

MIL-I-43553A  
 22 November 1985  
 SUPERSEDING  
 MIL-I-43553(MI)  
 12 January 1968

## MILITARY SPECIFICATION

### INK, MARKING, EPOXY BASE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

\*1.1 Scope. This specification covers a catalyzed epoxy system of marking inks for metallic, or other non-porous surfaces, and printed wiring boards.

\*1.2 Classification. Marking ink covered by this specification shall be of the following types, as specified (see 6.4).

Type I - General usage.

Type II - Nonconductive ink (for printed wiring boards).

\*1.3 Military part number. The military part number shall consist of the letter B, the basic number of this specification, and dash numbers or characters denoting type, color, quantity and container size.

Example:

	B	43553	-	I	BLK	01	PT
Basic spec no.	_____						
Type (see 1.2)	_____						
Color (Table I and 3.3)	_____						
Quantity	_____						
Container size (Table II and 5.1.1)	_____						

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Missile Command, ATTN: AMSMI-SE-TD-ST Redstone Arsenal, AL 35898-5270, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) at the end of this document or by letter.

FSC 7510

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TABLE I. Color identification

Color	Dash identification character
black	BLK
red	RED
orange	ORG
yellow	YEL
green	GRN
blue	BLU
white	WHT

TABLE II. Container size

Container	Dash identification character
ounce	OZ
pint	PT
quart	QT
gallon	GL

## 2. APPLICABLE DOCUMENTS

\*2.1 Government documents.

\*2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

## SPECIFICATIONS

## FEDERAL

H-B-621	Brush, Stencil
TT-C-490	Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coating
*	
PPP-B-591	Boxes, Shipping, Fiberboard, Wood-Cleated
PPP-B-636	Box, Shipping, Fiberboard
PPP-C-96	Cans, Metal, 28 Gage and Lighter

## MILITARY

MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-P-13949/3	Plastic Sheet, Base Material GE, Glass Base, Epoxy Resin, General Purpose, Copper-Clad
MIL-F-14256	Flux, Soldering, Liquid (Rosin Base)

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## STANDARDS

## FEDERAL

FED-STD-141 Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling, and Testing

\*FED-STD-191 Textile Test Methods

## MILITARY

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-202 Test Methods for Electronic and Electrical Component Parts

\*MIL-STD-810 Environmental Test Methods

\*(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3951 - Standard Practice for Commercial Packaging

(Application for copies of ASTM publications should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

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

\*2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

## 3. REQUIREMENTS

3.1 First article. When specified, a sample shall be subjected to first article inspection (see 4.2 and 6.2).

3.2 Material. The contractor is given latitude in the selection of raw materials and processes of manufacture, provided the product conforms to this specification.

3.3 Color. The color of the cured ink shall be as specified in the purchase order or contract (see table I and 6.2).

3.4 Composition. The ink shall be furnished in the form of two compounds; the basic ink compound and a hardener compound. The chemical composition of each compound shall be at the discretion of the manufacturer, and shall be such that the ink shall comply with all requirements specified herein.

3.4.1 Basic ink compound. The basic ink compound shall consist essentially of an epoxy resin in liquid, paste, or powder form.

\*3.4.2 Hardener compound. The hardener compound (catalyst) shall be in liquid, paste, or powder form for mixing with the ink compound just prior to using. The hardener shall cause the mixture to harden (cure) through chemical reaction at room ambient temperatures, or at other time/temperature ratios, as specified.

\*3.4.3 Additives. Ingredients may be added to the ink and hardener compounds to produce gloss or mat finishes. Other additives may be used to improve the leveling, flexibility, and adhesive qualities. No additives to type II ink shall affect its electrical resistance requirements (see 3.10).

\*3.4.4 Thinner. When specified in the contract or purchase order (see 6.2), a non-toxic thinner shall be furnished for reducing the ink for optimum application consistency. The thinner shall be compatible with the wiring board substrate.

3.5 Toxicity. The ink shall contain no benzene, chlorinated compounds, or other toxic or hydrolyzable chlorine derivatives. The cured ink shall not produce toxic substances and vapors at temperatures within the range of -56° to 76°C (-68° to 169°F) (See 4.5.2.1).

