

L-P-535E
April 27, 1979
SUPERSEDING
Fed. Spec. L-P-535D
June 6, 1973

FEDERAL SPECIFICATION

PLASTIC SHEET (SHEETING): PLASTIC STRIP:
POLY(VINYL CHLORIDE) AND POLY(VINYL CHLORIDE-VINYL ACETATE), RIGID

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 rigid unsupported poly(vinyl chloride) and poly(vinyl chloride-vinyl acetate) sheets (sheeting) and strip (see 6.4)

1.2 Classification.

1.2.1 Compositions, types, classes, and grades. Plastic sheet and sheeting covered by this specification shall be of the following compositions, types, classes, and grades as specified (see 6.2).

Composition A - Poly(Vinyl Chloride)

Type I - Normal impact strength, high stiffness and chemical resistance

Class 1 - Maximum stiffness and maximum chemical resistance.

Class 2 - Maximum stiffness and high chemical resistance.

Class 3 - High stiffness and maximum chemical resistance.

Type II - High impact strength, moderate chemical resistance.

Grade NT - Nontoxic according to intended use.

Grade GU - General use.

Type III - Medium impact strength, low chemical resistance.

Type IV - Good embossing characteristics.

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Composition B - Poly(Vinyl Chloride-Vinyl Acetate)

Type I - Unmodified.

Class 1 - Colored.

Class 2 - Colorless and transparent.

Class 3 - Optical quality.

Type II - Modified.

Class 1 - Medium impact strength.

Class 2 - Moderately high impact strength.

Class 3 - Very high impact strength.

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, Wrapping.
- UU-P-553 - Paper, Wrapping, Tissue.
- PPP-B-576 - Boxes, Wood, Cleated, Veneer, Paper Overlaid.
- PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated
- PPP-B-601 - Boxes, Wood, Cleated-Plywood.
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-3-1055 - Barrier Material, Waterproofed, Flexible.
- PPP-D-723 - Drums, Fiber.
- PPP-S-760 - Strapping, Nonmetallic (And Connectors).
- PPP-T-60 - Tape: Packaging, Waterproof.

Federal Standard:

Fed. Std. No. 123 - Marking for Shipment (Civil Agencies)

(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, D.C. 20402.)

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(Single copies of this specification and other Federal specifications required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, New York, Philadelphia, Washington, DC, Atlanta, Chicago, Kansas City, MO., Fort Worth, Houston, 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 the established distribution points in their agencies.)

Military Specification:

MIL-L-10547 - Liners, Case, and Sheet, Overwrap, Water-Vaporproof or Waterproof, Flexible.

Military Standards:.

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

MIL-STD-129 - Marking for Shipment and Storage.

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

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 256 - Impact Resistance of Plastics and Electrical insulating Materials.
- D 257 - D-C Resistance or Conductance of Insulating Materials.
- D 471 - Rubber Property - Effect of Liquids.
- D 542 - Index of Refraction of Transparent Organic Plastics.
- D 543 - Resistance of Plastics to Chemical Reagents.
- D 568 - Rate of burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position.
- D 570 - Water Absorption of Plastics
- D 618 - Conditioning Plastics and Electrical Insulating Materials for Testing.
- D 635 - Rate of Burning and/or Extent and Time Burning Of Self-Supporting Plastics in a Horizontal Position.
- D 637 - Surface Irregularities of Flat Transparent Plastic Sheets-
- D 638 - Tensile Properties of Plastics

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- D 648 - Deflection Temperature of Plastics Under Flexural Load.
- D 790 - Flexural Properties of Plastics and Electric Insulating Materials.
- D 792 - Specific Gravity and Density of Plastics by Displacement.
- D 793 - Short-Time Stability at Elevated Temperatures of Plastics Containing Chlorine.
- D 883 - Definitions of Term Relating to Plastics.
- D 2115 - Oven Beat Stability of Poly(Vinyl Chloride) Compositions.
- E 100 - ASTM Hydrometers.

(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., Traffic Department, 1616 P Street, N. W., Washington, DC 20036.)

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 Material. The rigid sheet (sheeting) and strip (see 6.4) shall be made of rigid poly(vinyl chloride) or of rigid poly(vinyl chloride-vinyl acetate), as designated by the composition (see 1.2.1 and 6.2), and any necessary plasticizers, stabilizers, and lubricants, with or without the addition of dyes, pigments, and fillers.

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3.2 Physical property requirements. Test specimens cut from the sheet (sheeting) and strip, and tested as specified in section 4, shall conform to the physical property requirements listed in tables I, II, III, IV, and V for the applicable composition, type, class, and grade. Except for composition A, type IV materials, if the sheet (sheeting) and strip is of such thickness that the necessary test specimens cannot be obtained from it, the specimens may be cut from a sheet 3.2mm (1/8 inch) in thickness, prepared from the same plastic composition under as nearly similar production conditions as in feasible. No special treatment shall be used that will tend to improve the properties of the specimens as compared with those of the sheeting supplied from this specification. An alternative procedure of heat laminating thin sheet to satisfy requirements for test specimen thickness shall be permitted. The conditions for lamination shall follow the recommendation of the supplier of the basic vinyl compounds. Composition A, type IV material shall be supplied in the thickness of base material specified in table V.

