

INCH-POUND

MIL-PRF-8184F

5 October 1998

SUPERSEDING

MIL-P-8184E

1 February 1989

PERFORMANCE SPECIFICATION

PLASTIC SHEET, ACRYLIC, MODIFIED

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers optical quality, transparent, modified acrylic plastic sheet.

1.2 Classification. The plastic sheet is furnished in the following types and classes (see 6.2).

1.2.1 Types. The types of plastic sheet are as follows:

Type I - For "as cast" applications or for stretching.

Type II - For "as cast" applications only; not for stretching.

1.2.2 Classes. The classes of plastic sheet are as follows:

Class 1 - Standard moisture absorption resistance.

Class 2 - Improved moisture absorption resistance.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division, Code 414100B120-3, Highway 547, Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 9330

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications. The following specifications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

| | | |
|-----------|---|--------------------|
| A-A-59107 | - | Toluene, Technical |
| TT-I-735 | - | Isopropyl Alcohol |

(Unless otherwise indicated, copies of the above specifications are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 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 (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | | |
|-----------|---|--|
| ASTM-D542 | - | Index of Refraction of Transparent Organic Plastics, Standard Test Method for (DoD adopted) |
| ASTM-D570 | - | Water Absorption of Plastics, Standard Test Method for (DoD adopted) |
| ASTM-D635 | - | Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, Standard Test Method for (DoD adopted) |

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| | | |
|------------|---|---|
| ASTM-D638 | - | Tensile Properties of Plastics, Standard Test Method for (DoD adopted) |
| ASTM-D648 | - | Deflection Temperature of Plastics Under Flexural Load, Standard Test Method for (DoD adopted) |
| ASTM-D696 | - | Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C and 30 Degrees C, Standard Test Method for (DoD adopted) |
| ASTM-D792 | - | Density and Specific Gravity (Relative Density) of Plastics by Displacement, Standard Test Methods for (DoD adopted) |
| ASTM-D1003 | - | Haze and Luminous Transmittance of Transparent Plastics, Standard Test Method for (DoD adopted) |
| ASTM-D1718 | - | Isobutyl Acetate (95% Grade), Standard Specification for (DoD adopted) |
| ASTM-E831 | - | Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis, Standard Test Method for |
| ASTM-F733 | - | Optical Distortion and Deviation of Transparent Parts Using the Double-Exposure Method, Standard Practice for (DoD adopted) |
| ASTM-G26 | - | Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials, Standard Practice for (DoD adopted) |

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

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

3. REQUIREMENTS

3.1 Qualification. The plastic sheet furnished under this specification shall be a product that is authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Materials. The plastic sheet shall be an acrylic plastic that is transparent and meets all the requirements of this specification.

3.2.1 Color. Unless otherwise specified (see 6.2), the plastic sheet shall be colorless.

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3.2.2 Dimensions. Dimensions of the plastic sheet shall be as specified by applicable drawings. Unless otherwise specified (see 6.2), the tolerance on length and width dimensions shall be ± 0.063 inch (1.6 mm).

3.2.3 Thickness. The actual thickness of the plastic sheet at any point shall be within the tolerances specified in table I. Thickness variations of sheets not included in table I shall be not greater than the tolerance for the next larger thickness.

3.3 Performance characteristics. The plastic sheet shall meet the requirements of table II when tested in accordance with table IV.

3.4 Formability. Formability shall be determined as specified in 4.5.4. The plastic sheet shall be formed into a hemispheric shape with an outside diameter of 10 ± 0.1 inches (25 ± 0.2 cm) and a draw of not less than 4.5 inches (11.5 cm).

3.5 Resistance to weathering. After exposure to accelerated weathering as specified in 4.5.11, the plastic sheet shall show no evidence of cracking, crazing, or other surface irregularities that affect visibility.

3.6 Optical uniformity.

3.6.1 Optical defects. The plastic sheet shall contain no optical defects, such as embedded particles, bubbles, scratches, or imperfections, that reduce visibility through the sheet and cause a variation in angular deviation of more than 5 minutes within a distance of not more than 20 inches (50 cm) on a grid board when tested as specified in 4.5.13.1. Blemishes that do not individually reduce visibility through the sheet shall be disregarded unless they form a cluster. Optical defects within 1 inch (25.4 mm) from the edge of the sheet shall also be disregarded.

3.6.2 Angular deviation. The plastic sheet shall contain no surface irregularities which cause angular deviations on either side of the undeviated position that are greater than the limits specified in table III when tested as specified in 4.5.13.2.

