

MIL-E-24403A(SH)  
 21 December 1981  
SUPERSEDING  
 MIL-E-24403(SHIPS)  
 31 December 1970  
 (See 6.4)

MILITARY SPECIFICATION  
 ELECTRODES - WELDING, FLUX CORED  
 GENERAL SPECIFICATION FOR

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for flux cored welding electrodes designed for use with the flux cored arc welding process with or without gas shielding.

1.2 Classification. Electrodes shall be furnished in the following forms and sizes (see table I), and in the type specified in the applicable detail specification (see 3.2 and 6.2):

- Form 3a - Electrode on small spool (4-inch flange)
- Form 3b - Electrode on large spool (12-inch and larger flange)
- Form 3d - Electrode wound in coils with support (60 pounds and under)
- Form 3e - Electrode wound in coils without support (over 60 pounds)
- Form 4 - Electrode wound in drums

TABLE I. Electrode diameter sizes.

Form	Diameter sizes (inches)					
3a	0.045	0.052	----	----	----	-----
3b	.045	.052	1/16	5/64	3/32	7/64
3d 3e 4	.045	.052	1/16	5/64	3/32	7/64, .012, 1/8, 5/32

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## 2. APPLICABLE DOCUMENTS

### 2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards 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

PPP-B-566 - Boxes, Folding, Paperboard.  
PPP-B-636 - Box, Fiberboard.  
PPP-B-676 - Boxes, Setup.  
PPP-B-1055 - Barrier Material, Waterproofed, Flexible.  
PPP-D-723 - Drums, Fiber.

##### MILITARY

MIL-W-10430 - Welding Rods and Electrodes, Preparation for Delivery of.  
MIL-E-24403/1 - Electrodes - Welding, Flux Cored, Ordinary Strength and Low-Alloy Steel.  
MIL-E-24403/2 - Electrodes - Welding, Flux Cored, Low-Alloy Steel.  
MIL-I-45208 - Inspection System Requirements.

#### STANDARDS

##### FEDERAL

FED-STD-151 - Metals, Test Methods.

##### MILITARY

MIL-STD-271 - Nondestructive Testing Requirements for Metals.

2.1.2 Other Government documents and publications. The following other Government documents and publications form a part of this specification to the extent specified herein.

##### DEPARTMENT OF LABOR

Code of Federal Regulations, Title 29,  
Part 1910 - Occupational Safety and Health Standards.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

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## PUBLICATIONS

## NAVAL SEA SYSTEMS COMMAND (NAVSEA)

NAVSEA 0900-LP-003-8000 - Metals, Surface Inspection Acceptance Standards.

NAVSEA 0900-LP-003-9000 - Radiographic Standards for Production and Repair Welds.

NAVSEA 0900-LP-005-5000 - Standard Procedures for Preproduction Testing Materials by the Explosion Bulge Test.

(Copies of specifications, standards, and publications required by contractors 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 specification 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)

D 635 - Rate of Burning or Extent and Time of Burning, or Both, of Self-Supporting Plastics in a Horizontal Position (DoD adopted).

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

## AMERICAN WELDING SOCIETY (AWS)

A3.0 - AWS Definitions - Welding and Cutting (DoD adopted).

B4.0 - Standard Methods for Mechanical Testings of Welds.

Z49.1 - Safety in Welding and Cutting.

(Application for copies should be addressed to the American Welding Society, Inc., 2501 N.W. 7th Street, Miami, FL 33125.)

(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 Qualification.** The electrodes furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

**3.2 Detail specifications.** Detail requirements or exceptions applicable to particular types of electrodes shall be as specified in the applicable detail specification. In the event of any conflict between the provisions of this specification and the detail specification, the latter shall govern.

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3.3 Definitions. For the purpose of this specification, the welding terms and definitions contained in AWS A3.0 shall apply.

3.4 General requirements.

3.4.1 Materials. Materials used in fabricating the electrodes shall be asbestos-free, and a certificate of compliance shall be submitted to the contracting activity when required (see 6.2).

3.4.2 Finish. Electrodes shall have a finished surface, free from slivers, depressions, scratches (excluding seams), and scale or foreign matter that would adversely affect the welding characteristics, the operation of the equipment or the properties of the deposited metal.

3.4.3 Uniformity of core ingredients. Electrodes shall have the core ingredients distributed throughout their length so that the performance of the electrodes and the properties of the weld metal deposited thereby are not adversely affected.

3.4.4 Chemical composition. The chemical composition of deposited metal shall be as specified in the detail specification (see 3.2).

3.4.4.1 Hydrogen content. The permissible hydrogen content of the deposited weld metal shall be as specified in the detail specification (see 3.2).

3.4.5 Mechanical properties. The deposited weld metal shall exhibit mechanical properties specified in the detail specification (see 3.2).

3.4.6 Soundness. Unless otherwise specified in the detail specification (see 3.2), groove welds shall meet the requirements of NAVSEA 0900-LP-003-8000 for magnetic particle inspection and NAVSEA 0900-LP-003-9000, class 1 for radiographic inspection.

3.4.7 Explosion bulge. When required by the detail specification (see 3.2), welds produced by the electrodes shall pass the explosion bulge test specified in 4.6.5.