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TABLE I. Composition A. Physical property requirements for rigid poly (vinyl chloride) sheet (sheeting) and strip

Property	Type I			Type II Grades NT and GU	TYPE III	Type IV
	Class 1	Class 2	Class 3			
Tensile strength, MPa ^{1/} (psi), min.	48.3 (7,000)	48.3 (7,000)	48.3 (7,000)	37.9 (5,500)	34.5 (5,000)	37.9 (5,500)
Modulus of elasticity in tension, MPa (psi), min.	2760 (400,000)	2760 (400,000)	2550 (370,000)	2070 (300,000)	2070 (300,000)	2070 (300,000)
Flexural strength, MPa (psi), min.	75.8 (11,000)	75.8 (11,000)	75.8 (11,000)	58.6 (8,500)	58.6 (8,500)	58.6 (8,500)
Impact strength (Isod), J/m ^{1/} (ft-lb/in) of notch, min.	34.7 (0.63)	34.7 (0.63)	26.7 (0.5)	267 (5.0)	80.1 (1.5)	267 (5.0)
Deflection temperature under load, °C, min.	70.0	70.0	66.0	66.0	66.0	66.0
Flammability ^{2/}						
Average extent of burning, mm ^{1/} (in.)	< 25 (1)	< 25 (1)	< 25 (1)	< 25 (1)	< 25 (1)	< 25 (1)
Average time of burning, seconds	< 10	< 10	< 10	< 10	< 10	< 10
Water absorption ^{3/} (24 hour immersion), percent, max.						
Thickness range, mm (in.)						
0.127 to 0.76 (0.005 to 0.030)				0.50		0.50
0.79 to 1.52 (.031 to .060)				.30		.30
1.55 to 2.5 (.061 to .100)				.25		.25
2.8 and above (.101 and above)				.15		.15

^{1/} Metric unit abbreviations: MPa = megapascal, J/m = joules per meter, mm = millimeter^{2/} See ASTM D 635^{3/} Specimens conditioned in an oven at 50° ± 1°C (122° ± 1.8°F) for 24 ± 0.1 hours.

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TABLE II. Composition B. Physical property requirements for rigid poly (vinyl chloride-vinyl acetate) sheet (sheeting) and strip

Property	Type I			Type II		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Tensile strength, MPa ^{1/} (psi), min.	41.4 (6,000)	46.9 (6,800)	46.9 (6,800)	37.9 (5,500)	34.5 (5,000)	34.5 (5,000)
Modulus of elasticity in tension, MPa (psi), min.	2410 (350,000)	2410 (350,000)	2410 (350,000)	2070 (300,000)	1900 (275,000)	1720 (250,000)
Impact strength (Isod), J/m ^{1/} (ft-lb/in) of notch, min.	21.4 (0.4)	21.4 (0.4)	21.4 (0.4)	53.4 (1.0)	160 (3.0)	534 (10.0)
Deflection of temperature under load, °C, min.	58	53	53	58	58	58
Specific gravity 23°/23°C, min.	1.35	1.35	1.35	NA ^{2/}	NA ^{2/}	NA ^{2/}
Flammability ^{3/}						
Average extent of burning, mm ^{1/} (in.)	< 25 (1)	< 25 (1)	< 25 (1)	< 25 (1)	< 25 (1)	< 25 (1)
Average time of burning, seconds	< 10	< 10	< 10	< 10	< 10	< 10
Refractive index, n 23D:						
Min.			1.52			
Max.			1.56			
Optical angular displacement ^{4/} , minutes, max.			10			
Water absorption ^{5/} (24 hour immersion), percent, max.						
Thickness range, mm (in.)						
0.127 to 0.76 (0.005 to 0.030)	0.50	0.50	0.50			
0.79 to 1.52 (.031 to .060)	.30	.30	.30			
1.55 to 2.5 (.061 to .100)	.25	.25	.25			
2.8 and above (.101 and above)	.15	.15	.15			

^{1/} Metric unit abbreviations: MPa = megapascal, J/m = joules per meter, mm = millimeter

^{2/} NA - Not applicable.

^{3/} See ASTM D 635.

^{4/} Applicable only to clear material with high-polish finish.

^{5/} Specimens conditioned in an oven at 50° ± 1°C (122° ± 1.8°F) for 24 ± 1 hour.

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TABLE III. Composition A. Property value for periodic lot check test requirements (not applicable to type IV materials)

Property	Type I			Type II	Type III
	Class 1	Class 2	Class 3	Grades NT and GU	
Chemical resistance:					
93.0 percent sulfuric acid, 14 days flotation at 55 deg. +/- 2 deg. C:					
Change in weight:					
Increase maximum percent	5.0 ^{L1} ↓	25.0	5.0 ^{L1} ↓	NA ^{L2} ↓	NA ^{L2} ↓
Decrease maximum percent	0.1 ^{L1} ↓	0.1	0.1 ^{L1} ↓	NA ^{L2} ↓	NA ^{L2} ↓
Change in flexural strength:					
Increase maximum percent	5.0 ^{L1} ↓	5.0	5.0 ^{L1} ↓	NA ^{L2} ↓	NA ^{L2} ↓
Decrease maximum percent	25.0 ^{L1} ↓	50.0	25.0 ^{L1} ↓	NA ^{L2} ↓	NA ^{L2} ↓
80 percent sulfuric acid, 30 days immersion at 60 deg. +/- 2 deg. C:					
Change in weight:					
Increase maximum percent	NA ^{L2} ↓	5.0	NA ^{L2} ↓	15.0	NA ^{L2} ↓
Decrease maximum percent	NA ^{L2} ↓	5.0	NA ^{L2} ↓	0.1	NA ^{L2} ↓
Change in flexural strength					
Increase maximum percent	NA ^{L2} ↓	15.0	NA ^{L2} ↓	25.0	NA ^{L2} ↓
Decrease maximum percent	NA ^{L2} ↓	15.0	NA ^{L2} ↓	25.0	NA ^{L2} ↓
ASTM Oil No. 3, 30 days immersion at 23 deg. C:					
Change in weight:					
Increase maximum percent	1.0	1.0	1.0	10.0	10.0
Decrease maximum percent	1.0	1.0	1.0	0.1	1.0
Oven heat stability				pass test	
Volume resistivity, ohm-cm, min.				10 ^{L1} ↓	
Tensile elongation at yield point, lengthwise, percent					
Min.				2.0	
Max.				4.5	
Penetration impact strength				see ^{L3} ↓	

^{L1}↓ Specimens washed in running water and dried by an air blast or other mechanical means shall show no sweating within 2 hours after removing from the acid bath.

