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Superseding AMS-L-P-391

Plastic Sheets, Rods and Tubing, Rigid Cast, Methacrylate (Multiapplication)

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared "Stabilized" by SAE AMS P, Polymeric Materials Committee, and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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NOTICE

This document has been taken directly from U.S. Military Specification L-P-391D, Notice 1, Amendment 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace L-P-391D, Notice 1, Amendment 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.

1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This specification covers methacrylate sheets, rods and tubes produced by casting or machining cast blanks. This specification does not apply to heat-formed and molded or extruded shapes, or shapes made by assembling two or more pieces.

1.2 Classification (see 6.4):

1.2.1 Types and grades: The methacrylate sheets, rods, and tubes conforming to this specification shall be of the following items, types, and grades, as specified (see 6.2).

Item A - Plastic sheet.
Item B - Plastic rod.
Item C - Plastic tubing.
Item D - Plastic sheet having an abrasion resistant coating.

Type I - General purpose material having ultraviolet light absorbing properties.
Type II - Special use material not having an ultraviolet light absorber.
Type III - Type I sheet having an abrasion resistant coating on one or both sides.

The following grades apply to both types I and II material. Grades B and C sheet apply to type III sheet.

Grade A 1/ - Special sheeting, thermally preshrunk sheet having a smooth glossy surface.

Grade B 1/ - Cell cast or continuous cast sheet, rods, and tubes having a matte or patterned finish.

Grade C 1/ - Cell cast or continuous cast sheet, rods, and tubes having a smooth surface finish obtained either by casting or highly polishing the surface.

1/ All grades may be ordered trimmed to size or untrimmed.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 U.S. Government Publications:

Available from DODSSP Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

PPP-B-585	Boxes, Wood, Wirebound
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Boxes, Wood, Nailed and Lock-Corner
PPP-B-636	Box, Fiberboard
FED-STD-123	Marking for Shipment (Civil Agencies)
FED-STD-00356	Commercial Packaging of Supplies and Equipment
MIL-P-116	Preservation - Packaging, Methods of
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 19428-2959.

ASTM D 542	Index of Refraction of Transparent Organic Plastics
ASTM D 618	Conditioning Plastics and Electrical Insulating Materials for Testing
ASTM D 637	Surface Irregularities of Flat Transparent Plastic Sheets
ASTM D 638	Tensile Properties of Plastics
ASTM D 648	Deflection Temperature of Plastics Under Flexural Load
ASTM D 673	Mar Resistance of Plastics
ASTM D 756	Resistance of Plastics to Accelerated Service Conditions
ASTM D 792	Specific Gravity and Density of Plastics by Displacement
ASTM D 1003	Haze and Luminous Transmittance of Transparent Plastics
ASTM D 1044	Resistance of Transparent Plastics to Surface Abrasion
ASTM D 1308	Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1499	Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
ASTM D 1501	Exposure of Plastics to Fluorescent Sunlamp
ASTM D 3002	Evaluation of Coatings for Plastics

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

Available from the American Trucking Associations Inc., Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.

National Motor Freight Classification

2.4 Uniform Classification Committee, Agent:

Available from the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.

Uniform Freight Classification

3. REQUIREMENTS:

3.1 Material:

The cast sheets, rods, and tubes shall be composed of methacrylate plastics. Type III sheet shall consist of a cast methacrylate substrate having an abrasion resistant coating on one or both sides.

3.2 Property values:

The sheets shall conform to the property values specified in table I and the rods and tubes shall conform to the property values specified in table II, when tested as specified in the applicable procedure of 4.3. For type III sheets, surface related tests shall be performed on the coated side or sides.

3.3 Thermal stability (applicable to grades A, B, and C sheet):

Grades A, B, and C sheet shall show no evidence of bubbling or blistering when subjected to the thermal stability test.