3.5 Spooled and coiled electrodes.

3.5.1 Tolerance (diameter size). Diameter of electrode shall not vary from the nominal diameter by more than the limits specified in table II.

TABLE II. Dimensional tolerances.

Nominal diameter	Tolerance
(Inch)	(Inch)
1/16 and smaller	+0.002
5/64 and larger	±0.003

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3.5.2 Winding. Each spool, coil, or drum shall be wound from one continuous length of electrode made from a single lot of material, as specified in the detail specification (see 3.2). The winding shall avoid producing kinks, waves, or sharp bends and shall be free to unwind without restriction. The starting end of the electrode shall be firmly fastened so that it is readily visible to the welder or welding operator.

3.5.3 Spool, coil, and drum weights. Spools, coils, and drum shall be furnished in weights specified in the applicable detail specification (see 3.2).

3.5.4 Cast and helix.

3.5.4.1 Electrodes shall be capable of uniform uninterrupted feeding on automatic or semi-automatic welding equipment.

3.5.5 Spool and coil dimensions.

3.5.5.1 Form 3a. Spools used for form 3a electrode shall conform to figure 1.

3.5.5.2 Form 3b. Spools used for form 3b electrode shall conform to figure 2.

3.5.5.3 Forms 3d and 3e. Coil dimensions shall be as specified in table III.

TABLE III. Coil dimensions and accessories.

Form	Width (maximum)	Inside diameter	Accessories	
			Ties <sup>1/</sup>	Liner <sup>2/</sup>
	(Inches)	(Inches)		
3d	3	6-3/4 + 1/8	3 minimum	Required
3d	4-5/8	12 + 1/8	3 minimum	Required
3e	5	22-7/2 minimum	4 minimum	Not required

<sup>1/</sup> Equally spaced ties shall consist of soft galvanized or coppered steel or nickel and nickel base alloy binding wire, 16 or 18 gauge, or steel straps 3/8-inch minimum width and 0.010-inch minimum thickness, or pressure sensitive adhesive coated, fiberglass reinforced tape 3/4-inch minimum width with a 160 pound per inch width minimum tensile strength and 2-inch minimum overlap. (Only coppered steel, nickel, and nickel base alloy wire and steel strap shall be used for binding nickel base alloys.)

<sup>2/</sup> Liner shall be of double kraft lined fiberboard 0.08-inch thick minimum and approximately 4-inches wide. Steel liner shall be used when required by the detail specification (see 3.2).

3.5.6 Identification. Electrodes shall be identified with the specification number, MIL-type, size, and lot control number.

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3.5.6.1 Forms 3a and 3b. Identification shall be placed on the flange of the spool so as to be visible when the spool is positioned on the machine for welding. Identification shall be placed in a manner that is not readily removable.

3.5.6.2 Form 3d. Identification shall be placed on the liner of the coil and shall be legible during the service life of the coil.

3.5.6.3 Form 3e. Identification shall be placed on a tag and the tag firmly attached at the inner end of the coil. The tag and marking shall be capable of resisting effacement or destruction.

3.5.6.4 Form 4. Identification shall be placed on the drum. It shall be legible during the use of the electrode.

#### 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 specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection system. The contractor shall provide and maintain an inspection system acceptable to the Government for supplies and services covered by this specification. The inspection system shall be in accordance with MIL-I-45208.

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

- (a) Qualification inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification tests will be authorized only to manufacturers of welding electrodes. Qualification tests shall be conducted at a laboratory satisfactory to NAVSEA. Qualification shall consist of the examination specified in 4.5.1 and in the detail specification, and the tests specified in 4.6.2 through 4.6.6 as specified in the requirements of the detail specification (see 3.2).

4.3.1 Sample for qualification tests. Unless otherwise specified in the detail specification (see 3.2), the electrode selected for testing shall be one spool of form 3b, one coil of form 3d, or one drum of form 4, of each size of each MIL-type for which the manufacturer desires to qualify. However, if the manufacturer's formulation is the same for a range of sizes of that MIL-type, only one size of that range of sizes shall be tested to qualify all sizes represented.

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4.3.2 Special instructions. When applying for qualification test authorization, or after tests have been conducted and reports submitted, the manufacturer shall furnish the information specified in 4.3.2.1 or 4.3.2.2. (Note: This information, together with qualification test results will be held in confidence by the Government as proprietary information.)

4.3.2.1 When production is in accordance with lot definition 4.4.2.1(a), the manufacturer shall furnish the following information:

- (a) Type and size range (each size manufactured shall be specified) for which qualification is desired (see 4.3.1).
- (b) Composition of tube, or strip, and flux ingredients in terms of nominal percentages for each constituent.
- (c) Composition of deposited weld metal.
- (d) Recommended amperage for each weld test and size of electrode to be qualification tested.
- (e) Brand name.