^{L2}↓ NA - Not applicable

^{L3}↓ There shall be no puncture, fracture, or crack in surface

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TABLE IV. Composition B. Property values for periodic lot check test requirements

Property	Type I			Type II		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
Thermal stability, mg. HCl per gm., max.	2.0	2.0	2.0	-	-	-
Volume resistivity, ohm-cm., min.	10 ^{L14J}	10 ^{L14J}	10 ^{L14J}	-	-	-

TABLE V. Composition A. Dimensional change after heating embossing material (applicable to type IV material only)

Before heating period	
Thickness of base sheet material	0.71mm (0.028 in.)
Thickness of base sheet material plus embossed characters	0.11mm (0.043 in.)
After heating in accordance with 4.3.17	
Thickness of base sheet material	0.71mm (0.028 in.)
Minimum thickness of base sheet material plus embossed characters	0.10mm (0.040 in.)

3.3 Dimensions and form. The nominal thickness, width, and length shall be specified in the contract or purchase order (see 6.2). Unless otherwise specified, the permissible tolerances from the nominal dimensions shall be shown below:

Thickness:	
Less than 2mm (0.08 in.)	plus 20 percent, minus 20 percent.
2 to 4mm (0.08 to 0.16 in.)	plus 15 percent, minus 15 percent.
Above 4mm (0.16 in.)	plus 10 percent, minus 10 percent.
Width:	plus 6.4, -0mm (plus 0.25, -0 in.)
Length of sheet:	plus 6.4, -0mm (plus 0.25, -0 in.)
Length of sheeting in roll:	plus 4 percent, minus 0 percent.
Squareness:	Difference in lengths of the diagonals of the cut sheets shall be not greater than 6.4mm (0.25 in.)

Sheeting supplied on roll form shall be continuous for any roll 375mm (15 in.) or less in diameter and shall have not more than two breaks (3 pieces) in any roll of larger diameter.

3.4 Color and transparency. The color and transparency (or opacity) shall be as specified by the procuring agency (see 6.2). When so specified the procuring agency shall specify the applicable color standard or other means

for the determination of such requirements.

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3.5 Finish. The sheet (sheeting) and strip shall be furnished with a high-polish, matte, grained, or special finish as specified in the contract or order (see 6.2).

3.6 Uniformity. The sheet (sheeting) and strip shall be uniform in color, transparency, or opacity (as applicable). It shall be uniform in finish, density, and other physical properties.

3.7 Resistance to acetone. The sheet (sheeting) and strip shall show no evidence of delamination or disintegration when tested as specified in 4.3.15. Swelling or softening of either or both test specimens shall not constitute failure.

3.8 Workmanship. The sheet (sheeting) and strip shall be free from warpage, cracks, scratches, bubbles, imbedded particles, and other defects that affect the appearance or which might affect the serviceability. (These defects shall be defined in accordance with ASTM D 883, as applicable.)

3.9 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 agency.

3.10 Nontoxicity. When grade NT is specified, the material furnished shall be made only of a compound certified for nontoxicity by the supplier in accordance with the procedure specified in 4.3.18.

3.11 Recovered materials. The material offered shall contain not more than 0.1 percent of recovered materials. Recovered materials are defined as material which has been collected or recovered from solid waste. Solid waste is defined as any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material including solid, liquid, semisolid, or contained gaseous material resulting from community activities. Excluded are solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or specific industrial discharges.

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 requirements as specified herein. Except as otherwise specified, the contractor may utilize his own facilities or any commercial laboratory acceptable to 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 that supplies and services conform to prescribed requirements.

4.2 Sampling for inspection and acceptance. Sampling for inspection and acceptance shall be performed in accordance with the provisions set forth in MIL-STD-105, except where otherwise indicated. For purposes of sampling, an inspection lot for examination and tests shall consist of all material of the same composition, type, class, grade, finish, thickness, and form submitted for delivery at one time.

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4.2.1 Inspection of materials and components. In accordance with 4.1 above, the contractor is responsible for insuring that materials and components used were manufactured, tested, and inspected in accordance with the requirements of referenced subsidiary specifications and standards to the extent specified. In the event of conflict, this specification shall govern. A contractor's certificate of compliance with 3.1 shall be furnished.

4.2.2 Inspection of the sheet (sheeting) and strip.

4.2.2.1 Examination of the sheet (sheeting) and strip. Examination shall be made in accordance with the classification of defects, inspection levels, and acceptable quality levels (AQLs) set forth below. The lot size, for purposes of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of packages of plastic sheets or rolls of plastic sheeting as applicable, for examination in 4.2.2.1.1, 4.2.2.1.2, 4.2.2.1.3, 4.2.2.1.4 and in units of shipping containers for examination under 4.2.2.1.5.

4.2.2.1.1 Examination of the sheet (sheeting) and strip for defects in appearance, construction, and workmanship. The sample unit for this examination, specified in table VI shall be one (1) linear yard full width, if in rolls, or one (1) sheet, as applicable. Not more than five (5) sample units shall be taken from any one roll or package of sheets.

TABLE VI. Examination for defects in appearance, construction, and workmanship

Examine	Defect
Form	Not in rolls or flat cut sheets, as specified.
Appearance	Not clean, presence of any imbedded particles, dirt, grit, or other foreign matter. Material not uniform in finish, color, transparency, or opacity, or not meeting specified requirements for these properties (see 3.4, 3.5, 3.6 and 6.2).
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 clean cut; ragged, crushed, or uneven edges.

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4.2.2.1.2 Examination of the sheet (sheeting) and strip for dimensional defects. The sample unit for this examination, specified in table VII, shall be one plastic sheet or roll, as applicable.

TABLE VII. Examination for dimension defects

Examine	Defect
Length and width	Varies by more than +6.4, -0mm (+0.25, -0 in.) from length and width specified.
Width of roll	Varies by more than +6.4, -0mm (+0.25, -0 in.) from width specified.
Length of roll	Varies by more then +4, -0 percent from length specified.
Thickness	Varies by more than tolerances specified for thickness.
Core (diameter)	Inside diameter less than 75mm (3 in.).
Roll continuity	Any break in rolls 375mm (15 in.) or less in diameter. More than 2 breaks in rolls larger than 375mm (15 in.) in diameter.

4.2.2.1.3 Examination of the sheet (sheeting) and strip for defects in assembly. The while unit for this examination, specified in table VIII, shall be one package of sheets or one roll, as applicable.

TABLE VIII. Examination for defects in assembly

Examine	Defect
Assembly of sheets	Not evenly stacked. Not interleaved to prevent adherence of sheets.
Assembly of roll	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 an adequate core. Core broken, collapsed, crushed, or mutilated.

