

L-P-393a

January 31, 1964

SUPERSEDING

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FEDERAL SPECIFICATION**PLASTIC MOLDING MATERIAL,
POLYCARBONATE, INJECTION AND EXTRUSION**

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 *Scope.* This specification covers one type of polycarbonate molding and extrusion material for general-purpose use (see 6.1).

1.2 Classification.

1.2.1 *Forms.* Polycarbonate injection molding and extrusion material shall be of the following forms, as specified (see 3.3 and 6.2):

Form 1—Pellets

Form 2—Powder

2. APPLICABLE SPECIFICATIONS, STANDARDS, AND OTHER PUBLICATIONS

2.1 *Specifications and standards.* The following specifications and standards, of the issues in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

Federal Specifications:

PPP-B-576—Box, Wood, Cleated, Veneer, Paper Overlaid.

PPP-B-585—Boxes, Wood, Wirebound.

PPP-B-591—Boxes, Fiberboard, Wood-Cleated.

PPP-B-601—Boxes, Wood, Cleated-Plywood.

PPP-B-621—Boxes, Wood, Nailed and Lock-Corner.

PPP-B-636—Box, Fiberboard.

PPP-B-640—Boxes, Fiberboard, Corrugated, Triple Wall.

PPP-C-96—Cans, Metal, 28 Gage and Lighter.

Federal Standards:

Fed. Std. No. 102—Preservation, Packaging, and Packing Levels.

Fed. Std. No. 123—Marking for Domestic Shipment (Civilian Agencies).

Fed. Test Method Std. No. 406—Plastics: Methods of Testing.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications, Standards, and Handbooks and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, and Auburn, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications, Standards, and Handbooks from established distribution points in their agencies.)

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Military Specification:

MIL-P-116—Preservation, Methods of.

Military Standard:

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

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

2.2 *Other publications.* The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply:

American Society for Testing and Materials (ASTM) Standards:

- D 149-61—Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials.
- D 150-59T—A-C Capacitance, Dielectric Constant, and Loss Characteristics of Electrical Insulating Materials.
- D 256-55—Impact Resistance of Plastics and Electrical Insulating Materials.
- D 570-59aT—Water Absorption of Plastics.
- D 613-61—Conditioning Plastics and Electrical Insulating Materials for Testing.
- D 638-61T—Tensile Properties of Plastics.
- D 648-56—Deflection Temperature of Plastics Under Load.
- D 746-57T—Brittleness Temperature of Plastics and Elastomers by Impact.
- D 790-61—Flexural Properties of Plastics.
- D 792-60T—Specific Gravity and Density of Plastics.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia 3, Pa.)

ASTIA Document:

AD 297457—Toxic Gases and Ignition Temperature Determinations.

(Application for copies should be addressed to the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.)

3. REQUIREMENTS

3.1 *Material.* The plastic compound shall consist basically of polycarbonate resin, so formulated as to meet the requirements of this specification. It shall be in forms suitable for injection molding and for extrusion as specified in the contract or order (see 6.2).

3.2 *Color and transparency.* Unless otherwise specified (see 6.2), the compound shall be furnished in its natural color and transparency. Added colorant (when used) shall not alter the physical, chemical, and electrical properties specified herein.

3.3 Forms.

3.3.1 *Form 1.* When specified (see 6.2), the form 1 compound shall be furnished in pellet form. Pellets shall be approximately 1/8 inch in diameter by 1/8 inch long.

3.3.2 *Form 2.* When specified (see 6.2), the form 2 compound shall be furnished as a free-flowing powder.

3.4 *Uniformity.* All lots of polycarbonate compound of the same grade and nominal form from one manufacturer shall be uniform in form, appearance, and physical properties.

3.5 *Property values.* Products manufactured from polycarbonate materials shall have the properties listed in table I. Unless otherwise specified (see footnote for brittleness in table I), the values obtained from each set of specimens shall be averaged (see 4.5.2.1), and the results so obtained shall meet the requirements specified in table I.

