

**MIL-P-3409**

15 FEBRUARY 1951

SUPERSEDING

Navy 17P8 (INT) (in part)

1 February 1945

Signal Corps Tentative

72-78 (in part)

1 February 1945

**MILITARY SPECIFICATION**

**PLASTIC-MATERIAL, MOLDING;  
RIGID THERMOPLASTIC, POLYDICHLOROSTYRENE;  
FOR USE IN ELECTRONIC, COMMUNICATIONS,  
AND ALLIED ELECTRICAL EQUIPMENT**

*This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments.*

**1. SCOPE**

**1.1 Scope.**—This specification covers the requirements for polydichlorostyrene molding compounds for use in electronic, communications, and allied electrical equipment.

**1.2 Classification.** — The polydichlorostyrene molding compounds covered by this specification shall be of the following types, as specified (see 6.2):

Type EH-1 — High-frequency applications, good heat resistance.

Type EH-2 — High-frequency applications, high heat resistance.

**2. APPLICABLE SPECIFICATIONS**

**2.1 Specifications.**—The following specifications, of the issue in effect on date of invitation for bids, form a part of this specification:

**FEDERAL SPECIFICATION**

L-P-406 — Plastics, Organic: General Specifications, Test Methods.

**NAVY DEPARTMENT SPECIFICATION**

General Specifications for Inspection of Material.

(*Army.*—Copies of specifications should be obtained from the procuring agency or as directed by that agency. Both the title and identifying number or symbol should be stipulated when requesting copies.)

(*Navy.*—Copies of Federal, Military, and Navy Department specifications may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C., except that activities of the Armed Forces should make application to the Commanding Officer, Naval Supply Center, Norfolk 11, Va. Both the title and identifying number or symbol should be stipulated when requesting copies.)

(*Air Force.*—Copies of Federal and Military specifications may be obtained upon application to the Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton 1, Ohio. Both the title and identifying number or symbol should be stipulated when requesting copies.)

**3. REQUIREMENTS**

**3.1 Material.**—The material shall consist of polydichlorostyrene compression, injection, or extrusion molding compounds so formulated as to meet the requirements of this specification.

**3.1.1 Uniformity.**—All molding compounds of the same brand from one manufacturer shall be uniform in texture, in color (see 3.1.2), and in the specified properties as de-

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terminated by the batch-acceptance tests. (See 4.2.3.)

**3.1.2 Color.**—The molding compounds shall be furnished in the colors, tints, or hues and with the tolerances specified or permitted. (See 6.2.)

**3.1.3 Property values.**—When specimens of the forms specified in table I are subjected to the required tests, the values obtained from any set of specimens for any specific property, after any one conditioning procedure specified in table I, shall be averaged; and the average value so obtained shall be not less than the minimum nor more than the maximum (as applicable) specified in table I.

#### **4. SAMPLING, INSPECTION, AND TEST PROCEDURES**

**4.1 Classification of tests.**—The methods of sampling, inspection, and tests shall be classified as follows:

Inspection tests.

- a. Pilot-batch-approval
- b. Batch-acceptance

**4.2 Inspection tests.**— Inspection tests shall be performed at the point of manufacture under the supervision of the Government inspector. They shall consist of pilot-batch-approval tests and batch-acceptance tests as indicated in table I.

**4.2.1 Inspection procedures for Navy purchases.**— For Navy purchases, the general inspection procedures shall be in accordance with the General Specification for Inspection of Material.

**4.2.2 Pilot-batch-approval.**— The pilot batch shall consist of the first batch of a specific type and brand of molding compound produced for Government end use under this specification, and shall not be required to be repeated unless a significant change occurs in the molding compound. (See 4.2.3.) A

batch is defined as a unit of the molding compound produced by one continuous production run or by a blend of two or more continuous production runs. Approval of the pilot batch shall be obtained before proceeding with the production of further batches under this specification.

**4.2.3 Batch-acceptance.**—Batch-acceptance tests shall be made on each batch of molding compound after pilot-batch approval has been obtained and shall be the basis on which acceptance or rejection of the batch is made. If significant differences between the results of batch-acceptance and pilot-batch-approval tests indicate that a change has occurred in the composition of the molding compound or in its processing, the inspector may at his discretion require the repetition of any or all of the pilot-batch-approval tests, to insure conformance of the molding compound to this specification.

