



# Provisional Standard Specification for Rods and Tubes of Polyethylene (PE)<sup>1</sup>

This provisional standard is issued under the fixed designation PS 106; the number immediately following the designation indicates the year of original adoption.

## 1. Scope

1.1 This provisional specification covers low, medium, and high density polyethylene rods, and tubes for general purpose, dielectric, and weather resistant applications.

1.1.1 *Coverage*—This provisional specification covers polyethylene rods and tubes made from material conforming to L-P-390.

1.2 *Classification*—Polyethylene rods and tubes include the applicable type, class, and grade (see 3.1 and 6.2) in accordance with Table 1, as follows:

1.3 This specification is intended to replace MIL-P-21922B.

NOTE 1—There is no similar or equivalent ISO standard.

1.4 The values are stated in inch-pound units.

1.5 The following precautionary caveat pertains only to the test method portion, 4.4, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 The classification system outlined is intended to be identical to that used by the Department of Defense for many years. No changes are intended at this time.

1.7 Provisional standards<sup>2</sup> achieve limited consensus through approval of the sponsoring subcommittee.

## 2. Referenced Documents

### 2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>3</sup>

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer<sup>3</sup>

D 1505 Test Method for Density of Plastics by the Density and Gradient Technique<sup>3</sup>

### 2.2 Federal Standards:<sup>4</sup>

L-P-390 Plastic, Molding, and Extrusion Material, Polyethylene and Copolymers (Low, Medium, and High Density)

TABLE 1 Types, Classes, and Grades of Rods and Tubes

Type	Application	Class 1 <sup>A</sup>	Grade	Color		
I	General purpose	L and M	1	natural and colors, including black		
			2	natural and colors, including black		
		H	1	natural and colors, including black		
			2	natural and colors, including black		
			3	natural and colors, including black		
II	Dielectric	L	4	natural and colors, including black		
			5	natural and colors, including black		
			M	1	natural	
				2	colors, including black	
				3	natural	
		H	1	colors, including black		
			2	natural and colors, including black		
		III	Weather resistant	L	1	natural and colors, including black
					2	natural and colors, including black
					3	natural and colors, including black
4	natural and colors, including black					
5	natural and colors, including black					
M	1			black (carbon 0.5 ± 0.1 % by weight)		
	2			black (carbon 2.50 ± 0.5 % by weight)		
	3			black (carbon 2.50 ± 0.5 % by weight)		
	4			black (carbon 2.50 ± 0.5 % by weight)		
	5			black (carbon 2.50 ± 0.5 % by weight)		
H	1	black (carbon 0.5 ± 0.1 % by weight)				
	2	black (carbon 2.50 ± 0.5 % by weight)				

<sup>A</sup>L = low density; M = medium density; and, H = high density.  
Form A = Rods  
Form B = Tubes

PPP-B-585 Boxes, Wood, Wirebound  
PPP-B-591 Boxes, Fiberboard, Wood-Cleated

<sup>1</sup> This provisional specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.20 on Plastic Products.

Current edition approved Jan. 29, 2001. Published February 2001.

<sup>2</sup> Provisional standards exist for two years subsequent to the approval date.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>4</sup> Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

- PPP-B-601 Boxes, Wood, Cleated-Plywood
- PPP-B-636 Box, Fiberboard
- 2.3 *Military Standards:*<sup>4</sup>
- MIL-P-116 Preservation, Method of
- MIL-L-10547 Liners, Case, Waterproof
- MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 Marking for Shipment and Storage
- 2.4 *National Motor Freight Traffic Association Document:*<sup>5</sup>
- National Motor Freight Classification
- 2.5 *Uniform Classification Document:*<sup>6</sup>
- Uniform Freight Classification

**TABLE 3 Tolerances for Tube Diameter and Wall Thickness**

Nominal Outside Diameter of Tubes, in. <sup>A</sup>	Tolerances, ±, in. <sup>B</sup>					
	On Outside Diameter, in.	On Wall Thickness, in. <sup>C</sup>				
		1/32	1/16	3/32	1/8	9/16
3/8 <sup>D</sup>	0.0075	0.005	0.006	0.008	0.009	...
1/2	0.010	0.005	0.007	0.009	0.010	0.012
5/8	0.011	0.005	0.007	0.009	0.010	0.012
3/4	0.0125	0.005	0.007	0.009	0.010	0.012
1	0.015	0.006	0.008	0.010	0.010	0.013
1 1/4	0.0175	0.006	0.008	0.010	0.010	0.013
1 1/2	0.020	0.006	0.008	0.010	0.010	0.014
2	0.025	0.006	0.009	0.010	0.011	0.015
2 3/4	0.035	0.006	0.010	0.010	0.012	0.015
2 1/2	0.030	0.006	0.009	0.010	0.012	0.015

<sup>A</sup>Intermediate sizes shall conform to the tolerances of the larger size.

