MIL-E-23765/2D(SH)
18 August 1987
SUPERSEDING
MIL-E-23765/2C(SH)
17 June 1983
(See 6.4)

MILITARY SPECIFICATION

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

This specification is approved for use within 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 low alloy steel solid bare welding electrodes, alloy cored bare welding electrodes and cut-length rods for use with gas metal-arc (GMA) and gas tungsten-arc (GTA) welding processes. This specification also covers low alloy steel solid or alloy cored bare welding electrodes for use with submerged-arc welding (SAW) processes employing a neutral granular flux, or for use with GMA processes.

1.2 Classification.

1.2.1 Electrode and rod types, forms and sizes. Electrodes and rods shall be provided in the types specified in table I in forms 3a, 3b, 3c, 3d, 3e, 4, and 6 with sizes as specified in MIL-E-23765 and table II herein.

1.2.2 Neutral granular flux types. Neutral granular flux for as-welded or stress relieved SAW applications shall be provided in the types qualified (see 3.2.3).

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 55Z3, 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.

AMSC N/A FSC 3439

TABLE I. Electrode type designation and chemical composition.

Chemical composition (percentage)[3]													
MIL-type[1] (with suffix RC)[2] (with suffix C)[4]	Process	Carbon	Manganese	Silicon	Phosphorus	Sulfur	Nickel	Molybdenum	Chromium	Vanadium	Aluminum	Titanium	Zirconium
80S-1	SAW	0.10-0.15	1.75-2.40	0.10	0.025	0.020	0.55-1.10	0.35-0.55	0.15	0.03	0.07	----	----
80S-2	SAW	.10- .17	1.70-2.20	.05	.025	.020	.15	.45- .60	.15	.03	.07	----	----
80S-3	GMA GTA	.07- .12	1.60-2.10	.50-.80	.025	.020	.15	.40- .60	.15	.03	.02	----	----
100S-1	All	.08	1.25-1.80	.20-.55	.012	.008	1.40-2.10	.25- .55	.30	.05	.10	0.10	0.10
100S-2	All	.08	1.25-1.80	.20-.55	.012	.008	1.40-2.10	.25- .55	.30	.05	.10	.10	.10
120S-1	All	.13	1.40-2.35	.25-.60	.012	.008	1.00-2.80	.30- .60	.60	.03	.10	.10	.10
120S-2	All	.13	1.40-2.35	.25-.65	.012	.008	1.00-2.80	.30- .60	.60	.03	.10	.10	.10

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, the sampling plan for chemical analysis shall be in accordance with MIL-E-23765.

2/ Addition of the suffix RC to any basic MIL-type designation, for example, MIL-type 100S-1RC, indicates a special MIL-type of electrode or rod which is not copper coated and for which the copper is 0.10 percent maximum. 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/ Alloy cored electrodes are designated by the suffix C.

5/ For MIL-120S-1 only, the molybdenum content can be up to 0.95 percent provided the chromium content does not exceed 0.30 percent.

TABLE II. Electrode form, size, and weight.

Form	Electrode diameter (inches)	Weight 1/ (pounds)
3a	All	1-1/2 and 2-1/2
3b	All	10 or 15
3b	All	25, 30, 35 or 44
3c	All	25, 50, or 60
3d	All	60 or 65
3e	All	150 or 200
4	All	750 or less
6	All	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. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

BB-O-925 - Oxygen, Technical, Gas and Liquid.

MILITARY

MIL-S-16216 - Steel Plate, Alloy, Structural, High Yield Strength (HY-80 and HY-100).
MIL-A-18455 - Argon, Technical.
MIL-S-23194 - Steel Forgings, Carbon and Low Alloy.
MIL-E-23765 - Electrodes and Rods - Welding, Bare, Solid and Alloyed Cored, General Specification for.
MIL-S-24238 - Steel Plate, Carbon and Low Alloy.
MIL-S-24645 - Steel Plate, Sheet, or Coil Age-Hardening Alloy, Structural, High Yield Strength (HSLA-80).

STANDARDS

FEDERAL

FED-STD-151 - Metals; Test Methods.

MILITARY

MIL-STD-147 - Palletized Unit Loads.
MIL-STD-271 - Requirements for Nondestructive Testing Methods.
MIL-STD-2149 - Standard Procedures for Explosion Testing Ferrous and Non-Ferrous Metallic Materials and Weldments.

2.1.2 Other Government publications. The following other Government publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

0900-LP-003-8000 - Metals, Surface Inspection Acceptance Standards.
0900-LP-003-9000 - Radiographic Standards for Production and Repair Welds.

(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 activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 302 - Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum Nickel. (DoD adopted)
A 508 - Standard Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels. (DoD adopted)
A 533 - Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel. (DoD adopted)
A 710 - Standard Specification for Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Columbium Alloy Steels.
E 83 - Standard Practice for Verification and Classification of Extensometers. (DoD adopted)

ASTM - Continued
E 604 - Standard Test Method for Dynamic Tear Testing of Metallic Materials. (DoD adopted)
E 1010 - Standard Practice for Preparation of Disk Specimens of Steel and Iron for Spectrochemical Analysis by Remelting.

