</u>	<u>Inspection levels</u>		<u>AQL's</u>
	Sheets	Rolls	
4.2.2.1.1	I	S-3	2.5
4.2.2.1.2	S-3	S-3	2.5
4.2.2.2	S-1	S-1	2.5
4.2.2.2.1	S-1	S-1	6.5

4.2.3 Testing of the end item. The end item shall be tested for applicable characteristics listed in table II. The sample unit quantity for each type shall be 2 consecutive square yards of material for rolls using the full width of the roll or the equivalent area for sheets. Disregard a minimum of three turns of film from each end of a roll before collecting sample. In cutting test specimens, no portion of the sample shall be taken closer than 10 percent of the width from either edge of the film. The lot shall be expressed in units of rolls of film or tubing, or packages of sheets, as applicable, of one type, grade, class, finish and size. Failure of one or more sample units to meet individual unit requirements shall be cause for rejection of the lot. For those characteristics applicable to the lot average, there shall be no evidence of failure to meet the requirements as specified.

<u>Lot size (rolls or packages of sheets, as applicable)</u>	<u>Sample size</u>
0 to 50	2
51 to 500	3
501 to 35000	5
35001 and over	8

NOTE: In instances where the supplier's operation is converting only, the tests may be considered that of a component in jumbo roll form purchased from an outside source.

## INSTRUCTIONS FOR TESTING

TABLE II

CHARACTERISTIC	Specification Reference		Requirements Applicable To		Number Determinations Per Unit	Results Reported As		Inspect Level	AQL
	Requirement	Test Method	Individ Unit	Lot Aver		Pass or Fail	Numerically to Nearest		
Material	3.1	<u>1/</u>							
Density	Table I	4.3.2		X	1		0.001 g./cm <sup>3</sup> .		
Impact resistance	Table I	4.3.3	X		1				
Tensile strength and elongation	Table I	4.3.4		X	5 machine direction 5 transverse for each sample unit		Pounds/square inch or Percent (as applicable)		
Slip	Table I	4.3.5	X		1		0.1		
Ink adhesion (for finish 2 only)	Table I	4.3.6	X		2		Percent		
Water-vapor permeability	Table I	4.3.7	X		3		0.01 g.		
Heat seal strength (tensile strength of heat sealed seams - percent of film tensile strength)	Table I	4.3.8		X	5 machine direction 5 transverse for each sample unit		Percent		

13

L-P-378D

## INSTRUCTIONS FOR TESTING

TABLE II (cont'd)

CHARACTERISTIC	Specification Reference		Requirements Applicable To		Number Determinations Per Unit	Results Reported As		Inspect Level	AQL
	Requirement	Test Method	Individ Unit	Lot Aver		Pass or Fail	Numerically to Nearest		
Thickness of film	3.3.1	4.3.9		X	5		0.0001 inch		
Film shrinkage	Table I	4.3.10		X	5 machine direction 5 transverse direction		Percent		
Tear strength	Table I	Method 5132 <u>2/</u>		X	5 machine direction 5 transverse direction		1 gram		
<p><u>1/</u> Unless otherwise specified, certificate of compliance is required and will be acceptable for the requirement stated.</p> <p><u>2/</u> Fed. Std. No. 191.</p>									

14

L-P-378D

### 4.3 Test methods.

4.3.1 Conditioning. The conditioning period prior to test shall be 48 hours; the atmospheric conditions, unless otherwise specified, shall be  $73.5^{\circ} \pm 2^{\circ}\text{F.}$  and  $50 \pm 4$  percent relative humidity.

4.3.2 Density. The density shall be determined in accordance with ASTM D-1505.

4.3.3 Impact resistance (dart). The impact resistance shall be determined in accordance with ASTM D-1709-67.

4.3.4 Tensile strength and elongation. The tensile properties of the film shall be determined in accordance with method A or B of method 1013 of Fed. Std. No. 406 using a 1 inch wide specimen.