3.7 Craze resistance. Craze resistance shall be determined as specified in 4.5.15. Stress to craze results shall be not less than the values specified below:

| | <u>Isopropyl Alcohol</u> | | <u>Toluene/Isobutyl Acetate</u> | |
|--------------|--------------------------|------------|---------------------------------|------------|
| | <u>Dry</u> | <u>Wet</u> | <u>Dry</u> | <u>Wet</u> |
| Class 1, psi | 2500 | 1500 | 2000 | 1500 |
| Class 2, psi | 2500 | 2000 | 2000 | 1600 |

TABLE I. Thickness, tolerances, and requirements varying with thickness.

| NOMINAL SHEET THICKNESS, Inch | THICKNESS TOLERANCES, Inch | | | FLEXURAL DEFORMATION TEMPERATURE | | | | WATER ABSORPTION, Percent, Maximum | FLAMMABILITY, Inch/Minute, Maximum | WARPAGE AFTER ACCELERATED WEATHERING, Inch, Maximum |
|-------------------------------|-----------------------------|---|--|----------------------------------|-----|---------|-----|------------------------------------|------------------------------------|---|
| | Sheet up to 36 by 60 inches | Sheet larger than 36 by 60 inches up to 60 by 80 inches | Sheet larger than 60 by 80 inches up to 72 by 100 inches | Minimum | | Maximum | | | | |
| | | | | °F | °C | °F | °C | | | |
| | | | | | | | | | | |
| 0.060 | ±0.012 | ±0.020 | — | 189 | 87 | 234 | 112 | 1.00 | 1.60 | 0.030 |
| 0.080 | ±0.012 | ±0.020 | — | 192 | 89 | 237 | 114 | 0.80 | 1.55 | 0.020 |
| 0.100 | ±0.012 | ±0.020 | — | 196 | 91 | 241 | 116 | 0.70 | 1.45 | 0.020 |
| 0.125 | ±0.015 | ±0.020 | ±0.030 | 199 | 93 | 244 | 118 | 0.65 | 1.40 | 0.015 |
| 0.150 | ±0.017 | ±0.020 | ±0.030 | 201 | 94 | 246 | 119 | 0.60 | 1.37 | 0.015 |
| 0.187 | ±0.020 | ±0.023 | ±0.030 | 205 | 96 | 250 | 121 | 0.50 | 1.35 | 0.015 |
| 0.220 | ±0.023 | ±0.025 | ±0.030 | 207 | 97 | 252 | 122 | 0.45 | 1.35 | 0.015 |
| 0.250 | ±0.025 | ±0.030 | ±0.035 | 209 | 98 | 253 | 123 | 0.40 | 1.35 | 0.015 |
| 0.312 | ±0.030 | ±0.035 | ±0.040 | 211 | 99 | 255 | 124 | 0.36 | 1.35 | 0.015 |
| 0.375 | ±0.035 | ±0.040 | ±0.045 | 212 | 100 | 257 | 125 | 0.30 | 1.30 | 0.015 |
| 0.417 | ±0.040 | ±0.045 | ±0.045 | 212 | 100 | 257 | 125 | 0.28 | 1.30 | 0.015 |
| 0.500 | ±0.040 | ±0.045 | ±0.050 | 214 | 101 | 259 | 126 | 0.25 | 1.30 | 0.015 |
| 0.625 | ±0.050 | ±0.050 | ±0.055 | 214 | 101 | 259 | 126 | 0.23 | 1.20 | 0.015 |
| 0.750 | ±0.050 | ±0.050 | ±0.060 | 214 | 101 | 259 | 126 | 0.20 | 1.10 | 0.015 |
| 0.875 | ±0.050 | ±0.050 | ±0.070 | 214 | 101 | 259 | 126 | 0.20 | 1.10 | 0.015 |
| 1.000 | ±0.050 | ±0.050 | ±0.075 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.015 |
| 1.250 | ±0.063 | ±0.063 | ±0.095 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.015 |
| 1.500 | ±0.075 | ±0.075 | ±0.112 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.015 |
| 1.750 | ±0.088 | ±0.088 | ±0.131 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.015 |
| 2.000 | ±0.100 | ±0.100 | ±0.150 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.015 |
| 2.250 | ±0.113 | ±0.113 | ±0.168 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.015 |
| 2.500 | ±0.117 | ±0.117 | ±0.175 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.010 |
| 3.000 | ±0.120 | ±0.120 | ±0.190 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.010 |
| 3.500 | ±0.140 | ±0.140 | ±0.210 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.010 |
| 4.000 | ±0.160 | ±0.160 | ±0.225 | 216 | 102 | 261 | 127 | 0.20 | 1.00 | 0.010 |