TABLE I.—*Property values*

| Property (see table IV) | Value required |
|--|-------------------|
| Density, range inclusive, D-23° C. g/ml. | 1.20 to 1.22 |
| Tensile yield strength, minimum, p.s.i. | 8000 |
| Tensile ultimate strength, minimum, p.s.i. | 9000 |
| Tensile ultimate elongation, minimum, percent | 60 |
| Flexural strength, minimum, p.s.i. ... | 11000 |
| Izod impact strength, minimum, ft. lb./inch of notch: | |
| 0.125 in. thick | 12 |
| 0.250 in. thick | 2.5 |
| Brittleness, —55° C. | ¹ |
| Deflection temperature, 264 p.s.i. minimum. °C. | 135 |
| Water absorption, 24 hrs., maximum percent | 0.35 |
| Dielectric constant, maximum, 1 mcs .. | 3.1 |
| Dielectric strength, 100 cps maximum, volts/mil. | 400 |
| Disipation factor, maximum, 1 mcs .. | 0.015 |
| Flammability (when specified, see 6.2): | |
| Ignition time, minimum, sec. | 90 |
| Burning time, maximum, sec. | 90 |
| Toxicity (when specified, see 6.2) quantities, parts per million, maxi- mum: | |
| Carbon dioxide | 15000 |
| Carbon monoxide | 1000 |
| Ammonia | 2500 |
| Aldehydes as H·CHO | 50 |
| Cyanides as HCN | 60 |
| Oxides of Nitrogen as NO ₂ | 100 |
| Hydrogen chloride | 100 |

¹ At least 5 out of 10 specimens shall not fail the brittleness test (see 4.5.3.5).

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

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.

4.1.1 *Test equipment and inspection facilities.* Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government.

4.2 *Classification of inspection.* The examination and testing of polycarbonate shall be classified as follows:

(a) Acceptance inspection (see 4.4).

(1) Inspection of product for delivery (see 4.4.1).

(2) Inspection of preparation for delivery (see 4.4.2). (Applicable only for direct procurement by or shipment to the Government.)

4.3 *Inspection conditions.* Unless otherwise specified herein, all inspections shall be made at room ambient temperature, relative humidity, and pressure. For reference purposes, the standard procedure and testing conditions specified in the general requirements of Fed. Test Method Std. No. 406 or in ASTM Standard D 618-61 shall be employed.

4.4 *Acceptance inspection.*

4.4.1 *Inspection of product for delivery.* Inspection of product for delivery shall consist of batch inspection (see 4.4.1.2) and periodic-batch inspection (see 4.4.1.3).

4.4.1.1 *Batch.* A batch of polycarbonate (see 3.1 to 3.3, inclusive) shall consist of all material produced under like conditions in an unchanged process by one manufacturer and inspected at one time.

4.4.1.2 *Batch inspection.* Batch inspection shall consist of the tests specified in table II.

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TABLE II.—*Batch inspection*

| Test | Requirement | Test Method |
|--|-------------|--------------|
| Density | see table I | see table IV |
| Tensile yield strength, tensile ultimate strength, and tensile ultimate elongation | | |
| Flexural strength | | |
| Dielectric constant and dissipation factor | | |
| Dielectric strength | | |
| | | |

4.4.1.2.1 *Sampling plan.* Batch sampling and inspection shall be made on each batch (see 4.4.1.1), and shall be the basis for acceptance or rejection of the batch (see 4.5.1).

4.4.1.3 *Periodic-batch inspection.* Periodic-batch inspection shall consist of the tests specified in table III. Shipment shall not be held up pending results of the inspection.

TABLE III.—*Periodic-batch inspection*

| Test | Requirement | Test Method |
|---|-------------|--------------|
| Izod impact strength | see table I | see table IV |
| Brittleness | | |
| Deflection temperature | | |
| Water absorption | | |
| Flammability and toxicity (when specified, see 6.2) | | |

4.4.1.3.1 *Sampling plan.* Periodic-batch sampling and inspection shall be made on the first batch (see 4.4.1.1) prepared for shipment under this specification, and on every 20th batch thereafter, or once every 2 years, whichever is more frequent (see 4.5.1).

4.4.1.3.2 *Noncompliance.* If a batch fails to pass periodic-batch inspection, the supplier shall take corrective action on the materials or process, or both, as warranted, and on all batches which can be corrected and which were manufactured under essentially the same conditions, with essentially

the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, periodic-batch inspection shall be repeated. Batch inspection may be reinstated; however, final acceptance shall be withheld until the periodic-batch reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the contracting officer.

4.4.1.4 *Rejection.* Failure to comply with any of the requirements of this specification shall be cause for rejection of the batch represented.

4.4.2 *Inspection of preparation for delivery.* Sample items and packs shall be selected and inspected in accordance with MIL-P-116 to verify conformance with the requirements in section 5 of this specification.

4.5 Methods of test.

4.5.1 *Sampling.* Three representative samples of equal size shall be selected from each batch prior to packaging. If sampling is done after packaging, three containers (packages or drums) shall be selected at random from each batch (see 4.4.1.1). Containers shall be opened carefully, making sure that there is no contamination from scale, paint, shattered heads, torn liners, or from any other cause. The three representative samples shall be composited, placed in a clean dry metal or glass container, and tightly closed.