4.3.2.2 When production is in accordance with lot definition 4.4.2.1(b), the manufacturer shall furnish the following information:

- (a) The type and size range (each size manufactured shall be specified) for which qualification is desired (see 4.3.1).
- (b) Chemical composition control limits for mill coil.<sup>1/</sup>
- (c) Method of determining chemical composition of the mill coil.<sup>1/</sup>
- (d) Production line quality control methods used in producing electrodes from chemically controlled mill coil.<sup>1/</sup>
- (e) Percent allowable variation (disclosed) from standard (not disclosed) for each formulated chemical element in the mix of chemically controlled flux material for each MIL-type electrode.<sup>1/</sup>
- (f) Method of determining chemical composition of the mix of chemically controlled flux material.<sup>1/</sup>
- (g) Production line quality control methods used in producing electrodes from chemically controlled flux material.<sup>1/</sup>
- (h) Recommended amperage for each weld test, and size of electrode to be qualification tested.
- (i) Brand name.

#### 4.4 Quality conformance inspection.

4.4.1 General. Electrodes shall be inspected in accordance with the definitions specified in 4.4.1.1 through 4.4.1.4.

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<sup>1/</sup> Information shall be furnished for NAVSEA evaluation.

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4.4.1.1 Dry batch. A dry batch of flux mixture is defined as the quantity of dry flux ingredients mixed at one time in one mixing vessel. A dry batch may be used singly or may be subsequently subdivided.

4.4.1.2 Dry blend. A dry blend is defined as one or more dry batches mixed in a mixing vessel and combined proportionately to produce a uniformity of mixed ingredients equal to that obtained by mixing the same total amount of dry ingredients at one time in one mixing vessel.

4.4.1.3 Heat of metal. A heat of metal is defined as that material obtained from one furnace melt.

4.4.1.4 Chemically controlled materials. The procedure for manufacturing flux cored electrodes using chemically controlled material is defined in 4.4.1.4.1 for flux material and in 4.4.1.4.2 for mill coil.

4.4.1.4.1 Flux material. Each dry batch (see 4.4.1.1) shall be chemically analyzed for conformance to the percent allowable variation (disclosed) from standard (not disclosed) for each formulated chemical element for each MIL-type electrode (see 4.3.2.2). The following additional conditions shall apply:

- (a) Identification of each dry batch as to the intended use based on the results of the chemical analysis.
- (b) Maintain record of chemical analysis.
- (c) Chemical analysis report of allowable variation from standard shall be available to the Government representative upon request.
- (d) Maintain traceability to each dry batch in lot identification of the electrodes.

4.4.1.4.2 Mill coil. Each continuously rolled mill coil of rod shall be chemically analyzed for conformance to the approved chemical composition control limits (see 4.3.2.2). The mill coils used for the production of one lot of electrodes shall be the product of one or more heats of metal. The following additional conditions shall apply:

- (a) One end of each mill coil furnished by mills prohibiting spliced-coil practice shall be sampled for the above chemical analysis. Both ends of each mill coil furnished by mills permitting one splice per coil shall be sampled for the above chemical analysis. Mill coils with more than one splice in each coil shall not be used.
- (b) All chemical analysis shall be certified by the laboratory and made available to the Government representative.
- (c) Mill coils of rod conforming to the established chemical composition control limits for a specific MIL-type electrode shall be appropriately identified and segregated to avoid mixups.

4.4.2 Sampling for quality conformance inspection. For quality conformance inspection, electrodes shall be selected in accordance with the lot definition in 4.4.2.1.



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4.4.2.1 Lot. A lot of electrodes is defined as the quantity of any one size and type produced from the following:

- (a) One dry batch (see 4.4.1.1) or one dry blend (see 4.4.1.2) and one heat of metal (see 4.4.1.3) not to exceed 25,000 pounds of electrodes, or
- (b) Chemically controlled dry batches of flux material (see 4.4.1.4.1) and chemically controlled mill coils (see 4.4.1.4.2) not to exceed 100,000 pounds of electrodes.

4.4.2.2 Sampling for examination of filled containers. Unit packages and shipping containers shall be sampled and examined in accordance with MIL-W-10430.

4.4.2.3 Sampling for visual examination and dimensional tolerance determination of electrode. Sample electrode shall be selected either from the production line immediately prior to packaging or from filled unit packages. If selected from the production line, the total number of samples shall be in accordance with table IV and the electrodes shall be selected throughout the "run" so that all parts of the lot are represented. If selection is made after the packaging operation, the total number of samples shall be in accordance with table IV and approximately the same amount of electrode shall be selected from each of the same unit packages. Electrode to form one complete circle shall be taken from each sample spool, coil, or drum.

TABLE IV. Sampling for visual examination and dimensional tolerance determination.

Lot size, number of spools, coils or drums in lot (see 4.4.2.1)	Sample size, number of spools, coils or drums selected at random for examination	Acceptance number, maximum number spools, coils or drums containing defective electrodes for acceptance of the lot
2 to 15	2	0
16 to 50	3	0
51 to 150	5	0
151 to 500	8	1
501 to 3200	13	2
3201 to 35000	20	3

4.4.3 The sample electrodes selected in accordance with table IV shall be examined in accordance with 4.5.1. If the applicable acceptance number of table IV is exceeded by the number of spools, coils, or drums containing electrodes that do not meet the visual and dimensional requirements specified in 3.4 and 3.5, the lot shall be rejected.

4.4.4 Sampling for chemical analysis. One specimen shall be selected from the lot (see 4.4.2.1) to verify conformance to the required chemical composition of deposited metal as specified in the detail specification (see 3.2).