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TABLE II. Performance characteristics.

| CHARACTERISTIC | REQUIREMENT |
|--|--|
| Specific gravity | 1.19 ±0.01 |
| Water absorption | See table I |
| Long term water absorption (class 2), percent, maximum | 2.90 |
| Flammability | See table I |
| Coefficient of thermal expansion per °F (°C), maximum | 0.000055 (0.00010) |
| Internal strain (dimensional change), percent, maximum | 1 |
| Flexural deformation temperature | See table I |
| Tensile strength, psi (MPa), minimum | 9000 (62.1) |
| Elongation, percent, minimum | 2 |
| Ultraviolet transmittance (290 to 330 mμ range), percent, maximum | 2 |
| Index of refraction ^{1/} | 1.49 ±0.01 |
| Luminous transmittance, percent, minimum ^{1/} Thickness, inch: 0.060 through 0.187 As received After accelerated weathering Over 0.187 through 0.312 As received After accelerated weathering Over 0.312 through 0.417 As received After accelerated weathering Over 0.417 through 1.250 As received After accelerated weathering Over 1.250 through 2.250 As received After accelerated weathering Over 2.250 through 3.000 As received After accelerated weathering Over 3.000 through 4.000 As received After accelerated weathering | 91 90 90 89 89 87 88 86 88 85 85 82 80 80 |
| Haze, percent, maximum ^{1/} As received After accelerated weathering | 3 4 |
| Warpage after accelerated weathering | See table I |
| Thermal stability | No evidence of blistering, crazing, or other thermal instability |

^{1/} Requirement is for colorless plastic sheet.

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TABLE III. Angular deviation.

| SHEET THICKNESS | LIMITS OF PERMISSIBLE DEVIATION <u>1/</u> |
|--|--|
| 0.060 inch through 0.220 inch | 7 minutes at any location more than 1 inch from the edge of the sheet. |
| Over 0.220 inch through 0.250 inch | 7 minutes at any location more than 3 inches from the edge of the sheet and 9 minutes between 3 inches and 1 inch of the edge. |
| Over 0.250 inch through 0.375 inch | 7 minutes at any location more than 3 inches from the edge of the sheet and 12 minutes between 3 inches and 1 inch of the edge. |
| Over 0.375 inch through 0.500 inch | 7 minutes at any location more than 3 inches from the edge of the sheet and 14 minutes between 3 inches and 1 inch of the edge. |
| Over 0.500 inch through 1.000 inch | 12 minutes at any location more than 3 inches from the edge of the sheet and 20 minutes between 3 inches and 1 inch of the edge. |
| Over 1.000 inch through 2.500 inches | 20 minutes at any location more than 3 inches from the edge of the sheet and 25 minutes between 3 inches and 1 inch of the edge. |
| Over 2.500 inches through 4.000 inches | 30 minutes at any location more than 3 inches from the edge of the sheet and 35 minutes between 3 inches and 1 inch of the edge. |

1/ Surface irregularities within 1 inch from the edge of the sheet shall be disregarded.

3.8 Instruction sheet. An instruction sheet containing information relating to the necessary precautions to be observed in the use, forming, cementing, handling, and storage of the plastic sheet shall be included in each shipping container.

3.9 Protective covering. A protective covering shall be applied to both sides of the plastic sheet to protect the surfaces from scratches and abrasions. The covering shall be easily removed without injury or damage to the surface. The plastic sheet shall be identified on the protective covering by specification number, type, class, thickness, manufacturer's code, and national stock number.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Conformance inspection (see 4.3).

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4.2 Qualification inspection. Qualification inspection shall consist of all the tests specified in table IV.

