

INCH-POUND  
 L-P-504E  
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SUPERSEDING  
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## FEDERAL SPECIFICATION

### PLASTIC SHEET AND FILM, CELLULOSE ACETATE

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 cellulose acetate plastic sheets and films of 0.001 to 1.000 inch (0.0025 to 2.54 cm) nominal thickness (see 3.1).

#### 1.2 Classification.

1.2.1 Types. Cellulose acetate sheets and film covered by this specification shall be of the following Types, as specified (see 6.2):

- I - General purpose.
- II - Mechanical and optical.
- III - Glazing (superior optical and outdoor weathering).

1.2.2 Part numbers. Part numbers for cataloging purposes under this specification shall be coded as follows:

LP504 - X  
 |           |  
           Type (1=I, 2=II, 3=III) (see 1.2.1)  
 Specification Designation

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (Code 53), Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## SPECIFICATIONS

## FEDERAL

PPP-8-636

Box, Shipping, Fiberboard

## STANDARDS

## MILITARY

MIL-STD-105

Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-129

Marking for Shipment and Storage

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

## ASTM

ASTM D256	Impact Resistance of Plastics and Electrical Insulating Materials
ASTM D542	Index of Refraction of Transparent Organic Plastics
ASTM D543	Resistance of Plastics to Chemical Reagents
ASTM D568	Rate of Burning and/or Extent of Time of Burning of Flexible Plastics in a Vertical Position
ASTM D570	Water Absorption of Plastics
ASTM D635	Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM D637	Surface Irregularities of Flat Transparent Plastic Sheets
ASTM D638	Tensile Properties of Plastics
ASTM D648	Deflection Temperature of Plastics Under Flexural Load
ASTM D696	Coefficient of Linear Thermal Expansion of Plastics
ASTM D792	Specific Gravity and Density of Plastics by Displacement
ASTM D882	Tensile Properties of Thin Plastic Sheeting

## ASTM

ASTM D883	Standard Definitions of Terms Relating to Plastics
ASTM D1003	Haze and Luminous Transmittance of Transparent Plastics
ASTM D4329	Operating Light and Water Exposure Apparatus (Fluorescent UV-Condensation Type) For Exposure of Plastics

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103-1187).

## NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC.

## National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic, Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.)

## UNIFORM CLASSIFICATION COMMITTEE

## Uniform Freight Classification Rules

(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. Plastic sheet and film shall be processed from virgin cellulose acetate polymer, appropriately plasticized, without the addition of dyes or pigments (unless otherwise specified). Clean cellulose acetate scrap from the sheet or film manufacturing process may be reworked provided it is blended with the same type of material by the same manufacturer. The use of cellulose diacetate or triacetate is acceptable, but they shall not be blended together.

3.1.1 Laminations. Laminated cellulose acetate shall not be permitted when Type III material is specified. Laminated products shall be prohibited when the material is to be subjected to outdoor weathering.

3.1.2 Form. Types I and II material shall be furnished as cut sheets or rolls, as specified (see 6.2). Type III shall be furnished as cut sheets only.

3.1.2.1 Film. Unless otherwise specified, film material (as defined in ASTM D883) shall be supplied in rolls. Each roll shall be wound on a substantial core with an inside diameter of not less than 3 inches (7.6 cm). The rolls shall not exceed 150 pounds (60 kg) in weight or 14 inches (35 cm) in diameter, and shall be suitably restrained from unwinding.

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3.2 Dimensions and tolerances.

3.2.1 Material thickness. The nominal dimensions and tolerances for the Type I and II material thicknesses shall be as specified in Table IA. The nominal dimensions and tolerances for the Type III material thickness shall be as specified in Table IB.

TABLE IA. Nominal thicknesses and tolerances for Types I and II material.

Nominal Thickness Inch (cm)	Actual Thickness 1/	
	Minimum, Inch (cm)	Maximum, Inch (cm)
.001 to .004 (.0025 to .01)	Nominal - .00025 (.00064)	Nominal + .00025 (.00064)
.005 (0.013)	.0045 (.014)	.006 (.0152)
.0075 (0.019)	.0065 (.0165)	.0085 (.0216)
.008 (0.019)	.007 (.0165)	.009 (.0216)
.010 (0.025)	.009 (.023)	.011 (.028)
.015 (0.038)	.014 (.035)	.017 (.043)
.020 (0.051)	.018 (.046)	.022 (.056)
.025 (0.064)	.023 (.058)	.027 (.068)
.030 (0.076)	.028 (.071)	.033 (.084)
.040 (0.102)	.037 (.094)	.044 (.112)
.050 (0.127)	.047 (.119)	.054 (.137)
.060 (0.152)	.057 (.145)	.064 (.163)
.070 (0.178)	.067 (.170)	.074 (.188)
.080 (0.203)	.076 (.193)	.084 (.213)
.090 (0.229)	.086 (.218)	.095 (.241)
.100 (0.254)	.095 (.241)	.105 (.267)
.110 (0.279)	.105 (.267)	.115 (.292)
.125 (0.318)	.120 (.305)	.132 (.335)
.135 (0.343)	.130 (.330)	.144 (.366)
.150 (0.381)	.144 (.366)	.158 (.401)
.160 (0.406)	.153 (.389)	.168 (.427)
.175 (0.444)	.168 (.427)	.183 (.465)
.185 (0.470)	.177 (.450)	.195 (.495)
.200 (0.508)	.190 (.483)	.210 (.533)
.225 (0.572)	.215 (.546)	.240 (.610)
.250 (0.635)	.240 (.610)	.265 (.673)
.500 (1.27)	.485 (1.23)	.515 (1.31)
1.000 (2.54)	.985 (2.50)	1.015 (2.58)

1/ - For Type I material, the average determined thickness shall fall within the specified minimum and maximum tolerance requirements. For Type II material, the thickness determined at any given point shall meet the specified minimum and maximum tolerance requirements.