4.2.2.1.4 Examination of the sheet (sheeting) and strip for defects in the count per package of sheets or length per roll. The sample unit for this examination, specified in table IX, shall be one package of sheets or one roll, as applicable.

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TABLE IX. Examination for defects in count per package or length per roll

Examine	Defect
Sheets	Average count per package of sheets less than specified.
Rolls	Average length or weight per roll, as applicable, less than specified.

4.2.2.1.5 Examination of preparation for delivery. An examination shall be made, in accordance with table X, to determine that packaging, packing and markings comply with the requirements of section 5. The sample unit for this examination 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.

TABLE X. Examination for preparation for delivery

Examine	Defect
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 of materials. Inadequate application of components, such as: incomplete closures of case liners or container flaps, loose or inadequate strappings, bulged or distorted containers.
Count	Less than specified or indicated quantity of packages or rolls per shipping container.
Weight	Gross or net weight exceeds specified requirements.
Markings	Interior or exterior markings (as applicable) omitted, illegible, incorrect, incomplete or not in accordance with contract requirements.

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4.2.2.1.6 Inspection levels and acceptable quality levels (AQLs) for examinations. The inspection levels for determining the sample size and the acceptable quality levels (AQLs) expressed in defects per 100 units shall be as follows:

<u>Examination paragraph</u>	<u>Inspection level</u>	<u>AQL</u>
4.2.2.1.1	I	1.5
4.2.2.1.2	S-3	2-5
4.2.2.1.3	S-2	2.5
4.2.2.1.4	S-2	-
4.2.2.1.5	S-2	4.0

4.2.3 Testing. The sheet (sheeting) and strip shall be tested for characteristics listed in tables I, II, III, IV, and V, as applicable. Testing shall be in accordance with the test methods specified herein for each lot submitted for inspection. Sampling shall be in accordance with H:EL-STD-105 and the lot size, for the purpose of determining sample size for testing, shall be expressed in units of 45 kilogram (100 pounds) of sheet (sheeting) or strip. The inspection level shall be S-1. The sample size (number of units of product drawn from a lot) shall be in accordance with the single sampling plan for normal inspection, and each unit shall consist of sufficient material to prepare all specimens required for testing. Each sample unit shall be tested and must meet all applicable requirements of section 3. Test results for each characteristic in each sample unit shall be the averaged results from the specimens tested for that characteristic.

4.2.3.1 Classification of tests. All tests shall be classified as follows:

- (a) Lot acceptance tests (see 4.2.3.2).
- (b) Periodic lot check tests (see 4.2.3.3).

4.2.3.2 Lot acceptance tests. Lot acceptance tests shall be made on each lot of material and shall be the basis for acceptance or rejection of the lot. The lot acceptance tests shall consist of the tests shown in tables I and 11, as applicable, except for composition A, type IV material. Composition A, type IV material shall require the tests shown in tables I and V as lot acceptance tests.

4.2.3.3 Periodic lot check tests. Periodic lot check tests shall be made on the first lot of material furnished under this specification and on any subsequent lot specified by the procuring agency for material of the same composition, type, class, and grade. Periodic lot check tests shall consist of the test shown in tables III and IV, as applicable. When periodic lot check tests are made, they shall be included in the basis for acceptance or rejection of the lot (see 4.2.3.2). Composition A, type IV material shall not require periodic lot check tests.

4.3 Test methods and conditioning. The test specimens shall be conditioned and tested at 23 deg. +/- 2 deg. C (73.4 deg. +/- 3.6 deg. F) and 50 +/- 5 percent relative humidity in accordance with procedure A of ASTM D 618, unless other conditions are specified in the applicable test method.

4.3.1 Tensile strength and modulus of elasticity. Five specimens shall be tested in accordance with ASTM D 638. The specimens shall conform to figure 1 of ASTM D 638.

4.3.2 Flexural strength. Five specimens shall be tested in accordance with procedure B of ASTM D 790. The specimens shall conform to dimensions specified in ASTM D 790, as applicable.

4.3.3 Impact strength, Izod. Five specimens shall be tested in accordance with method A of ASTM D 256. Specimens shall conform to dimensions specified in ASTM D 790, as applicable.

4.3.4 Deflection temperature under load. Three specimens shall be tested in accordance with ASTM D 648. Specimens shall conform to dimensions specified in ASTM D 648,, as applicable. Conditioning shall be in accordance with procedure B of ASTM D 618, except the minimum conditioning time shall be 24 hours.

4.3.5 Flammability Ten specimens shall be tested in accordance with ASTM D 635 for material over 1.27mm (0.050 in) in thickness and in accordance with ASTM D 568 for material 1.27mm (0.050 in) and under in thickness. Specimen dimensions shall be as specified in the ASTM test method used. Average extent of burning and average time of burning shall be determined.

4.3.6 Specific gravity. Three specimens shall be tested in accordance with method A of ASTM D 792.

4.3.7 Water absorption. Where applicable, three specimens shall be tested in accordance with ASTM D 570. Specimens shall conform to dimensions specified in ASTM D 570, as applicable.

4.3.8 Refractive index. Three specimens of composition B, type I, class 3 material shall be tested in accordance with ASTM D 542. Specimens shall conform to dimensions and shall be tested at the temperature specified in ASTM D 542.

4.3.9 Optical angular displacement. Three specimens of composition B, type I, class 3 material shall be tested in accordance with procedure A of ASTM D 637. Specimens shall be as specified in ASTM D 637.

4.3.10 Chemical resistance. Three specimens shall be tested in accordance with ASTM D 543. The hydrometers shall be in accordance with ASTM E 100. Test requirements shall be as specified in table III and the following:

(a) 93.0 percent sulfuric acid - The acid shall be at 66 deg. Baume (92.98 to 93.41 percent sulfuric acid (H_2SO_4), sp. gr. 1.8344 to 1.8364 at 16 deg./16 deg. C (60 deg./ 160 deg. F). This test shall be run in a test tube selected for size so that the specimen floats vertically.