### 4.3.5 Slip.

4.3.5.1 Apparatus. The inclined plane apparatus shall consist of the following:

- a. A smooth board approximately 26 by 26 by  $3/4$  inch to serve as the plane.
- b. A steel block  $4-1/2$  by  $2-1/2$  by  $3/4$  inch to serve as a carrier and a loading medium for the sliding specimen.
- c. A piece 12 by  $2-3/4$  by  $1/8$  inch thick cellular rubber sheeting of medium density as a cover for the block to assure intimate contact between the sliding and the stationary specimens. The rubber is brought up and around the ends of the block to fit snugly and is taped in place. The total weight of block and rubber shall be 1000 g.
- d. An interval timer accurate to 0.2 second.
- e. A vertical coefficient of friction indicator (tangent scale) graduated in 0.02 tangent units.
- f. Four strips of cellophane tape 20 inches in length and 1 inch wide shall be taped approximately 4 inches apart to the top surface of the plane so that the long dimension is parallel to the sliding motion of the block. These strips are marked at intervals of 2.5 inches with a wax crayon to serve as the scale for the sliding block.

L-P-378D

4.3.5.2 Specimens. Extreme care shall be taken in handling the material to keep the surface free of dust, lint, or fingerprints. Specimens for the plane shall be 22 inches in the machine direction and 17 inches in the transverse direction. The specimens for the sponge-rubber covered metal sled shall be 12 inches in the machine direction and 3 inches in the transverse direction. Both specimens shall be cut from adjacent areas of the same piece. Sufficient block and plane specimens of each sample shall be cut so that tests of sides A to A, A to B, and B to B can be made.

4.3.5.3 Procedure. Level the apparatus. Tape the larger specimen to the clean, dry surface of the plane over the crayon-marked cellophane tape, smoothing the film sufficiently to eliminate wrinkles without stretching it. Tape the smaller specimen to the sponge-rubber covered metal block with the machine direction of the film parallel to the length of the block, pulling tightly to eliminate wrinkles without stretching the film. All combinations of the two sides, A and B of the film shall be tested. With the plane at an angle of zero degree, place the film-covered block on the film specimen.

a. On the plane so that the long dimension is parallel to the inclination when the plane is tilted.

b. With the two polyethylene film surfaces in contact.

c. Near the end of the plane that will be elevated.

Slowly elevate the plane until that angle is reached which is sufficient to allow the block to slide of its own accord. Stop elevating the plane at this point. If the film-covered block stops sliding before it has traveled 12.5 inches, change the film of the block and place it on a fresh portion of the film on the plane. Then elevate the plane in increments of 0.02 tangent units on the vertical coefficient of friction indicator, until the block travels, unaided, at least 12.5 inches. The tangent of the angle at which the block slides this distance is recorded as the static coefficient of friction of the specimen being tested. This tangent is read directly from the vertical coefficient of friction indicator, the top side of the plane being the reference point. Do not test a block specimen more than once and do not use the same portion of the specimen on the plane more than once for test purposes.

Raise the plane to a position 0.02 to 0.04 tangent units higher than the static coefficient of friction. Mount a new film specimen on the metal block and place the block on the plane for test as described above. Hold the block in place for at least ten seconds and then release. If the block does not begin to slide of its own accord, nudge it slightly to



L-P-378D

initiate sliding. When the block begins to slide, start the timer and determine the time it takes for the block to slide 2.5, 5.0, 7.5, 10.0, and 12.5 inches. The rate of sliding shall be approximately constant over the 12.5 inch length. Only the time for the last ten inches is used to calculate the coefficient of friction. If any marked accelerating or deceleration is noted, discard the determination and repeat the test. Calculate the reciprocal rate of sliding as follows:

$$\frac{\text{Time to slide 12.5 in.} - \text{time to slide 2.5 in.}}{10} = \text{rate in sec./in.}$$

This gives the rate at which the block slides down the plane 10 inches. Repeat this procedure at various angles using fresh specimens each time until at least two reciprocal rates above and two below 30 sec./in. are obtained. The kinetic coefficient of friction is calculated at a reciprocal rate of sliding of 30 sec./in. The rates of sliding above and below 30 sec./in. are plotted with rates of sliding versus the corresponding tangents. The tangent corresponding to a reciprocal rate of 30 sec./in. is taken from this plot. This tangent is numerically equal to the kinetic coefficient of friction of the sample. If a reciprocal rate of sliding slower than 30 sec./in. cannot be obtained, then the kinetic coefficient of friction is taken as the tangent of the lowest angle at which the block will slide at least 12.5 in.