3.2.2 Length and width. The length and width of the sheet and roll material shall be as specified in the contract or order. The standard trim size for sheet material shall be 20 by 50 inches (50.8 by 127 cm). Unless otherwise specified, the length and width tolerances for sheets and the width tolerances for rolls shall be  $\pm 0.25$  inch (0.64 cm). The tolerance for roll length shall be -0.

TABLE IB. Nominal thicknesses and tolerances for Type III material(1/).

Nominal thickness Inch (cm)	Tolerance Inch (cm)	/	Nominal thickness Inch (cm)	Tolerance Inch (cm)
0.060 (.152)	+ .006 (.015)	/	.187 (.474)	+ .013 (.033)
.080 (.203)	+ .007 (.018)	/	.220 (.559)	+ .015 (.038)
.100 (.254)	+ .008 (.020)	/	.250 (.635)	+ .017 (.043)
.125 (.318)	+ .010 (.025)	/	.500 1/ (1.27)	+ .015 (.038)
.150 (.381)	+ .011 (.028)	/	1.000 1/ (2.54)	+ .015 (.038)

1/ - The thickness determined at any given point shall meet the specified tolerance requirements.

3.3 Color. Unless otherwise specified (see 6.2), the material shall be furnished clear (as manufactured), without color additives. When a color is specified, the contract or order shall indicate the spectral transmission, reflection limits and haze requirements before and after exposure to accelerated weathering.

3.4 Finish. The material shall be furnished with a high polish finish, unless a matte finish or other special finish is specified in the contract or purchase order. Polish describes surface smoothness in terms of light reflection, generally mirror-like, but with localized distortion of reflected images.

3.5 Physical and mechanical properties. The physical and mechanical properties of the cellulose acetate material shall be as specified in Tables II and III.

3.6 Chemical resistance. The resistance of the cellulose acetate to specific chemicals shall be as specified in the contract or purchase order (see 6.5).

3.7 Instruction sheet. When specified, a dated instruction sheet covering the limitations of the material and the necessary precautions to be observed in handling, storing, cutting, drilling, machining, forming, bending, adhesive bonding, polishing and cleaning shall be furnished with each unit package in the shipment. Instruction sheets shall describe all compounds, materials and equipment mentioned therein, in sufficient detail to permit nonproprietary procuring using Government specifications when available. Instruction sheets shall be approved by the procuring activity prior to issuance.

3.8 Resistance to accelerated weathering. After exposure to the accelerated weathering test specified in 4.4.12, Type III material shall show no cracking, crazing, surface instability, or other defect that reduces visibility through the material. Requirements for parallel light transmittance, haze and warpage after accelerated weathering shall be as specified in Table III.

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TABLE II. Physical and mechanical requirements for cellulose acetate material. 1/