<sup>B</sup>Tolerances for diameter apply to the average outside diameter as determined by averaging two mutually perpendicular diameters in the same cross sectional plan. Tolerance for wall thickness applies to the maximum and minimum wall thickness measured at any point around the circumference and includes eccentricity.

<sup>C</sup>Tolerances for wall thickness greater than 3/16 in. shall be as specified by the procuring activity.

<sup>D</sup>Tolerances for tubes smaller than 3/8-in. or larger than 2-3/4 in. outside diameter, shall be as specified by the procuring activity (see 6.2).

### 3. Requirements

3.1 *Materials*—Unless otherwise specified by the procuring activity (see 6.2), Type I material of L-P-390 shall be used for extrusion of rods and tubes.

3.2 *Property Values*—The rods and tubes shall conform to the property values for density and melt index specified in L-P-390 (see 4.3.2).

#### 3.3 Dimensions and Tolerances:

3.3.1 *Diameter and Wall Thickness*—The diameter of rods shall be the nominal diameter specified by the procuring activity (see 6.2) and tolerances shall be as specified in Table 2. The outside diameter and wall thickness of tubes shall be as specified by the procuring activity (see 6.2) and tolerances shall be as specified in Table 3.

3.3.2 *Length of Rods*—Unless otherwise specified by the procuring activity (see 6.2), rods shall be furnished in lengths of 48 or 72 in. depending upon which is more nearly standard for the diameter specified. When both lengths are standard, the longer one shall be preferred. Tolerances for length shall be + 1.0, - 0.0 in. for rods 1-in. or less in diameter and + 2.0, - 0.0 in. for rods greater than 1-in. in diameter (see 6.2). Rods shall be supplied in straight lengths.

3.3.3 *Length of Tubes*—Unless otherwise specified by the procuring activity (see 6.2), tubes shall be furnished in straight lengths of 72 + 1.0, - 0.0 in. (see 6.2).

3.4 *Color*—The color of the rods and tubes shall be as specified by the procuring activity (see 6.2).

3.5 *Centerless Grinding*—When specified by the procuring activity, rods and tubes shall be extruded oversize and then centerless ground to the outside diameter specified. The rods or tubes shall be held to the outside diameter tolerance and surface finish specified in the contract or purchase order. The wall thickness shall be as specified, plus or minus the acceptable tolerances.

3.6 *Certification*—The manufacturer shall present certification that the material used in preparing the rods and tubes conforms to the applicable type, class, and grade of material specified in L-P-390 (see 6.2). The certificate shall state the material designation, color, and type, grade, and class of L-P-390 to which it conforms. The certificate shall be presented prior to, or at the time of delivery of the lot, and shall be signed by a responsible agent of the supplier, and shall be accompanied by evidence of the agent's authority to bind his principal.

3.7 *Workmanship*—The rods and tubes shall be free from kinks (see 6.3), blisters, cracks, bubbles, discolorations, craze, surface scratches that form definite indentations, wrinkles, dents, die or heat marks.

### 4. Quality Assurance Provisions

4.1 *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the government. The government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 *Inspection of Materials and Components*—In accordance with 4.1, the supplier is responsible for insuring that materials and components used are manufactured, tested, and inspected in accordance with the requirements of referenced,

<sup>5</sup> Available from the American Trucking Association, Inc., Tariff Order Section, 1616 "P" Street, NW, Washington, DC 20036.

<sup>6</sup> Available from the Uniform Classification Committee, Room 1006, 222 South Riverside Plaza, Chicago, IL 60606.

