

MIL-E-23765/1E(SH)
23 August 1985
SUPERSEDING
MIL-E-23765/1D(SH)
9 February 1981
(See 6.3)

MILITARY SPECIFICATION

ELECTRODES AND RODS - WELDING, BARE, SOLID AND ALLOYED CORED, ORDINARY STRENGTH AND LOW ALLOY STEEL

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 ordinary strength steel solid bare and alloyed cored welding electrodes and cut-length rods for use with the gas metal-arc (GMA), gas tungsten-arc (GTA), and submerged-arc welding (SAW) processes. This specification also covers a neutral granular type flux for SAW.

1.2 Classification. Electrodes and rods shall be furnished in the types specified in table I and in forms 3a, 3b, 3c, 3d, 3e, 4, and 6 with sizes in accordance with MIL-E-23765, and table II herein.

1.2.1 Neutral granular flux type. Neutral granular flux for SAW applications shall be furnished in the type specified in 3.4.

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 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 3439

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TABLE I. Type designation and chemical composition.

MIL-type ^{1/} (with suffix RC) ^{2/}	Process	Chemical composition (percentage) ^{3/}							Other
		Carbon	Manganese	Silicon	Phosphorus	Sulfur			
70S-1	GMA, GTA, SAW	0.07 - 0.19	0.90 - 1.40	0.15 - 0.35	0.025	0.035			-----
70S-2	GMA, GTA, SAW	.06	1.00 - 1.40	.40 - .60	.025	.035			4/
70S-3	GMA, GTA, SAW	.07 - .19	0.90 - 1.40	.40 - .70	.025	.035			-----
70S-4	GMA, GTA, SAW	.07 - .15	.90 - 1.40	.65 - .85	.025	.035			-----
70S-5	GMA, GTA, SAW	.07 - .19	.90 - 1.40	.30 - .60	.025	.035			0.50 - 0.90 aluminum
70S-6	GMA, GTA, SAW	.08 - .14	1.40 - 1.70	.80 - 1.15	.025	.035			-----
70S-7	SAW	.10 - .18	1.70 - 2.10	0.05	.025	.035			-----
70S-8	SAW	.08 - .12	0.90 - 1.40	.05	.025	.035			.40 - .60 molybdenum
70S-9	SAW	.10 - .18	1.70 - 2.10	.05	.025	.035			.40 - .60 molybdenum

^{1/} When the basic MIL-type electrode or rod has a copper coating in accordance with 3.2.1 herein, the maximum weight percent of copper in the electrode or rod due to the coating and the residual copper content in the steel shall be 0.30 percent maximum. When more than one production line is being used to deposit copper coating on a single lot of electrodes, apply the appropriate procedure in accordance with the sampling plan for chemical analysis of MIL-E-23765.

^{2/} Addition of the suffix RC to any basic MIL-type designation, for example, MIL-type 70S-1RC indicates a special MIL-type of electrode or rod which is not copper coated and for which the copper and phosphorus content are 0.10 percent and 0.012 percent maximum, respectively. Other requirements of this specification which apply to a basic MIL-type shall also apply to the special MIL-type counterpart with the restricted copper and phosphorus content (see 6.2).

^{3/} Wherever single values are shown, they are maximum values.

^{4/} Aluminum 0.05 - 0.15, zirconium 0.02 - 0.12, and titanium 0.05 - 0.15.

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TABLE II. Form, size and weight.

Form	Electrode diameter (inch)	Weight ^{1/} (pounds)
3a	A11	1-1/2 and 2-1/2
3b	A11	10 or 15
3b	A11	25 or 35
3c	A11	25, 50, or 60
3d	A11	60 or 65
3e	A11	150 or 200
4	A11	750 or less
6	A11	10 or 50

^{1/} Tolerance on net weight shall be plus or minus 10 percent.

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

- BB-C-101 - Carbon Dioxide (CO₂): Technical and U.S.P.
- BB-O-925 - Oxygen, Technical, Gas and Liquid.
- UU-S-48 - Sacks, Shipping, Paper.
- PPP-D-723 - Drums, Fiber.