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4.4.5 Sampling for weld tests. Sufficient quantity of electrode shall be selected from each lot (see 4.4.2.1) for use in the preparation of such welds as may be required by the detail specification (see 3.2).

4.5 Inspection procedures.

4.5.1 Visual examination and dimensional tolerance determination. Each sample length of electrode selected in accordance with 4.4.2.3 shall be examined to verify conformance to visual and dimensional tolerance requirements specified in 3.4 and 3.5 and in the detail specification (see 3.2). The electrode diameter of each sample shall be measured at two places approximately 2 inches from each end. Several readings shall be taken at each place to determine the maximum and minimum diameters. The maximum and minimum diameters for the place having the maximum deviation shall be recorded.

4.5.2 Quality conformance weld test. Samples selected in accordance with 4.4.4 and 4.4.5 shall be used to perform such tests as may be required by the detail specification (see 3.2) to verify conformance to the chemical composition, soundness, and mechanical properties of deposited weld metal.

4.5.3 Certification. Results of examinations and tests (see 4.5.1 and 4.5.2) shall be certified by a responsible company official and furnished to the consignee.

4.6 Test procedure.

4.6.1 Preparation of welds. Weld test shall be prepared as specified in the detail specification (see 3.2).

4.6.2 Weld tests.

4.6.2.1 Nondestructive tests.

4.6.2.1.1 Magnetic particle inspection. Magnetic particle inspection shall be in accordance with MIL-STD-271.

4.6.2.1.2 Mechanical tests. When required by the detail specification (see 3.2), tensile and impact test specimens shall be prepared and tested in accordance with AWS B4.0.

4.6.3 Chemical analysis sample. The weld metal sample for chemical analysis shall be taken from a weld metal pad, a groove weld, or the fractured end of an all weld metal tensile specimen. In the case of a dispute, the weld metal pad shall be used.

4.6.3.1 Weld metal pad. A 1 by 3 by 1/2 inch high (minimum) pad shall be deposited in multiple pass layers on a plain low carbon-steel base plate. The pad may be quenched in hot water (above 180°F) after each pass to speed cooling. If this technique is used, the pad shall be air cooled for approximately 1 minute prior to water quenching. After quenching, the pad shall be allowed to dry prior to depositing the next pass. When the required height has been deposited, the top surface shall be machined to clean bright metal and then a chemical analysis sample machined. No metal shall be removed within 3/8 inch of the base plate. The procedure shall be recorded and made available in case of a dispute.

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4.6.3.2 Groove weld sample. Sample drillings or slices shall be taken from the groove weld after weld reinforcement has been removed to present a clean surface. The sample shall be taken along the longitudinal axis and from the upper third of the weld thickness.

4.6.3.3 Tensile specimen sample. The sample shall be machined from the parallel section of fractured tensile specimens.

4.6.4 Chemical analysis. Chemical analysis of the deposited weld metal sample shall be determined in accordance with the procedures specified in FED-STD-151 either method 111.1 or method 112.1. In case of a dispute, the analysis shall be conducted in accordance with FED-STD-151, method 111.1.

4.6.5 Diffusible weld metal hydrogen test. The diffusible weld metal hydrogen for each electrode being tested shall be determined in accordance with figure 3 and notes thereto.

4.6.6 Explosion bulge. When required by the detail specification (see 3.2), the crack starter and explosion bulge weldments shall be prepared and tested in accordance with NAVSEA 0900-LP-005-5000.

4.6.7 Unsatisfactory test results. If the results of any test is determined to be unsatisfactory, two retests shall be permitted. The results of both retests shall be satisfactory for lot acceptance.

4.7 Inspection of packaging. The packaging, packing and marking shall be inspected for compliance with section 5 of this document.

## 5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions.)

5.1 Packaging. Electrodes shall be packaged level A or C in accordance with the following as specified (see 6.2).

### 5.1.1 Level A packaging.

5.1.1.1 Wrapping form 3a and 3b spools. Each spool shall have the periphery of electrodes wrapped with paper backed aluminum foil, minimum 0.0035-inch thick laminated to 30-pound basis weight kraft paper. Wrapping shall be held in place with tape. In lieu of wrapping, individual spools may be placed in an extruded polyethylene bag as follows: The bag shall be 0.004-inch thick, and the bottom and top of the bag shall be closed after loading.

5.1.1.2 Packaging, form 3a spools. Each spool shall be placed in a set-up or folding paper box conforming to PPP-B-676 or PPP-B-566 respectively, at the option of the contractor. Twenty spools shall then be placed in a fiberboard box, class 3 container of MIL-W-10430. Box closure, reinforcement, and waterproofing shall be in accordance with method V of the appendix to PPP-B-636.

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5.1.1.3 Packaging form 3b spools. Each spool shall be placed in a fiberboard box, class 3 container of MIL-W-10430. Box closure, reinforcement, and waterproofing shall be in accordance with method V of the appendix to PPP-B-636.

5.1.1.4 Packaging forms 3d and 3e coils. Form 3d coil with liner shall be individually packaged by any one of the following procedures. Selection of the procedure shall be at the contractor's option.