TABLE IV. Qualification inspection.

| CHARACTERISTIC | REQUIREMENT PARAGRAPH | TEST METHOD OR PARAGRAPH |
|--------------------------------------|-----------------------|--------------------------|
| Thickness | 3.2.3 | 4.5.1 |
| Specific gravity | Table II | ASTM-D792 |
| Water absorption | Table I | ASTM-D570 <u>1/</u> |
| Long term water absorption | Table II | 4.5.2 |
| Flammability | Table I | ASTM-D635 |
| Coefficient of thermal expansion | Table II | 4.5.3 |
| Formability | 3.4 | 4.5.4 |
| Internal strain | Table II | 4.5.5 |
| Flexural deformation temperature | Table I | 4.5.6 |
| Tensile strength | Table II | 4.5.7.1 |
| Elongation | Table II | 4.5.7.2 |
| Ultraviolet transmittance | Table II | 4.5.8 |
| Index of refraction | Table II | 4.5.9 |
| Luminous transmittance | Table II | 4.5.10 |
| Haze | Table II | 4.5.10 |
| Resistance to weathering | 3.5 | 4.5.11 |
| Warpage after accelerated weathering | Table I | 4.5.12 |
| Optical uniformity | 3.6 | 4.5.13 |
| Thermal stability | Table II | 4.5.14 |
| Craze resistance | 3.7 | 4.5.15 |
| Instruction sheet | 3.8 | Visual |
| Protective covering | 3.9 | Visual |

1/ Test specimens shall be conditioned at a temperature of 221 to 230 °F (105 to 110 °C) for 1 hour, then immersed in water at room temperature for 24 hours prior to testing.

4.2.1 Qualification test sample. The qualification test sample shall consist of not less than 10 square feet (1 square meter) of plastic sheet for each thickness. Individual sheet dimensions shall be not less than 12 by 18 inches (30 by 45 cm). To be qualified for all thicknesses, manufacturers shall submit samples of plastic sheet with nominal thicknesses of 0.060 inch (1.5 mm), 0.250 inch (6.4 mm), 0.500 inch (12.7 mm), 1.000 inch (25.4 mm), 2.250 inches (5.7 cm), and 4.000 inches (10.2 cm). Qualification of two consecutive thicknesses, such as 0.060 inch and 0.250 inch, automatically extends qualification to all thicknesses within the range. Qualification samples for specific thicknesses may also be submitted.

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4.2.1.1 Test specimens. Test specimens shall be prepared from a portion of the sheet sample (see 4.2.1), machined and polished to a specific thickness required by the applicable test, to complete the tests specified for flammability (see table IV), coefficient of thermal expansion (see 4.5.3), formability (see 4.5.4), flexural deformation temperature (see 4.5.6), mechanical properties (see 4.5.7), ultraviolet transmittance (see 4.5.8), and craze resistance (see 4.5.15).

4.3 Conformance inspection.

4.3.1 Visual and dimensional inspection. Each lot (see 6.4) shall be sampled as specified (see 6.2). Visual and dimensional defects shall be as specified in table V.

TABLE V. Visual and dimensional inspection.

| INSPECTION | DEFECT |
|---------------------|---|
| Appearance | Any visible haze. Scratches, cuts, cracks, or other damage. Optical defects such as striae, bubbles, blisters, "fish-eyes", and other blemishes except as described in 3.6.1. Embedded dirt or foreign material. Rough, uneven edges. |
| Color | Not colorless, or not color specified. |
| Protective covering | Not easily peeled. Surfaces marked when removed. |
| Length and width | Varies by more than ± 0.250 inch (6.4 mm) for stock size sheets, unless otherwise specified (see 6.2). Varies by more than ± 0.060 inch (1.5 mm) for trimmed sheets. |
| Thickness | Varies by more than the applicable tolerance specified in table I. |

4.3.2 Physical and mechanical inspection. Three samples shall be randomly selected from each lot (see 6.4). Test specimens shall be prepared from each sample to complete the tests specified in table VI.

4.4 Test conditions.

4.4.1 Standard conditions. Unless otherwise specified in the applicable test method, all tests and inspections shall be conducted at a temperature of 77 ± 2 °F (25 ± 1 °C) and a relative humidity of 50 ± 5 percent.

4.4.2 Test results. Unless otherwise specified in the applicable test method, all test results shall be recorded as the average of the number of specimens being tested as well as each individual value.

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TABLE VI. Physical and mechanical inspection.

| CHARACTERISTIC <u>1/</u> | REQUIREMENT PARAGRAPH | TEST PARAGRAPH | NUMBER OF DETERMINATIONS PER SAMPLE | RESULTS RECORDED AS | |
|--|-----------------------|----------------|-------------------------------------|---------------------|-------------------------------------|
| | | | | PASS OR FAIL | AVERAGE NUMERICALLY TO THE NEAREST: |
| Internal strain | Table II | 4.5.5 | 2 | X | — |
| Flexural deformation temperature | Table II | 4.5.6 | 2 | — | 0.1 °C |
| Angular deviation | 3.6.2 | 4.5.13.2 | 2 | — | 1 minute |
| Craze resistance, toluene/isobutyl acetate, wet only | 3.7 | 4.5.15 | 2 | X | — |

1/ Angular deviation shall be determined prior to internal strain and flexural deformation temperature.