**4.2.4 Test equipment and inspection facilities.**—The manufacturer shall furnish and maintain all necessary facilities and equipment for making all tests. The test equipment shall be adequate in quantity to enable inspection to keep up with production, and shall be of sufficient accuracy and quality to permit the performance of the required tests.

**4.2.5 Results of tests.**—A copy of the results of the pilot-batch-approval and batch-acceptance tests shall be furnished the Government inspector.

**4.2.6 Rejection.**—Failure to comply with any of the requirements of table I shall result in rejection of the batch of molding compound.

#### **4.3 Test procedures.**

##### **4.3.1 Specimens.**

**4.3.1.1 Number.**—The number of specimens to be tested shall be as specified in table I.

TABLE I.—Property values for specimens made from polydichlorostyrene molding compounds.

Property to be tested	Test method		Specimens			Conditioning procedure (See 4.3.1.5.)	Unit (Max. or Min.)	Value required for each type of material	
	Spec. I-P-406 method No.	Modified by paragraph	Form and dimensions	Number tested				Type EH-1	Type EH-2
				Pilot-batch approval tests	Batch-acceptance tests				
Water absorption	7031	4.3.2.1	2-in. disk, 1/8 in. thick	3	3	(See 4.3.2.1.)	% (Max.)	0.05	0.05
Insulation resistance	4041	4.3.2.2	(See fig. 1.)	3	—	C-96/23/50	Meg. (Min.)	10 <sup>7</sup>	10 <sup>7</sup>
Volume resistivity	4041	4.3.2.3	4-in. disk, 1/8 in. thick	5	—	C-96/23/50	Meg.-cm. (Min.)	10 <sup>8</sup>	10 <sup>8</sup>
Dielectric strength, flatwise: Short-time test Step-by-step test	4031	4.3.2.4	4-in. disk, 1/8 in. thick	5	3	C-96/23/50	Volts per mil (Min.)	500	500
				5	—	C-96/23/50		450	450
Dielectric break-down: Short-time test Step-by-step test	4031	4.3.2.5	(See fig. 1.)	3	—	C-96/23/50	kv. (Min.)	50	50
				3	—	C-96/23/50		45	45
Dielectric constant:	4021	—	2-in. disk, 1/8 in. thick	—	—	(Max.)	(Max.)	—	—
At 1 megacycle									
At 30 megacycles									
Dissipation factor:	4021	—	2-in. disk, 1/8 in. thick	5	3	C-96/23/50	(Max.)	2.70	2.70
				5	—	C-96/23/50 + D-48/50 + D-1/2/23		2.70	2.70
				5	—	C-96/23/50 + D-48/50 + D-1/2/23		2.70	2.70
Loss factor:	4021	—	2-in. disk, 1/8 in. thick	(a)	—	C-96/23/50	(Max.)	0.0004	0.0004
				—	—	C-96/23/50 + D-48/50 + D-1/2/23		.0040	.0040
				—	—	C-96/23/50 + D-48/50 + D-1/2/23		.0005	.0005
At 1 megacycle									
At 30 megacycles									
Impact strength, edgewise	1071	4.3.2.6	(See fig. 2.)	5	5	C-96/23/50	Ft.-lbs per in. notch (Min.)	0.25	0.25
				5	—	E-1/-55		.25	.25
Flexural strength flatwise	1031	—	5x1/4x1/2 in.	5	—	C-96/23/50	P.s.i. (Min.)	6,000	8,000
	1101	4.3.2.7	1/2-in. cube	5	—	(See 4.3.2.7.)		% (Max.)	0.75
Deformation under load	2011.1	—	5x1/4x1/2 in.	3	3	C-96/23/50	°C (Min.)	85	100
Heat-distortion temperature	2021	—	6x1/2x1/8 in.	5	—	C-96/23/50		In. per min. (Max.)	Self-extinguishing

\* Determinations made concurrently with those for dielectric constant, with same specimens.

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**4.3.1.2 Form.**—The form of the standard test specimens shall be as described in the applicable method of Specification L-P-406, and as modified in table I herein.

**4.3.1.3 Preparation.**

**4.3.1.3.1 From compression- or injection-molding compounds.**—These specimens shall be molded by methods representative of sound practice.

**4.3.1.3.2 From extrusion compounds.**—The  $\frac{1}{4}$ - by  $\frac{1}{2}$ -inch bars shall be die-cut or machined from extruded strip. All other specimens shall be die-cut or machined from extruded strip, or from compression- or injection-molded blanks.