- (a) In class 3d unit containers in accordance with MIL-W-10430.
- (b) Spirally wrapped with one or more layers of waterproof material conforming to class C-1 of PPP-B-1055 and secured with a double tie of 1/16 inch minimum diameter, medium or soft tempered, steel wire.
- (c) Placed in a minimum 0.004 inch thick low density polyethylene bag. Closure shall be by heat sealing or pressure sensitive tape. Each bagged coil shall be further placed in a set-up, folding paper box or fiberboard box conforming to PPP-B-676, PPP-B-566, or PPP-B-636 respectively at the option of the contractor. Setup or folding paper boxes shall not exceed ten pounds gross weight.

Alternatively, 3d coils may be individually placed in a fiber drum for the level of packing specified. Form 3e coils shall also be placed in fiber drums for the level of packing specified.

5.1.1.5 Packaging form 4 drums. Drums shall conform to PPP-D-723 as follows (see 6.2):

- (a) Grade A, type II or III for overseas shipments.
- (b) Grade A, type I for domestic shipment and storage.

Drums shall be provided with cores fabricated from convolutely wound kraft lined fiberboard of minimum 0.012 inch thickness. Electrode shall be capable of removal from the top of the drum. Drums shall be closed by means of a lever locking band. When specified (see 6.2), cores shall be fitted with a slinger ring attachment.

## 5.1.2 Level C packaging.

5.1.2.1 All forms of electrode. Packaging shall be sufficient to afford adequate protection against physical damage during shipment from the contractor to the using activity and until early use.

5.2 Packing. Electrodes shall be packed level A, B or C of MIL-W-10430 as specified in the contract or order (see 6.2).

## 5.3 Marking.

5.3.1 Interior packages. Shipment marking information for electrodes shall be provided on interior packages in accordance with the manufacturer's commercial practice. The information shall include lot identification, type, size, specification number, manufacturer's or distributor's name, manufacturer's or distributor's brand or type designation. In addition,

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each coil with liner, spool or drum shall have the following warning label, or equivalent, permanently affixed to the body of the coil, spool or drum in a prominent position and in legible type. Coils without support shall have a tag bearing the following warning label, or equivalent, in legible type securely attached to both ends of the coil:

**WARNING: Protect yourself and others. Read and understand this label.**

**FUMES AND GASES** can be dangerous to your health. **ARC RAYS** can injure eyes and burn skin. **ELECTRIC SHOCK** can kill.

Read and understand the manufacturer's instructions and your employer's safety practices.

Keep your head out of the fumes.

Use enough general ventilation or exhaust at the arc or both to keep fumes and gases from your breathing zone, and the general area.

Wear correct eye, ear and body protection.

Do not touch live electrical parts.

See American National Standard 249.1 "Safety in Welding and Cutting" published by the American Welding Society, 2501 N.W. 7th St., Miami, FL 33125; OSHA Safety and Health Standards, 29 CFR 1910 are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

**DO NOT REMOVE THIS LABEL**

#### 5.3.2 Exterior shipping containers and palletized unit loads.

Shipment marking information shall be provided on exterior shipping containers and palletized unit loads in accordance with the manufacturer's commercial practice. In addition to the information required for interior packages as specified in 5.3.1 except the warning label, the information shall include shipping destination, stock number furnished with contract or order, customer's order number, customer's item number, and customer's name.

#### 5.3.3 All containers shall be marked "ASBESTOS FREE".

#### 5.4 Use of loose-fill material.

5.4.1 Level A packaging and levels A and B packing. Use of all types of loose-fill materials for packaging and packing applications such as cushioning, filler, or dunnage is prohibited for materials destined for shipboard installation/stowage.

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5.4.2 Level C packaging and packing. When loose-fill type materials are used for packaging and packing applications such as cushioning, filler, and dunnage, all containers (unit, intermediate, and shipping) shall be marked or labelled with the following information:

## "CAUTION

Contents cushioned, etc., with loose-fill material.  
Not to be taken aboard ship.  
Remove and discard loose-fill material.  
If required, recushion with cellulosic material,  
bound fiber, fiberboard, or transparent flexible  
cellular material."

## 6. NOTES

6.1 Intended use. This specification covers electrodes intended for use with the flux cored arc welding process with or without gas shielding.

6.2 Ordering data. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of the applicable detail specification.
- (c) Types, form, and sizes required (see 1.2 and 3.2).
- (d) When a certificate of compliance is required (see 3.4.1).
- (e) Level of packaging and packing required (see 5.1 and 5.2).
- (f) Packaging required for form 4 drums (see 5.1.1.5).
- (g) If slinger ring attachment is to be provided with cores (see 5.1.1.5).