3.4 Simulated weathering resistance:

3.4.1 Types I and II sheet: When specified by the procuring agency (see 6.2), types I and II sheet shall be subjected to simulated weathering (see 4.3.13.1) and shall show no evidence of cracking, crazing, surface instability, discoloration, or other changes which prevent light transmittance and haze properties from meeting the requirements specified in table I.

3.4.2 Type III sheet: Type III sheet shall be subjected to simulated weathering (see 4.3.13.2) and shall show no evidence of surface deterioration which prevents abrasion and mar resistance, coating adhesion, and light transmittance properties from meeting the applicable requirements specified in table I.

3.5 Accelerated service conditions resistance (applicable only to type III sheet):

Type III sheet shall be subjected to accelerated service conditioning (see 4.3.14) and shall show no evidence of change in abrasion and mar resistance, and coating adhesion properties (see table I).

TABLE I. Property values for cast sheets

Property	Type I	Type II	Type III	Remarks
Index of refraction, n_D 23°C. min.	1.49	1.48	NA[1]	Clear and colorless material only.
max.	1.50	1.50	1.46	
Specific gravity[2], min.	1.18	1.18	1.18	Unpigmented.
max.	1.20	1.20	1.20	
Haze, max., percent	3.0	3.0	2.0	Grades A and C colorless material only - not applicable to sheets over 1/2 inch in thickness.
Light transmittance, min., percent:				
0.060 to 0.187 in. thick	91	91	93	Colorless material, grades A and C only.
0.220 to 1.000 in. thick	89	89	91	
1.125 to 2.000 in. thick	87	87	89	
Spectral transmittance at any wavelength in the 290 to 330 nm. band, with 0.250 in. thick sheet, max., percent[3]	5	NA	5	Colorless material, type I and type III, grade C only.
Displacement factor, max.[4]				
0.060 to 0.500 in. thick	50	50	50	Grades A and C colorless and transparent colors in flat sheets only.
0.625 to 1.000 in. thick	80	80	80	
1.125 to 2.000 in. thick	125	125	125	
Shrinkage, max., percent:				
Grades B and C	2.8	2.8	2.8	Sheets only, must show no evidence of bubbling or blistering.
Grade A	1.0	1.0	NA	Sheets only, must show no evidence of bubbling or blistering.
Deflection temperature under load at 264 p.s.i., min., °C.				
0.060 to 0.500 in. thick[5]	87	87	87	
Above 0.500 to 1.000	88	88	88	
Above 1.000 to 4.000	93	93	93	

TABLE I. Property values for cast sheets (cont'd)

Property	Type I	Type II	Type III	Remarks
Tensile strength, min., p.s.i.	9000	9000	9000	
Elongation at rupture, min., percent	2	2	2	
Abrasion resistance, max., percent haze	NA	NA	4.0	Before and after simulated weathering conditioning. Before and after accelerated service conditioning.
Mar resistance, max., percent haze	NA	NA	4.0	Before and after simulated weathering conditioning. Before and after accelerated service conditioning.
Coating adhesion, min., percent retention	NA	NA	88	Before and after simulated weathering conditioning. Before and after accelerated service conditioning.
Chemical resistance, visual examination for surface alteration	NA	NA	No change	Type III only.

1/ NA indicates not applicable.
2/ For pigmented material, specific gravity shall be as specified by the procuring agency.
3/ When testing other thickness, the value found shall be adjusted to 0.250 in. thickness. Thick sheet shall be machined to 0.250 in. thickness and polished.
4/ Applies to the area greater than 3 in. from the edge of the sheet.
5/ For thickness less than 0.060 inches, deflection temperature shall be as specified by the procuring agency.