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- MIL-A-18455 - Argon, Technical.
- MIL-S-22698 - Steel Plate and Shapes, Weldable Ordinary Strength and Higher Strength: Hull Structural.
- MIL-S-23194 - Steel Forgings, Carbon and Alloy.
- MIL-E-23765 - Electrodes and Rods - Welding, Bare, Solid, General Specification for.
- MIL-S-24238 - Steel Plate, Carbon and Low Alloy.

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STANDARDS

FEDERAL

FED-STD-151 - Metals; Test Methods.

MILITARY

MIL-STD-147 - Palletized Unit Loads.

MIL-STD-278 - Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels in Ships of the United States Navy.

(Copies of specifications and standards 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)

A 285 - Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength. (DoD adopted)

A 516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower-Temperature Service. (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)

B4.0 - Standard Methods for Mechanical Testing of Welds. (DoD adopted)

(Application for copies should be addressed to the American Welding Society, Inc., 550 NW LeJeune Road, P.O. Box 351040, Miami, FL 33135.)

UNIFORM CLASSIFICATION COMMITTEE AGENT

Uniform Freight Classification Ratings, Rules, and Regulations

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publications Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(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.

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3. REQUIREMENTS

3.1 Electrodes and rods furnished under this specification shall conform to MIL-E-23765 and as specified herein.

3.2 Coating.

3.2.1 Basic MIL-type. Basic MIL-type electrodes and rods may have either a clean, bright finish or a uniform continuous well-bonded smoothly drawn copper coating on a clean surface. Diameters 3/32 inch or smaller may be coated with other types of rust preventatives, provided such coatings do not impair useability of the electrodes or the quality or soundness of weld metal deposits.

3.2.2 Special MIL-type with suffix RC. Special MIL-type electrodes and rods, designated by the suffix RC (see footnote 2 of table I), shall not be copper coated but may have either a bright finish or a special protective coating, provided the coating does not impair useability of the electrode or rod or the quality and soundness of the weld metal deposits.

3.2.3 MIL-type with suffix F. The MIL-type designation of a qualified flux consists of the MIL-type designation of the electrode it was qualified with, plus the suffix F (for example, MIL-70S-F).

3.2.3.1 Neutral granular flux, type MIL-70S-F, shall have a Wall neutrality number N of 35 or less.

3.3 Chemical composition. Chemical composition of unwelded electrode and rod shall be as specified in table I and footnotes thereto.

3.4 Mechanical properties. Unless otherwise specified (see 6.2), the mechanical properties of weld metal as-deposited shall be as specified in table III. The tensile properties, impact properties and bend test requirements for stress relieved weld metal deposited by the SAW or GMA and GTA processes shall be as specified in tables IV and V.

TABLE III. Mechanical properties for as-deposited GMA, GTA and SAW welds. ^{1/}

MIL-type ^{2/} _{8/}	Ultimate tensile strength (minimum lb/in ²)	Yield strength (lb/in ²)	Percent elongation, in 2 inches	Bend
^{3/} 70S-1 ^{4/} 70S-2 ^{4/} 70S-3 ^{4/} 70S-4 ^{4/7/} 70S-6 ^{5/} 70S-5 ^{9/} 70S-F	70,000	55-70,000	22	^{6/}

See footnotes at top of next page.

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- 1/ Single values are minimum.
- 2/ Direct current (dc) reverse polarity (rp) for GMA and SAW, and dc straight polarity (sp) for GTA.
- 3/ Argon plus 2 percent oxygen (GMA) or argon (GTA).
- 4/ Argon plus 2 percent oxygen (GMA), carbon dioxide (GMA), or argon (GTA).
- 5/ Carbon dioxide (GMA) or argon (GTA).
- 6/ Guided bend test specimens shall be as specified in AWS B4.0. The specimens shall have no cracks on the convex surface. Tears less than 1/8 inch on the corner of the bend specimen are acceptable.
- 7/ The yield strength of 70S-6 shall be 55-80,000 pounds per square inch (lb/in²).
- 8/ GMA shall be used for welding with electrode sizes under 3/32 inch and SAW shall be used for welding with electrode sizes 3/32 inch and larger.
- 9/ 70S-F is a qualified flux (see 3.2.3 and 4.2.3).

TABLE IV. Weld metal properties for stress relieved specimens cooled at 200 degrees Fahrenheit (°F) per hour (see 3.4.1 and 3.4.1.1).