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

AMERICAN WELDING SOCIETY (AWS)
A4.3 - Procedures for Determination of Diffusible Hydrogen Content of Martensitic, Bainitic and Ferritic Weld Metal Produced by Arc-Welding.
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 Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which 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 specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Electrodes and rods provided under this specification shall be in accordance with MIL-E-23765 and as specified herein. Neutral granular flux provided under this specification shall be in accordance with the requirements specified herein.

3.2 MIL-types.

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 and smaller may be coated with other types of rust preventatives provided such coatings do not impair usability 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 usability of the electrodes or rods or the quality and soundness of the weld metal deposits.

3.2.3 MIL-type with suffix F. For as-welded or stress relieved applications, 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-100S-1F).

3.2.4 Special MIL-120 types with suffix X. MIL-120 electrodes, rods or alloy cored electrodes qualified using alternating current (ac) (see footnote 1 of table III) shall be designated by the suffix X.

3.2.5 Special MIL-100 and MIL-120 types with suffix SR. MIL-100 and MIL-120 electrodes, rods or alloy cored electrodes tested in the stress relieved condition (see 3.4.1) shall be designated with the suffix SR.

3.3 Chemical composition. Chemical composition of unwelded electrodes and rods and weld metal deposited in an inert atmosphere using the GTAW process by alloy cored electrodes shall be in accordance with table I.

3.4 Mechanical properties. The mechanical properties of weld metal in the as-welded condition shall be in accordance with table III. The mechanical properties of weld metal in the stress relieved condition shall be in accordance with table IV.

TABLE III. Mechanical properties for as-welded SAW, GMA and GTA welds. 1/ 12/

MIL-type 13/ (with suffix C)	Heat input	Yield strength 2/ (lb/in^2)	Elongation in 2 inches minimum (percent)	Transverse bend	Impact 3/				Explosion bulge
					Charpy V-notch		Dynamic tear 4/		
					Energy ft-lb minimum average	Temperature °F	Energy ft-lb minimum average	Temperature °F	
100S-1 100S-1F	5/	82,000 to 110,000	16	6/	7/ 35 7/ 60	Minus 60 0	8/ 300 9/ 450	Minus 20 30	10/
100S-2 100S-2F	5/	82,000 to 97,000	16	6/	7/ 35 7/ 60	Minus 60 0	8/ 300 9/ 450	Minus 20 30	10/
120S-1 120S-1F	11/	102,000 to 122,000	14	6/	7/ 45 7/ 60	Minus 60 0	8/ 400 9/ 575	Minus 20 30	10/
120S-2 120S-2F		102,000 to 117,000							

1/ The ultimate tensile strength and percentage reduction of area shall be recorded for information only. The electrode type shall be tested using direct current (dc) reverse polarity for GMA and as-welded SAW and dc straight polarity for GTA. For MIL-120 types only, testing may be performed using ac and supplied with the suffix X.

2/ The yield strength shall be measured at 0.2 percent offset by using a class B extensometer in accordance with ASTM E 83, or better.

3/ Requirements of both Charpy V-notch and dynamic tear shall be met for qualification testing and either of the two tests for quality conformance testing. Percent shear fracture shall be reported.

4/ Requirements for 5/8-inch dynamic tear test shall be in accordance with ASTM E 604.

5/ The test assembly welding heat input for each lot of material being tested shall be:

(a) One test assembly at 110,000 joules per inch minimum for quality conformance inspection.
(b) One test assembly at 55,000 to 65,000 joules per inch and another test assembly at 110,000 joules per inch minimum for schedule A qualification testing.
(c) One test assembly at 110,000 joules per inch minimum for schedule B qualification testing. Any appropriate welding heat input shall be used for the root layer and minor repair deposited by the GMA, GTA and SAW processes.

6/ Transverse side bend specimens shall be tested as specified in AWS B4.0. The specimens after bending shall have no cracks or other indications greater than 1/8 inch in any direction on a convex surface. Tears less than 1/8 inch on the corner of the bend specimen are acceptable.

7/ The average value of five tests shall be equal to or greater than the minimum average value specified. No two specimens shall have values below the minimum average specified. One specimen can have value of 10 foot-pounds below the minimum average specified.

8/ The average value of two tests shall be equal to or greater than the minimum average value specified. One specimen can have a value of 50 foot-pounds below the minimum average specified.

9/ The average value of two tests shall be equal to or greater than the minimum average value specified. One specimen can have a value of 25 foot-pounds below the minimum average specified.

10/ The tests shall be conducted at zero degrees Fahrenheit (°F) in accordance with MIL-STD-2149 and in accordance with the following. Two crack starter tests shall be conducted. The four bulge tests shall be conducted only when required by NAVSEA. Performance is considered satisfactory provided the following conditions are met:

(a) Crack starter.