\*3.6 Mixing properties. The ink and hardener compound shall mix freely to produce a homogenous mixture, free from skins, lumps, sediment, and precipitant materials, and shall be of a consistency suitable for the intended method of application. After mixing, the chemical components shall not gel during the specified pot life of the ink at room ambient temperature, and chemicals that may separate shall be readily dispersible.

\*3.7 Pot life. The useful life of the combined two-part ink when mixed as specified by the manufacturer shall be not less than four hours, unless otherwise specified (See 4.5.2.2).

3.8 Curing. The ink, when applied mixed to a vertical or horizontal surface and air-cured for 5 days at room ambient temperature, or at other time and temperatures when recommended by the manufacturer, shall be completely cured for test purposes (See 4.5.2.3).

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\*3.8.1 Cure for handling. The combined two-part ink, when mixed as specified by the manufacturer, shall be cured for handling when exposed to a temperature of 65.5°C (150°F) for 30 minutes (See 4.5.2.3.1).

3.9 Adhesion. Cured ink impressions on glass shall not deteriorate when subjected to trichloroethylene vapors at 86.5° to 88°C (187.7° to 190.4°F) for a period of not less than 3 minutes or more than 6 minutes (See 4.5.2.4).

3.10 Electrical resistance (for type II only). The material cured as specified herein and prior to high humidity conditioning, shall have an electrical resistivity of  $10^{12}$  ohms, minimum. After conditioning as specified in 4.5.2.5, the material shall have an electrical resistivity of  $10^{10}$  ohms minimum (See 4.5.2.5).

### 3.11 Environmental and storage conditions.

3.11.1 Abrasion resistance. Cured ink impressions shall retain their legibility after subjection to 300 to 303 revolutions of the CS-10 abrasive wheel while under a load of 1000 grams (See 4.5.3.1).

\*3.11.2 Chemical resistance. Cured ink impressions shall not deteriorate when immersed for 30 minutes in water, 1,1,1 trichloroethane, denatured ethyl alcohol, and methyl alcohol (See 4.5.3.2).

\*3.11.2.1 Chemical resistance (type II only). In addition to 3.11.2, type II cured ink shall be resistant to hot solder and solder flux (See 4.5.3.2.1).

\*3.11.3 Salt spray resistance. Cured ink impressions shall not deteriorate when exposed to a 20 percent salt spray solution at 33° to 37°C (92° to 98°F) for a period of not less than 48 hours (See 4.5.3.3).

3.11.4 Light fastness. Cured ink impressions shall not fade and shall remain legible when tested as specified in 4.5.3.4.

3.11.5 Stability. Cured ink impressions shall not fade, chip, peel, or flow and shall remain legible when exposed to a temperature of  $118 \pm 3^\circ\text{C}$  ( $245 \pm 5^\circ\text{F}$ ) for a period of not less than 24 hours (See 4.5.3.5).

3.11.6 Fungus resistance. Cured ink impressions shall not support fungi growths when tested in accordance with 4.5.3.6.

3.11.7 Storage life. The ink compounds shall be free from grit, lumps, and skins and shall not gel, settle, harden nor otherwise deteriorate while stored for not less than one year in the original containers (see 4.5.5).

3.12 Workmanship. The materials shall be free and clean of foreign particles and other contamination and shall be of uniform quality, condition, and appearance.

#### 4. QUALITY ASSURANCE PROVISIONS

\*4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 specifications where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

\*4.2 First article sample. The first article sample shall be prepared using the same materials and methods proposed for the preparation of subsequent production lots of ink. First article samples which do not meet all the requirements of this specification shall be subject to rejection and return to the supplier.

4.3 Classification of inspections. The inspection requirements specified herein are classified as follows:

\*a. First article inspection.

b. Quality conformance inspection.

\*4.3.1 First article inspection. First article inspection shall be conducted only on the first article sample and shall consist of all examinations and tests specified herein.

\*4.3.2 Quality conformance inspection. Quality conformance inspection for acceptance of the ink shall be as specified in table III.

Table III. Quality conformance inspection.

Requirement	Req. Para.	Test Para.
a. Toxicity	3.5	4.5.2.1
b. Mixing properties	3.6	4.5.2.2
c. Pot life	3.7	4.5.2.2
d. Curing test	3.8	4.5.2.3
e. Curing for handling	3.8.1	4.5.2.3.1
f. Adhesion	3.9	4.5.2.4
* g. Electrical resistance (type II only)	3.10	4.5.2.5

4.3.2.1 Lot size. The lot size for quality conformance inspection shall consist of all ink manufactured at one time, from one batch, forming part of one contract or order, and submitted for acceptance at the same time and place.

