

INCH-POUND

MIL-P-46872A(MI)
16 July 1990
~~SUPERSEDING~~
MIL-P-46872(MI)
14 December 1973

MILITARY SPECIFICATION
POTTING AND MOLDING OF CABLE ASSEMBLIES,
PROCESS FOR

This specification is approved for use by the US Army Missile Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the potting and molding process for cable assemblies using elastomeric compounds.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-M-24041 - Molding and Potting Compound, Chemically Cured, Polyurethane

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

AMSC N/A
DISTRIBUTION STATEMENT A.
unlimited.

FSC 14GP
Approved for public release; distribution is

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(Unless otherwise indicated, copies of the federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 740 - Standard Specification for Methyl Ethyl Ketone

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Materials and equipment.

3.1.1 Materials. The potting and molding compounds and primers used shall conform to MIL-M-24041, Category B, type optional. The sealant shall be compatible with the potting and molding compounds and shall be procured from the same manufacturer.

3.1.2 Equipment.

3.1.2.1 Vacuum system. A vacuum system capable of producing a differential pressure of not less than 29.5 inches of mercury (in/hg) shall be used to remove entrapped air from the potting and molding compounds.

3.1.2.2 Mixing containers. Mixing containers shall be of a nonporous material.

3.1.2.3 Air pressurization equipment. Air pressurization equipment shall be capable of delivering moisture-free air at not less than 90 pound-force per square inch gage (psig).

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3.1.2.4 Brushes. Brushes shall have natural, nonmetallic bristles.

3.1.2.5 Cable molds. Cable molds shall be easy to assemble, impervious to temperature change, strong and solid in construction, and easy to remove after the potting or molding compound has set.

3.1.2.6 Injection gun. The injection gun shall be a manual or air-operated caulking gun with a disposable liner and nozzle.

3.1.2.7 Thermometer. The thermometer shall be of the immersion type with a temperature range of zero to 100° Celsius (C) (32 to 212° Fahrenheit [F]).

3.1.2.8 Abrasive paper. The abrasive paper shall be number 40 to 60 grit.

3.1.2.9 Curing apparatus. The curing apparatus shall be an air-circulating oven, infrared equipment, heater strips, or rods. The apparatus shall be capable of maintaining the curing temperature within $\pm 2^{\circ}\text{C}$ ($\pm 3.6^{\circ}\text{F}$), and shall have incorporated a means of preventing hot spots (see 6.2.3) during the curing process.

3.2 Potting and molding facility.

3.2.1 Dimensions and location. The dimensions of an acceptable potting and molding area shall be governed by the volume of work. They shall be of sufficient size to permit proper processing of cables without the cables being piled or walked on by personnel. The area shall contain sufficient equipment and supplies to prevent the need for an overlap of operations. The potting and molding facility shall be isolated from all other activities that could result in contamination (see 6.2.1) such as dust, metallic particles, water, oil, and grease.

3.2.2 Ventilation. The potting and molding facility shall be provided with adequate ventilation to accommodate the volume of compounds, solvents, and primers being used per hour. Forced-draft ventilation where vapors are generated is necessary, and fumes shall be drawn away from the operator and vented to the outside. The responsible safety agency shall be consulted to determine the proper ventilation requirements in relation to the quantity of material being used.

3.2.3 Environmental conditions. The temperature of the potting and molding area shall be maintained at $24^{\circ} \pm 2^{\circ}\text{C}$ ($75.2^{\circ} \pm 3.6^{\circ}\text{F}$). The relative humidity shall be not greater than 55 percent. The environment of the area shall be subject to examination and test at all times by an authorized quality assurance representative. A hygrometer (see 6.2.4) and thermometer of sufficient quality to record an accuracy of ± 5 percent relative humidity and $\pm 1^{\circ}\text{C}$ ($\pm 1.8^{\circ}\text{F}$) shall be installed within the potting and molding area. The hygrometer and thermometer records shall be maintained for six months and shall be made available to the procuring activity upon request during this period.

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3.3 Compound storage life. Storage life of the potting and molding compounds shall be in accordance with MIL-M-24041.