PROPERTY	Type I Material		Type II Material				Type III Material	Test Method	
	Thickness, Inch 2/	Thickness, Inch 2/	Thickness, Inch 2/	Thickness, Inch 2/	Thickness, Inch 2/	Thickness, Inch 2/			
Refractive index, 23°C:	0.001 to 0.030	0.061 to 0.100	0.001 to 0.030	0.031 to 0.060	0.061 to 0.100	0.101 to 0.250	1.485 1.495	4.4.1	
	1.485 1.495	1.485 1.495	1.485 1.495	1.485 1.495	1.485 1.495	1.485 1.495			
Specific gravity, 23°/23°C (73.4°/73.4°F):	1.27 1.34	1.27 1.34	1.27 1.34	1.27 1.34	1.27 1.34	1.27 1.34	1.25 1.35	4.4.2	
	--	--	--	--	--	--			
Haze, maximum, percent	--	--	3.0	3.0	5.0	8.0	4/	4.4.3	
Parallel light transmission, minimum %	--	--	88	86	3/	3/	4/	4.4.3	
Optical-angular displacement, maximum, minutes	--	--	--	--	--	--	5	4.4.4	
Optical distortion value, minimum	--	--	--	--	--	--	4	4.4.4	
Water absorption:									
Weight gain plus soluble matter loss, maximum percent	9.0 4.0	7.5 2.0	7.0 1.0	4.5 0.5	7.0 4.0	6.5 2.0	5.5 1.0	3.5 0.5	4.4.5
Soluble matter loss, maximum, %	--	--	--	--	--	--	--	--	4.4.6
Flammability, maximum:									
Over 0.050 in. thick, in. per min.	--	6	4	4	--	3.5	3.0	2.5	(ASTM D635)
(Over .1270 cm. thick, cm per min)	--	(15.4)	(10.2)	(10.2)	--	(8.9)	(7.6)	(6.3)	
0.031 to 0.050 in. thick, sq in./sec	--	0.4	--	--	--	0.25	--	--	4.4.6
(.0787 to .1270 cm. thick, cm <sup>2</sup> x10 <sup>-3</sup> /sec)	--	(0.26)	--	--	--	(0.16)	--	--	
0.016 to 0.030 in. thick, sq in./sec	0.5	--	--	--	0.25	--	--	--	4.4.6
(.0406 to .0762 cm. thick, cm <sup>2</sup> x10 <sup>-3</sup> /sec)	(0.32)	--	--	--	(0.16)	--	--	--	
0.011 to 0.015 in. thick, sq in./sec	1.0	--	--	--	0.50	--	--	--	4.4.6
(.0279 to .0381 cm. thick, cm <sup>2</sup> x10 <sup>-3</sup> /sec)	(0.64)	--	--	--	(0.32)	--	--	--	
.003 to .010 in. thick, sq in./sec	1.5	--	--	--	1.0	--	--	--	4.4.6
(.0076 to .0254 thick cm., cm <sup>2</sup> x10 <sup>-3</sup> /sec)	(0.97)	--	--	--	(0.64)	--	--	--	
.001 to .002 in. thick, sq in./sec	6.0	--	--	--	4.0	--	--	--	4.4.6
(.0025 to .0051 thick cm., cm <sup>2</sup> x10 <sup>-3</sup> /sec)	(3.9)	--	--	--	(2.6)	--	--	--	

TABLE II (continued). Physical and mechanical requirements for cellulose acetate material. 1/

PROPERTY	Type I Material		Type II Material		Type III Material	Test Method
	Thickness, Inch 2/		Thickness, Inch 2/			
	0.001 to 0.030	0.061 to 0.100	0.001 to 0.030	0.061 to 0.100		
Deflection temperature at 264 psi (1.82 MPa) fiber stress:						
Minimum:						
•C	5/	55	5/	55	55	4.4.7
•F	5/	131	5/	131	131	
Maximum:						
•C	--	--	--	--	80	4.4.8
•F	--	--	--	--	176	
Tensile strength, minimum, psi (MPa)	5300 (36.6)	4500 (31.0)	6000 (41.4)	5000 (34.5)	4750 (32.4)	
Elongation at rupture, minimum percent	25	25	25	25	20	4.4.8
Impact strength, Izod, minimum ft-lbf per inch (Joules per meter)						
At 23°C (73.4°F)	5/	1.4 (74.2)	5/	1.4 (74.2)	1.4 (74.2)	4.4.9
At -40°C (-40°F)	5/	0.25 (13.3)	5/	0.25 (13.3)	0.25 (13.3)	
Thermal expansion coefficient:						
Per °C	--	--	--	--	0.00018	4.4.10
Per °F	--	--	--	--	0.00010	

1/ See Table III for requirements applicable only to Type III.

2/ When sheet thickness greater than 0.250 inch (0.64 cm) are supplied, specimens obtained from 0.250 inch (0.64 cm) thick sheet shall be tested for conformance to Table II (see 4.2.1.2.3.1).

3/ Values shall conform to those given in Table III for Type III materials of equivalent thickness.

4/ Requirement varies with thickness as specified in Table III.

5/ This test method is limited by a minimum specimen thickness. Specimens obtained from 0.125 in. (0.32 cm) thick material shall be tested for conformance to Table II (see 4.2.1.2.3.1).

6/ For material supplied in thicknesses less than 0.125 in. (0.318 cm) but greater than or equal to 0.04 in. (0.10 cm), composite specimens shall be tested for conformance to Table II as specified in 4.4.7. For thicknesses less than 0.04 in. (0.10 cm), note 5/ above shall apply.

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TABLE III. Physical requirements which vary with thickness for Type III cellulose acetate plastic sheets.

Nominal thickness	Water absorption, weight gain plus soluble matter loss, maximum	Parallel light transmission, minimum	Parallel light transmission after accelerated weathering, minimum	Haze, Maximum	Haze after accelerated weathering, maximum	Warpage after accelerated weathering, maximum	Rate of burning, maximum	Formability Radius
	Percent	Percent	Percent	Percent	Percent	Inch (cm)	In./min. (cm/min)	Inch (cm)
0.060 (.152)	5.0	85	84	5	7	0.090 (.279)	3.5 (8.9)	1.5 (3.8)
.080 (.203)	4.3	84	82	5	7	.080 (.203)	2.7 (6.8)	2.0 (5.1)
.100 (.254)	3.4	83	80	6	8	.070 (.178)	2.4 (6.1)	2.5 (6.4)
.125 (.318)	3.0	81	78	6	8	.060 (.152)	2.0 (5.1)	3.1 (7.9)
.150 (.381)	2.7	80	77	7	9	.050 (.127)	2.0 (5.1)	3.8 (9.7)
.187 (.474)	2.2	78	75	7	9	.040 (.102)	2.0 (5.1)	4.7 (12)
.220 (.559)	2.0	76	73	8	10	.035 (.089)	2.0 (5.1)	5.5 (14)
.250 (.635)	1.9	74	71	9	11	.030 (.076)	2.0 (5.1)	6.3 (16)
.500 (1.27)	1/	1/	1/	1/	1/	1/	1/	1/
1.000 (2.54)	1/	1/	1/	1/	1/	1/	1/	1/

1/ When sheet thickness greater than 0.250 inch (0.64 cm) are supplied, specimens obtained from 0.250 inch (0.64 cm) thick sheet shall be tested for conformance to Table III (see 4.2.1.2.3.1).