4.5 Methods of inspection.

4.5.1 Thickness. Thickness measurements shall be made with any device having an accuracy of 0.001 inch (0.025 mm) and shall meet the requirement of 3.2.3.

4.5.2 Long term water absorption. Three test specimens, measuring 1 by 2 by 0.125 inch (2.5 by 5.0 by 0.3 cm), shall be vacuum dried at 158 ±2 °F (70 ±1 °C) for 72 ±1 hours. The specimens shall be weighed to the nearest milligram (W_1) and immediately immersed in water at 140 ±2 °F (60 ±1 °C) for 25 days +1, -0 hours. After removal from the water, the specimens shall be immediately dried with a soft cloth and reweighed (W_2). Long term water absorption shall meet the requirement in table II when calculated as follows:

$$\text{Percent long term water absorption} = \left(\frac{W_2 - W_1}{W_1} \right) \times 100$$

4.5.3 Coefficient of thermal expansion. Two test specimens, 0.250 inch (6.4 mm) thick, shall be tested in accordance with ASTM-D696 or ASTM-E831. Results shall meet the requirement in table II.

4.5.4 Formability. Two test specimens shall be formed to determine conformance to 3.4. Forming conditions shall be in accordance with the manufacturer's instructions. Plastic sheet that is 0.500 inch (12.7 mm) or less in thickness shall be tested in the "as cast" form. Plastic sheet that is over 0.500 inch in thickness shall be machined to 0.500 inch prior to testing.

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4.5.5 Internal strain. Two conditioned 12- by 18-inch (30- by 45-cm) plastic sheets shall be tested. Each sheet shall be considered to be a 12- by 12-inch (30- by 30-cm) specimen supported by the remainder of the sheet. Two fine lines shall be scribed at right angles crossing the center of the 12- by 12-inch area. Finely scribed gauge marks shall then be placed 2 inches (5 cm) from the edge of the specimen area on each of these lines. The distance between each pair of gauge marks shall be measured to the nearest 0.060 inch (1.5 mm) and the data recorded. Each sheet shall be hung by one short edge in a circulating air oven at 320 ± 18 °F (160 ± 10 °C) for the time indicated below:

| <u>Nominal Sheet Thickness, Inch</u> | <u>Minimum Heating Time, Minutes</u> |
|--------------------------------------|--------------------------------------|
| 0.250 and less | 16 |
| 0.375 | 25 |
| 0.500 | 33 |
| 0.750 | 55 |
| 1.000 | 79 |
| 1.500 | 136 |
| 2.000 | 203 |
| 2.500 | 240 |
| 3.000 | 300 |
| 3.500 | 350 |
| 4.000 | 400 |

After removal from the oven, the sheets shall be cooled to standard conditions (see 4.4.1) while hanging vertically. The distance between each pair of gauge marks shall be remeasured. The dimensional change shall be computed as the percent change in distance between the gauge marks from the first measurement. The average of the four values shall be recorded and shall meet the requirement in table II.

4.5.6 Flexural deformation temperature. Two test specimens shall be tested in accordance with ASTM-D648 except that the thickness of the sample being tested shall become the width of the specimen. Those thicknesses not in the range specified in ASTM-D648 shall be plied or machined. The unmachined surface shall be on a side. The load shall be calculated to give a maximum fiber stress of 264 psi (1,820 kPa). Each value shall be recorded and shall meet the requirement in table I.

4.5.7 Mechanical properties. Tensile and elongation test specimens shall be prepared from as received plastic sheet that is 0.500 inch (12.7 mm) or less in thickness. Plastic sheet that is over 0.500 inch in thickness shall be machined to 0.500 inch using the "as cast" surface as the face of the specimen. The machined surface shall be polished. The specimens shall be type II specimens as described in ASTM-D638. Prior to testing, machined specimens shall be annealed at 194 °F (90 °C) for not less than 2 hours and slowly cooled (less than 27 °F (15 °C) per hour) to 74 °F (23 °C) to relieve stresses induced during machining.

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4.5.7.1 Tensile strength. Five test specimens shall be tested in accordance with ASTM-D638. Results shall meet the requirement in table II.

4.5.7.2 Elongation. Elongation shall be determined in accordance with ASTM-D638. The mean elongation immediately before fracture shall meet the requirement in table II.