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(b) 80 percent sulfuric acid - The concentration of sulfuric acid (H_2SO_4) must be held to an 80 +/- 2 percent level to meet the requirements of this specification. The samples must be immersed completely. Glass or acid-resistant wire may be used for sinkers.

(c) Adjustment of acid strength - The sulfuric acid (H_2SO_4) content of the acid solutions may be determined by titration with sodium hydroxide (NaOH) solution and methyl orange indicator or by specific gravity with hydrometers sensitive and accurate to 0.001. The sulfuric acid (H_2SO_4) content should be adjusted to the required strength by mixing dilute and concentrated acids.

(d) ASTM Oil No. 3 - ASTM Oil No. 3 shall meet the requirements specified in ASTM D 471.

4.3.11 Oven heat stability. Where applicable, three specimens shall be tested in accordance with ASTM D 2115. Specimens shall conform to dimensions specified in ASTM D 2115. After testing, specimens shall pass requirements to be specified by procuring agency.

4.3.12 Volume resistivity. Where applicable, five specimens shall be tested in accordance with ASTM D 257, using silver painted electrodes.

4.3.13 Tensile elongation at yield point. Tensile elongation at yield point shall be determined in accordance with ASTM D 638, using speed B. The yield point and specimen preparation and dimensions shall be as specified in ASTM D 638.

4.3.14 Penetration impact strength.

4.3.14.1 Specimens. Specimens shall be 100mm (4 in) in diameter by thickness of the material, except that for sheets greater than 6.4mm (0.25 in) in thickness specimens shall be carefully machined down to 6.40 +/- 0.64mm (0.250 +/- 0.025 in) and tested.

4.3.14.2 Specimen support. The specimen shall be supported in a steel frame fitted with a bezel and a hardened steel penetrator as shown on figures 1, 2, and 3. The frame shall be mounted rigidly on a heavy steel bedplate. A steel ball, of the diameter and weight specified for the particular specimen thickness in table XI, shall be used to deliver the impact.

TABLE XI. Diameters and weights of steel balls for penetration impact strength test

Specimen thickness mm (in.)	Diameter of ball, mm (in.)		Weight of ball kilogram (pound)		Weight tolerance +/-kilogram (pound)	
	mm	(in.)	kilogram	(pound)	+/-kilogram	(pound)
0.8 (1/32)	33.3	(1-5/16)	0.14	(0.30)	0.002	(0.005)
1.3 (1/20)	38.1	(1-1/2)	0.23	(.50)	0.004	(.01)
1.6 (1/16)	39.7	(1-9/16)	0.28	(.63)	0.007	(.015)
2.4 (3/32)	47.6	(1-7/8)	0.44	(.97)	0.008	(.02)
3.2 (1/8)	54.0	(2-1/8)	0.64	(1.42)	0.01	(.03)
4.0 (5/32)	57.2	(2-1/4)	0.76	(1.68)	0.02	(.05)
4.8 (3/16)	60.3	(2-3/8)	0.89	(1.97)	0.02	(.05)
5.6 (7/32)	63.5	(2-1/2)	1.08	(2.30)	0.02	(.05)
6.4 (1/4)	66.7	(2-5/8)	1.21	(2.66)	0.02	(.05)

4.3.14.3 Procedure. The impact blow shall be delivered by allowing the steel ball to fall on the center of the penetrator head from a height of 10 feet. A single blow shall be delivered to each specimen. The damage caused in each specimen shall be observed and noted. The following types of damage shall constitute failure of the specimen to withstand the impact:

- (a) Puncture
- (b) Fracture
- (c) Crack in the surface

4.3.15 Acetone resistance. Place three 25-by 100 mm (1-by 4-in.) specimen in separate 400-ml beakers so that they are supported at an angle in the beaker, with the 25mm (1 in.) edge resting on the bottom of the beaker. Totally immerse the specimen in anhydrous acetone (ACS grade or equivalent) previously conditioned to 23 deg. +/- 1 deg. C (73.4 deg. +/- 1.8 deg. F) and cover with a watch glass. Age the submerged specimens for 2 hours at 23 deg. +/- 1 deg. C (73.4 deg. +/- 1.8 deg. F) and visually inspect for evidence of delamination and disintegration. A failure consists of separation of the components as evidenced by curling of delaminated sections or separation into granular components. Any other changes in the specimen such as swelling or softening shall not constitute a failure.

4.3.16 Thermal stability. Where applicable, three specimens shall be tested in accordance with ASTM D 793.

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4.3.17 Dimensional change after embossing material (applicable only to composition A, type IV. Three specimens shall be prepared by cutting to the credit card size of 84.1mm (3-5/16 in.) by 54.0mm (2-1/8 in.) The specimens shall be embossed in a credit card embossing machine to give the initial (before heating) dimensions shown in table V. Thickness of the base specimen and base specimen plus raised characters shall be measured with a micrometer or other instrument which is adequate. Specimens shall be heated to 74 deg. +/- 1 deg. C (165 deg. +/- 1.8 deg/ F) and maintained at this temperature for a minimum period of 30 minutes in a circulating air oven. After the heating period, specimens shall be removed and allowed to cool. Thickness of the base specimen and the specimen plus raised characters shall be measured with a micrometer.

4.3.18 Nontoxicity. Certification for nontoxicity shall be conducted in accordance with the intended use of the material as follows:

(a) For use in potable water systems, the material shall be properly selected to meet conditions of service and, in addition, be certified by the National Sanitation Foundation Testing Laboratory or other impartial agency using an equivalent program of control.

(b) For use as plastic food wrappers and containers, the material shall be approved by Food and Drug Administration.

(c) For use as plastic materials in clothing and equipage, such that contact with the skin under normal usage or intimate and frequent handling or other medical implications are present, the material shall be approved by the Defense Personnel Support Center, ATTN: DPSC-ATTS.

5. PREPARATION FOR DELIVERY

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

5.1.1 Level A.

5.1.1.1 Sheeting and strip. Sheeting and strip shall be supplied in rolls. Each roll shall be wound on an adequate core with an inside diameter of not less than 75mm (3 in.). The rolls shall not exceed 68 kilogram (150 pounds) in weight and shall be suitably restrained from unwinding. Each roll shall be wrapped with, at least one layer of kraft wrapping paper, conforming to UU-P-268, and tightly sealed with tape conforming to PPP-T-60.