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#### 4.4 Quality conformance inspections.

4.4.1 Unit of product. The unit of product shall consist of one container of ink and one container of hardener combined into a unit package (see 5.1.1).

#### 4.4.2 Sampling.

\*4.4.2.1 Sampling for visual examination. Sampling for fill, color, workmanship, and packaging, packing and marking shall be in accordance with MIL-STD-105, inspection level II, and AQL of 2.5 percent defective.

4.4.2.2 Sampling for testing. Unless otherwise specified (see 6.2), two unit packages shall be selected at random from the lot for inspection testing.

#### 4.5 Test methods.

4.5.1 Test specimen preparation. The following test specimens shall be prepared from ink that has been mixed in accordance with the manufacturer's recommendations. The test plates shall be cleaned in accordance with applicable methods specified in TT-C-490 or any applicable process or combination of processes which will accomplish thorough cleaning without damage to the specimens before ink application.

4.5.1.1 Glass specimen. Prepare test specimens by applying the ink to two 4 by 4 inch pieces of glass. Using a stencil brush conforming to H-B-621, stencil the letters "ABCDE" approximately .750 inch high. Use sufficient ink to obtain neat, legible letters, but not enough to cause the ink to smear. Cure in a flat (horizontal) position (see 3.8).

4.5.1.2 Copper, aluminum, steel, plastic specimens. Prepare test specimens by applying the ink to two 4 by 4 inch pieces of each of the following materials: sheet copper, aluminum, steel and plastic. Using a stencil brush conforming to H-B-621, stencil the letters "ABCDE" approximately .750 inch high. Use sufficient ink to obtain neat, legible letters, but not enough to cause the ink to smear. Cure on edge in a vertical position (see 3.8).

#### 4.5.2 Testing for quality conformance.

4.5.2.1 Toxicity. To determine conformance with 3.5, the ink shall be tested for toxic components in accordance with MIL-M-14.

\*4.5.2.2 Mixing properties and pot life tests. The useful (pot) life is ended when the mixed ink is too hard to work without the addition of thinner (See 3.7).

4.5.2.3 Curing test. To determine conformance to 3.8, one test specimen prepared in accordance with 4.5.1.1, and one each of those prepared in accordance with 4.5.1.2, shall be subjected to 5 days of air curing at room ambient temperature or at other time and temperatures when recommended by the manufacturer. After curing, the specimens shall be examined for complete cure without running, rupting, or loss of legibility or color.

4.5.2.3.1 Curing for handling test. Bake the newly prepared test specimens, one prepared in accordance with 4.5.1.1, and one of those prepared in accordance with 4.5.1.2, in an appropriate oven at 66.5°C (150°F) for 30 minutes; remove and let cool for 10 minutes at room ambient temperature. Test with the finger, using moderate pressure. The ink shall be considered dry enough to handle when the soft tacky condition no longer exists and the ink feels dry to the touch.

\*4.5.2.4 Adhesion test. To determine conformance to 3.9, the cured test specimens, one in accordance with 4.5.1.1 and one in accordance with 4.5.1.2, shall be subjected to trichloroethylene vapor cleaning at 86.5° to 88°C (187.7° to 190.4°F) for not less than 3 minutes or more than 6 minutes in accordance with vapor degreasing methods approved by the procuring activity. The specimens shall be inspected for loosening, dissolving, disintegrating or obliterating.

\*4.5.2.5 Electrical resistivity (for type II only). Test samples shall be prepared using an epoxy-glass copper clad laminate conforming to MIL-P-13949/3 type GEN0610C2/00 A1A. Configuration shall be as defined in figure 1. The electrical resistivity tests shall be conducted with a potential of 500 volts direct current (Vdc). The samples shall be conditioned at standard conditions of 77°F. + 10°F (25°C + 5°C) and relative humidity of 50 + 20 percent and shall be checked for a minimum resistivity of  $10^{12}$  ohms. Immediately following this test, the samples shall be conditioned for 48 hours at standard temperature and 95 percent relative humidity. The samples shall be tested for a minimum resistivity of  $10^{10}$  ohms at 77° ± 10°Fahrenheit.