TABLE II. Property values for cast rods and tubes

Property		Type I	Type II
Index of refraction, $n_D^{23°C}$.	min.	1.48	1.48
	max.	1.50	1.50
Specific gravity[1/],	min.	1.18	1.18
	max.	1.20	1.20
Spectral transmittance at any wavelength in the 290 to 330 nm. band, 0.250 in. thickness max. percent[2/]		5	NA[3/]
Deflection temperature under load at 264 p.s.i., min. °C.			
0.060 to 0.500 in. thick		87	87
Above 0.500 to 1.000		90	90
Above 1.000		93	93
Tensile strength, min., p.s.i.		8000	8000
Elongation at rupture, min., percent		2	2

1/ For pigmented material, specific gravity shall be as specified by the procuring agency.
2/ When testing other thicknesses, the value found shall be adjusted to 0.250 in. thickness. Thick rods, tubes, and shapes shall be machined to 0.250 in. thickness and polished for testing.
3/ NA indicates not applicable.

3.6 Color:

Unless otherwise specified, sheets, rods, and tubes shall be colorless. When color is specified, certain optical properties, including refractive index, haze, and luminous transmittance, are not applicable. The method of determination and the uniformity of the color shall be specified by the procuring agency in consultation with the supplier (see 6.2).

3.6.1 End color of rods and tubes: When required, end color of rods and tubes shall not exceed the limit defined by the color standard specified by the procuring agency. The method of examination shall be as specified by the procuring agency (see 6.2).

3.7 Dimensions and tolerances:

All measurements shall be made either at 23° ± 2°C (73.4° ± 3.6°F), or corrected to 23°C (73.4°F). When correction to 23°C (73.4°F is required, pertinent information, including measurement temperature, shall be reported to the procuring agency.

3.7.1 Sheets: The nominal length, width and thickness shall be as specified by the procuring agency (see 6.2). For trimmed sheets, types I and II, tolerance on length and width shall be ± 0.125 inch. For untrimmed sheets, types I and II, up to and including 1/2 inch thick, length and width shall be not less than 2.5 percent larger than nominal. For untrimmed sheets, types I and II, greater than 1/2 inch through 4 inches thick, length and width shall be not less than 1 percent larger than nominal. Tolerances for thickness of cell cast sheets shall be as specified in tables III and IV. Tolerances and thickness of continuous cast sheet shall be as specified in table V. The standard widths for continuous cast sheet shall be 36 inches through 96 inches and standard length shall be as specified in table V. Type III sheet, cut to trimmed sizes, shall have the same tolerances as type I sheet. Untrimmed type III sheet may have one or more edges trimmed, but the dimensions supplied shall be equal to or larger than nominal.

TABLE III. Nominal thickness and tolerances for grade A (preshrunk) cell cast sheets

Nominal thickness inch	Permissible thickness variation, inch		
	Size 1 1/	Size 2 2/	Size 3 3/
0.060	±0.017	±0.025	NA 4/
0.080	±0.017	±0.025	NA
0.100	±0.017	±0.025	NA
0.125	±0.020	±0.025	±0.035
0.187	±0.025	±0.030	±0.035
0.250	±0.030	±0.035	±0.040
0.312	±0.035	±0.040	±0.045
0.375	±0.040	±0.045	±0.050
0.500	±0.045	±0.050	±0.050
0.625	±0.055	±0.055	±0.055
0.750	±0.055	±0.055	±0.060
0.875	±0.055	±0.055	±0.070
1.000	±0.055	±0.055	±0.075
1.250	±0.070	±0.070	±0.100
1.500	±0.080	±0.080	±0.120
1.750	±0.095	±0.095	±0.140
1.875	±0.105	±0.105	±0.155
2.000	±0.105	±0.105	±0.155

1/ Size 1 - Nominal sheet sizes 36 by 60 inches and smaller, and 40 by 50 inches and smaller.

2/ Size 2 - Nominal sheet sizes larger than size 1 up to and including 48 by 84 inches, 53 by 80 inches, and 60 by 72 inches.

3/ Size 3 - Nominal sheet sizes larger than size 2 up to and including 67 by 102 inches, and 72 by 96 inches.

4/ NA indicates not applicable.