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

5.1.2 Level B.

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5.1.2.1 Sheets 508 by 1270mm (20 by 50 in.). A piece of tissue paper 508 by 1270mm (20 by 50 in.) or larger conforming to UU-P-553 shall be placed between adjacent plastic sheets.

5.1.3 Commercial. Sheeting and strip shall be packaged in accordance with the manufacturer's standard practice to afford protection against deterioration and damage.

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

5.2.1 Level A.

5.2.1.1 Rolls. Packaged rolls of sheeting or strip shall be packed in fiber drums or boxes conforming to type II or III, grade A of PPP-D-723 or class weather-resistant, V3c or V3s of PPP-B-636. Closures shall be in accordance with the applicable specification.

5.2.1.2 Sheets. Packages of sheets shall be packed in overseas class or type shipping containers conforming to PPP-B-591, PPP-B-601, PPP-B-621, PPP-B-636 (class weather-resistant, V3c or V3s) or PPP-B-576. Unless otherwise specified, containers shall be provided with a case liner made of material conforming to PPP-B-1055 and fabricated in accordance with MIL-L-10547. Case liners for containers conforming to PPP-B-636 shall be omitted provided all seams including manufacturer's joints are sealed with tape conforming to PPP-T-60. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto, or with nonmetallic strapping conforming to PPP-S-760. The gross weight of wood or wood-cleated containers shall not exceed approximately 45 kilograms (200 pounds); fiber board containers shall not exceed the weight limitations of the applicable container specification.

5.2.2 Level B.

5.2.2.1 Rolls. Packaged rolls of sheeting or strip shall be packed in fiber drums or boxes conforming to type I, grade A of PPP-D-723 or class domestic of PPP-B-636. Closures shall be in accordance with the appropriate specification.

5.2.2.2 Sheets. Packages of sheets shall be packed in domestic class or type shipping containers conforming to PPP-B-591, PPP-B-601, PPP-B-621, PPP-B-636, or PPP-B-576. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto, or with nonmetallic strapping conforming to PPP-S-760. The gross weight of wood or wood-cleated containers shall not exceed 45 kilograms (200 pounds); fiber board containers shall not exceed the weight limitations of the applicable container specification.

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5.2.2.2.1 Sheets 508 by 1270mm (20 by 50 in.) (GSA standard packing). Sixty plastic sheets, packaged as specified in 5.1.2.1, shall be packed into a fiber board box conforming to PPP-B-636, type, class, and style optional. The box shall meet the special requirements of table I of PPP-B-636. Closure shall be in accordance with the appendix to PPP-B-636.

5.2.3 Commercial. Packing shall be in accordance with commercial practice adequate to insure 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 Marking.

5.3.1 Civil agencies. Unit packaging and shipping containers shall be marked in accordance with Fed. Std. No. 123.

5.3.2 Military agencies. In addition to any special marking required by the contract or purchase order, unit packages and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Composition A sheeting and strip is used because of its resistance to chemicals, moisture and oxidation, transparency or ease of coloring, mechanical strength, dimensional stability, and low cost. The values for these properties vary with type, class, and grade, the higher impact types being lower in strength and in resistance to chemicals and to weather.

Type I, class 1 should be specified for applications which require the maximum chemical and temperature resistance but which do not require resistance to impact. Examples are linings for tanks for holding hot concentrated acids, and hoods, ducts and on blades for handling corrosive fumes. Since this class is rather difficult to fabricate, class 2 or 3 should be specified for less critical applications. Type II is used in thin gauges for blister packaging and as swimming pool liners, and in thicker gauges for vacuum forming into trays and drip pans for refrigerators and into military dummies and decoys. Type II may be used for opaque, white cartographic sheeting. Type II, grade NT is used for nontoxic applications (see 4.3.18). Type III is used for applications in which the impact strength and chemical resistance of the material are relatively unimportant. Type IV material is used in applications such as credit cards which require maintenance of original embossing after exposure to summer temperature conditions.

Composition B sheeting and strip is used where greater flexibility is desired that can be obtained with the sheetings of composition A. Composition B sheeting and strip normally is odorless, tasteless, water resistant, self-extinguishing, has good dielectric properties, and low toxicity. Examples of uses are given below:

Type I:

- Class 1 - Three-dimensional displays for educational purposes.
Three-dimensional decorations.
- Class 2 - Recording discs.
- Class 3 - Transparent cartographic sheeting.

Type II:

- Class 1 - Luminous ceilings.
Spiral book bindings.
- Class 2 - Decorative and structural wall panel laminates.
Instrument dial covers.
- Class 3 - Bas-relief maps.
Signs and charts.
Navigation and computing charts.
Slide rules.
Identification cards.
Instrument dial faces.

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) Composition, type, class, and grade, as applicable, required.
- (c) Oven heat stability requirements for specimens to pass (see table III and 4.3.11).
- (d) Dimensions and form required (see 3.3).
- (e) Color and transparency required, if any (see 3.4).
- (f) Finish desired (see 3.5).
- (g) Suitability for use with explosives, if required (see 3-9).
- (h) Selection of the applicable levels of packaging and packing (see 5.1 and 5.2).

6.3 Suitability for use with explosives. Information concerning suitability of many plastics for use with various explosives under various conditions is on file at U. S. Armament Research and Development Command, Dover, NJ 07801. Procurement activities desiring information on this subject should contact U.S. Armament Research and Development Command, Dover, NJ 07801.

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6.4 Definitions.

(a) "Sheeting" - A form of plastic in which the thickness is very small in proportion to length and width and in which the plastic is present as a continuous phase throughout, with or without filler.

(b) "Film" - An optional term for sheeting having nominal thickness not greater than 0.254mm (0.010 in.)

(c) "Sheet" - A piece of sheeting produced as an individual piece rather than in a continuous length, or cut as an individual piece from a continuous length.

Note: The above definitions were taken from ASTM D 883. In this specification, the term "Sheet" is used in the sense defined in (c), while "sheeting" is used to describe material supplied in continuous lengths, each term including both film and thicker material.