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**3.9 Optical defects.** Type III material shall conform to the requirements for angular displacement and optical distortion in Table II. Minor defects determined by visual examination are allowed provided the number of occurrences does not exceed a limit determined by dividing the area, in square feet, of the sheet being tested, by four. If this limit is exceeded, this shall be considered a major defect, and be cause for rejection. Minor defects shall include each imbedded particle, bubble, scratch and crazed area which reduces visibility through the plastic, and shall also include each localized imperfection and blemish which produces an angular displacement of more than five minutes, when tested as specified in 4.4.4. Localized imperfections and blemishes which do not appear to reduce visibility, nor cause an angular displacement of more than five minutes, shall be classified as a minor defect if grouped in an objectionable pattern.

**3.10 Surface stability.** Type III material shall show no change in surface appearance when visually compared to an untreated control specimen after testing in accordance with 4.4.14.

**3.11 Formability.** When tested in accordance with 4.4.11, the Type III material shall not contain visible evidence of cracking, crazing or other surface irregularities on the specimens after cooling to room temperature, nor after completion of the accelerated weathering test.

**3.12 Special military requirements.**

**3.12.1 Suitability for use with explosives.** When suitability for use with a particular explosive is required, a special test shall be conducted at a designated Government laboratory to determine compliance of the material in this respect (see 6.3). This test shall be requested by the procuring activity.

**3.13 Workmanship.** The material shall be free from warpage, cracks, scratches and other defects that affect the appearance or that might affect the serviceability. In addition, the material shall be uniform in color, transparency or opacity, finish, density and other physical properties.

#### **4 QUALITY ASSURANCE PROVISIONS**

**4.1 Responsibility for inspection.** Unless otherwise specified herein or in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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.

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4.1.1 Responsibility for compliance. All items must 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 defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as quality conformance inspections and tests, see 4.2.1.

4.2.1 Quality conformance inspection. Quality conformance inspections shall be performed on every lot of material supplied (see 4.2.1.1) and shall be conducted as specified herein.

4.2.1.1 Lot formation. Unless otherwise specified, a lot shall consist of all the material of the same Type, finish, thickness, color and form submitted for inspection at one time.

4.2.1.2 Sampling for inspection. All sampling plans as specified herein shall be in accordance with MIL-STD-105.

4.2.1.2.1 Sampling for visual inspection of end item. The lot size shall be the number of packages of plastic sheets or rolls of film as applicable, except for preparation of delivery (see 4.2.1.3.1.4). The inspection levels, acceptable quality levels (AQL) and sample unit shall be as specified in Table IV. Examinations and classification of defects shall be as specified in 4.2.1.3.1.1 through 4.2.1.3.1.4. To the greatest extent possible, samples selected for one examination may be used for subsequent visual examinations.

TABLE IV. Sampling Plans for Visual Inspections

Examination Paragraph	Sample Unit	Inspection Level	AQL
4.2.1.3.1.1	One linear yard (one meter) or 1 sheet 1/	I	1.5
4.2.1.3.1.2	1 sheet or roll	S-3	2.5
4.2.1.3.1.3	One package of sheets or one roll	S-2	2.5
4.2.1.3.1.4	1 shipping container	S-2	4.0

1/ No more than 5 sample units shall be taken from any roll or package of sheets.

4.2.1.2.2 Sampling for physical and mechanical property inspection.

4.2.1.2.2.1 Rolls. The lot size shall be expressed as the total number of rolls. The number of rolls to be sampled from the lot shall be determined in accordance with inspection level S-1. A sample unit shall consist of a sufficient amount of material (at least 3 ft<sup>2</sup> (0.29m<sup>2</sup>)) taken from each roll sampled to conduct the required tests as specified in 4.2.1.3.2.

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4.2.1.2.2.2 Sheets. The lot size shall be expressed as the total number of sheets. The number of sample units required to be taken from the lot shall be determined in accordance with inspection level S-1; however, no more than one sample unit shall be selected from each package of sheets. A sample unit shall consist of a sufficient amount of material to conduct the required tests as specified in 4.2.1.3.2.

4.2.1.2.3 Special sampling procedures for physical and mechanical property testing.

4.2.1.2.3.1 Thickness requirements. When the as supplied Type I and II materials cannot be tested for heat deflection and impact resistance due to minimum thickness limitations in the test methods (see Table II), specimens shall be obtained from material having a thickness of 0.125 in. (0.32 cm). When the as supplied Type I, II, or III material thickness is over 0.250 inch (0.635 cm), specimens shall be obtained from material having a thickness of 0.250 in. (0.635 cm) (see Tables II and III). All material from which these specimens are taken shall be manufactured from the same plastic composition and under (as much as possible) the same conditions as the material being supplied. In addition, no special treatment shall be used to improve the material properties of the specimens. The suppliers shall furnish the correct number of sample units based on the sampling plan specified in 4.2.1.2.2.