TABLE IV. Nominal thickness and tolerance for grades B and C cell cast sheets

Nominal thickness, inch[1/]	Permissible variation, inch		
	Size 1[2/]	Size 2[3/]	Size 3[4/]
0.030	+0.007[5/] -0.009	NA	NA[6/]
0.040	+0.006[5/] -0.010	NA	NA
0.050	+0.006[5/] -0.010	NA	NA
0.060	+0.015 -0.019	+0.024 -0.027	NA
0.080	+0.014 -0.020	+0.022 -0.028	NA
0.100	+0.013 -0.021	+0.021 -0.029	NA
0.125	+0.015 -0.025	+0.020 -0.030	+0.030 -0.040
0.150	+0.016 -0.030	+0.022 -0.036	+0.029 -0.050
0.187	+0.017 -0.033	+0.022 -0.038	+0.027 -0.043
0.220	+0.020 -0.040	+0.025 -0.045	+0.029 -0.050
0.250	+0.020 -0.040	+0.025 -0.045	+0.030 -0.050
0.312	+0.022 -0.048	+0.027 -0.053	+0.032 -0.058
0.375	+0.025 -0.055	+0.030 -0.060	+0.035 -0.065
0.500	+0.025 -0.065	+0.030 -0.070	+0.035 -0.075

TABLE IV. Nominal thickness and tolerance for grades B and C cell cast sheets (cont'd)

Nominal thickness, inch[1/]	Permissible variation, inch		
	Size 1[2/]	Size 2[3/]	Size 3[4/]
0.625	+0.033 -0.077	+0.033 -0.077	+0.038 -0.082
0.750	+0.030 -0.080	+0.030 -0.080	+0.040 -0.090
0.875	+0.026 -0.084	+0.026 -0.084	+0.046 -0.104
1.000	+0.023 -0.087	+0.023 -0.087	+0.048 -0.112
1.250	+0.052 -0.094	+0.052 -0.094	+0.052 -0.094
1.500	+0.039 -0.121	+0.039 -0.121	+0.077 -0.159
1.750	+0.049 -0.137	+0.049 -0.137	+0.092 -0.180
2.000	+0.058 -0.152	+0.058 -0.152	+0.108 -0.202
2.250	+0.070 -0.166	+0.070 -0.166	NA
2.500	+0.079 -0.181	+0.079 -0.181	NA
2.750	+0.092 -0.194	+0.092 -0.194	NA
3.000	+0.102 -0.208	+0.102 -0.208	NA
3.250	+0.114 -0.222	+0.114 -0.222	NA

TABLE IV. Nominal thickness and tolerance for grades B and C cell cast sheets (cont'd)

Nominal thickness inch 1/	Permissible variation, inch		
	Size 1 2/	Size 2 3/	Size 3 4/
3.500	+0.121 -0.239	+0.121 -0.239	NA 6/
3.750	+0.134 -0.252	+0.134 -0.252	NA
4.000	+0.142 -0.268	+0.142 -0.268	NA

1/ Thickness of unshrunk sheet will increase approximately 4 percent when it is heated at thermoforming temperatures.

2/ Size 1 - Nominal sheet sizes 36 by 60 inches and smaller, 40 by 50 inches and smaller.

3/ Size 2 - Nominal sheet sizes larger than size 1 up to and including 48 by 84 inches, 53 by 80 inches, and 60 by 72 inches.

4/ Size 3 - Nominal sheet sizes larger than size 2 up to and including 67 by 102 inches, and 72 by 96 inches. Sheet sizes 48 by 120, and 84 by 132 inches are available in nominal thicknesses of 0.125, 0.187, and 0.250 inch, and in grade A only.

5/ For colorless sheet only, tolerances shall be +0.014, -0.009 for 0.030 inch thickness, +0.013, -0.017 for 0.040 inch thickness, and +0.013, -0.017 for 0.050 inch thickness.

6/ NA indicates not applicable.