3.4 Health and safety precautions. When carelessly handled, the chemicals utilized for potting and molding may cause severe physiological reactions. The chemicals involved are safe when properly handled by trained personnel, and when the following precautions are carefully observed:

- a. Avoid contact of solvents, primers, and compounds with the skin. Special care shall be taken to prevent contact with open breaks on the skin. Inhaling and injection of vapors shall be avoided. If the eyes are accidentally contaminated, flush with water and obtain medical attention immediately.
- b. Areas of the skin exposed to solvents, primers and compounds, shall be cleaned with an approved cleaner and then with a non-abrasive soap and clean water. Cleanser jars, bottles, tools, or containers shall be used individually, never commonly, by personnel. Personnel shall not smoke or eat until after a thorough cleansing of exposed skin areas.
- c. No smoking or open flames shall be allowed within 25 feet of an operation where compounds, primers, and solvents are being used. NO SMOKING signs shall be displayed in conspicuous places.

CAUTION

Methyl-ethyl-ketone (MEK) shall not be stored in, or used from, an open container. Only containers approved by the responsible safety agency shall be used.

The material shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency.

3.5 Examination (prior to potting or molding). The cable assemblies shall bear a tag indicating that examination for workmanship, electrical continuity, and short circuits has been performed.

3.6 Preparation of cable assemblies. Before preparation, the type of sheath material used shall be determined. The cable and primer shall be prepared in accordance with the requirements for the applicable material.

3.6.1 Wicking. To prevent wicking during the cable molding operation, the cable jacket termination shall be sealed with an elastomeric sealant (see 3.1.1). The sealant shall be processed in accordance with the manufacturer's instructions.

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3.6.2 Preparation of sheath material. The sheath material shall be prepared as follows:

- a. Remove all grease, oil, wax, and dirt with MEK conforming to ASTM D 740 from the area to be covered by the potting or molding compound.
- b. Abrade the sheath 0.125 ± 0.062 inch above the area to be covered by the potting or molding compound.
- c. Clean the abraded area with a dry, natural, non-metallic bristled brush.
- d. For a neoprene sheath, wipe the abraded area with a clean, lint-free cloth or disposable wiper dampened with MEK, changing the wiping area of the cloth or wiper as it becomes soiled. Dry the sheath with a clean, lint-free cloth, disposable wiper, or a jet of clean, dry air.
- e. For a polyvinyl chloride (PVC) sheath, brush or wipe the sheath 0.125 ± 0.062 inch above the area to be covered with potting or molding compound with uncontaminated MEK until the surface becomes tacky.
- f. For other sheath materials, follow the manufacturer's instructions for cleaning.
- g. If a primer is required, prime the abraded sheath area with the correct primer for the approved compound. Apply the primer 0.062 ± 0.031 inch above the area to be covered with potting or molding compound. Allow to dry in accordance with the manufacturer's instructions.

3.6.3 Preparation of connector. The connector shall be prepared as follows:

- a. Use a small nonmetallic bristled brush or a lint-free cloth, dampened with MEK to clean the connector and wiring.

CAUTION

Wiring insulation shall not be exposed to the cleaning solvent to the extent that swelling or other forms of degradation occur.

- b. If a primer is required, apply as recommended by the manufacturer to areas of the connector that will contact the molding compound.

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- c. Prior to potting or assembling into a mold, inspect electrical connectors for binding of the coupling ring. The coupling ring shall rotate freely for proper connector engagement. Examine the connector for bent or misaligned pins. Attach a mating connector or mating device to all connectors with wire sizes of American Wire Gage (AWG) 10 and larger.

3.7 Mold preparation. Molds shall be prepared as follows:

- a. Examine and clean the mold cavities and vent ports as necessary.
- b. If required, apply mold release to all surfaces of the cavity mold and dry in accordance with the manufacturer's instructions.

3.8 Assembly for molding. The mold shall be assembled, as follows, to receive the molding compound:

- a. Examine the cable assembly to determine that preparation procedures for the applicable sheath material are compatible as specified in 3.6.
- b. Assemble the two half-sections of the mold around the cable assembly.
- c. Examine the assembly for correct alignment and positioning of the cable and connector, and then tighten the clamping screws.
- d. Place the mold in a molding position with the cable connector down.

3.9 Preparation of potting and molding compounds.

3.9.1 Liquid. The liquid compound shall be two-part units, consisting of base resin and activator, and shall be prepared as follows:

- a. Determine that the material has been acceptance tested and meets the requirements specified in MIL-M-24041, and that the shelf life has not expired.

