

**L-P-392a**

January 29, 1964

**SUPERSEDING**

Int. Fed. Spec. L-P-40392 (Army-SigC)

April 17, 1962

**FEDERAL SPECIFICATION****PLASTIC MOLDING MATERIAL, ACETAL,  
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 acetal molding (injection and extrusion) material for general-purpose use and for weather-resistant applications (see table I and 6.1).

**1.2 Classification.**

**1.2.1 Types and classes.** The acetal molding material shall be of the types and classes shown in table I, as specified (see 6.2).

**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 or request for proposal, 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.

**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.

**TABLE I. Types and classes**

Type	Normal fabricating process	Application	Class	Additive	Color
I	Injection molding	General purpose	1	Antioxidant	Natural (see 3.1.2)
		Weather resistant	2	Carbon black	Black (see 3.1.1.2)
			3	Light stabilizer	Natural (see 3.1.1.3)
II	Extrusion	General Purpose	1	Antioxidant	Natural (see 3.1.2)

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(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.)

#### **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 publications 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 150-59T—A-C Capacitance, Dielectric Constant, and Loss Characteristics of Electrical Insulating Materials.

D 618-61—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 789-62T—Nylon Injection Molding and Extrusion Materials.

D 792-60T—Specific Gravity and Density of Plastics.

D 1238-62T—Measuring Flow Rates of Thermoplastics by Extrusion Plastometer.

E 42-57—Operation of Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Artificial Weathering Test.

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

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

### **3. REQUIREMENTS**

**3.1 Material.** The material shall consist of acetal resin so formulated as to meet the requirements of this specification and shall be suitable for injection molding and extrusion.

#### **3.1.1 Additives.**

**3.1.1.1 Antioxidant.** Types I and II, class 1, shall contain an antioxidant.

**3.1.1.2 Carbon black.** Type I, class 2, shall contain a concentration of uniformly-dispersed, high-color carbon black (see 6.4).

**3.1.1.3 Light stabilizer.** Type I, class 3, shall contain a concentration of light stabilizer.

**3.1.2 Color (see table I).** Unless otherwise specified, (see 6.2), acetal shall contain no color pigment.

**3.1.3 Form.** Acetal shall be in the form of pellets and shall contain a surface lubricant when specified (see 6.2).

**3.2 Property values.** Unless otherwise specified, the values obtained from each set of specimens for any property shall be averaged (see 4.5.2.1) and the results so obtained shall meet the requirements specified in table II.

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TABLE II. *Property values*

Property (see table V)	Value Required			
	Type I			Type II
	Class 1	Class 2	Class 3	Class 1
Density, as received, range, inclusive, D <sub>25</sub> <sup>c</sup> , g/ml.	1.39 to 1.44			
Melting point, minimum, °C <sup>1</sup>	158			
Melt flow rate, minimum, grams per 10 minutes	3.5			
Melt flow rate, maximum, grams per 10 minutes	—			2.0
Tensile yield strength, minimum, psi.	8,000			
Elongation, minimum, percent	10			30
Tensile modulus of elasticity, minimum, psi	350,000			
Dielectric constant, maximum, 1 mcs	3.8	4.1	2.9	3.9
Dissipation factor, maximum, 1 mcs	0.007	0.008	0.025	0.008
Deflection, temperature, minimum, °C.	100			
Weather resistance	—	2	3	—

<sup>1</sup> The melting-point temperature shall be recorded at the first appearance of a transparent area in the middle of each specimen.

<sup>2</sup> Specimens shall retain at least 65 percent of original elongation after 500 hours exposure to weather-resistant test.

<sup>3</sup> Specimens shall retain at least 50 percent of original elongation after 500 hours exposure to weather-resistant test.

#### 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 acetal shall be classified as follows:

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.)

**4.3 Inspection conditions.** Unless otherwise specified herein, all inspection shall be made at room ambient temperature, relative humidity, and pressure.

#### 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 acetal (see 3.1 to 3.1.3 inclusive, as applicable) shall be defined as a unit of product prepared for shipment, and may consist of a uniform blend of two or more "production runs" of acetal of the same type and class, and color, when applicable.

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

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TABLE III. *Batch inspection*

Test	Requirement	Test method
Density .....	(See table II)	(See table V)
Melting point ..		
Melt flow rate ..		

**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 IV, as applicable. Shipment shall not be held up pending results of the inspection.

TABLE IV. *Periodic-batch inspection*

Test	Requirement	Test method
Tensile yield strength, elongation, and tensile modulus of elasticity .....	(See table II)	(See table V)
Dielectric constant and dissipation factor ..		
Deflection temperature .....		
Weather resistance .....		

**4.4.1.3.1 Sampling plan.** Periodic-batch sampling and inspection shall be made on the first batch (see 4.4.1.1) of each particular composition prepared for shipment, and on every twentieth batch thereafter of the same composition, 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 essen-

tially 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 reinstituted; 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 dry, clean metal or glass container, and tightly closed.

## 4.5.2 Specimens.

**4.5.2.1 Number and form.** Five specimens or sample charges of the form specified in the applicable document or paragraph (see

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table V) shall be prepared as specified in 4.5.2.3. Specimens, as applicable, shall be not more than 1/8-inch thick.

**4.5.2.2 Additional specimens.** 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.** When required, specimens shall be molded using the supplier's recommended technique.