#### 4.3.6 Ink adhesion.

4.3.6.1 Apparatus. The apparatus shall consist of the following:

- a. A clean, flat table at least 6 feet long and 2 feet wide.
- b. A roll of No. 44 Texcel tape, 1/2 inch wide or equivalent (see 1/, 6.3).
- c. One roll of commercial pressure-sensitive adhesive cellophane tape, 1 inch wide.
- d. Scissors.
- e. A smooth rubber roller and metal clip, as used in photography.
- f. Flexible cord, approximately 6 feet long with a diameter of 1/32 inch.
- g. A sandbag weighing 1500 g.
- h. Two steel bars approximately 1/4 inch thick, 2 inches wide, and 15 inches long.

L-P-378D

- i. A timer, accurate to plus or minus 1 second.
- j. A spatula with a blade 4 inches long and 1/2 inch wide.
- k. A circulating air oven capable of maintaining a temperature of  $40^{\circ} \pm 3^{\circ}$  ( $105^{\circ} \pm 5^{\circ}\text{F.}$ ).
- l. A Cenco-Bakelite Pulley No. 75660, or equivalent (see 2/, 6.3).
- m. An anilox hand proofer, 165 line screen, or equivalent (see 3/, 6.3).
- n. No. 3 Zahn Cup Viscometer, or equivalent (see 4/, 6.3).
- o. SPI Standard Ink Sample Flexo Ink No. 1, or equivalent (see 5/, 6.3).
- p. Denatured ethyl alcohol, 95 percent.

4.3.6.2 Specimens. The specimens shall be 6 inches by the width of the material.

4.3.6.3 Procedure. Select printing side of film specimen and place it face up on the table, taking care that this side is not handled, smudged, or wiped. Anchor one 6 inch end of the film by a clip or weight to prevent slippage during ink application. Stir ink thoroughly, adjust viscosity with alcohol to 22 seconds using the No. 3 Zahn cup. Apply approximately 5 ml. of diluted ink to nip of Anilox hand proofer and roll ink out over the entire length of the specimen. When specimen is unusually long it may be necessary to make several such rollouts. Allow ink to dry in air for 5 minutes, place in circulating air oven at  $40^{\circ} \pm 3^{\circ}\text{C.}$  ( $105^{\circ} \pm 5^{\circ}\text{F.}$ ) for 10 minutes to insure removal of solvent. Remove inked specimen from oven, allow to cool for 1 minute, and place on testing table printed side down. Apply a piece of 1 inch wide pressure sensitive adhesive cellophane tape down the center of the entire length of the uninked side to prevent specimen from tearing during the test. Roll out any air bubbles or wrinkles with a soft roller. Turn specimen over so that inked side is up.

Place the two steel bars on either side of the inked area to prevent motion of the specimen during the cellophane tape test. Apply a piece of the 1/2 inch wide No. 44 Texcel tape or equivalent over the inked area of the specimen, which has the uninked side supported by the strip of the 1 inch wide pressure sensitive adhesive cellophane tape. The 1/2 inch wide tape shall be 3 inches longer than the specimen and free 3 inch end of the tape shall be turned back on itself by  $180^{\circ}$  to form a tab. Roll out any air bubbles or wrinkles under the No. 44 Texcel tape with the soft rubber roller. Attach clip fastened to cord, which supports the 1500 g. sandbag to the tab of the 1/2 inch tape. Place cord over the pulley and allow slack to be taken up and then release the sandbag.

L-P-378D

Examine the inked area of the film which was under the tape to determine degree of ink removal. Estimate the percent of area from which ink is removed using successive areas 3 by 1/2 inch wide (the width of the tape) for this purpose. The total stripped area of the specimen shall be examined and the estimates made on the small areas averaged. The results from the specimens tested shall be averaged.