4.5.8 Ultraviolet transmittance. The spectral transmittance of a test specimen, 0.250 inch (6.4 mm) thick, shall be determined with a monochromator having a bandwidth of 10 millimicrons or less and a photometer having a reproducibility of ± 1 percent. Results shall meet the requirement in table II.

4.5.9 Index of refraction. Three test specimens shall be tested in accordance with the refractometer procedure of ASTM-D542. Results shall meet the requirement in table II.

4.5.10 Luminous transmittance and haze. Three test specimens, measuring 2 by 3 inches (5 by 7 cm), shall be examined as specified in ASTM-D1003, procedure A or B, for luminous transmittance and haze. The same specimens shall be subjected to accelerated weathering (see 4.5.11). After weathering, the specimens shall be immersed in distilled water for not longer than 10 seconds, blotted to remove surface moisture, and re-examined. Luminous transmittance and haze results shall meet the requirements in table II.

4.5.11 Accelerated weathering. Test specimens from 4.5.10 shall be subjected to accelerated weathering in accordance with ASTM-G26, method A for 240 hours. Each test specimen shall be visually examined for conformance to 3.5, then subjected to examinations for luminous transmittance and haze (see 4.5.10) and warpage (see 4.5.12).

4.5.12 Warpage after accelerated weathering. Test specimens from 4.5.11 shall be conditioned on a plane surface. After conditioning, the specimens shall be measured for warpage by determining the greatest distance from a straight edge connecting diagonally opposite corners to the near surface of the plastic. This distance shall be measured by using any device having an accuracy of 0.001 inch (0.025 mm). The warpage recorded shall be the maximum value, not an average, and shall meet the requirement in table I.

4.5.13 Optical uniformity.

4.5.13.1 Optical defects. The plastic sheet shall be visually examined for conformance to 3.6.1. Local areas which are suspected of containing optical defects that cause reduced visibility or distortion shall be tested in accordance with ASTM-F733.

4.5.13.2 Angular deviation. The angular deviation shall be determined in accordance with ASTM-F733 except that the displacement factor (angular deviation minutes) shall be determined by multiplying the maximum image movement in inches on the grid board by 12. Each sheet shall be examined, then rotated 90°, and re-examined for conformance to 3.6.2.

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4.5.14 Thermal stability. Two conditioned 12- by 18-inch (30- by 45-cm) plastic sheets shall be tested. Each sheet shall be hung in a circulating air oven at 356 ± 9 °F (180 ± 5 °C) for 2 hours +5, -0 minutes. After removal from the oven, the sheets shall be cooled to standard conditions (see 4.4.1) while hanging vertically, then visually examined for conformance to table II.

4.5.15 Craze resistance.

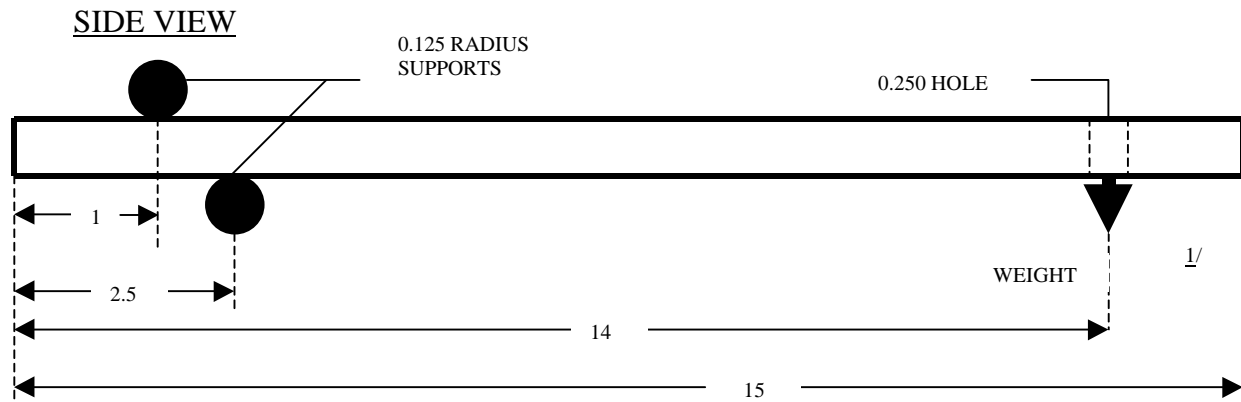
4.5.15.1 Conditioning of specimens. Twenty specimens, measuring 1 by 15 inches (2.5 by 38.1 cm) with thickness from 0.250 inch (6.4 mm) up to and including 0.500 inch (12.7 mm) shall be annealed at 248 ± 2 °F (120 ± 1 °C) for 2 hours. Specimens with thickness greater than 0.500 inch shall be machined to 0.500 inch. Immediately following the annealing process, ten specimens shall be conditioned at standard conditions (see 4.4.1) for 48 hours. The remaining ten specimens shall be cooled in air for 1 hour, immersed in water at 120 ± 2 °F (49 ± 1 °C) for 24 hours, then immersed in water maintained at 73 ± 2 °F (23 ± 1 °C) for 2 to 3 hours. Throughout all immersion times, the specimens shall not be in contact with one another. Wet specimens shall be tested within 15 minutes of removal from water. Dry specimens shall be tested as soon as possible after completion of the conditioning period.