4.5.2 *Specimens.*

4.5.2.1 *Number and form.* The number of specimens shall be as specified (see table IV). Specimens of the form specified in the applicable document or paragraph (see table IV) shall be molded as specified in

4.5.2.3. Unless otherwise specified herein, the thickness shall be 0.125 ± 0.0125 inch.

4.5.2.2 *Additional specimens.* Except for impact strength and brittleness, when the test result of a specimen deviates from the average of the other specimens by more than four times the average deviation of the other specimens, that specimen shall be discarded and another specimen from the same composite shall be tested and used in its place.

4.5.2.3 *Molding.* Dry polycarbonate shall be used in molding (see 6.3). Specimens shall be injection molded at a cylinder temperature of 260° to 315° C. inclusive, (500° to 599° F. inclusive), on a cycle of a minimum of 30 seconds. The temperature of the mold shall be 77° to 93° C. inclusive, (170.6° to 199.4° F. inclusive). Other necessary molding conditions shall be as recommended by the supplier, except that all specimens representing one lot shall be molded under the same conditions.

4.5.3 *Test methods.* Test methods shall be as specified in table IV.

4.5.3.1 *Density.* Method A of ASTM D 792-60T shall be used.

4.5.3.2 *Tensile yield strength, tensile ultimate strength, and tensile ultimate elongation.* Type I or type III specimens and speed B shall be used.

4.5.3.3 *Flexural strength.* Procedure A shall be used.

4.5.3.4 *Izod impact strength (see 4.5.2.1 and 4.5.2.3).* Tests shall be performed on machine notched injection-molded specimens of 0.125-inch and 0.250-inch thickness.

4.5.3.5 *Brittleness.* Test specimen thickness shall be 0.075 ± 0.010 inch. The test shall be terminated after a single impact blow to a specimen at the specified temperature (see table I).

4.5.3.6 *Deflection temperature.* The specimen shall be tested under a load which will produce a fiber stress of 264 p.s.i. and the temperature at which a deflection of 0.010 inch is obtained shall be reported.

TABLE IV.—*Test methods¹ and number of specimens*

| Test (see table I) | Method No. of Fed. Test Method Std. No. 406 | ASTM publication | Modified by paragraph | Number of specimens to be tested |
|---|---|------------------------|-----------------------|----------------------------------|
| Density | 5011 | D792-60T | 4.5.3.1 | 5 |
| Tensile yield strength, tensile ultimate strength, and tensile ultimate elongation .. | 1011 | D638-61T | 4.5.3.2 | 5 |
| Flexural strength | 1031 | D790-61 | 4.5.3.3 | 5 |
| Izod impact strength | 1071 | ² D256-56 | 4.5.3.4 | 10 |
| Brittleness | 2051 | D746-57T | 4.5.3.5 | 10 |
| Deflection temperature | 2011 | D648-56 | 4.5.3.6 | 5 |
| Water absorption | ³ 7031 | ³ D570-59aT | 4.5.3.7 | 5 |
| Dielectric constant and dissipation factor .. | 4021 | D150-59T | 4.5.3.8 | 5 |
| Dielectric strength | 4031 | D149-61 | 4.5.3.9 | 5 |
| Flammability and toxicity (when specified, see 6.2) | — | — | 4.5.3.10 | 4 |

¹ Either Fed. Test Method Std. No. 406 or ASTM publications may be used, as applicable.

² Method A shall be used.

³ Procedure A shall be used.

⁴ As specified in test procedure.

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4.5.3.7 *Water absorption.* Specimens shall be conditioned in accordance with procedure B of ASTM D 618-61.

4.5.3.8 *Dielectric constant and dissipation factor.* The test voltage shall not exceed 400 volts per 0.001 inch of thickness of the test specimen.

4.5.3.9 *Dielectric strength.* The test voltage shall be applied and increased uniformly at the rate of 500 volts per second until the maximum test voltage (400 volts per 0.001 inch of thickness of the test specimen) is attained. The test voltage then shall be maintained for 60 to 65 seconds. Specimens shall be conditioned for at least 48 hours at $23^{\circ} \pm 3^{\circ}\text{C}$. ($73.4^{\circ} \pm 5.4^{\circ}\text{F}$.) and relative humidity of 50 ± 2 percent.

4.5.3.10 *Flammability and toxicity (when specified, see 6.2).* Specimens shall be tested in accordance with ASTIA document AD 297457.