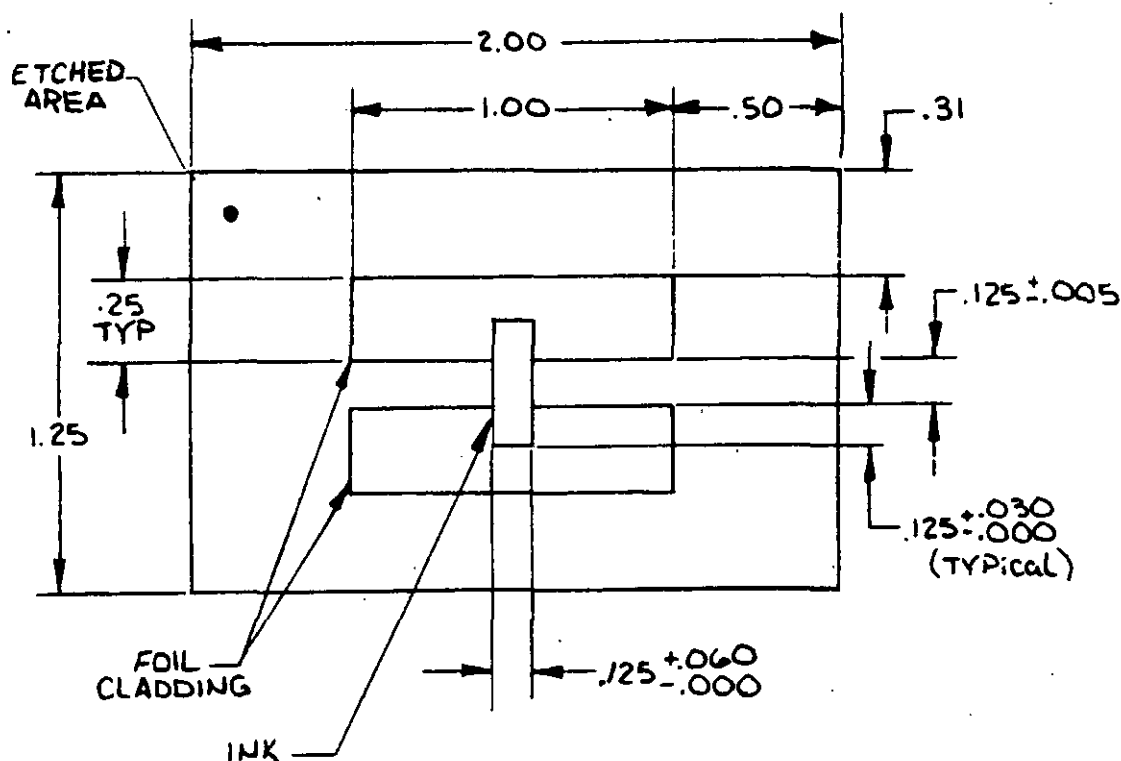


FIGURE 1. Resistivity test sample



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### 4.5.3 Testing for environmental and storage requirements.

\*4.5.3.1 Abrasion resistance. To determine conformance to 3.11.1, the test specimens prepared in accordance with 4.5.1.1, and 4.5.1.2, shall be positioned with the ink impressions under the CS-10 abrasive wheel, and subjected to 300 revolutions under a load of 1000 grams, in accordance with method 6192 of FED-STD-141. The cured ink impressions shall be inspected for legibility.

\*4.5.3.2 Chemical resistance. To determine conformance to 3.11.2, two specimens, prepared in accordance with 4.5.1.1, shall be immersed in water, 1,1,1 trichloroethane, denatured ethyl alcohol, and methyl alcohol, for a period of 30 minutes at a temperature of  $30^{\circ} \pm 1^{\circ}\text{C}$  ( $86^{\circ} \pm 2^{\circ}\text{F}$ ), in each solution. After rinsing in water the specimens shall be inspected for softness or damage.