4.2.1.2.3.2 Formability (Type III). When the continuous length of a Type III sample unit is less than that required for the formability tests, the required number of specimens shall be cut from larger lengths of the same material and thickness. The length of specimen required is approximately 6.3 times the formability radius specified in Table III.

4.2.1.3 Examination and testing.

4.2.1.3.1 Visual examination of end item.

4.2.1.3.1.1 Defects in appearance. Samples selected in accordance with 4.2.1.2.1 shall be examined for defects in appearance as specified in Table V.

TABLE V. Examination of the end item for defects in appearance construction and workmanship, 1/.

Examine	Defects
Form	Not in rolls or flat cut sheets, as specified.
Appearance	Not clean, presence of any imbedded particles, dirt, grits or other foreign matter.
	Material not uniform in finish, color, transparency or opacity (as applicable) in accordance with contractual requirements.
Construction and workmanship	Any cracks, scratches, bubbles, warpage, striae, pits or other defects that would affect serviceability.
	Any cut, puncture, sharp crease, wrinkle, tear or hole.
	Edges not cut clean; ragged, crushed or uneven edges.

1/ Minor optical imperfections and blemishes shall be evaluated as indicated in 3.9 before being scored as defects.

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4.2.1.3.1.2 Dimensional defects. Samples selected in accordance with 4.2.1.2.1 shall be examined for dimensional defects as specified in Table VI.

TABLE VI. Examination of the end item for dimensional defects.

Examine	Defects
Length and width of sheets	Varies by more than plus or minus 1/4 inch (0.635 cm) from length and width specified.
Width of rolls	Varies by more than plus or minus 1/4 inch (0.635 cm) from width specified.
Thickness	Not within specified tolerances or range, as applicable.
Core (diameter)	Inside diameter less than 3 inches (7.6 cm).
Rolls (diameter)	Outside diameter more than 14 inches (35 cm).

4.2.1.3.1.3 Assembly and count defects. Samples selected in accordance with 4.2.1.2.1 shall be examined for assembly and count defects as specified in Table VII.

TABLE VII. Assembly and count defects.

Examine	Defects
Assembly of sheets	Not evenly stacked.
	Not interleaved to prevent adherence of sheets.
Assembly of rolls	Not suitably restrained to prevent unwinding.
	Material not wound evenly and tightly on roll causing uneven edges or telescoping of the roll.
	Rolls not wound on a substantial core. Core broken, collapsed, crushed or mutilated.
Count	- Sheet
	- Rolls
	Average count per package of sheets is less than specified.
	Average length or weight per roll, as applicable, less than specified.

4.2.1.3.1.4 Examination of preparation for delivery. Samples selected in accordance with 4.2.1.2.1 shall be examined as specified in Table VIII to determine that packaging, packing and marking comply with the requirements of Section 5. The lot size for this examination shall be the number of shipping containers. The sample unit shall be one shipping container, fully packed, selected just prior to the closing operation. Shipping containers fully prepared for delivery shall be examined for closure defects.

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TABLE VIII. Examination of preparation for delivery.

Examine	Defects
Packaging	Not level specified; not in accordance with contract requirements.
	Sheets or rolls (as applicable) not unit wrapped and packaged, as specified.
	Packaging material not as specified; closures not accomplished by specified or required methods or materials.
Packing	Not level specified; not in accordance with contract requirements.
	Any nonconforming component, component missing, damaged or otherwise defective affecting serviceability.
	Container not as specified; closures not accomplished by specified or required methods or materials.
	Inadequate application of components such as: incomplete closures of case liners, container flaps, loose or inadequate strappings, bulged or distorted container.
Count	Less than specified or indicated quantity of packages or rolls per shipping container.
Weight	Gross or net weight exceeds specified requirements.
Instruction sheet	Missing or not as specified (see 3.7).
Markings	Interior or exterior markings (as applicable) omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements.
Precautionary markings	Missing or not as specified (see 5.3.3).

4.2.1.3.2 Physical and mechanical testing of end item. Each end item sample unit selected in accordance with 4.2.1.2.2 shall be tested for conformance to the physical and mechanical requirements in Table IX. The number of specimens for each test and method of reporting test results are contained in Table IX. Failure to conform to any of the requirements in Table IX shall be cause to reject the represented lot.