4.3.7 Water vapor permeability. The water vapor permeability shall be determined in accordance with ASTM E-96-66, condition E.

4.3.8 Heat seal strength.

4.3.8.1 Apparatus. The apparatus shall consist of the appropriate heat sealing equipment with accurate controls of temperature, pressure and time, and the tensile testing equipment specified in 4.3.4.

4.3.8.2 Specimens. From each sample unit, a sufficient number of representative 6 by 12 inch pieces of the material shall be cut. Half of the specimens shall have the 12 inches in dimension parallel to the machine direction and half parallel to the transverse direction. Each specimen shall be folded in the middle, its two 6 inch ends accurately aligned and sealed together by means of a 1/16 inch wide flat heat seal 1/4 inch from the edge. The sealing conditions shall be adjusted, using the film manufacturer's recommendations as a guide, to make a seal having the best appearance and the highest seal strength. When the optimum setting has been found, all other specimens shall be sealed under the same conditions. The specimens whose seals show evidence of poor workmanship shall not be tested. Seal strength values obtained during adjustment of the sealing apparatus shall not be used in computing the average heat seal strength value. From the flattened tubes formed cut 1 inch wide bands perpendicular to the seam, discarding the end strips. The bands shall be permitted to cool for a minimum of one hour in standard atmosphere. They shall then be cut along the fold line to form 1 inch wide specimens with the heat sealed seams extending across the specimens at their mid-lengths, which shall then be tested.

4.3.8.3 Procedure. Each specimen shall be tested in accordance with 4.3.4, except that the heat sealed seam shall be in the middle of the test length.

4.3.8.4 Report. Calculate the average breaking load in pounds for each sample unit. Divide each average by the lot average breaking load, for the appropriate direction, obtained in 4.3.4, and multiply by 100 to obtain the unit average heat seam breaking load in percent. Average these averages to obtain the average percent heat seal breaking load of the lot.

L-P-378D

4.3.9 Thickness. The gage used for the measurement of thickness shall be a dead weight type equipped with a dial graduated to read directly to 0.0001 inch. The presser foot shall be circular with a diameter of  $0.25 \pm 0.01$  inch. The presser foot and moving parts connected therewith shall be weighted so as to apply a total load of  $3 \pm 0.1$  ounce to the specimen. The presser foot and anvil surface shall be planed to within 0.0001 inch and parallel to each other within 0.0001 inch. Measurement shall be taken across the full width of the roll or sheet. No individual measurement shall be less than the nominal thickness and the tolerance and the average of all measurements on the unit shall be not greater than the nominal thickness and the tolerance. Lay-flat tubing shall be cut open and thickness measurement made on a single thickness.

4.3.10 Film shrinkage. Five  $1 \times 6 \pm 1/64$ " specimens shall be cut with the long specimen dimension in the machine direction and five  $1 \times 6 \pm 1/64$ " specimens cut with the long dimension in the transverse direction. A suitable flat container approximately  $10" \times 10" \times 2"$  shall be filled to a depth of one inch with reagent grade glycerin. The glycerin shall be heated to  $270^\circ \pm 5^\circ\text{F}$ . and maintained at that temperature with gentle agitation throughout the test. One specimen at a time shall be placed in the heated glycerin and allowed to remain for 10 seconds. The specimen shall be carefully removed and laid out flat to cool on an absorbent material such as a soft cloth or paper towel. The specimen shall be measured to the nearest  $1/64$  inch after it has cooled. The percent shrinkage shall be determined using the following formula:

$$\frac{\text{Initial Sample Length} - \text{Length of Sample after Test}}{\text{Initial Length}} \times 100 = \% \text{ shrink}$$

The average of five samples tested in each direction shall be used to determine compliance with the requirements of table I.