MIL-type <u>5/</u>	70S-1, -2, -3, -4, -5, -6 and 70S-F ^{<u>3/</u>}
Shielding gas	<u>1/</u>
Ultimate tensile strength, minimum lb/in ²	70,000
Yield strength, minimum lb/in ²	52,000
Percent elongation in 2 inches, minimum	26
Average Charpy V-notch impact energy, minimum ft-lb <u>2/</u>	20 at minus 20°F <u>4/</u>

- 1/ The shielding gases used in GMA and GTA welding shall be as specified in the footnotes to table III using dcrp or dcsp, respectively.
- 2/ Individual impact test results shall be reported. The test results used in determining each average (average of five observations minimum) Charpy V-notch impact energy value shall contain no more than one observation below the value specified in table IV and that observation shall be not more than 5 foot-pounds (ft-lb) below the value specified in table IV.
- 3/ 70S-F is a qualified flux (see 4.2.3).
- 4/ Except 70S-5 which shall be tested at 0°F.
- 5/ GMA shall be used for welding with electrode sizes under 3/32 inch and SAW shall be used for welding with electrode sizes 3/32 inch and larger.

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TABLE V. Weld metal properties for stress relieved specimens cooled at 10°F per hour (see 3.4.1 and 3.4.1.1).

Electrode MIL-type	70S-7, -8, -9	70S-1, -2, -3, -4, -5, -6
Flux	1/, 3/ 70,000	1/, 3/ 70,000
Ultimate tensile strength, minimum lb/in ²	38,000	38,000
Yield strength, minimum lb/in ²	22	26
Percent elongation in 2 inches, minimum	15 at 10°F	20 at minus 20°F ^{5/}
Average Charpy V-notch impact energy minimum ft-lb ^{2/}		

- ^{1/} Unless otherwise specified (see 6.2), type MIL-70S-F flux shall be used to achieve the required mechanical properties, using the SAW process with dcrp. This will qualify the particular electrode-flux combination.
- ^{2/} Individual impact test results shall be reported. The test results used in determining each average (average of five observations minimum) Charpy V-notch impact energy value shall contain no more than one observation below the value specified in table V and that observation shall be not more than 5 foot-pounds (ft-lb) below the value specified in table V.
- ^{3/} The shielding gases used in GMA and GTA welding shall be as specified in the footnotes to table III using dcrp or dcsp, respectively.
- ^{4/} Except the minimum average Charpy energy for 70S-8 and 70S-9 shall be 25 and 30 ft-lb, respectively.
- ^{5/} Except 70S-5 which shall be tested at 0°F.

3.4.1 Stress relief. General requirements for stress relief shall be in accordance with MIL-STD-278. Holding temperatures, time at holding temperature, and cooling rates shall be as specified in 3.4.1.1 or 3.4.1.2, as applicable.

3.4.1.1 Stress relief (200°F per hour cooling rate). Weldments shall be stress relieved at 1125 + 25°F, held at temperature for 2 hours minimum, and furnace cooled at a maximum rate of 200°F per hour from the stress relief (holding) temperature to 500°F.

3.4.1.2 Stress relief (10°F per hour cooling rate). Weldments shall be stress relieved at 1125 + 25°F for one of the following time periods as specified (see 6.2): (a) 50 hours minimum or greater, or (b) held at temperature for 1 hour per inch of weld thickness (for weld thicknesses less than 1 inch the minimum holding time shall be proportional to the weld thickness but shall be not less than 30 minutes). The test plates treated by either method (a) or (b) shall be cooled at a maximum rate of 10°F per hour from the stress relief (holding) temperature to 600°F.

3.5 Slag removal. The slag deposited during SAW welding shall be capable of being readily removed from weld deposits with hand tools (not air or power operated).

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4. QUALITY ASSURANCE PROVISIONS

4.1 The quality assurance provisions shall be as specified in MIL-E-23765 and as specified herein.

4.2 Qualification tests. Qualification tests shall be in accordance with table VI. The test sample of electrodes or flux selected in accordance with 4.3.2 of MIL-E-23765 shall be used for these tests.

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TABLE VI. Summary of tests required for qualification.