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TABLE IX. Instructions for testing (sample unit). 1/

Characteristic	Requirement	Test Paragraph	Number of specimens per sample unit	Results reported as	
				Pass or fail 2/	Numerically to the nearest 3/
Refractive Index -----	Table II	4.4.1	Avg of 3	--	0.001
Specific gravity -----	Table II	4.4.2	Avg of 3	--	0.01
Parallel light transmission Type II -----	Table II	4.4.3	Avg of 3	--	0.1 percent
Type III As rec'd -----	Table III	4.4.3	Avg of 3	--	0.1 percent
After accelerated weathering -----	Table III	4.4.3	Avg of 3	--	0.1 percent
Haze Type II -----	Table II	4.4.3	Avg of 3	--	0.1 percent
Type III As rec'd -----	Table III	4.4.3	Avg of 3	--	0.1 percent
After accelerated weathering -----	Table III	4.4.3	Avg of 3	--	0.1 percent
Optical angular displacement Type III only -----	3.9	4.4.4	Avg of 3	--	1 minute
Water absorption Types I and II					
Weight gain and soluble matter loss	Table II	4.4.5	Avg of 3	--	0.1 percent
Soluble matter loss -----	Table II	4.4.5	Avg of 3	--	0.1 percent
Type III -----	Table III	4.4.5	Avg of 3	--	0.1 percent
Flammability Types I and II	Table II	4.4.6	Avg of 3	--	0.1 in./min. (0.25 cm/min.)
Over 0.050 inch (0.127 cm) thick -----	Table II	4.4.6	Avg of 3	--	0.02 sq. in./sec. (1.29x10 <sup>-3</sup> cm <sup>2</sup> /sec.)
Under 0.050 inch (0.127 cm) thick -----	Table III	4.4.6	Avg of 3	--	0.1 in./minute (0.25 cm/min.)
Type III -----					
Deflection temperature Minimum -----	Table II	4.4.7	Avg of 3	--	Degree
Maximum (Type III only) -----	Table II	4.4.7	Avg of 3	--	Degree
Tensile strength -----	Table II	4.4.8	Avg of 5	--	psi (MPa)
Elongation at rupture -----	Table II	4.4.8	Avg of 5	--	percent

TABLE IX(continued). Instructions for testing (sample unit). 1/

Characteristic	Requirement	Test Paragraph	Number of specimens per sample unit	Results reported as 3/	
				Pass or fail 2/	Numerically to the nearest
Impact strength (Izod) @ 23°C (73.4°F) -----	Table II	4.4.9	Avg of 5	--	0.01 ft.lb/in. notch (0.53J/m notch)
@ -40°C (-40°F) -----	Table II	4.4.9	Avg of 5	--	0.01 ft.lb/in. notch (0.53J/m notch)
Thermal expansion coefficient	Table II	4.4.10	Avg of 2	--	0.00001/°
Type III only -----	Table III	4.4.11	3	X	--
Formability, Type III only -----	3.8	4.4.12	3	X	--
Accelerated weathering	Table III	4.4.13	Avg of 3	--	0.001 in(0.0025 cm)
Type III only -----	3.10	4.4.14	2	X	--
Warpage after accelerated weathering -----	3.6	4.4.15	3	X	--
Surface stability -----	3.12.1	See 6.3	1	X	--
Chemical resistance (when specified) -----					
Suitability for use with explosives 4/-----					

1/ All requirements apply to the individual sample unit.

2/ If failure is indicated, report description of failure.

3/ Test reports shall include all values obtained before averaging.

4/ When specified, the contracting officer shall designate the testing laboratory (see 6.3).

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**4.3 Standard conditions.** Unless otherwise specified, standard conditions shall be  $23 \pm 1.1^{\circ}\text{C}$  ( $73.4 \pm 2^{\circ}\text{F}$ ) and  $50 \pm 4$  percent relative humidity. Unless otherwise specified, all specimens shall be conditioned at standard condition for a minimum of 24 hours.

**4.4 Test methods.**

**4.4.1 Refractive index.** Three specimens shall be tested in accordance with the refractometric procedure of ASTM D542. The requirements for this test are applicable only to clear (as manufactured) materials, see 3.3.

**4.4.2 Specific gravity.** Three specimens shall be tested in accordance with ASTM D792.

**4.4.3 Light transmission and haze.** Three specimens shall be tested as specified in ASTM D1003, Procedure A or B, for light transmission and haze. The same specimens shall then be subjected to the accelerated weathering of 4.4.12, followed by examination for warpage as specified in 4.4.13. Following this, they shall be immersed in distilled water, maintained at a temperature of  $23^{\circ} \pm 1.1^{\circ}\text{C}$  ( $73.4^{\circ} \pm 2^{\circ}\text{F}$ ) for not more than ten seconds. The surface moisture shall then be removed by carefully blotting the specimen prior to the determination of parallel light transmission and haze. Rubbing the specimen to remove surface moisture shall not be permitted. The requirements for this test are applicable only to clear (as manufactured) materials with a high polish finish (see 3.3 and 3.4).

**4.4.4 Optical uniformity and distortion.** Three entire sheets of material shall be used for examination in accordance with ASTM D637. Each sheet shall be examined, then rotated  $90^{\circ}$  and re-examined.

**4.4.5 Water absorption.** Three test specimens shall be conditioned 4 hours at  $50^{\circ} \pm 3^{\circ}\text{C}$  ( $122^{\circ} \pm 5.4^{\circ}\text{F}$ ). Type I and II materials shall be tested in accordance with the 24 hour immersion procedures of ASTM D570. Type III shall be tested in accordance with the long term immersion procedure of ASTM D570.