TABLE V. Nominal thickness, length, and tolerances for Grades B and C continuous cast sheeting 1/

Nominal thickness, inch	Permissible variation in thickness, inch as supplied in reel form or flat sheet	As supplied in reel form	
		Standard nominal length in feet 2/	Permissible variation in length, feet
0.080	±0.010	2/	-0, +1
0.100	±0.010	2/	-0, +1
0.110	±0.011	2/	-0, +1
0.125	±0.012	2/	-0, +1
0.135	±0.013	2/	-0, +1
0.150	±0.015	2/	-0, +1
0.170	±0.017	2/	-0, +1
0.187	±o.019	2/	-0, +1
0.220	±0.022	2/	-0, +1
0.250	±0.025	2/	-0, +1

1/ If defective portions are included in a continuous reel, they shall not exceed 10% of the total length in feet supplied. The length of any such defective portions are to be credited (deducted from the gross footage supplied) at no cost to the purchaser.

2/ Nominal lengths of reels shall be as agreed upon between supplier and procuring agency. Standard lengths vary from 250 to 750 feet as thickness decreases. Nominal widths are 8 feet.

3.7.2 Rods: The nominal length and diameter shall be as specified by the procuring agency (see 6.2). The tolerance on length shall be ± 0.0625 inch with diameters no greater than 3.00 inches, and 0.125 inch for rods with diameters above 3.00 inches. Tolerances for diameter shall be as specified in table VI.

TABLE VI. Nominal diameter and tolerances of cast rods

Nominal diameter, inch	Diameter tolerances, inch
0.25 to 0.50	±0.005
0.625 to 1.00	±0.010
1.125 to 2.00	±0.015
2.25 to 3.00	±0.030
3.25 to 5.5	±0.040
6.0 to 8.5	±0.050
9 to 11	±0.060

3.7.3 Tubes: The nominal length, outside diameter, and wall thickness shall be as specified by the procuring agency (see 6.2). The tolerance on outside diameter and wall thickness shall be as specified in tables VII and VIII. The tolerance for length shall be ± 0.0625 inch.

TABLE VII. Nominal outside diameter and tolerance of cast tubes

Nominal outside diameter, inch	Outside diameter tolerance, inch		Difference between maximum and minimum outside diameter (one tube) not to exceed, inch
	Plus	Minus	
1.500 to 3.000	0.010	0.020	0.025
3.125 to 3.875	0.015	0.030	0.040
4.000 to 6.094	0.015	0.045	0.060
7.000 to 12.000	0.015	0.065	0.080

TABLE VIII. Nominal wall thickness and tolerances of cast tubes

Nominal wall thickness, inch	Permissible wall thickness tolerance, inch
0.125	±0.015
0.150	±0.019
0.187	±0.019
0.250	±0.025
0.375	±0.035
0.500	±0.045
0.750	±0.060

3.8 Workmanship:

The sheets, rods, and tubes shall be free from warpage, cracks, scratches, blisters, voids, foreign matter and other defects that may affect appearance or which may affect serviceability. Bubbles in rods and tubes shall not exceed 0.156 inch in any dimension, and no more than three such bubbles are acceptable in any standard length not less than 48 inches. Bubbles are not permitted in rods and tubes less than 48 inches in length.

3.8.1 Flatness of sheets (applicable only to cell cast sheets): Types I and II sheet shall be free from edge kink warpage and from edge "S" warp. Type III sheet less than or equal to 0.125 inch thick may have "S" warp with a maximum deviation of 1.0 inch from a flat surface. Type III sheet greater than 0.125 inch thick shall be free from edge kink warpage and from "S" warp. Overall bow warp is permitted for all types of sheet if it can be displaced by light finger pressure to conform to a flat surface.

3.8.2 Corner letgoes for sheets (applicable to either trimmed or untrimmed sheets): Masked sheets of thickness equal to or less than 2.000 inches shall be free of let-goes within their specified minimum nominal length and width.

NOTE: A let-go is commonly defined as an area of laminated glass in which an initial adhesion between glass and interlayer is debonded.