MIL-types	Form	Tests required for qualification								Test procedure	Requirements	
		Cast	Helix	Chemical	Wall number	Radio- graphy	Tensile ^{1/}	Bend	Impact			
All electrodes	3b or 3d	X	X								4.7.4 of MIL-E-23765	3.6.4 of MIL-E-23765 Table I herein
				X							4.7.3 of MIL-E-23765	
						X					4.7.2.1 of MIL-E-23765	
70S-1 70S-2 70S-3 70S-4 70S-5 70S-6	3b or 3d							X			Figure 1 herein and 4.7.2.2 of MIL-E-23765	For the as-welded condition - table III herein
							X		X	Figure 2 herein and 4.7.2.2 of MIL-E-23765	For the stress relieved condition (200°F per hour, cooling), table IV herein	
						X			X	Figure 2 herein and 4.7.2.2 of MIL-E-23765		
70S-7 70S-8 70S-9	3d								X		Figure 2 herein and 4.7.2.2 of MIL-E-23765	For the stress relieved condition (10°F per hour, cooling), table V herein
									X		4.2.3.2 herein	
										X	Figure 1 herein and 4.7.2.1 of MIL-E-23765	
70S-F (flux)	3d									X	Figure 1 herein and 4.7.2.2 of MIL-E-23765	For the as-welded condition - table III herein
							X				Figure 1 herein and 4.7.2.2 of MIL-E-23765	

1/ Includes ultimate tensile strength, 0.2 percent of offset yield strength and percent elongation in 2 inches.

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4.2.1 MIL-70S-1, -2, -3, -4, -5, and -6. MIL-70S-1, -2, -3, -4, -5, and -6 electrodes shall be deposited in the flat position. The 1/16-inch size shall be deposited by using the GMA welding process. The 1/8-inch size shall be deposited by using the SAW process and a MIL-70S-F qualified granular neutral flux. These tests are conducted to qualify electrode sizes under 3/32 inch for the GMA welding process or electrode sizes 3/32 inch and larger for the SAW process. The shielding gas shall be in accordance with table III except that an argon plus 2 percent oxygen weldment and a carbon dioxide weldment shall be made for MIL-type 70S-2, 70S-3, 70S-4, and 70S-6. Weldments shall be tested in the as-welded and stress relieved condition. (Stress relief shall be in accordance with 3.4.1 and 3.4.1.1.)

4.2.2 MIL-S-70S-7, -8, and -9. MIL-70S-7, -8, and -9 electrodes shall be deposited by the SAW process. Weldments shall be tested in the 50-hour minimum stress relieved condition only. The stress relief temperature and cooling rate from the stress relief temperature to 600°F shall be in accordance with 3.4.1 and 3.4.1.2.

4.2.3 MIL-70S-F. MIL-70S-F flux shall be used in combination with 1/8-inch size electrode types MIL-70S-2, -3, -4, or -6 to deposit weld metal by the SAW process. Weldments shall be tested in the as-welded and stress relieved condition. (Stress relief shall be in accordance with 3.4.1 and 3.4.1.1.)

4.2.3.1 Prior to welding the test plates for flux qualification, the Wall neutrality number N shall be determined in accordance with 4.2.3.2.

4.2.3.2 Determination of the Wall neutrality number N shall be in accordance with the following:

- (a) Weld test pad (minimum size - 1 inch wide by 4 inches long by 5/8 inch high) shall be prepared on a steel test plate in accordance with MIL-S-24238 using the SAW process with the flux to be tested in combination with a 1/8-inch diameter electrode (type MIL-70S-1, -2, -3, -4, -5, or -6). Welding parameters shall be as follows:

Electrode stickout	- 1 to 1-1/2 inches
Welding current	- 500 \pm 10 amperes, dcrp
Arc voltage	- 28 \pm 1 volts
Travel speed	- 15 \pm 1 inches per minute
Interpass temperature	- 300°F maximum.

- (b) A second weld test pad shall be made using the same parameters except that the arc voltage shall be increased to 36 \pm 1 volts.

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- (c) The top surfaces of the weld pads shall be ground or machined to clean metal. Then samples sufficient for analysis shall be removed by machining. No weld metal shall be removed within 1/2 inch of the base plate. The samples shall be chemically analyzed for silicon and manganese. Chemical analysis methods shall be in accordance with FED-STD-151. The Wall neutrality number N shall be calculated by the following formula. The absolute values of the change in silicon and manganese levels shall be used.

$$N = 100 [|\Delta Si| + |\Delta Mn|]$$

In addition, the chemical samples taken shall each be analyzed for all of the other elements specified in table I and complete analysis for each shall be reported.