**4.4.6 Flammability.** Specimens over 0.050 inch (0.127 cm) thick shall be tested as specified in ASTM D635. All other thicknesses shall be tested in accordance with ASTM D568. Results shall be reported as indicated in Table IX.

**4.4.7 Deflection temperature.** Three specimens shall be tested in accordance with ASTM D648. For material having a thickness less than 0.125 in. (0.318 cm) but equal to or greater than 0.04 in. (0.10 cm), composite specimens as specified in ASTM D648 shall be prepared and tested.

**4.4.8 Tensile strength and elongation.** For material having a thickness of 0.040 inches (0.10 cm) or greater, tensile testing shall be performed in accordance with ASTM D638. If the material thickness is less than 0.04 inches (0.10 cm), tensile testing shall be performed in accordance with ASTM D882. In either case five specimens shall be used and percent elongation shall be determined at break.

**4.4.9 Impact strength, Izod.** The impact tests shall be conducted in accordance with Method A or C of ASTM D256. Five specimens shall be conditioned and tested at  $23^{\circ} \pm 1.1^{\circ}\text{C}$  ( $73.4^{\circ} \pm 2^{\circ}\text{F}$ ), and five additional specimens shall be conditioned for at least 24 hours at  $-40^{\circ} \pm 2^{\circ}\text{C}$  ( $-40^{\circ} \pm 3.6^{\circ}\text{F}$ ) prior to testing at this temperature.



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4.4.10 Thermal expansion coefficient. Two specimens shall be tested in accordance with ASTM D696. If the results obtained on the two specimens agree within 10 percent of the larger value, the mean of the two values shall be reported. If not, the test shall be repeated until a given pair of specimens yield two values which are within the 10 percent tolerance, and the mean of these two values shall be reported.

4.4.11 Formability. Three specimens shall be subjected to the formability test as specified herein. The radius over which the material is being formed shall be as specified in Table III. The specimen length shall be three times the formability radius for the particular thickness being tested. The width of the specimen shall be 4 inches (10.3 cm). The heating and forming shall be in accordance with the manufacturer's instructions. The heating shall be at the temperature and for the time specified. Uniform, dry oven heat is preferable but heating in a suitable oil is satisfactory. The forming shall be done over wooden molds covered with soft lintless cloth. The pressure used in forming and the length of time during which the plastic remains in the forms shall be in accordance with the manufacturer's instructions. After the formed specimens have been cooled to room temperature, 20° to 30°C (68° to 86°F), a section 1.5 inches (3.9 cm) along the circumference and 4 inches (10.2 cm) long shall be cut from each of the specimens and they shall be subjected to the accelerated weathering test, see 4.4.12. The specimens shall be examined before and after exposure to the accelerated weathering test for conformance to 3.11.

4.4.12 Accelerated weathering. The three specimens from 4.4.3 and three from 4.4.11 shall be subjected to the accelerated weathering test in ASTM D4329, except that the duration of the test shall be ten-12 hour cycles (120 hours) and each 12 hour cycle shall consist of 8 hours of UV exposure at 140°F (60°C) and 4 hours of condensation exposure at 104°F (40°C).

4.4.13 Warpage after accelerated weathering. The accelerated weathering specimens shall be conditioned on a plane surface. After conditioning, the specimens shall be measured for warpage by determining the greatest perpendicular distance from a straight edge connecting diagonally opposite corners to the rear surface of the plastic. This distance shall be measured by means of a dial micrometer, a thickness gage, or any other device having an accuracy of 0.001 inch (0.0025 cm). The warpage reported shall be the maximum value, not the average for the three specimens. This test shall be completed before the specimens are immersed in distilled water, as required in 4.4.3.

4.4.14 Surface stability. Two specimens each 2 by 3 inches (5.1 by 7.6 cm) by the thickness of the material being tested shall be immersed in U.S.P Petrolatum, or equivalent at  $100^{\circ} \pm 3^{\circ}\text{C}$  ( $212^{\circ} \pm 5.4^{\circ}\text{F}$ ) for 3 minutes, removed, cooled and cleaned with a soft cloth or lens paper. The immersed specimen shall be compared to an untreated control for compliance to 3.10.

4.4.15 Chemical resistance. Three specimens shall be tested in accordance with ASTM D543.

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## 5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A or commercial as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Rolls. Each roll shall be wrapped with at least one layer of kraft wrapping paper and tightly sealed with waterproof tape.

5.1.1.2 Sheets. Sheet material shall be interleaved with paper to prevent adherence of sheets to each other and shall be overwrapped as specified in 5.1.1.1.

5.1.2 Commercial. Roll and sheet material shall be packaged in accordance with the manufacturer's standard practice to afford protection against deterioration and damage during shipment, handling and storage.

5.2 Packing. Packing shall be level A, or commercial, as specified.

5.2.1 Level A.

5.2.1.1 Rolls. Rolls packaged in accordance with 5.1.1.1 shall be packed in quantities specified in the contract or purchase order in a close fitting box conforming to PPP-B-636, weather resistant class. The box shall be closed, waterproofed and reinforced in accordance with the appendix of PPP-B-636.