**4.3.1.4 Tolerances.** — Unless otherwise specified, tolerances on dimensions shall be  $\pm 5$  percent.

**4.3.1.5 Conditioning.**—Specimens shall be conditioned before test, as specified in table I.

**4.3.1.5.1 Nomenclature.**—The following letters shall be used to indicate the respective general conditioning procedures:

- Condition A —As received; no special conditioning.
- Condition C —Humidity conditioning.
- Condition D —Immersion conditioning in distilled water.
- Condition E —Temperature conditioning.
- Condition des.—Desiccation conditioning, cooling over silica gel or calcium chloride in a desiccator at 23° C. for 16 to 20 hours.

**4.3.1.5.2 Designation.** — Conditioning procedures shall be designated as follows:

- a. A capital letter indicating the general condition of the specimen; i.e., as received, humidity, immersion, or temperature conditioning.

- b. A number indicating in hours the duration of the conditioning.
- c. A number indicating in degrees centigrade the conditioning temperature.
- d. A number indicating relative humidity, whenever relative humidity is controlled.

The numbers shall be separated from each other by slant marks, and from the capital letter by a dash. A sequence of conditions shall be denoted by use of a plus (+) sign between the successive conditions.

**4.3.1.5.3 Conditioning procedures.**—Conditioning procedures shall be as specified in table II.

**4.3.1.6 Measurement of specimens.**—Specimens shall be examined, and dimensions required to be recorded shall be measured to the nearest 0.001 inch by using a suitable micrometer or vernier caliper. All other dimensions shall be measured to the nearest  $\frac{1}{32}$  inch. Such measurements shall be made before conditioning in each case and after completion of the test whenever required.

**4.3.2 Methods of test.**—The test methods shall be in conformance with the applicable method in Specification L-P-406 (see table I) and as modified below:

**4.3.2.1 Water absorption.**—The method shall be as specified in method 7031 of Specification L-P-406; except that oven conditioning at 50° C. shall be for 48 hours, and immersion shall be in water at 23°  $\pm$  2° C.

**4.3.2.2 Insulation resistance.** — The apparatus specified in method 4041 of Specification L-L-406, or equivalent shall be used. Electrodes shall be Pratt and Whitney No. 3 tapered pins or equivalent. The test potential shall be applied between the pair of electrodes when inserted successively in the numbered holes (see fig. 1), and the average of the three readings shall be taken as the reading for the specimen.

TABLE II.—Conditioning procedures

Designation	Time tolerance			Test temperature and humidity	Remarks
	Oven or air	Hot water	Cool water		
C-96/23/50 -----	-0, + indef.	----	----	23° ± 5° C., 50% ± 5% RH	If convenient, store the specimens at 23° C. and 50 percent RH before tests are started.
C-96/23/50 + D-48/50 + D-½/23 -----	-0, + 2 hrs.	-0, + 2 hrs.	-0, + 2 hrs.	23° ± 5° C., 50% ± 5% RH	Start test within 2 minutes after removing specimens from final conditioning bath.
E-1/-55 -----	-0, + 2 hrs.	----	----	-55° ± 2° C.	Test in refrigerator.
E-48/50 + des. + D-24/23 ----- (for water absorption)	-0, + 2 hrs.	----	-0, + 2 hrs.	23° ± 5° C., 50% ± 5% RH	Start test within 2 minutes after removing specimens from final conditioning bath.
E-12/50 to E-18/50 (for deformation under load)	----	----	----	50° ± 0.5° C.	----

Note 1.—After immersion conditioning, surface water shall be removed by wiping the specimen with a damp cloth, followed by wiping with a dry cloth.

**4.3.2.3 Volume resistivity.**—The apparatus specified in method 4041 of Specification L-P-406, or equivalent, shall be used.

**4.3.2.4 Dielectric strength.**—With the exceptions noted herein, the apparatus and test procedure shall be as specified in method 4031 of Specification L-P-406. The test shall be made under oil at a frequency not exceeding 100 cycles per second.