4.3 Quality conformance inspection. Electrodes and rods selected in accordance with 4.5.5, 4.5.5.1 and 4.5.5.2 of MIL-E-23765 shall be used for the tests specified in table VII. Unless otherwise specified (see 6.2), electrode types MIL-70S-1, -2, -3, -4, -5, and -6 shall be deposited in the flat position using the GMA welding process for electrode sizes under 3/32 inch and the SAW process for electrode sizes 3/32 inch and larger. The shielding gas shall be in accordance with table III and as specified (see 6.2) and type 70S-F flux for SAW. The specimens shall be tested in the as-welded condition. Unless otherwise specified (see 6.2), electrode types MIL-70S-7, -8, and -9 shall be deposited in the flat position using the SAW process and type MIL-70S-F flux. The test specimen coupons of the weldment shall be stress relieved in accordance with 3.4.1 and 3.4.1.2 prior to testing. When specified (see 6.2), the holding time at temperature for the treatment shall be in accordance with 3.4.1.2(a). Unless otherwise specified (see 6.2), the holding time at temperature for the treatment shall be in accordance with 3.4.1.2(b). When specified (see 6.2), electrode types MIL-70S-1, -2, -3, -4, -5, and -6 shall be tested in the stress relieved condition in accordance with 3.4.1 and 3.4.1.2, and the holding time at temperature for the treatment shall be in accordance with 3.4.1.2(a) or (b).

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TABLE VII. Summary of tests required for quality conformance inspection.

MIL- types	Form Size	Quality conformance inspection						Test procedure	Requirements
		Cast	Helix	Chemical	Radio- graphy	Tensile ^{1/}	Alloy identity		
All ^{3/} electrodes and rods	All All	X	X					4.7.4 of MIL-E-23765	3.6.4 of MIL-E-23765
				X				4.7.3 of MIL-E-23765	Table I herein
					X			<u>2/</u> 4.7.2.1 of MIL-E-23765	3.5.4 of MIL-E-23765
70S-F flux	NA NA					X		<u>2/</u> 4.7.2.2 of MIL-E-23765	Table III, IV or V herein
							X	4.7.5 of MIL-E-23765	3.5.5 of MIL-E-23765
					X			<u>2/</u> 4.7.2.1 of MIL-E-23765	3.5.4 of MIL-E-23765
							X	<u>2/</u> 4.7.2.2 of MIL-E-23765	Table III herein

1/ Includes ultimate tensile strength, 0.2 percent offset yield strength and percent elongation in 2 inches.

2/ Welds shall be prepared in accordance with figure 1 when tests are to be conducted in the as-welded condition, and in accordance with figure 2 when tests are to be conducted in the stress relieved condition.

3/ When a heat of metal is processed into electrodes and rods, weld tests shall be required only with electrodes.

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4.4 Base metal. The base metal steel used for the tests required herein shall be in accordance with one of the following or equivalent, as specified (see 6.2):

- (a) Grade B steel of MIL-S-22698.
- (b) Composition C of MIL-S-23194 or MIL-S-24238.
- (c) Grade 70 of ASTM A 516.
- (d) Grade C of ASTM A 285.

4.5 Certification of quality conformance. A certification of quality conformance shall be furnished with each lot of material offered for acceptance. The certification shall include quantitative results of specified chemical and mechanical tests, and qualitative results of nondestructive tests on the lot.

4.5.1 The minimum certification data required shall be as listed on figure 3 and may be submitted in the format shown. The certification shall include the parameters used in welding the test plate and shall identify the flux used in test plates welded with the SAW process.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Packaging of electrodes. Packaging of electrodes shall be as specified in MIL-E-23765.

5.2 Packing of flux.

5.2.1 Packing. Packing shall be level A or C as specified (see 6.2).

5.2.1.1 Level A. Welding flux shall be packed in bags or drums as specified (see 6.2).

5.2.1.1.1 Drums. Drums shall conform to type II or III, grade A of PPP-D-723.

5.2.1.1.2 Bags. Bags shall be of a waterproof type and shall be in accordance with UU-S-48 (extensible heavy duty shipping sack kraft paper).