(d) "Strip" - Material limited to a width of 150mm (6 in.) or less.

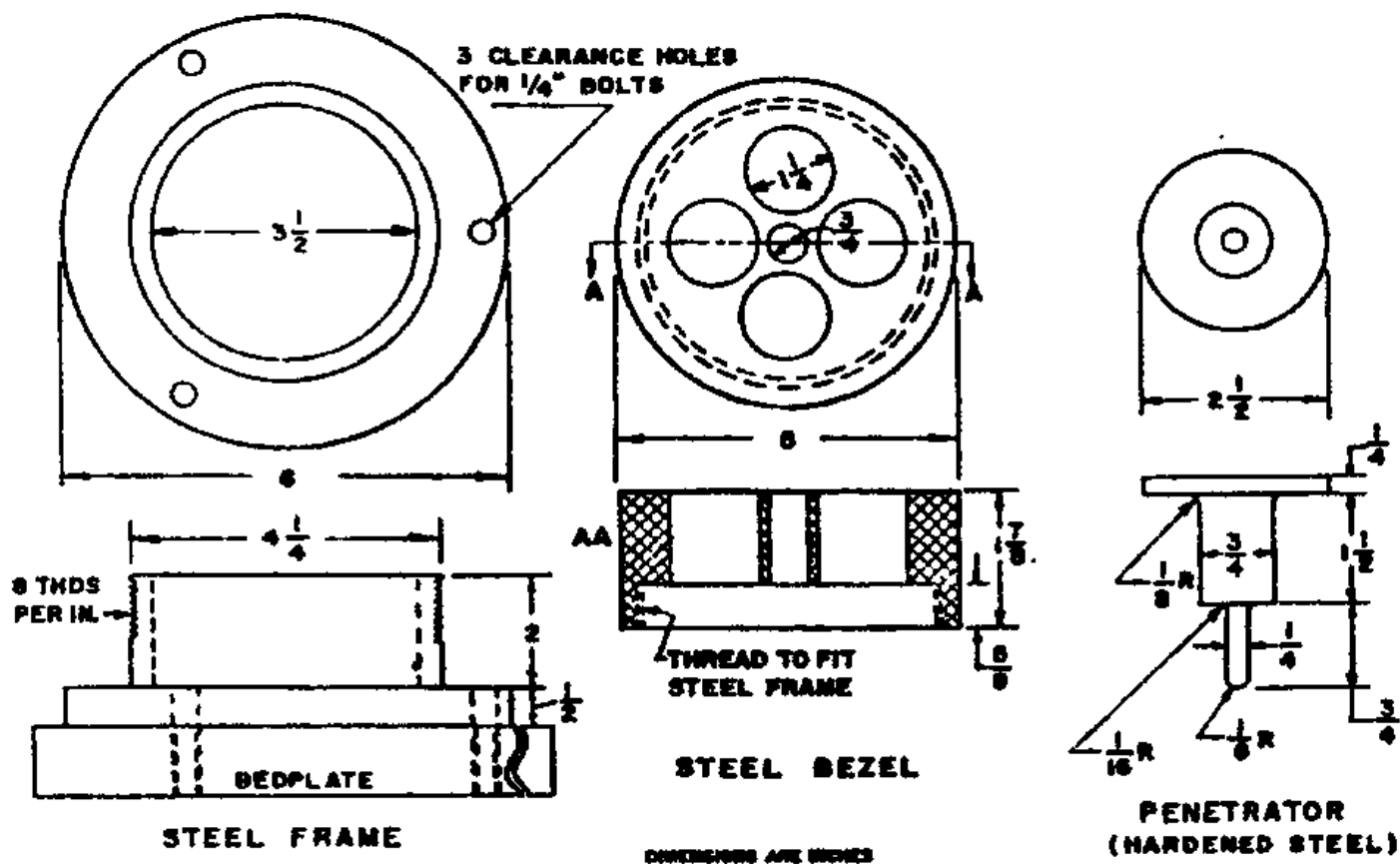


FIGURE 1. Penetration impact strength test apparatus.

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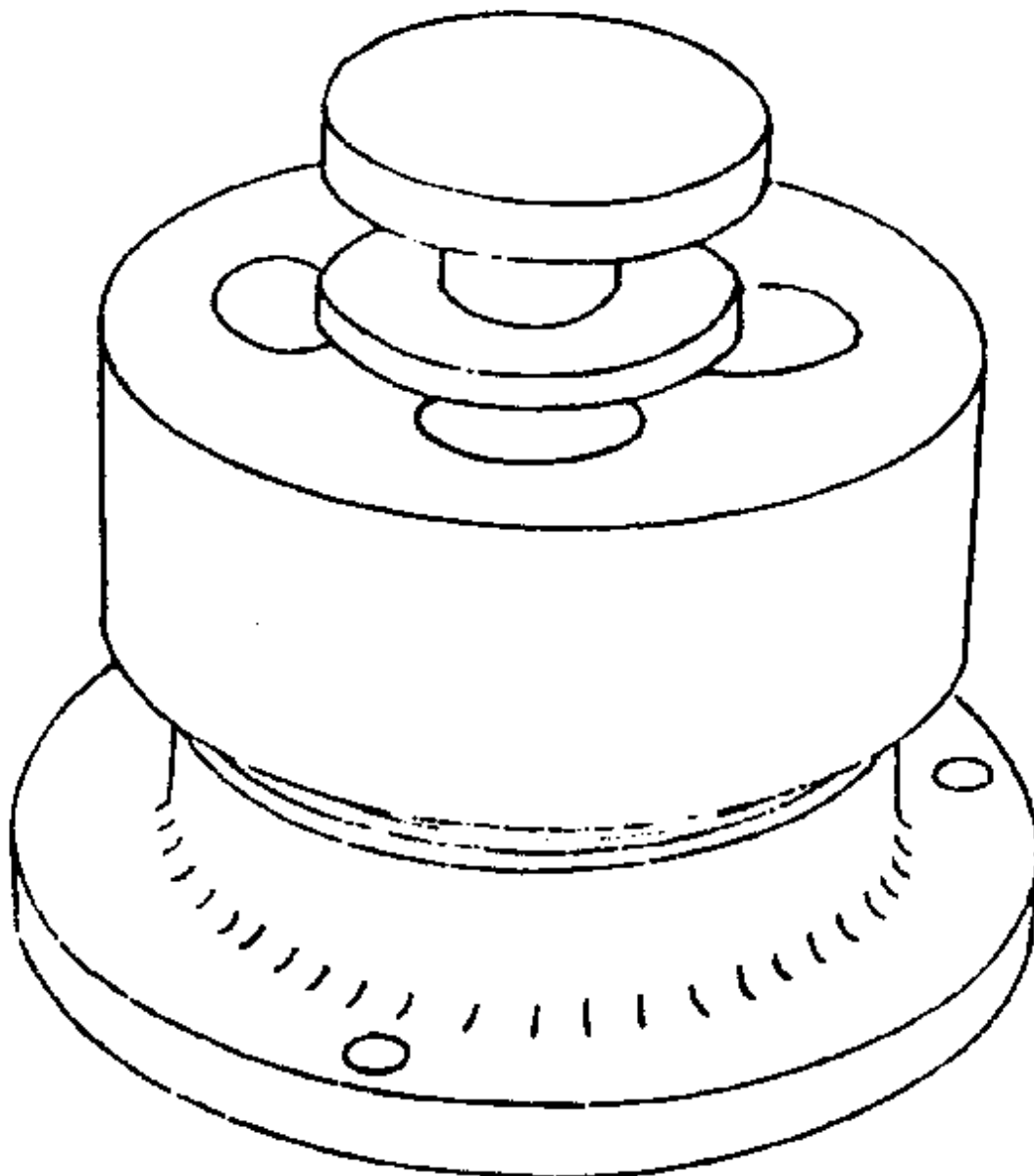