CAUTION

Use premeasured kits as supplied by the manufacturer. Do not use broken or partially used kits.

- b. Examine the contents of the base resin and activate for solidification.
- c. If either part has thickened, solidified, or crystallized, heat that part to $90^{\circ} \pm 5^{\circ}\text{C}$ ($194^{\circ} \pm 9^{\circ}\text{F}$).

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Use a thermometer (see 3.1.2.7) to determine the actual material temperature. Occasional stirring is essential during heating to assure uniformity and to hasten the molding process. Allow to return to room temperature before mixing.

- d. Place the base resin and activator in a clean, dry, nonporous container having at least five times the volume of the combined parts. Blend parts thoroughly, avoiding fast stirring and whipping that may entrap excessive air.
- e. Place the container in a vacuum chamber and apply a vacuum of not less than 29.5 inches Hg. Maintain the pressure until foaming subsides. The foaming should subside within 20 minutes. If foam is still present after 30 minutes, the compound should not be used.
- f. Transfer the degassed compound into the injection gun cartridge, using care not to entrap air.
- g. Place the plunger in the cartridge next to the potting and molding material. Exercise care not to entrap air while inserting the plunger.

3.9.2 Thawing of premixed frozen cartridges. It is essential that the thawing time and temperature of frozen cartridges be closely controlled to obtain sufficient application life. An increase in either thawing time or temperature will reduce application life, and a decrease in either thawing time or temperature will result in an incomplete thaw. The following steps shall be followed for thawing premixed frozen cartridges.

- a. Remove the cartridge from storage and thaw for 30 minutes at $49^{\circ} \pm 2^{\circ}\text{C}$ ($120.2^{\circ} \pm 3.6^{\circ}\text{F}$). The thawing methods used shall not cause degradation of the compound.
- b. Complete thawing and check the plunger to make sure that no air is entrapped.
- c. When once thawed, premixed frozen cartridges shall not be refrozen. The cartridges shall not be used after application life has expired.

3.10 Molding instructions. The molding process shall be performed as follows:

- a. Insert the cartridge into the injection gun. (If air-operated, adjust the pressure to provide a slow, even flow of compound.)

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- b. Place the nozzle of the loaded cartridge into the injection port, maintaining the required pressure. Force the compound slowly into the mold until it emerges from the vent holes.
- c. Slowly withdraw the gun nozzle from the injection port, maintaining the required pressure on the gun to assure that the injection port will be filled with compound. Plug the injection port and allow the compound to settle in the mold. Settling may be aided by tapping the sides of the mold with a soft rubber-tipped hammer.
- d. Allow 15 to 20 minutes for settling, then inject additional compound into the mold until the compound is flowing from the vents. Slowly withdraw the gun nozzle from the injection port, maintaining the required pressure on the injection gun to assure that the injection port will be filled with compound.
- e. Plug the injection port on the side of the mold.

3.11 Curing (molding only).

3.11.1 Curing schedule. Curing schedules shall be selected as recommended by the manufacturer.

3.11.2 Molded assembly. The molded assembly shall be submitted for inspection only after it has completed the recommended cure cycle and cooled to room temperature.

3.12 Potting instructions. Potting shall be performed as follows:

- a. Examine the cable assembly and determine that the preparation procedures for the applicable sheath materials are completed as specified in 3.6.
- b. Insert the cartridge into the injection gun. (If air-operated, adjust the air pressure to provide a slow, even flow of compound.)
- c. Prepare a hardness test sample from each mixed batch by using a small container to make a button of the compound (approximately 1.000 inch in diameter by 0.750 inch thick). Cure according to the same schedule assigned to the job it is taken from. The button shall accompany the cable throughout the remainder of the cure cycle.
- d. Carefully separate the conductors in the connector, taking special care not to damage any conductors or contacts.
- e. Position the nozzle in the center of the contacts near the connector insert.

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- f. Start the flow of the compound, assuring an even flow around all pins.
- g. Keep the nozzle tip at the swell level and continue the injection until the required level is attained. Let the compound settle for not less than 5 minutes. Replenish to the required level.

3.13 Curing (potting only). It is permissible to select curing schedules as recommended by the manufacturer, but these schedules shall be within the limitations of MIL-M-24041.