5.2.1.2 Palletization. When specified (see 6.2), bags and drums shall be palletized for shipment in accordance with MIL-STD-147.

5.2.1.3 Level C. Welding flux shall be packed in containers in a manner to ensure safe delivery and acceptance at destination. Containers shall comply with the Uniform Freight Classification Rules or other carrier regulations applicable to the mode of transportation.

5.2.2 Marking. Flux containers shall be marked as specified in MIL-E-23765.

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5.2.3 Use of polystyrene (loose-fill) material.

5.2.3.1 For domestic shipment and early use and level C packing. Unless otherwise approved by the contracting activity (see 6.2), use of polystyrene (loose-fill) material for domestic shipment and early use and level C packing applications such as cushioning, filler and dunnage shall be prohibited. When approved, exterior containers shall be marked and labelled as follows:

"CAUTION

Contents cushioned, etc., with polystyrene (loose-fill) material,
Not to be taken aboard ship.
Remove and discard loose-fill material before shipboard storage.
If required, recushion with cellulosic material."

5.2.3.2 For level A packing. Use of polystyrene (loose-fill) material is prohibited for level A packing applications such as cushioning, filler and dunnage.

6. NOTES

6.1 Intended use.

6.1.1 General. This specification covers the welding materials described in 6.1.1.1 through 6.1.1.11 which, when deposited on the applicable base metals specified in 4.4, will meet the mechanical properties specified herein for the different welding processes and conditions.

6.1.1.1 Type MIL-70S-1. Type MIL-70S-1 electrode is primarily used for multiple pass welding killed steel.

6.1.1.2 Type MIL-70S-2. Type MIL-70S-2 electrode contains aluminum, zirconium, and titanium in addition to the silicon and manganese content. This electrode is particularly adapted to producing sound welds in semi-killed and rimmed steels as well as killed steels.

6.1.1.3 Type MIL-70S-3. Type MIL-70S-3 electrode has a higher silicon content than type MIL-70S-1. This electrode can be used to make multiple pass welds in semi-killed and killed steels.

6.1.1.4 Type MIL-70S-4. Type MIL-70S-4 electrode has a higher silicon content than type MIL-70S-3. This electrode is used where welding application requires a higher arc voltage or conditions require more deoxidization than type MIL-70S-3.

6.1.1.5 Type MIL-70S-5. Type MIL-70S-5 electrode contains manganese, silicon, and aluminum. This electrode should be used only for structural work when exceptional deoxidization of weld metal is required.

6.1.1.6 Type MIL-70S-6. Type MIL-70S-6 electrode contains a high manganese and silicon content and produces welds with high impact properties.

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6.1.1.7 Type MIL-70S-7. Type MIL-70S-7 electrode contains a high manganese mild steel composition which is capable of attaining table V properties when deposited by the SAW process.

6.1.1.8 Type MIL-70S-8. Type MIL-70S-8 electrode is an intermediate manganese-molybdenum composition which is used in SAW welding of mild steel.

6.1.1.9 Type MIL-70S-9. Type MIL-70S-9 electrode is a high manganese-molybdenum composition for SAW welding which retains the highest mechanical properties after stress relief.

6.1.1.10 Special MIL-type with suffix RC. Restricted copper electrodes and rods will be used when specified in 6.2 (see table I).

6.1.1.11 Type MIL-70S-F. Type MIL-70S-F is a neutral granular flux intended for submerged arc welding with the type MIL-70S series electrodes.

6.2 Ordering data. Acquisition documents should specify the following in addition to the ordering data required in MIL-E-23765.