6.2.1 Electrodes shall be ordered by the pound.

6.3 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List QPL 24403 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, DC 20362, and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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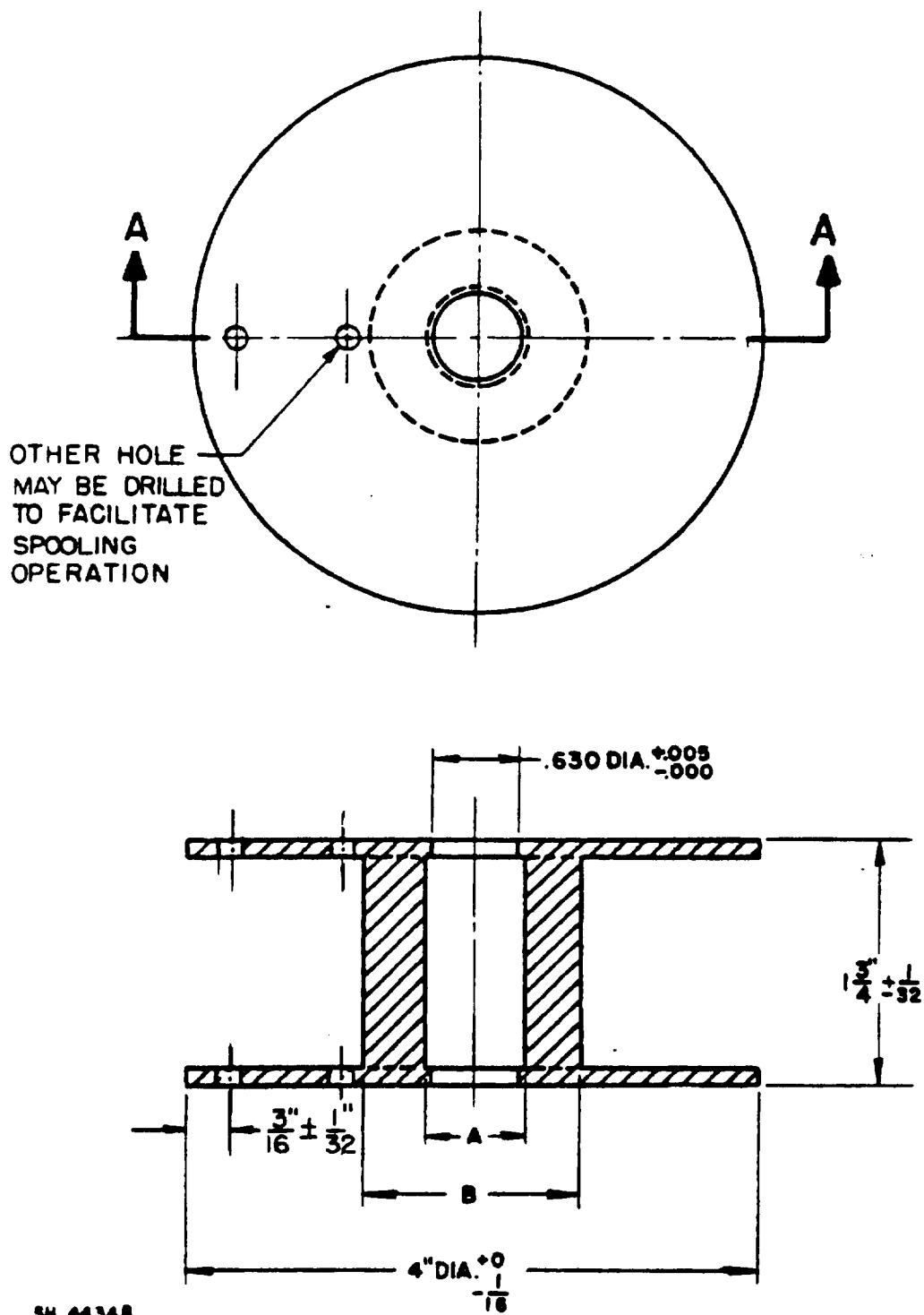
6.4 Changes from previous issue. Asterisks (\*) are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:

Navy - SH

(Project 3439-N368)

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FIGURE 1. Details for form 3a spools.