5. PREPARATION FOR DELIVERY

For civil agency procurement, the definitions and applications of the levels of packaging and packing shall be in accordance with Fed. Std. No. 102.

5.1 Preservation and packaging (see 6.2).

5.1.1 *Level A.* Polycarbonate in the form of free-flowing powder shall be packed in type V, class I metal cans conforming to PPP-C-96, in quantities of 5 pounds net weight, as specified (see 6.2). Plan A exterior coating shall be used.

5.1.2 *Level C.* Polycarbonate in the form of pellets or free-flowing powder shall be afforded preservation and packaged in accordance with the supplier's commercial practice.

5.2 Packing (see 6.2).

5.2.1 *Level A.* The packaged item shall be packed in containers conforming to any of

the following specifications at the option of the supplier:

| Specification | Container | Class or Style |
|---------------|--|----------------|
| PPP-B-576 | Box, Wood, Cleated, Veneer, Paper Overlaid | Class 2 |
| PPP-B-585 | Boxes, Wood, Wire-bound | Class 2 or 3 |
| PPP-B-591 | Boxes, Fiberboard, Wood-Cleated | Style A or B |
| PPP-B-601 | Boxes, Wood, Cleated-Plywood | Style A or B |
| PPP-B-621 | Boxes, Wood, Nailed and Lock-Corner | Class 2 |
| PPP-B-636 | Box, Fiberboard | Class 2 |
| PPP-B-640 | Boxes, Fiberboard, Corrugated, Triple Wall | Class 2 |

Box closures and strapping shall be as specified in the applicable box specification or appendix thereto. Banding (reinforcement requirements), excluding metal, is required and will be applied in accordance with the provisions outlined in the appendix to the specification. The gross weight of wood boxes shall not exceed 200 pounds; contents of fiberboard boxes shall not exceed the limitations of the applicable box specification.

5.2.2 *Level B.* The item shall be packed in accordance with 5.2.1 except that the containers shall be constructed for domestic requirements. Fiberboard boxes shall be banded as prescribed in the appendix of the box specification. Box closures shall be as specified in the applicable box specification or appendix thereto.

5.2.3 *Level C.* The packaged item shall be packed in containers of the type, size, and kind commonly used for the purpose, in a manner that will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply with the carrier rules and regulations applicable to the mode of transportation.

5.2.4 General. Exterior containers shall be uniform in shape and size, shall be of minimum cube and tare consistent with the protection required, and shall contain identical quantities of identical items.

5.3 Marking.

5.3.1 Civil agencies. In addition to any special marking required by the contract or order, unit packages, intermediate packages, and exterior shipping containers shall be marked in accordance with Fed. Std. No. 123.

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

6. NOTES

6.1 Intended use. Polycarbonate may be utilized in applications where dimensional stability, high-impact resistance, and good dielectric properties are needed. It is self-extinguishing and fungus resistant. In specifying this material, design engineers are cautioned that polycarbonates are not recommended for applications requiring good fatigue strength when subjected to ultraviolet light exposure.

6.2 Ordering data. Purchasers should exercise any desired options offered herein and procurement documents shall specify the following:

- (a) Title, number, and date of this specification.
- (b) Color, if applicable (see 3.2).
- (c) Form (see 1.2 and 3.3).
- (d) Special considerations concerning examination record (when applicable).
- (e) Request for sample (when essential), and specify the intended purpose of the sample.
- (f) Flammability and toxicity require-

ment (when specified, see 3.5).

- (g) Information for preparation for delivery (see section 5).

6.3 Preparation of specimens. Extreme care must be taken to prevent moisture absorption. Sealed containers should be heated to 121° C. (250° F.) before opening; before use, polycarbonate in unsealed containers must be thoroughly dried overnight or 15 hours at 121° C. (250° F.) in flat trays at a depth not to exceed one inch. Failure to follow these precautions may affect the property values of the specimens.

6.4 Transportation description. Transportation description and minimum weights applicable to this commodity are:

Pellets

Rail:

Plastics, not otherwise indexed by name, granular.

Carload minimum weights 10,000, 20,000, and 30,000 pounds, subject to Rule 34, Uniform Freight Classification.

Motor:

Plastic pellets.

Truckload minimum weights 30,000 pounds, subject to Rule 115, National Motor Freight Classification.

Powder

Rail:

Plastics, not otherwise indexed by name.

Carload minimum weight 30,000 pounds.

Motor:

Plastics, powder.

Truckload minimum weight 30,000 pounds, subject to Rule 115, National Motor Freight Classification.

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MILITARY CUSTODIANS:

Army—EL

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