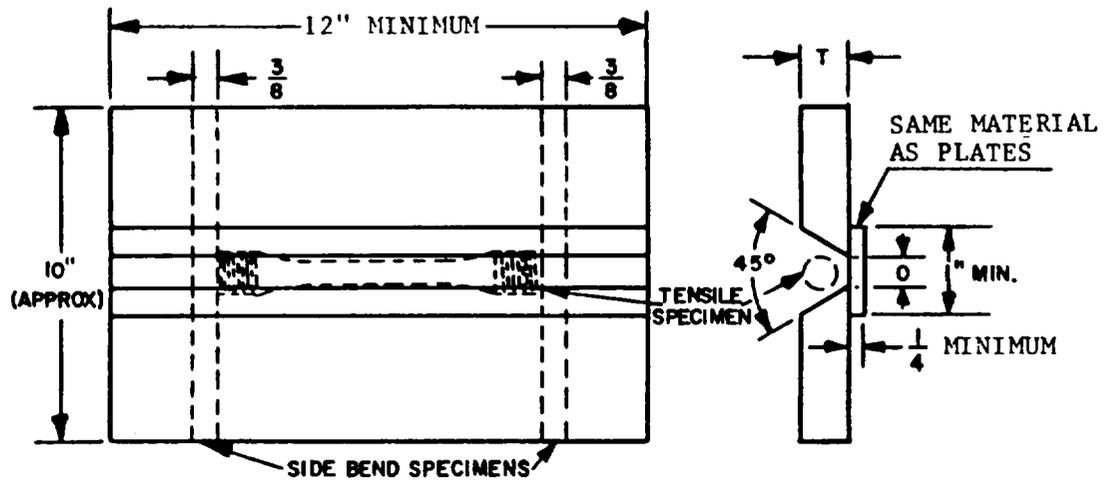
- (a) Whether the copper and phosphorus content should be restricted (see footnote ^{2/} of table I and 6.1.1.10).
- (b) If mechanical properties of weld metal as-deposited are other than as specified (see 3.4).
- (c) If neutral granular flux is to be used other than as specified (see footnote ^{1/} of table V).
- (d) For electrode types MIL-70S-7, -8, and -9, whether the holding time at temperature for the stress relief treatment should be in accordance with 3.4.1.2(a) (see 4.3).
- (e) For electrode types MIL-70S-1, -2, -3, -4, -5, and -6, whether the tests shall be conducted in the stress relieved condition in accordance with 3.4.1 and 3.4.1.2 and if so whether the holding time at temperature should be in accordance with 3.4.1.2(a) or 3.4.1.2(b) (see 4.3).
- (f) Whether SAW in combination with any neutral granular flux or GMA welding process should be used with item (e) above (see 4.3).
- (g) Whether only the argon plus 2 percent oxygen weld test or only the carbon dioxide weld test is required for 70S-2, 70S-3, 70S-4, and 70S-6 (see 4.3).
- (h) Other base metal steel for use in tests, if required (see 4.4 and figures 1 and 2).
- (i) Level of packing required (see 5.2.1).
- (j) For level A packing, if bags or drums are required (see 5.2.1.1).
- (k) If required, whether bags or drums should be palletized for shipment (see 5.2.1.2).
- (l) If use of polystyrene (loose-fill) material is required (see 5.2.3.1).

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6.3 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-N569)

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SH 5986A

TABLE VIII. Weld test details.

Form	Types	T (inch)	O (inch)
All	All	3/4	1/2

FIGURE 1. Weld joint for soundness and for mechanical tests in the as-welded condition.

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Notes to figure 1:

1. Unless otherwise specified (see 6.2), base plate shall be selected in accordance with 4.4.
2. Assembly shall be at room temperature at start of welding. The interpass temperature shall be $300 \pm 25^{\circ}\text{F}$ until welding is completed. Should welding be interrupted, the assembly shall be allowed to cool in still air at room temperature, and prior to resumption of welding the assembly shall be reheated to the interpass temperature ($300 \pm 25^{\circ}\text{F}$).
3. Welding currents and pass sequence shall be in accordance with sound welding practices, and as recommended by the manufacturer.
4. Shielding gas shall be argon for GTA welding and argon plus 2 percent oxygen or carbon dioxide for the GMA process. The argon oxygen and carbon dioxide used for this test shall be in accordance with MIL-A-18455, BB-O-925 and BB-C-101 grade B, type 1, respectively. Type MIL-70S-F flux shall be used for SAW.
5. After completion of the weld, it shall be allowed to cool, the backing strip shall be removed, and the weld radiographed as specified in MIL-E-23765. The weld shall be cut as shown resulting in a tensile coupon suitable for 0.505 inch diameter specimens for quality conformance testing. When qualification tests are being conducted, the weld shall be cut as shown to yield the two side bend coupons also. No base metal shall be removed within 1/2 inch of the edges of the face of the weld by flame cutting. Only sawing or machining shall be used.
6. The tensile coupon shall be machined into a 0.505 tensile specimen and the two side bend specimens prepared and tested as specified in MIL-E-23765.