FIGURE 2. Penetration impact strength test jig, assembled.

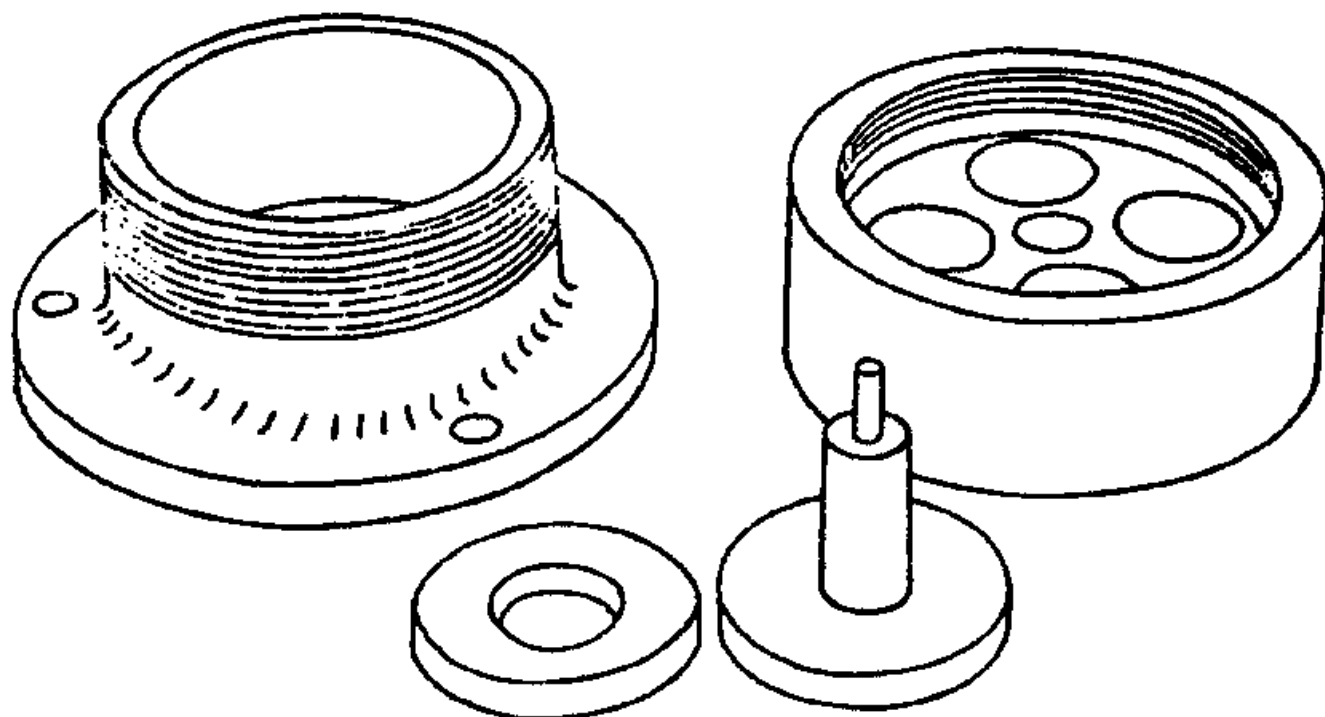


FIGURE 3. Penetration impact strength test jig, disassembled.

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Military Custodians:

Army - MR
Navy - SH
Air Force - 11

Preparing Activity:

Army - MR

Civil Agency Coordinating Activities:

Review activities:

Army - ER, AR, ME
Navy - YD
Air Force - 99
DLA - GS

GSA-FSS
DOE

User activity;

Navy - AS

U.S. GOVERNMENT PRINTING OFFICE: 1979 - 281-172/1040

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NOTICE OF
VALIDATION

INCH-POUND

L-P-535E
NOTICE 2
29 March 1991

FEDERAL SPECIFICATION

PLASTIC SHEET (SHEETING): PLASTIC STRIP: POLY(VINYL CHLORIDE)
AND POLY(VINYL CHLORIDE-VINYL ACETATE), RIGID

L-P-5352, dated 27 April 1979, has been reviewed and determined to be valid
for use in acquisition.

Custodians:

Army - MR
Navy - SH
Air Force- 11

Preparing activity:

Army - MR

Civil agency coordinating activity:

GSA - FSS

AMSC N/A

PSC 9330

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