\*4.5.3.2.1 Chemical resistance (type II only). To determine conformance to 3.11.2.1, two test samples, prepared as in figure 1, shall be coated with a thin continuous film of flux applied with acid brush over ink designator. The flux shall be rosin based type RMA in accordance with MIL-F-14256. Test shall be performed immediately after fluxing and sample shall be floated circuit side up, in a solder bath for ten seconds. Bath temperature shall be maintained at  $500^{\circ}\text{F} \pm 10^{\circ}$ . Samples shall then be cooled to room temperature and immersed in solvent specified in 3.11.2 for one minute. Ink shall not soften or indicate loss of adhesion. Softening shall be determined by rubbing the ink with a pad of folded cheese cloth.

\*4.5.3.3 Salt spray resistance. To determine conformance to 3.11.3, two test specimens, prepared in accordance with 4.5.1.1, shall be subjected for a period of 48 hours to a salt spray of 20 percent salt solution at  $33^{\circ}$  to  $37^{\circ}\text{C}$  ( $92^{\circ}$  to  $98^{\circ}\text{F}$ ) in accordance with test method 101, test condition B of MIL-STD-202. The specimens shall be inspected for evidence of deterioration or fading.

\*4.5.3.4 Light fastness test. To determine conformance to 3.11.4, one half of the surface of test specimens on glass, prepared in accordance with 4.5.1.1, and on copper, in accordance with 4.5.1.2, shall be covered to obscure light, and the remaining half shall be exposed for 24 hours to the radiation of a glass-enclosed, carbon-arc lamp in accordance with method 5660 of FED-STD-191. After exposure, the ink impressions shall be inspected for fading and loss of legibility.

\*4.5.3.5 Stability test. To determine conformance to 3.11.5, test specimens prepared in accordance with 4.5.1.1 on glass, and 4.5.1.2 on aluminum shall be heat aged at  $118^{\circ} \pm 3^{\circ}\text{C}$  ( $254^{\circ} \pm 5^{\circ}\text{F}$ ) in a suitable drying oven for a period of not less than 24 hours. The test specimens shall be inspected for thermal damage, loss of legibility, change of color, chipping, peeling, and flowing.

\*4.5.3.6 Fungus resistance. To determine conformance to 3.11.6, one glass test specimen of 4.5.1.1 of cured ink impressions, and one plastic test specimen of 4.5.1.2, shall be subjected to the test method applicable to mixed spore growth on plastic material in accordance with MIL-STD-810, Method 508. The test specimens shall be inspected and there shall be no evidence of fungi growth.

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\*4.5.4 Component and material inspection. In accordance with 4.1, components and materials shall be inspected in accordance with all the requirements of referenced documents, unless otherwise excluded, amended, modified, or qualified in this document or applicable purchase order.

\*4.5.5 Certification. A certificate of compliance shall be furnished with each shipment of lot stating that the ink will have a minimum one year shelf life free of the the characteristics specified in 3.11.7.

4.6 Rejection. Individual units of lots, as applicable, of basic ink compound and hardener compound which do not meet the requirements of this specification shall be rejected and returned to the supplier.

\*5. PACKAGING

5.1 Preservation. Preservation shall be level A or level C, as specified (see 6.2).

\*5.1.1 Level A. The basic ink compound and hardener compound shall be placed in separate 1-ounce, 1-pint, 1-quart, or 1-gallon metal cans or plastic containers as specified in the contract or purchase order. Metric equivalents are acceptable. The cans shall be oblong, conforming to type V, class 2, of PPP-C-96. The cans shall be fabricated from special coated manufacturer's ternplate and shall be provided with an exterior non-metallic coating in accordance with plan B of PPP-C-96. One each, can or plastic container of the ink compound and the hardener compound shall be combined into a container as a unit pack that will adequately protect the contents. When specified in the contract or purchase order, one of the cans or containers in the unit pack shall be of adequate size to serve as a mixing container. The ratio of the quantity of the ink to the quantity of the hardener shall be the same as the mixing ratio recommended by the supplier.

5.1.2 Level C. Unless otherwise specified, the ink compound and the hardener shall be packaged in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level A or Level C, as specified (see 6.2).

5.2.1 Level A. Unit packages specified in 5.1.1 shall be overpacked in boxes conforming to PPP-B-591 class II, or PPP-B-636 type CF or SF. Boxes shall not exceed the applicable size and weight limitations of the box specification. Shipping containers shall be closed and strapped in accordance with the appendix of the applicable box specification.