4.5.15.2 Procedure. Each specimen shall be measured, taped with a 0.125-inch (3.2-mm) wide black matte tape (Chartpak or equivalent) as shown on figure 1, and set up as a cantilever beam under the load derived from the equation on figure 1. The specimens shall be placed under the load for 10 minutes before adding the test fluids. Ten specimens (five wet and five dry) shall be tested with isopropyl alcohol conforming to TT-I-735 and ten specimens (five wet and five dry) shall be tested with a 1 to 2 by weight mixture of toluene conforming to A-A-59107 and isobutyl acetate conforming to ASTM-D1718. The fluids shall be applied to a filter paper, which, in turn, shall be applied to the specimen (see figure 1). The filter paper shall remain wet during the entire exposure period by adding more test fluid with an eyedropper when necessary. As crazing progresses toward the load, the filter paper shall be moved down the specimen. Exposure time to each fluid shall be 30 minutes +1, -0 minutes. The position of the last craze point shall be marked on the side of the specimen. The distance from the last craze point to the load point shall be measured using a combination square that is modified with a plumb line and leveling bob. The stress to craze shall meet the requirements of 3.7 when calculated as follows:

$$\text{Stress to craze, psi} = \left(\frac{6LW}{wt^2} \right) \times 100$$

where: L = length from last craze point to load point
 W = applied load in pounds
 w = specimen width
 t = specimen thickness

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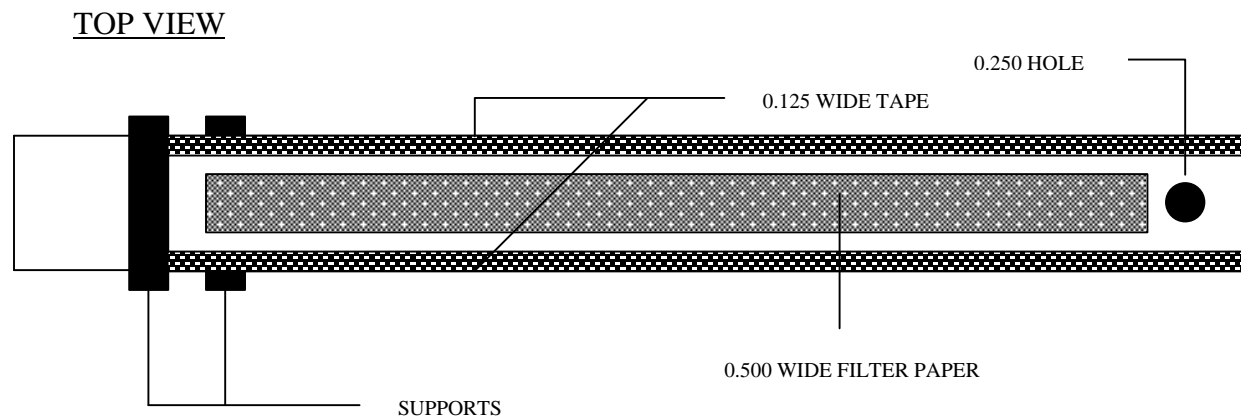


1/ Applied weight as follows:

$$W = \left(\frac{w t^2 \sigma}{6L} \right)$$

Where:

- W = applied weight (pounds)
- w = specimen width (1 inch)
- t = specimen thickness (inch)
- σ = outer fiber stress (4000 psi)
- L = distance from fulcrum to load point (11.5 inches)



DIMENSIONS IN INCHES

FIGURE 1. Crazing apparatus configuration.

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5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature, which may be helpful, but is not mandatory.)