Unmasked sheets in thicknesses no greater than 0.250 inches may have letgoes within any or all of the corner areas which are defined as isosceles triangles with 3-inch sides. Corner letgoes in unmasked sheets that are thicker than 0.250 inches up to and including 2.000 inches are permitted within any or all of the corner areas which are defined as isosceles triangles with 6-inch sides. For unmasked sheets out-of-tolerance corner letgoes, within an isosceles triangle that has no more than twice the allowable length for sides, shall be accepted if removed. For masked and unmasked sheets in thicknesses greater than 2.000 inches, letgoes may exist provided they do not extend more than 1/64 inch below the surface. For continuous cast sheet only, edge letgoes less than 1/64 inch in depth may exist within one inch of the sheet edges provided physical integrity is not impaired.

3.8.3 Chips and dirt in sheets:

3.8.3.1 Chips for sheets in thickness equal to or less than 2.000 inches: For type I and type II sheet, maximum permissible size shall be 0.125 inch. For type III sheet, maximum permissible size shall be 0.187 inch. Chips that are approximately the maximum permissible size for each type of sheets, shall not have a frequency greater than one chip per 4 square feet of sheet area. Chips less than the maximum permissible size for each type of sheet shall not form a concentrated pattern that may affect serviceability. Chips out-of-tolerance in size may be knifed off and considered acceptable if the remaining blemish could be removed by polishing, except for type III sheets which cannot be easily polished.

3.8.3.2 Chips for sheets in thicknesses greater than 2.000 inches: Chips may exist providing they do not extend more than 1/64 inch above the surface.

3.8.3.3 Dirt and contaminants: For type I and type II sheet, maximum permissible dimension shall be 0.125 inch. For type III sheet, maximum allowable dimension shall be 0.187 inch. Dirt and contaminants less than 1/32 inch shall be disregarded. The maximum permissible frequency for dimensions ranging from 1/32 inch to the maximum permissible for each type of sheet shall be one per 4 square feet of sheet area for thickness up to and including 0.500 inch, and 1 per square foot for thickness exceeding 0.500 inch.

3.8.4 Other defects in sheets, rods, and tubes: Minor type defects such as mold or handling scratches which can be removed by polishing shall be permitted for type I and type II sheet provided these are not objectionable individually or in grouped patterns. For type III sheet, maximum permissible length for mold scratches shall be 1 inch; maximum permissible length for medium or heavy handling scratches or abrasions shall be 2 inches; maximum permissible length of light handling scratches or abrasions shall be 6 inches; scratches or abrasions less than 0.250 inch and back-to-back mold scratches shall be disregarded unless they form a concentrated pattern that may affect serviceability. For type III sheet, the maximum permissible frequency for allowable scratches and abrasions as defined above shall be one per 4 square feet of sheet area. Excluding side letgoes for types I, II, and III sheets in thicknesses greater than 2.000 inches and for unmasked sheets that are thicker than 0.250 inches up to and including 2.000 inches, defects within one inch of the untrimmed edge of the sheet, which do not significantly reduce mechanical strength of the sheet, shall be permitted. Side letgoes for sheets thicker than 2.000 inches may exist providing they do not extend more than 1/64 inch below the surface. Side letgoes for unmasked sheets thicker than 0.250 inches and up to and including 2.000 inches shall be allowed within a 2 inch band from the untrimmed edge of the sheet. Rods and tubes shall be free of striae and other blemishes that may affect serviceability.

3.8.4.1 Optical clarity of rods (applicable to grade C only): Grade C cast rods in 20 inch lengths, after polishing the ends, shall have optical clarity that will enable clean print of the size 7 lines per column inch and 16 characters to the linear inch to be read when viewed through the length of the rod under good illumination. The optical clarity of rods 3 inches and less in diameter shall not be impaired by heating for the time periods and temperatures specified in table IX, followed by cooling to 23° ± 2°C (73.4° ± 3.6°F) before testing.