**TABLE 2 Rod Diameter Tolerances, Including Out of Roundness**

Nominal Diameter, in. <sup>A</sup>	Tolerance, plus minus		Nominal Diameter, in.	Tolerance, plus minus	
	plus	minus		plus	minus
1/8	0.010	0.010	1 1/4	0.025	0.020
3/16	0.010	0.010	1 1/2	0.025	0.020
1/4	0.010	0.010	2	0.040	0.020
5/8	0.010	0.018	2 1/2	0.048	0.020
1/2	0.010	0.018	3	0.250	0.000
5/8	0.010	0.018	4	0.250	0.000
3/4	0.010	0.018	5	0.250	0.000
7/8	0.010	0.020	6	0.250	0.000
1	0.010	0.020	7	0.250	0.000

<sup>A</sup>Intermediate diameters shall conform to the tolerances of the larger diameters.

subsidiary specifications and standards to the extent specified. In the event of conflict, this specification shall govern.

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 rods of one nominal diameter, or tubes of one nominal outside diameter and wall thickness of the same type, class and grade of material, submitted for delivery at one time.

4.3 *Inspection of the Rods and Tubes:*

4.3.1 *Examination of the Rods and Tubes*—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 rods or tubes as applicable, for examination in 4.3.1.1-4.3.1.3, and in units of shipping containers for examination under 4.3.1.4.

4.3.1.1 *Examination of the Rods and Tubes for Defects in Color, Centerless Grinding, and Workmanship*—The sample unit for this examination, specified in Table 4, shall be one rod or one tube, as applicable. Not more than five sample units shall be taken from any one package of rods or tubes.

4.3.1.2 *Examination of Rods and Tubes for Dimensional Defects*—The sample unit for this examination, specified in Table 5, shall be one rod or tube, as applicable.

4.3.1.3 *Examination of the Rods and Tubes for defects in the Count for Package*—The sample unit for this examination, specified in Table 6 shall be one package.

4.3.1.4 *Examination of Preparation for Delivery Requirements*—An examination shall be made in accordance with Table 7 to determine that packaging, packing, and marking 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.

4.3.1.5 *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:

Examination Section	Inspection Level	AQL
4.3.1.1	I	1.5
4.3.1.2	S-3	2.5
4.3.1.3	S-2	...
4.3.1.4	S-2	4.0

4.3.2 *Testing*—The rods or tubes shall be tested for the density and melt index characteristics specified in 3.2 for each

**TABLE 4 Examination for Defects in Color, Centerless Grinding, and Workmanship**

Examine	Defect
Color and centerless grinding	Color improper Centerless grinding improper
Workmanship	Not free from kinks, blisters, cracks, bubbles, discolorations, craze, surface scratches forming indentations, wrinkles, dents, die or heat marks.

**TABLE 5 Examination for Dimensional Defects**

Examine	Defect
Diameter of rods	Nominal diameter improper or varies more than tolerances specified in Table 1.
Outside diameter and wall thickness of tubes	Improper outside diameter or wall thickness. Tolerances not within that specified in Table 2.
Length of rods	Improper length. Not within tolerances specified for length of rods.
Length of tubes	Improper length. Not within tolerances specified for length of tubes.

**TABLE 6 Examination for Defects in the Count for Package**

Examine	Defect
Rods and tubes	Average count per package less than specified.

**TABLE 7 Examination of Preparation for Delivery**

Examine	Defect
Packaging	Not level specified; not in accordance with contract requirements.  Rods or tubes 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, improper taping or inadequate stapling.
Count	Less than specified or indicated quantity of packages per shipping container.
Weight	Gross or net weight exceeds specified requirements.
Markings	Interior or exterior markings (as applicable) omitted, illegible, incorrect, incomplete, of improper size, location, sequence, method of application, or not in accordance with contract requirements.

lot submitted for inspection, in accordance with the test methods specified herein. The lot size for the purpose of determining sample size for testing shall be expressed in units of packages of rods or tubes. The sample unit shall consist of approximately two feet of rod or tube. The inspection level shall be S-1 with an acceptance number of 0. The results for each test shall be the averaged results of the specimens.

4.4 *Test Methods:*

4.4.1 *Specimen Preparation*—Specimens shall be die out or machined from rods or tubes for density determinations. For melt index determinations, specimens may be in any of the

forms specified in Test Method D 1238.

4.4.2 *Conditioning Test Specimens*—The specimens shall be conditioned in accordance with Procedure A of Practice D 618. Testing shall be at  $23 \pm 2^\circ\text{C}$  ( $73.4 \pm 3.6^\circ\text{F}$ ) and  $50 \pm 5\%$  relative humidity.

4.4.3 *Density*—Duplicate determinations shall be made using two separate specimens. Testing shall be in accordance with Test Method D 1505.