## 5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A, B, or C, as specified (see 6.2).

### 5.1.1 Level A.

5.1.1.1 Rolls. Polyolefin continuous film or tubing shall be uniformly wound on a convolute or spiral wound paperboard tube (core) as specified in 3.5.1. Film widths between 4 feet and 10 feet shall be folded prior to or during the rolling operation to provide a width no greater than 51 inches. Film widths over 10 feet shall be folded prior or during the rolling operation to provide a width not greater than 65 inches. Each roll shall be restrained from unwinding and wrapped with at least one thickness of 30 pound minimum

L-P-378D

basis weight kraft paper conforming to grade B of UU-P-268. The wrap shall be lapped approximately six inches and secured the entire length of the roll with 3 inch minimum width pressure-sensitive or gummed paper tape conforming to PPP-T-76; type IV of PPP-T-60; or type III, grade B of PPP-T-45. The widths of the wrapper shall be such that the wrapper can be folded over the ends of the roll. The folded ends of the wrapper shall be fastened either by tucking into the tube and placing a restraining device into the tube or by gluing a circular piece of the same paper over the folded wrapper ends. Alternative to wrapping in kraft paper, each roll may be wrapped in polyolefin film identical to that on the roll and the wrap secured with pressure-sensitive tape specified herein or heat sealed. Each wrapped roll of film shall be packaged in a snug-fitting fiber drum conforming to type III, grade D of PPP-D-723 with closure to be in accordance with the specification requirements; or in a box conforming to grade V3c, style RSC (end opening) of PPP-B-636 with closure and waterproofing by means of tape in accordance with the specification appendix.

5.1.1.2 Flat cut sheets. Five hundred flat cut sheets of film of one description only, shall be evenly stacked on a fiberboard pad and completely wrapped with at least one thickness of minimum 30 pound basis weight kraft paper conforming to grade B of UU-P-268. The wrap shall be secured with pressure-sensitive or gummed paper tape. Each bundle shall be packaged in a close fitting fiberboard box conforming to grade V3c, style FTC of PPP-B-636. All seams and joints shall be taped with minimum 2-inch wide tape conforming to type IV of PPP-T-60.

5.1.2 Level B (civil agencies).

5.1.2.1 Rolls. Each roll of film or tubing shall be uniformly wound on a convolute or spiral wound paperboard tube (core) as specified in 3.5.1. Film widths between 4 feet and 10 feet shall be folded prior to or during the rolling operation to provide a width no greater than 51 inches. Film widths over 10 feet shall be folded prior to or during the rolling operation to provide a width not greater than 65 inches. Each roll shall be suitably restrained to prevent unwinding, and packaged in a snug-fitting fiberboard box conforming to type CF (variety SW) or SF, class domestic, style optional of PPP-B-636 and the box securely closed.

5.1.2.2 Flat cut sheets. Five hundred cut sheets of film of one description only, shall be packaged on a unit pad and secured as normally practiced by the industry. One thousand sheets of one description only shall then be packaged in a box as specified in 5.1.2.1.

5.1.3 Level C. Film shall be packaged to afford adequate protection against physical damage during shipment from the supply source to the first receiving activity. The supplier may use his standard practice when it meets this requirement.

L-P-378D

5.2 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level A. Rolls and sheets of film of one description only, packaged as specified in 5.1, shall be packed in a snug-fitting cleated-plywood shipping container conforming to overseas type, style A or I, grade A or B, type 2 load of PPP-B-601. Each shipping container shall be closed and reinforced in accordance with the appendix of the container specification. The weight of contents of each container shall not exceed 150 pounds.

5.2.2 Level B. Rolls and sheets of film of one description only, packaged as specified in 5.1, shall be shipped without further packing.

5.2.3 Level C. Film, packaged as specified in 5.1, shall be packed in a manner to insure carrier acceptance and safe delivery at destination at the lowest transportation rate for such supplies. Containers shall be in accordance with Uniform Freight Classification Rules or National Motor Freight Classification Rules, as applicable.