TABLE IX. Heating conditions for determining stability of optical clarity of rods 1/

Rod diameter, inches	Temperature	Time, minutes
0.250 to 0.500	150°C (302°F)	30
0.625 to 1.5	145°C (293°F)	50
1.625 to 3.00	145°C (293°F)	75

1/ Rods larger than 3.0 inches in diameter and machined from large castings, will not pass the optical clarity test after the heating cycle.

3.8.4.2 Turbidity of rods and tubes (applicable to grade C only): When required, turbidity of grade C rods and tubes shall not exceed the limit defined by a turbidity standard specified by the procuring agency. The method of examination shall be as specified by the procuring agency (see 6.2).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier 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 type, grade, and nominal thickness submitted for delivery at one time.

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

4.2.2 Inspection of material:

4.2.2.1 Inspection of sheets, rods and tubes: Examination of sheets, rods, and tubes shall be made in accordance with the classification of defects, inspection levels and acceptable quality levels (AQLs) set forth below. The lot size, for purpose of determining the sample size in accordance with MIL-STD-105, shall be expressed in units of packages of plastic sheets, rods, or tubes for examination in 4.2.2.1, and 4.2.2.2, and in units of shipping containers for examination in 4.2.2.3.

4.2.2.1.1 Examination of sheets, rods, and tubes for defects in appearance and workmanship: The sample unit for the examination specified in table X shall be one sheet, rod, or tube.

TABLE X. Examination of sheets, rods, and tubes for defects in appearance and workmanship

Examine	Defects
Sheets, rods and tubes	Not free from warpage, cracks, scratches, blisters, voids, and foreign matter (see 3.8).
Rods and tubes	Bubbles not in accordance with 3.8.
Sheets	Not free from edge kink warpage and edge "S" warp (see 3.8.1). Not in accordance with 3.8.1 for type III sheet equal to or less than 0.125 inch thick.
Sheets	Letgoes exceeding dimensions specified (see 3.8.2).
Sheets	Chips or dirt not in accordance with requirements (see 3.8.3.1, 3.8.3.2, and 3.8.3.3). Other defects not in accordance with requirements (see 3.8.4).

4.2.2.1.2 Examination of sheets, rods, and tubes for defects in dimensions: The sample unit for the examination specified in table X shall be one sheet, rod, or tube.

TABLE XI. Examination of sheets, rods, and tubes for dimensional defects

Examine	Defects
Sheets	Nominal length, width, or thickness not as specified. Length or width tolerance not as specified in 3.7.1. Thickness tolerance not as specified in tables III, IV, and V.
Rods	Nominal length and diameter not as specified. Tolerance for length not as specified in 3.7.2. Tolerances for diameter not as specified in table VI.
Tubes	Nominal length, outside diameter, and wall thickness not as specified. Tolerance for outside diameter not as specified in table VII. Tolerance for wall thickness not as specified in table VIII. Tolerance for length not as specified in 3.7.3.

4.2.2.1.3 Examination of preparation for delivery: An examination in accordance with table XII, shall be made to determine that packaging, packing, and marking comply with specified contract requirements. 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 XII. Examination for defects in preparation for delivery

Examine	Defect
Packaging	Not level specified. Not individually packaged, multiple packaged, or intermediate packaged, as specified. Packaging material not as specified: closure not accomplished by specified or required methods or materials; component missing. Weight of intermediate package exceeds specified requirements.
Packing	Not level specified. Containers not as specified, closures not accomplished by specified or required methods of materials. Any nonconforming component, component missing, damaged or otherwise defective, affecting serviceability.
Count	Less than specified or indicated quantity.
Weight	Gross weight exceeds specified requirements.
Markings	Interior or exterior markings, as applicable, omitted, illegible, incorrect, incomplete, of improper size, location, sequence or method of application, or not in accordance with contract requirements.