4.4.4 *Melt Index*—Three determinations shall be made for melt index (flow rate) in accordance with Test Method D 1238, using Condition E.

## 5. Preparation for Delivery

5.1 *Application*—The requirements of Section 5 apply only to purchase by or direct shipment to the government.

5.2 *Packaging*—Packaging shall be Level A or C, as specified (see 6.2).

### 5.2.1 Level A:

5.2.1.1 *Unit Packaging*—Unless otherwise specified in the contract or purchase order (see 6.2), rods and tubes shall be packaged in quantities specified by the procuring activity in accordance with Method III of MIL-P-116. Rods or tubes of only one set of nominal dimensions shall be placed in one package.

5.2.1.2 *Intermediate Packaging*—When required, specified quantities of unit packages shall be intermediately packaged as specified in the contract or purchase order (see 6.2).

5.2.2 *Level C*—Rods or tubes shall be preserved and packaged to afford adequate protection against deterioration and damage during shipment from the supply source to the first receiving activity.

5.3 *Packing*—Packing shall be Level A, B, or C, as specified (see 6.2).

5.3.1 *Level A*—Rods or tubes packaged as specified in 5.2.1 shall be packed in containers conforming to PPP-B-585 (overseas type), PPP-B-601 (overseas type), or PPP-B-636 (class weather resistant). Unless otherwise specified containers shall be provided with a case liner conforming to MIL-L-10547. Closure shall be in accordance with the applicable container specifications or appendix thereto. The gross weight of wood or wood cleated boxes shall not exceed 200 lb.

5.3.2 *Level B*—Rods or tubes packaged as specified in 5.2.1 shall be separated by thickness and shall be packed in domestic class or type shipping containers conforming to PPP-B-591, PPP-B-601, or PPP-B-636. Closure shall be in accordance with the applicable container specification or appendix. The gross weight of the containers shall not exceed 150 lb except for the PPP-B-636 box, which shall not exceed the weight limitations of the box specification.

5.3.3 *Level C*—Rods and tubes packaged as specified in 5.2, shall be packed in a manner to ensure carrier acceptance, and safe delivery at destination at lowest transportation rate for such supplies. Containers shall be in accordance with Uniform

Freight Classification rules or National Motor Freight Classification rules, as applicable.

5.4 *Marking*—In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with MIL-STD-129.

## 6. Notes

6.1 *Intended Use*—The bulk of polyethylene rods and straight length tubes are intended for use as machine shop stock for machining into components of electrical and corrosion resistant equipment and items. Small diameter tubes, usually furnished in coils, may be used as laboratory tubing for carrying water and corrosive liquids. Smaller diameter rods may be used for decorative beading.

6.2 *Ordering Data*—Procurement documents should specify the following:

### 6.2.1 Procurement Requirements:

6.2.1.1 Title, number, and date of this specification.

6.2.1.2 Type if other than Type I, class, and grade of material required (see 1.2).

6.2.1.3 Outside diameter required (see 3.3.1).

6.2.1.4 Tube wall thickness required (see 3.3.1).

6.2.1.5 Length required (see 3.3.2 and 3.3.3).

6.2.1.6 Color required (see 3.4).

6.2.1.7 Centerless grinding and surface finish, if required (see 3.5).

6.2.1.8 Tube diameter and wall thickness tolerances, when centerless grinding is specified (see 3.5).

6.2.1.9 Packaging and packing required including unit packaging quantities, if required (see 5.2 and 5.3).

6.2.2 *Contract Data Requirements*—Data specified in paragraphs 3.2 and 3.6 will be listed directly on a DD Form 1423 incorporated into the contract.

6.3 *Kinked and Bowed*—Rods and tubes containing a bend that is not a uniform bow are considered kinked. Rods and tubes uniformly curved over the entire length are considered bowed. Unless otherwise specified, bowed rods and tubes are acceptable, and kinked rods and tubes are unacceptable. Numerical limits for bowing may be specified by the procuring activity.

6.4 *Degradation of Material*—Extrusion under excessive temperature conditions may cause degradation of the material as evidenced by a change in appearance and an increase in melt index.

6.5 *Coils*—The procuring activity may specify that small diameter tubes be supplied in coils of specified lengths. Usual coil lengths are 50-ft and 100-ft. Because of the tendency for coiled tubes to contain coil set and kinking, it is recommended that only tubes supplied in straight lengths be ordered for use as machine shop stock.

## 7. Keywords

7.1 polyethylene; rod; tubes

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*