6.1 Intended use. The modified acrylic plastic sheet is used in the production and maintenance of military aircraft exposed for prolonged periods to extreme seagoing environments not encountered by civilian aircraft. It is superior to conventional acrylic plastic sheet for craze and heat resistance. The intended use of the plastic sheet is for canopies, cockpit windows, and cabin windows that require a transparency with excellent optical, formability, outdoor weathering, and craze and heat resistant characteristics. Type II material is not intended for use in stretching operations to produce sheets and forms conforming to MIL-PRF-25690.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Type and class (see 1.2).
- c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- d. Color and optical requirements, when required (see 3.2.1).
- e. Dimensional tolerance requirements, when other than specified (see 3.2.2 and table V).
- f. Sampling procedures (see 4.3.1).
- g. Packaging requirements (see 5.1).

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6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion on Qualified Products List QPL-8184 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Commander, Naval Air Warfare Center Aircraft Division, Code 4.3.4.3, Building 2188, 48066 Shaw Road, Unit 5, Patuxent River, MD 20670-1908.

6.3.1 Inspection reports and additional information. When authorizing the forwarding of qualification samples, the qualifying activity will require the manufacturer to submit, along with the samples, two copies of the manufacturer's test report showing that the material to be submitted for qualification conforms to the requirements of this specification, and two copies of the manufacturer's instruction sheet (see 3.8). The qualification samples will be plainly and durably marked with the following information and forwarded to the test facility identified in the letter of authorization.

Sample for qualification inspection
PLASTIC SHEET, ACRYLIC, MODIFIED
Specification MIL-PRF-8184F
Type, class, and thickness
Manufacturer's name
Plant address (where sheet is manufactured)
Submitted by (name and date) for qualification inspection in accordance with the requirements of MIL-PRF-8184F under authorization of (reference authorization letter).

6.3.2 Retention of qualification. To retain qualification of a product approved for listing on the QPL, the manufacturer will verify by certification to the qualifying activity that the manufacturer's product complies with the requirements of this specification. The time of periodic verification by certification will be every two years from the date of original qualification and will be initiated by the Government. The Government reserves the right to re-examine the qualified product whenever deemed necessary to ensure that the product continues to meet any or all of the specification requirements.

6.4 Lot formation. Unless otherwise specified, a lot consists of the total number of plastic sheets of the same type, class, and thickness, forming part of one order or contract, submitted for inspection at one time.

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6.5 Suggested inspection levels. Manufacturing processes of the plastic sheet are such that slight variations in length, width, thickness, and appearance necessitate the use of acceptance sampling plans for visual and dimensional inspection. Suggested inspection levels, taken from ASQC-Z1.4, "Sampling Procedures and Tables for Inspection by Attributes" (American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202), are as follows:

| <u>Inspection</u> | <u>Inspection Level</u> |
|-------------------|-------------------------|
| Visual | I |
| Dimensional | S-3 |

6.6 Solubility. The plastic sheet may be attacked or undergo swelling in ketones, esters, aromatic hydrocarbons, and chlorinated hydrocarbons.

6.7 Variation of physical properties with temperature. Many physical properties of the plastic sheet vary with temperature. Designers, engineers, draftsmen, and prospective users of the product should consider this fact.

6.8 Subject term (key word) listing.

Aircraft transparency
 Craze resistance
 Heat resistance
 Weatherability

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

CONCLUDING MATERIAL

Custodians:
 Army - CR
 Navy - AS
 Air Force - 11

Preparing activity:
 Navy - AS
 (Project 9330-0091)

Review activities:
 Army - AV, MR
 Navy - EC, MC, SH
 DLA - GS

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
MIL-PRF-8184F

2. DOCUMENT DATE (YYMMDD)
981005

3. DOCUMENT TITLE

PLASTIC SHEET, ACRYLIC, MODIFIED

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)
(1) Commercial:

7. DATE SUBMITTED
(YYMMDD)

(2) DSN:
(If Applicable)

8. PREPARING ACTIVITY

a. NAME
COMMANDER
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION

b. TELEPHONE NUMBER *(Include Area Code)*
(1) Commercial (732) 323-2947 (2) DSN 624-2947

c. ADDRESS *(Include Zip Code)*
CODE 414100B120-3
HIGHWAY 547
LAKEHURST, NJ 08733-5100

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:
Defense Logistics Agency (DLSC-LM),
Attn: Carla Jenkins/John Tascher
8725 John J. Kingman Road, Ste 2533
Fort Belvoir, VA 22060-6221
Telephone (703) 767-6874