5.2.1.2 Sheets. Sheets packaged in accordance with 5.1.1.2 shall be packed as specified in 5.2.1.1 or alternatively cleated plywood, wire bound, nailed wood or triple walled fiberboard boxes shall be acceptable shipping containers when lined with a waterproof barrier material. The edges of the barrier material shall be sealed with waterproof tape or adhesive.

5.2.2 Commercial. Sheets and rolls packaged as specified in 5.1.2 shall be packed in a manner that will insure acceptance by common carrier and provide product protection against loss and damage during multiple shipments, handling and storage. The shipping container shall be in compliance with National Motor Freight Classification and Uniform Freight Classification.

5.3 Marking.

5.3.1 Civil purchases. Marking shall be as specified in the contract or order.

5.3.2 Military purchases. In addition to any special markings required by the contract or purchase order, unit packages and shipping containers shall be marked in accordance with MIL-STD-129 and shall include the following information:

L-P-504 and revision letter  
Color (if other than colorless)  
Finish (if other than high polish)  
Size and thickness

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### 5.3.3 Precautionary marking.

5.3.3.1 Rolls. In addition to the marking above, the following precautionary marking shall appear in letters not less than 0.75 inch (1.91 cm) in height on at least one side, and wherever practical, on two sides of each drum or box containing rolls:

STAND ON END  
KEEP COOL AND DRY

5.3.3.2 Sheets. Containers for flat sheets shall be marked on at least one side, and wherever practical on two opposite sides, with the following:

STORE FLAT  
KEEP COOL AND DRY

## 6. NOTES

6.1 Intended use. The Type I material is intended for use in bulletin board covers, index guide cards and containers. Type II material is intended for use in ordinary glazing applications, transparent housings for instruments and safety goggles and helmets. Type III material is intended for applications requiring superior optical properties and resistance to outdoor weathering. Type III material is not for use as a glazing material on any aircraft. Reference to this specification on drawings or in product specifications may be made in order to specify flat or straight material to be used in the fabrication of a part. It must be clearly understood that the requirements apply to the flat or straight material prior to forming or fabrication and not necessarily to the material in its final form. The chief characteristics of cellulose acetate plastic sheets are their thermoplasticity, toughness, high impact strength and ease of fabrication. Their limited resistance to cold flow and the dimensional changes to be expected in service must be considered. Cellulose acetate plastics are only suitable for applications involving relatively low loads and in which some shrinkage on aging can be tolerated.

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 required (see 1.2.1).
- c. Form required (see 3.1.2).
- d. Dimensions required (see 3.2).
- e. Color required, if any (see 3.3).
- f. Finish desired (see 3.4).
- g. Chemical resistance required, if any (see 3.6).
- h. Suitability for use with explosives, if desired (see 3.12.1).
- i. Selection of the applicable levels of packaging and packing.

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6.3 Suitability for use with explosives. Information on suitability or unsuitability of some polymeric materials and adhesives for use with explosives is available at ARRADCOM. Applications for tests to determine the suitability of adhesives with explosives or propellants should be made to the Commander, U.S. Army Armament Research and Development Command, Dover, NJ 07801, Attn: Chief, Stability Section DRDAR-LCN-DP-B.

6.4 Ultraviolet transmission. With respect to transmission of ultraviolet light, cellulose acetate material is intermediate between ordinary glass (low transmission) and general purpose methyl methacrylate (relatively high transmission).

6.5 Chemical resistance. In general, the cellulose acetate polymer will degrade (decompose) in the presence of fairly concentrated acids (ie. 10% nitric, 30% sulfuric, or 10% hydrochloric) and bases (such as sodium hydroxide or 10% ammonium hydroxide). Softening, swelling or dissolution will occur when cellulose acetate is exposed to polar solvents such as ketones (ie. acetone) and esters (ie. ethyl acetate). As a result, it is not recommended to use cellulose acetate where contact with these types of materials may occur.

6.6 Subject term (keyword) Listing.

Cellulose  
Cellulose Acetate  
Cellulosics  
Plastic  
Plastic Film  
Plastic Sheet

MILITARY INTERESTS:

Custodians:

Army - MR  
Navy - AS  
Air Force - 11

Review Activities:

Army - CR, EA, GL, ME  
DLA - GS

Civil Agency Coordinating Activities

COM-NBS  
GSA-FSS

Preparing Activity:

Navy - AS  
(Project No. 9330-1156)

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER  
L-P-504E

2. DOCUMENT DATE (YYMMDD)  
17 June 1991

3. DOCUMENT TITLE  
PLASTIC SHEET AND FILM, CELLULOSE ACETATE

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

e. DATE SUBMITTED (YYMMDD)

(1) Commercial  
(2) AUTOVON  
(If applicable)

8. PREPARING ACTIVITY

a. NAME

Commanding Officer  
NAEC, SESD, Code 53

b. TELEPHONE (Include Area Code)

(1) Commercial  
(908) 323-7481

(2) AUTOVON  
624-7481

ADDRESS (Include Zip Code)

Lakehurst, NJ 08733-5100

**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:**  
Defense Quality and Standardization Office  
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466  
Telephone (703) 756-2340 AUTOVON 289-2340