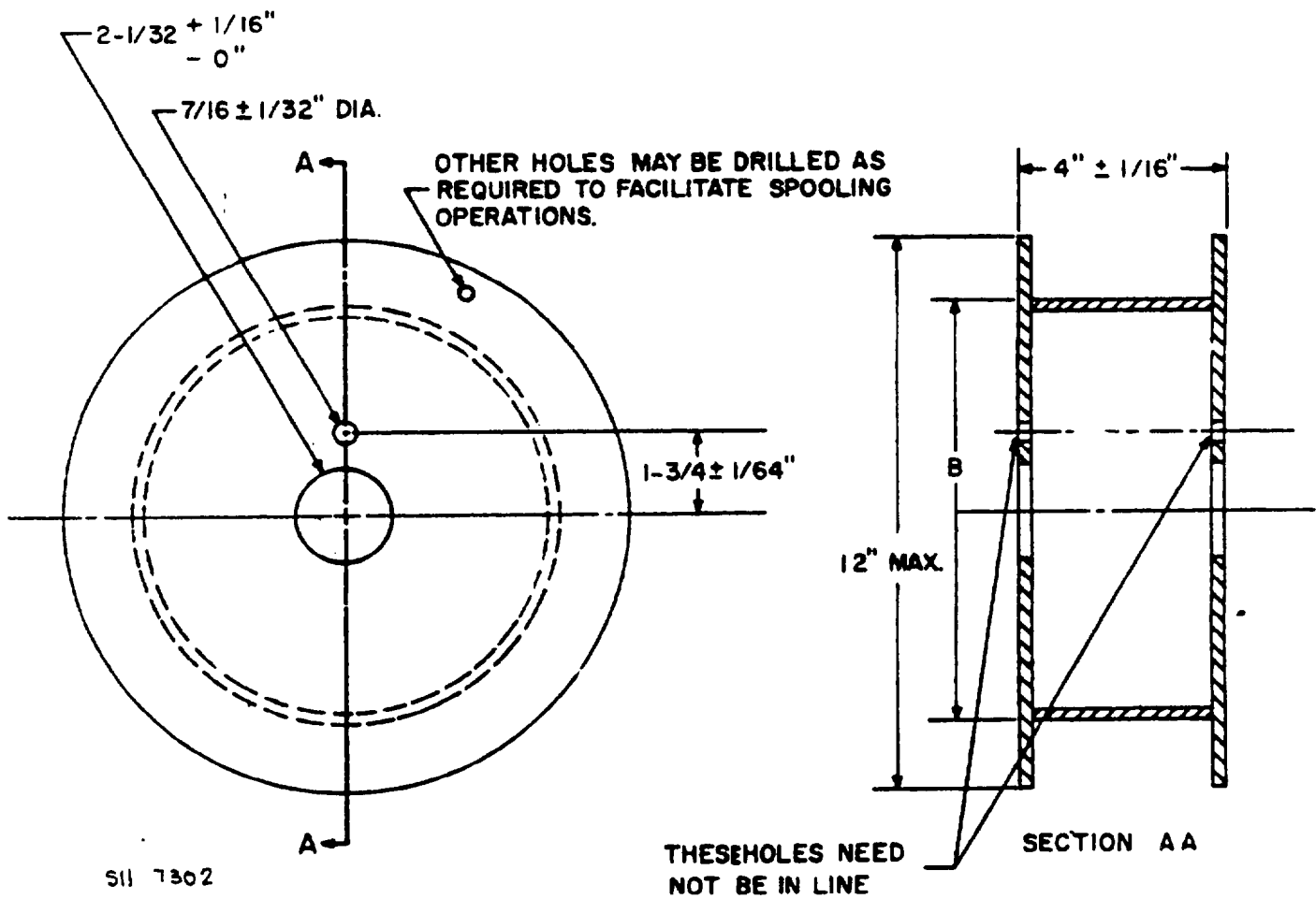


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## Notes to figure 1:

1. Flange and barrel material shall be nonconductive, and of such construction to carry the net weight of specified electrode and retain stability under handling, shipment, storage, and use. Spools shall be constructed of hardboard flanges and cardboard barrels. Plastic spools may be used provided they are made of a material that is self-extinguishing by the test of ASTM D 635.
2. All dimensions in inches.
3. Dimension A, inside diameter of barrel, shall be such that swelling of the barrel or misalignment of the barrel and flanges does not result in the core of the spool being less than the inside diameter of the flanges.
4. Dimension B, outside diameter of barrel, shall be such as to permit proper feeding of the electrode.
5. Spooled electrode alloy shall be labeled and identified as to type and size of electrode in accordance with commercial practice.
6. The ends of the electrode shall be securely fastened to the hub and either flange by any means that permits accessibility to the starting end, while satisfactorily retaining the electrode on the spool until used, and, moreover, does not interfere with unspooling operation during welding.

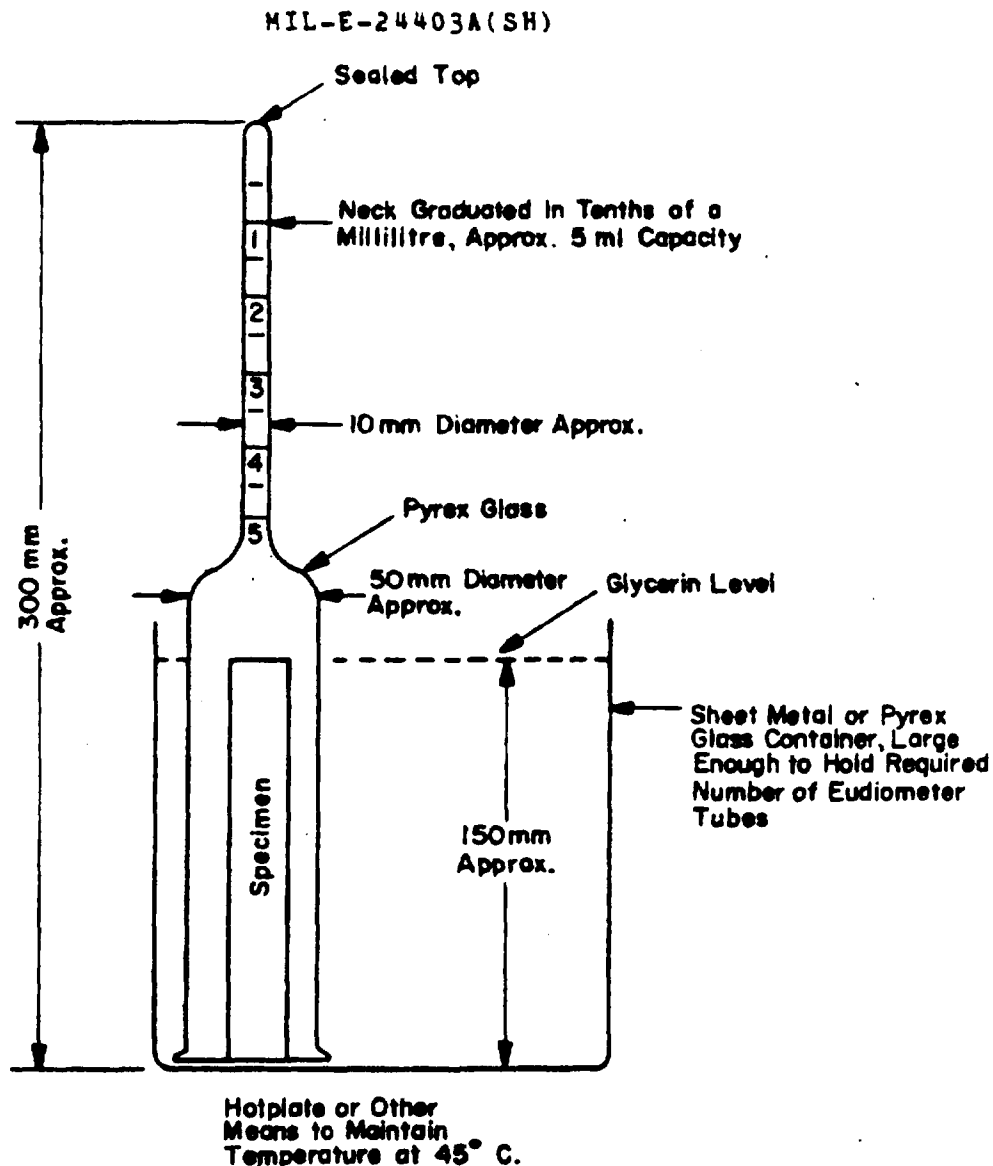
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FIGURE 2. Typical details for form 3b spools.