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

**4.5.3.1 Density.** Method A or B shall be used.

**4.5.3.2 Melting point.**

**4.5.3.2.1 Apparatus.** The apparatus shall consist of the following items:

- (a) A melting-point apparatus. (See 6.4.)
- (b) A thermometer graduated from 150° to 300°C., inclusive, (302° to 572° F., inclusive) in 1°C. (1.8°F.) increments. (See 6.4.)
- (c) Round cover glasses, 18 millimeters in diameter.
- (d) Silver wool to serve as heat contact.
- (e) Tongs for handling the cover-glass sandwich.

**4.5.3.2.2 Procedure.** The thermometer shall be placed in the thermometer well with a small amount of silver wool. The block shall be preheated to 190° to 200°C., inclusive (374° to 392°F., inclusive). Cut a shaving from a pellet or molded specimen and place the shaving on top of a cover glass. The glass with the shaving shall be placed on the heated block. Place a second cover glass on top of the shaving. Heat and press gently on the second cover glass to form a thin film. Remove the cover-glass sandwich from the block with a pair of tongs and allow the sandwich to cool to room ambient temperature. The apparatus shall be turned off and allowed to cool to about 150°  $\pm$  5°C. (302°  $\pm$  9°F.). The cover-glass sandwich shall be returned to the block. Adjust the magnifier to give a clear view of the stage. The powerstat shall be turned on and adjusted to about 10° to 15°C., inclusive, (18° to 27° F. inclusive) below the expected melting point at a rate of 3°  $\pm$  1°C. (5.4°  $\pm$  1.8°F.) per minute. The heating rate shall then be decreased to give a temperature rise of not more than 1°C. (1.8°F.) per minute. Observe and record the melting-point temperature. (See table II.)

**4.5.3.3 Melt flow rate.** A load of 1,050 grams and a temperature of 190°C. (374° F.) shall be used.

**4.5.3.4 Tensile yield strength, elongation, and tensile modulus of elasticity.** Type I specimens and speed B shall be used.

TABLE V. Test methods<sup>1</sup>

Test (see table II)	Method number of Fed. Test Method Std. No. 406	ASTM publi- cation or paragraph	Modified by paragraph
Density .....	5011	D792-60T	4.5.3.1
Melting point (type I, class 2 only) .....	—	D789-62T	—
Melting point (except type I, class 2) .....	—	4.5.3.2	—
Melt flow rate .....	—	D1238-62T	4.5.3.3
Tensile yield strength, elongation, and tensile modulus of elasticity .....	1011	D638-61T	4.5.3.4
Dielectric constant and dissipation factor .....	4021	D150-59T	4.5.3.5
Deflection temperature .....	2011	D648-56	4.5.3.6
Weather resistance .....	—	E42-57	4.5.3.7

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

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**4.5.3.5 Dielectric constant and dissipation factor.** The specimens shall be conditioned in accordance with procedure D of ASTM Publication D 618-61.

**4.5.3.6 Deflection temperature.** Only a single fiber stress of 264 p.s.i. shall be applied.

**4.5.3.7 Weather resistance.** Type E apparatus shall be used. Specimens shall be exposed for 500 hours. Specimens shall then be subjected to the elongation test. (See table V.)

## 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.** Material in the form of pellets shall be packaged as specified and afforded preservation in accordance with MIL-P-116.

**5.1.2 Level C.** Material in the form of pellets shall be afforded preservation and packaging 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, Wirebound	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, 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 paragraph 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.



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**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.** Acetal may be utilized in applications where excellent abrasion resistance, dimensional stability, low coefficient of friction, good retention of mechanical and electrical properties, and exceptional nontracking and noncarbonizing characteristics are desired. Acetal may be used in the manufacture of bearings, gears, knobs, assembly housings, telephone handsets, etc. It also has good chemical resistance to organic compounds and is satisfactory for use in dilute solutions of some acids and bases.

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

- (a) Title, number, and date of this specification.
- (b) Type and class (see 1.2.1).
- (c) Color, if applicable (see 3.1.2).
- (d) Surface lubricant (see 3.1.3).
- (e) Information for preparation for delivery (see section 5).

**6.3 Melting point apparatus.** The Fisher-Johns Melting Point Apparatus, catalog No. 12-144, and the 150° to 300°C. thermometer found in the Thermometer Kit, Short Range, catalog No. 12-144-15, available from Fisher Scientific Company, Pittsburgh, Pennsylvania, have been found suitable.

**6.4 Carbon black.** Channel carbon black, with particles averaging 20 millimicrons or less in diameter, has been found to fulfill the requirements for type 1, class 2 of this

specification. The following commercial grades of this size are available: United Carbon Company's Kosmos BB, Godfrey L. Cabot's Monarch 74, Witco Chemical Company's Witco 100, Columbian Carbon Company's No. 999, and Blinney and Smith's Superba (see 3.1.1.2).

**6.5 Engineering information.** Typical properties of acetal are described in table VI. These property values are not to be used for specification purposes.

TABLE VI. Typical property values of acetal

Property	Value	ASTM test method
Hardness, Rockwell .....	M-75	D785-62
Resistance to heat, continuous °F. ....	185-250	—
Moisture absorption, maximum, percent .....	0.25	D570-69aT
Dielectric strength, S.T., volts mil. ....	465	D149-61

**6.6 Transportation description.** Transportation descriptions and minimum weights applicable to this commodity are:

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

Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Gov-

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ernment thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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