**4.3.2.4.1 Short-time test.** — The voltage shall be increased uniformly at the rate of 500 volts per second.

**4.3.2.4.2 Step-by-step test.** — The voltage shall be increased in the increments shown in table III. It shall be held at each step for 1 minute and then changed to the next higher

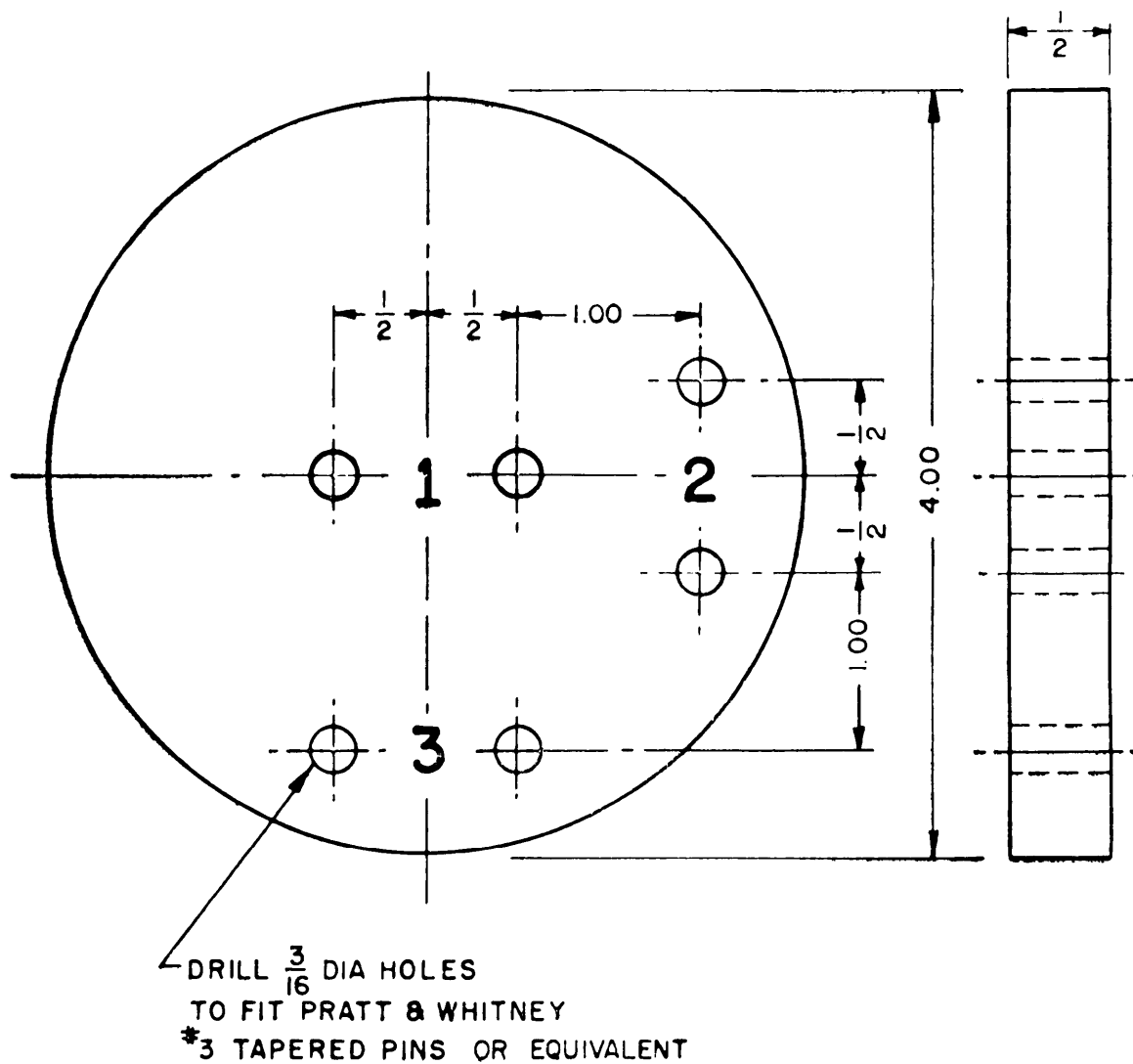
one within 10 seconds. This process shall be continued up to failure.

TABLE III.—Voltage increase for step-by-step test

Break-down by short-time method	Increment of increase
<i>Kilovolts</i>	<i>Kilovolts</i>
12.5 or less -----	0.5
Over 12.5 to 25, inclusive -----	1.0
Over 25 to 50, inclusive -----	2.5
Over 50 to 100, inclusive -----	5.0
Over 100 -----	10.0

**4.3.2.5 Dielectric break-down.**—With the exceptions noted herein, the apparatus and procedure shall be as specified in method 4031 of Specification L-P-406. The test shall

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ALL DIMENSIONS IN INCHES.