5.3 Palletization (military requirement). When specified (see 6.2), film of one description only, packed as specified in 5.2, shall be palletized in accordance with load type I or XIII (as applicable) of MIL-STD-147. Each prepared load shall be bonded with primary and secondary straps in accordance with bonding means F, K, and L (as applicable). Pallet patterns for type I loads shall be in accordance with the appendix of MIL-STD-147. Interlocking of type I loads shall be effected by reversing the pattern of each course. If the container is of a size which does not conform to any of the pallet patterns specified in MIL-STD-147, the pallet pattern used shall first be approved by the contracting officer. Storage aid 5 shall apply for type XIII loads.

5.4 Marking.

5.4.1 Civil agencies. In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with Fed. Std. No. 123.

5.4.2 Military requirements. In addition to any special marking required by the contract or order, interior packages, shipping containers and palletized unit loads shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Polyolefin film covered by this specification is intended for use in general purpose packaging applications where high degree of water resistance, moderate moisture vapor resistance, and dust protection are

L-P-378D

desired. The polyolefin sheet or strip is not intended for use in special packaging applications where special grease or oil resistance properties may be required.

6.1.1 Other applications. The class 1 film is for uses such as building material shrouds, including materials and similar non-food applications. The class 2 film is for uses such as food wrappings and the protection of critical items. In certain applications, some material requirements of this specification may not be essential and in the interest of overall economy and practicability conformance to and testing for, certain specific requirements, may be omitted in the applicable end item specifications. In view of the many applications, it is impossible to cover all conditions of use and the following are furnished for guidance purposes only:

<u>Use</u>	<u>Requirements recommended as not applicable to</u>
Packaging of clothing and related items where dust protection and appearance only are required	Impact resistance, slip, water-vapor permeability, and heat seal strength.
Window component in equipage	Slip, ink adhesion, water-vapor permeability.

The end item specification should specify which requirements of this document are not required and unless specific exception is made in the applicable end item specification, all requirements of this document are applicable.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type, class, grade, finish, and thickness required (see 1.2.1, 1.2.2, 3.3.1 and 3.4).
- (c) Color required, if applicable (see 3.1.1 and 3.1.2).
- (d) Form, length and width required (see 3.2, 3.5 and 3.6).
- (e) Whether roll material is single thickness or lay flat tubing (see 3.2).
- (f) If a specific core diameter is required (see 3.5.1).
- (g) Whether material is intended for class 1, 2, 3, or 4 applications.
- (h) Selection of applicable levels of packaging and packing (see 5.1 and 5.2).
- (i) When palletization is required (see 5.3).
- (j) When level B packaging is required for Civil agencies (see 5.1.2).



L-P-378D

**6.3 Source of materials or apparatus (see 4.3.6.1):**

- 1/ Texcel tape may be obtained from Industrial Tape Corporation, New Brunswick, New Jersey.
- 2/ Cenco-Bakelite Pulley No. 75660 may be obtained from Central Scientific Company, 1702 Irving Park Road, Chicago, Illinois.
- 3/ Anilox Hand Proofer may be obtained from Interchemical Corporation, P.O. Box 35, Hackensack, New Jersey.
- 4/ Zahn Cup Viscometer, No. 3 may be obtained from General Electric Company, Schenectady, New York.
- 5/ SPI Standard Ink Sample Flexo Ink No. 1 may be obtained from the Society of Plastic Industry, 250 Park Avenue, New York, New York.

**6.4 Supersession data.** This specification includes the requirements of MIL-P-3803 for polyolefin sheet and strip in thicknesses from 0.0010 to 0.0060 inch.

**6.5** Sheet and strip, as used in the title of this specification, are not synonymous with the ASTM definition of sheet and strip. For the purpose of cataloging, a sheet is defined as a plastic film furnished in widths greater than 6 inches and a strip as a film furnished in widths of 6 inches or less.

**Custodians:**

Army - GL  
Navy - SA  
Air Force - 69

**Review activities:**

Army - MD, MJ, SM  
Air Force - 71, 84

**User activities:**

Army - EL, AV  
Navy - MC, EC  
Air Force - 80

**Preparing activity:**

Army - GL

**Civil Agency Interest:**

AGR  
COM  
GSA  
JUS-FPI

★ U. S. GOVERNMENT PRINTING OFFICE : 1973 O - 514-175 ( 262 )

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 20 cents each.