\*5.2.2 Level C. The basic ink compound and hardener containers packaged in accordance with 5.1.2 shall be packed as specified in ASTM D 3951.

5.3 Marking.

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5.3.1 Level A. Each container of ink and hardener shall be labeled in accordance with MIL-STD-129 or ASTM D 3951, as applicable. In addition, each container of ink and hardener shall contain the following:

- a. Name and address of the manufacturer.
- b. Quantity and color.
- c. Date of manufacture.
- d. Deterioration and storage life instructions.
- e. Contract or order number.

\*5.3.2 Unit package marking. In addition to the unit package marking required by MIL-STD-129 or ASTM D 3951, each unit package container shall be marked as follows:

5.3.2.1 Basic ink compound container. Each basic ink compound container shall include the characteristics peculiar to the cured ink, recommended uses, instructions for mixing and application, and handling precautions.

5.3.2.2 Hardener compound container. Each hardener compound container shall include the statement "Catalyst for (insert product designation for basic ink compound)," instructions for mixing and handling precautions.

\*5.3.2.3 The following precautionary statement shall be included in the labeling:  
WARNING: CAUSES IRRITATION. MAY CAUSE ALLERGIC SKIN REACTION, AVOID CONTACT WITH EYES, SKIN, AND CLOTHING. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

5.3.3 Bar code marking. Bar code marking is not required when the area is less than 2.50 inches by 3.00 inches.

\*5.3.4 Level C. Interior and exterior containers shall be marked as specified in ASTM D 3951 when that document is used as the packaging reference. Interior and exterior packs prepared in accordance with specific military requirements shall be marked as specified in MIL-STD-129.

## 6. NOTES

\*6.1 Intended use. Epoxy based marking ink covered by this specification is intended for marking rigid materials such as metal, glass, plastics, and other hard and durable materials. It is suitable for application by letter-press printing, roller and offset printing, rubber stamping, marking machine, silk screening, stencilling, spraying, and by hand with steel pen and brush. Type II ink is intended for use in marking printed wiring boards.

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6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification.
- \* b. Military part number (see 1.3) denoting type, color of ink and quantity required (see 3.3 and 5.1.1). Equivalent metric units are acceptable.
- \* c. First article sample, if required (see 3.1).
- d. Whether thinner is required and quantity (see 3.4.4).
- e. Sampling plans required, if other than specified in 4.4.2.
- f. Selection of applicable level(s) of packaging and packing required (see 5.1 and 5.2).
- \* g. If mandatory to meet service conditions, specify whether basic compound and hardener shall be level A packaged in metal cans or plastic containers (see 5.1.1).

6.3 Handling precautions. The amine type hardener or catalyst used in this ink preparation is a health hazard. Precautions should be taken not only in mixing and curing, but also in the general handling of these catalysts. Proper ventilation and care in avoiding personal contact with these compounds should minimize the hazards of handling these materials.

\*6.4 Cross-reference data. Applications which reference MIL-I-43553, dated 12 January 1968, and which were in use prior to the approved date of this revision, apply to Type I ink (general useage), which is not to be used for marking printed wiring boards.

\*6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Project No. 7510-0302

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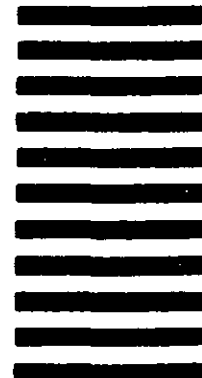
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**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL***(See Instructions - Reverse Side)***1. DOCUMENT NUMBER**

MIL-I-43553A

**2. DOCUMENT TITLE**

INK, MARKING, EPOXY BASE

**3a. NAME OF SUBMITTING ORGANIZATION****4. TYPE OF ORGANIZATION (Mark one)**☐

VENDOR

☐

USER

☐

MANUFACTURER

☐

OTHER (Specify): \_\_\_\_\_

**b. ADDRESS (Street, City, State, ZIP Code)****5. PROBLEM AREAS****a. Paragraph Number and Wording:****b. Recommended Wording:****c. Reason/Rationale for Recommendation:****6. REMARKS****7a. NAME OF SUBMITTER (Last, First, MI) - Optional****b. WORK TELEPHONE NUMBER (Include Area Code) - Optional****c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional****8. DATE OF SUBMISSION (YYMMDD)**