FIGURE 1.—Specimen for insulation resistance and dielectric break-down tests. (See 4.3.2.2 and 4.3.2.5.)

be made under oil at a frequency not exceeding 100 cycles per second. Electrodes shall be Pratt and Whitney No. 3 tapered pins, or equivalent. The test potential shall be applied between the pair of electrodes when inserted successively in the numbered holes (see fig. 1), and the average of the three readings shall be taken as the reading for the specimen.

**4.3.2.5.1 Short-time test.** — The voltage shall be increased uniformly at the rate of 500 volts per second.

**4.3.2.5.2 Step-by-step test.** — The voltage shall be increased in the increments shown in table III. It shall be held at each step for 1 minute and then changed to the next higher one within 10 seconds. This process shall be continued up to failure.

**4.3.2.6 Impact strength.** — The test shall be made as specified in method 1071 of Specification L-P-406, except that the test specimen shall be as shown on figure 2 herein.

**4.3.2.7 Deformation under load.** — The method shall be as specified in method 1101 of Specification L-P-406, except that preconditioning and conditioning shall be from 12 to 18 hours at 50° C. and the total load applied shall be 70 pounds.

**4.4 Test reports.** — Test reports shall be made as specified in section I, paragraph 8, of Specification L-P-406; in addition, a summary sheet of test results shall be furnished.

**4.4.1 Accuracy of calculations.** — Observed or calculated values shall be rounded off to the nearest digit in the last right-hand place of figures used in expressing the specified value, except as follows:

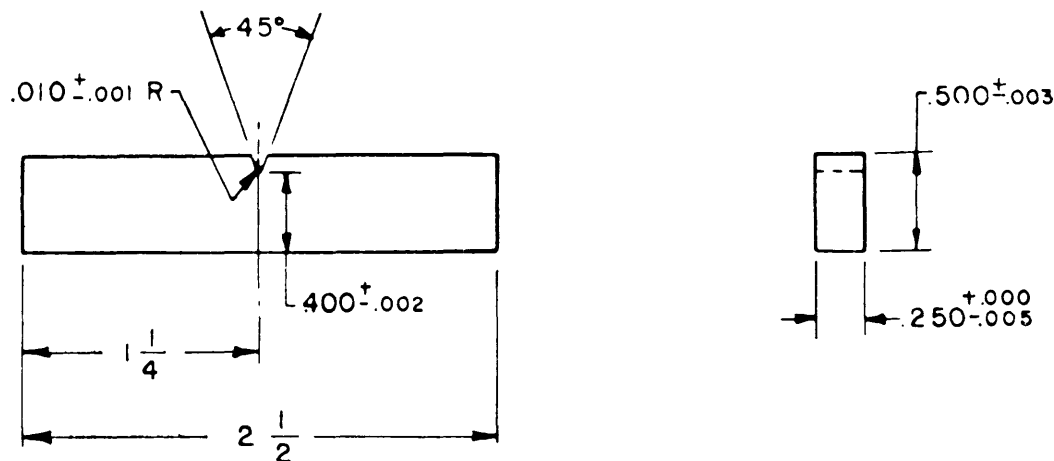
- a. From 500 to 1,000 —to the nearest 5.
- b. From 1,001 to 10,000—to the nearest 100.

## 5. PREPARATION FOR DELIVERY

**5.1 Not applicable to this specification.**

## 6. NOTES

**6.1 Intended use.** — Parts made from these types of molding compounds are intended for high-frequency applications. They retain their properties relatively unimpaired over a wide range of frequencies, temperatures, and humidities. They possess excellent dimensional stability and stability at low temperatures. Heat resistance is relatively high for thermoplastic materials.



ALL DIMENSIONS IN INCHES.

FIGURE 2.—Impact strength test specimen. (See 4.3.2.6.)

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**6.2 Ordering data.** — Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type desired. (See 1.2.)
- c. Color, with tolerances required. (See 3.1.2.)

**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 Government 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.

**Custodian:**

Army—Signal Corps

**Other interest:**

Army—EOQT

Navy—AOSHS

Air Force.



## SPECIFICATION ANALYSIS SHEET

Form Approved  
Budget Bureau No. 119-R004INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

ORGANIZATION (Of submitter)

CITY AND STATE

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QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

DIRECT GOVERNMENT CONTRACT

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

YES

NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

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