4.2.2.1.4 Inspection levels and AQLs for examinations: The inspection levels for determining the sample size and the AQL, expressed as defects per 100 units shall be as follows:

Examination paragraph	Inspection level	AQL
4.2.2.1.1	I	2.5
4.2.2.1.2	S-2	4.0
4.2.2.1.3	S-2	2.5

4.2.3 Testing: The sheets shall be tested for the applicable characteristics listed in table I, and the rods and tubes for the applicable characteristics listed in table II, in accordance with the test method specified herein for each lot submitted for inspection. The lot size, for the purpose of determining sample size for testing shall be expressed in units of packages of sheets, rods, or tubes, as applicable. The sample unit shall consist approximately of only sufficient material to prepare all required specimens. The inspection level shall be S-1 with an acceptance number of 0. When the test method requires testing more than one specimen, the results for each test shall be the averaged results of the specimens.

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 sheets, rods, or tubes, as applicable, and, in conjunction with the above examination, shall be the basis for acceptance or rejection of the lot, except when periodic lot check tests are required. For type I and II sheet, lot acceptance tests shall consist of tests for specific gravity, spectral transmittance (for type I only), shrinkage, and deflection temperature under load (see table I). For type III sheet lot acceptance tests shall consist of tests for specific gravity, spectral tramsmittance, deflection temperature under load, abrasion resistance, mar resistance and coating adhesion (see table I). For rods and tubes, lot acceptance tests shall consist of tests for specific gravity, spectral transmittance (for type I only), and deflection temperature under load (see table II).

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 (see 6.2). For grades B and C sheet, periodic lot check tests shall consist of all tests specified in table I and the thermal stability test (see 3.3). For grade A sheet, periodic lot check tests shall consist of all tests specified in table I. For type III sheet, periodic lot check tests shall consist of all tests specified for grade C and the simulated weathering and accelerated service conditions tests (see 4.3.13.2 and 4.3.14). For rods and tubes, periodic lot check tests shall consist of all tests specified in table II. When periodic lot check tests are made, they shall be included in the basis for acceptance or rejection of the lot.

4.3 Test methods:

4.3.1 Test specimen preparation: Unless otherwise specified, the dimensions of specimens shall conform to that specified in the applicable test procedure.

4.3.1.1 Sheets: Test specimens shall be cut from sheet. When 0.250 inch thick sheet is not available for spectral transmittance determination, lower thicknesses may be used with adjustment of the values to that for 0.250 inch thick specimens. The method of adjustment shall be as specified by the procuring agency (see 6.2). Sheets with thickness greater than 0.250 inch shall be machined to 0.250 inch thickness and polished before measuring spectral transmittance.

4.3.1.2 Rods and tubes: Test specimens shall be cut from the rods or tubes, as applicable. If test specimens cannot be cut from rods or tubes, specimens shall be prepared from the same material under conditions specified by the manufacturer.

4.3.2 Test specimen conditioning: Unless otherwise specified, test specimens shall be conditioned in accordance with procedure A of ASTM D 618 and tested at 23° ± 2°C (73.4° ± 3.6°F) and 50 ± 5 percent relative humidity.

4.3.3 Index of refraction: One specimen shall be tested in accordance with ASTM D 542.

4.3.4 Specific gravity: One specimen shall be tested in accordance with method A of ASTM D 792.

4.3.5 Haze (applicable only to grade C sheet): One specimen shall be tested in accordance with ASTM D 1003, except that test specimens shall not exceed 0.500 inches in thickness.

4.3.6 Light transmittance (applicable only to grade C sheet): One specimen shall be tested in accordance with ASTM D 1003, at the same time it is tested in accordance with 4.3.5.

4.3.7 Spectral transmittance in the ultraviolet region (applicable only to type I and type III grade C sheet, and type I rods and tubes): One specimen shall be tested for spectral transmittance in 290 to 330 nonometers (nm.) wavelength band. The spectral transmittance shall be determined by means of a monochromator having a band width of 10 nm. or less and a photometer having a reproducibility of ± 1 percent of full scale.

4.3.8 Displacement factor (applicable only to grade C sheet): One test specimen 18.0 ± 0.1 by 18.0 ± 0.1 inch shall be tested in accordance with ASTM D 637.