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## Notes to figure 2:

1. Flange and barrel material shall be nonconductive, and of such construction to carry the net weight of specified electrode and retain stability under handling, shipment, storage and use. Spools shall be constructed of hardboard flanges and cardboard barrels. Plastic spools may be used provided they are made of a material that is self-extinguishing by the test of ASTM D 635.
2. All dimensions in inches.
3. Dimension B shall be such as to permit proper feeding of electrode.
4. Flanges shall not be out of parallel more than 3/16 inch. Flanges shall not toe in.
5. The ends of the electrode shall be securely fastened to the hub and either flange by any means that permits accessibility to the starting end, while satisfactorily retaining the electrode on the spool until used, and, moreover, does not interfere with unspooling operation during use.
6. Spool rim may be provided with a removable plug (one side only).



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FIGURE 3. Sketch of apparatus for determining diffusible hydrogen in weld metal.

Notes to figure 3:

1. The testing of each electrode requires four separate diffusible hydrogen determinations.
2. The specimen plate material shall be any ordinary strength steel containing not more than 0.25 percent carbon, 0.35 percent silicon, 0.04 percent phosphorus, and 0.05 percent sulfur.
3. The size of each specimen plate shall be approximately 1/2 by 1 by 5 inches.
4. Surfaces of each specimen plate before welding shall be thoroughly cleaned of all rust, mill scale, lubricants, and other deleterious material.

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## Notes to figure 3 (continued):

5. Each specimen plate shall be weighed to the nearest 0.1 gram (g) before welding.
6. The sample electrode shall be taken from the production line just prior to packaging, or from a freshly opened package and tested without delay.
7. The welding parameters shall be the option of the manufacturer, but the values used for current, arc voltage and arc travel speed, shall be reported.
8. A single stringer bead (without weaving), 4-inches long shall be deposited on one of the 1 by 5 inch faces of each of the four specimen plates.
9. Within 30 seconds of the completion of the welding operations, each welded specimen shall be cleaned of slag and then quenched in water at approximately 20°C for a sufficient time that it does not subsequently become hot to the touch. The welded specimen shall then be further cleaned of all welding slag and any loosely adhering spatter, dried, and placed in the glycerine bath and the eudiometer tube placed over the welded specimen. No more than 1 minute shall elapse between extinguishing of the arc and placement of the welded specimen under the eudiometer tube.
10. The four welded specimens shall be welded and placed in the hydrogen collecting apparatus within 30 minutes. Each welded specimen shall be placed under a separate eudiometer tube.
11. The four welded specimens and their separate eudiometer tubes shall be tested in the same tank or container.
12. Glycerine with a minimum purity of 95 percent by volume shall be used as the confining liquid.
13. The glycerine bath shall be maintained at a temperature of  $45 \pm 3^{\circ}\text{C}$  during the test.
14. The welded specimens shall be kept immersed in the glycerine for a period of 48 hours minimum.
15. At the completion of the test period, the amount of hydrogen collected shall be measured to the nearest 0.05 milliliter (mL).
16. After the completion of the test period, the welded specimens shall be removed from the glycerine, cleaned, dried, and weighed to the nearest 0.1 g to determine the amount of the deposited weld metal.
17. The weight of the deposited weld metal shall be determined by subtracting the weight of each specimen plated from the weight of the welded specimen.
18. The volume of the hydrogen collected divided by the weight of deposited weld metal is the diffusible hydrogen content in mL per g of deposited weld metal.
19. Each separate test result shall be reported along with the average of the four values.



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