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Notes to figure 2:

1. Unless otherwise specified (see 6.2), base plate shall be selected in accordance with 4.4.
2. Assembly shall be at room temperature at start of welding. The interpass temperature shall be controlled within $300 \pm 25^{\circ}\text{F}$ until welding is completed. Should welding be interrupted, the assembly shall be allowed to cool in still air at room temperature, and prior to resumption of welding the assembly shall be reheated to the interpass temperature ($300 \pm 25^{\circ}\text{F}$).
3. Welding currents and pass sequence shall be in accordance with sound welding practices, and as recommended by the manufacturer.
4. Shielding gas shall be argon for the GTA process and argon plus 2 percent oxygen or carbon dioxide for the GMA process. The argon, oxygen and carbon dioxide gases used for this test shall be in accordance with MIL-A-18455, BB-O-925 and BB-C-101 grade B, type 1, respectively. Use type MIL-70S-F flux for SAW when tests are to be conducted in the as-welded or the stress relieved condition in accordance with 3.4.1.1. Use any neutral granular flux for SAW when tests are to be conducted in the stress relieved condition in accordance with 3.4.1.2.
5. After completion of the weld, it shall be allowed to cool, the backing strip shall be removed, and the weld radiographed as specified in MIL-E-23765. The weld shall be cut as shown resulting in a tensile coupon suitable for 0.505 inch diameter specimen, and for qualification testing only a coupon of size sufficient for five Charpy V-notch specimens. No base metal shall be removed within 1/2 inch of the edges of the face of the weld by flame cutting. Only sawing or machining shall be used.
6. The tensile coupon, prior to machining, shall be stress relieved in accordance with 3.4.1.1 or 3.4.1.2, as applicable.
7. The stress-relieved coupon shall be machined into a 0.505 inch tensile specimen and tested as specified in MIL-E-23765.
8. Prior to machining specimens, the Charpy V-notch impact coupon, when required, shall be subjected to the same heat treatment applied to the tensile coupon in note 6. Five Charpy V-notch specimens shall be machined to dimensions as specified in FED-STD-151. The notch shall be normal to the plate surface.
9. Impact properties for the five specimens shall be obtained at test temperatures specified in table IV herein plus or minus 3°F .

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1. Manufacturer or distributor _____

2. Address _____
3. Mill order no. _____
4. Customer _____
5. Customer order no. _____
6. Identification:
- Specification MIL-_____ Type _____
- Condition _____ Deposition process _____
(as-welded, stress relieved)
- Form _____ Size _____ Coating (see 3.2) _____
- Lot no. _____ Heat _____ Melter^{1/} _____
7. Alloy identity check: in process splice _____
at spooling _____
8. Chemical analysis:
- Carbon _____
Manganese _____
Silicon _____
Phosphorus _____
Sulphur _____
9. Mechanical properties:
- Ultimate tensile strength _____
Yield strength _____
Elongation _____
Charpy impact _____
Bend _____
10. Cast _____
11. Helix _____
12. Radiography _____
13. We hereby certify that the above material has been inspected and tested in accordance with the listed specification and is in conformance with all requirements.
- Signature of responsible company official _____
- Date _____

Those items not applicable to the particular MIL-type shall be marked "NA".

^{1/} See 4.6.3 of MIL-E-23765

FIGURE 3. Certification of quality conformance.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-R-23765/1E(SH)	2. DOCUMENT TITLE
3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION <i>(Mark one)</i> <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER <i>(Specify):</i> _____
b. ADDRESS <i>(Street, City, State, ZIP Code)</i>	
5. PROBLEM AREAS	
a. Paragraph Number and Wording:	
b. Recommended Wording:	
c. Reason/Rationale for Recommendation:	
6. REMARKS	
7a. NAME OF SUBMITTER <i>(Last, First, MI) - Optional</i>	b. WORK TELEPHONE NUMBER <i>(Include Area Code) - Optional</i>
c. MAILING ADDRESS <i>(Street, City, State, ZIP Code) - Optional</i>	8. DATE OF SUBMISSION <i>(YYMMDD)</i>

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)