3.14 Repairs.

3.14.1 Repairable defects. Repairable defects shall consist of those defects capable of repair without affecting serviceability, or without leaving undesirable latent effects as determined by the individual item inspection. Final acceptance shall be as specified in Section 4.

3.14.2 Minor repairs. Minor repairs shall be considered as surface cavities that do not penetrate to the conductors and which measure not greater than 0.50 inch.

3.14.2.1 Minor repair procedure. Minor repairs shall be made as follows:

- a. Clean surface to be repaired.
- b. Remove contaminants by wiping with MEK.
- c. Prepare approved compound in accordance with the manufacturer's instructions and fill the cavity or cavities with the mixed compound.
- d. Position a sheet of polyethylene or other film that will not adhere to the compound and secure in place. The cavity shall be completely filled with compound.
- e. Cure in accordance with the manufacturer's instructions.
- f. Remove the film and inspect as specified in Section 4.

3.14.3 Major repair. Major repair shall be those cavities that penetrate to the depth of the conductors, or which measures greater than 0.5 inch.

3.14.3.1 Major repair procedure. Major repairs shall be made as follows:

- a. Mask the entire outside of the connector and the cable sheath immediately adjacent to the termination of the tapered portion of the cable molding. The masking shall be sufficient to protect the connector from damage while preparing the mold.

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- b. Remove sufficient compound to determine the extent of the cavity depth. Remove at least 0.10 inch of compound from the entire surface of the cable mold, assuring that no damage is done to the connector, conductor, contact, or cable sheath.
- c. Clean the entire surface with a clean, dry brush or a jet of clean, dry air.
- d. Remove masking from the connector and cable and attach the same type mold form that was used for the original molding. Remold the connector as specified in 3.10.
- e. Cure in accordance with manufacturer's instructions.
- f. Inspect as specified in Section 4.

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Inspection. After each potted or molded cable assembly has completed the required cure time and cooled to room temperature, it shall be tested and inspected in accordance with the following paragraphs.

4.2.1 Appearance and workmanship. The potted and molded surfaces shall be free from surface bubbles, blisters, tackiness, gas pockets, and other defects that will degrade the finished product.

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4.2.2 Hardness. The hardness test for molded assemblies shall be performed on the completed mold and the hardness test for the potted assemblies shall be performed on the samples prepared as specified in 3.12 using a shore A scale durometer (see 6.2.2). The hardness of the cured compound shall conform to MIL-M-24041.

4.2.3 Adhesion. Each cable shall be flexed at the tapered, molded, or potted portion not less than five times to determine if the compound is securely bonded to the cable sheath or connector. Care shall be taken to avoid damage to the assembly during inspection and test. Separation of the material from the cable or connector shall be cause for rejection.

4.3. Toxicological product formulations. The contractor shall have the toxicological product formulations and associated information available for review by the contracting activity to evaluate the safety of the material for the proposed use.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification outlines the process for the potting and molding of cable assemblies.

6.2 Definitions.

6.2.1 Contamination. The presence of impurities in the potting or molding compound or on the surface of the cable, tools, and molds to be used in the potting and molding process.

6.2.2 Durometer. An instrument for measuring the relative hardness of a compound.

6.2.3 Hot spots. The concentration of heat in a relatively small portion of a given area.

6.2.4 Hygrometer. An instrument for measuring the relative moisture (humidity) of air.

6.2.5 Sealant. An elastomeric material used to prevent wicking at the ends of a cable.

6.2.6 Wicking. The wetting out, by capillary action or excessive pressure, of a liquid compound into a cable beyond the point where a mold stops; thus, creating a stiff portion of cable beyond the mold area.

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6.3 Metrication. Wherever inch/pound measurements are used in this document, metric equivalents in accordance with FED-STD-376 shall be acceptable.

6.4 Subject term (keyword) listing.

Casting material
Elastomeric compound
Encapsulating mixture
Snaping compound

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - MI

Preparing Activity:
Army - MI

User:
Army - AR

Project 14GP-A121

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-P-46872A(MI)	2. DOCUMENT DATE (YYMMDD) 16 July 1990
3. DOCUMENT TITLE Potting and Molding of Cable Assemblies, Process for			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME Commander US Army Missile Command		b. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (205) 876-6980 746-6980	
c. ADDRESS (Include Zip Code) ATTN: AMSMI-RD-SE-TD-ST Redstone Arsenal, AL 35898-5270		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	