First shot:
Crack starter bead must crack.
Percent reduction in thickness obtained for information only.
No piece shall be thrown out of material being tested.
No through-thickness cracks shall be present.
No cracks shall extend into hold-down area (see note).

Second shot:
Percent reduction in thickness obtained for information only.
No piece shall be thrown out of material being tested.
Through-thickness cracks are acceptable.
No cracks shall extend into hold-down area (see note).

(b) Bulge.

First shot:
Percent reduction in thickness obtained for information only.
No piece shall be thrown out of material being tested.
No through-thickness cracks shall be present.
No cracks shall extend into hold-down area (see note).

Second shot:
Percent reduction in thickness obtained for information, 3 percent reduction per shot is expected.
No piece shall be thrown out of material being tested.
No through-thickness cracks shall be present.
No cracks shall extend into hold-down area (see note).

(c) Additional shots: Shots shall continue until a minimum of 10 percent reduction in thickness is obtained on one or both plates or either side of the weld. The performance is considered satisfactory provided the following conditions are met:

No piece shall be thrown out of material being tested.
Through-thickness cracks are acceptable.
No cracks shall extend into hold-down area (see note).
Shots shall be discontinued when cracks go into the hold-down area, a through-thickness crack occurs, or if the reduction in thickness requirements are met.

NOTE: The bulge area is defined as that plate over the diehole (9-inch radius) plus the rounded outside corners (3-inch radius) plus 1/2 inch for a total circle diameter of 25 inches. The hold-down area is defined as the area outside of this circle.

11/ The test assembly welding heat input for each lot of material being qualification tested or quality conformance inspected shall be 55,000 to 65,000 joules per inch.
12/ All conformance retests shall be reported to the user, including original test results and explanation of the cause for retest.
13/ Alloy cored electrodes are designated by suffix C.

TABLE IV. Mechanical properties for stress relieved welds.4/

MIL-type5/	Ultimate tensile strength (minimum lb/in^2)	0.2 percent offset yield strength (minimum lb/in^2)	Percent elongation 1.4 or 2 inches (minimum)	Average Charpy V-notch impact energy (minimum ft-lb)1/ at 10°F	Guided bend
80S-1, 80S-1F, 80S-2, 80S-2F, and 80S-3	80,000	50,000	20	30	2/
100S-1 100S-2	90,000	80,000	18	35	2/
120S-1 120S-2	3/	3/	3/	3/	2/

See footnotes on next page.

1/ Individual impact test results shall be reported. The test results used in determining each average Charpy V-notch impact energy value shall contain no more than one observation below the value as specified in table IV and that observation shall not be more than 5 foot-pounds below the value indicated in accordance with table IV. Percent shear fracture shall be reported.
2/ Guided bend test specimens shall be tested as specified in AWS B4.0. The specimens after bending shall have no cracks or other indications greater than 1/8 inch in any direction on a convex surface. Tears less than 1/8 inch on the corner of the bend specimen are acceptable.
3/ The required mechanical properties after stress relief on 120S type weld metal shall be as specified (see 6.2). The electrode types shall be tested using dc reverse polarity or ac for SAW, and dc straight polarity for GTA.
4/ See 3.4.1.
5/ Alloy cored electrodes are designated by suffix C.

3.4.1 Stress relief. Type 80S weld metal test plates and, when specified (see 6.2), types 100S and 120S weld metal plates shall be stress relieved at 1125 ± 25°F for one of the following periods as specified (see 4.2 and 6.2): (a) for 50 hours minimum or greater as specified (see 6.2) 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 temperature to 600°F.

3.5 Soundness. Welds deposited with type 100S-1, 100S-2, 120S-1 and 120S-2 electrodes shall be in accordance with NAVSEA 0900-LP-003-8000 for magnetic particle inspection. Radiographs or welds deposited with all types of electrodes shall be in accordance with class I production welds as specified in NAVSEA 0900-LP-003-9000.

3.6 Diffusible hydrogen. The diffusible hydrogen levels in milliliters per 100 grams (mL/100 grams) of deposited weld metal shall not exceed the values specified in table V.

TABLE V. Diffusible hydrogen values.

MIL-type	Welding process	Maximum average	Maximum single value
100S-1 120S-1	GMA	4.0	4.8
100S-1 120S-1	SAW	6.0	7.2
100S-2 120S-2	GMA	2.0	2.8
100S-2 120S-2	SAW	3.0	3.8
100S-1F 120S-1F	SAW	6.0	7.2
100S-2F 120S-2F	SAW	3.0	3.8

3.7 Moisture content of MIL-100 and MIL-120 type fluxes. The total water content (both hygroscopic and absorbed) of MIL-100S-1F, MIL-100S-2F, MIL-120S-1F or MIL-120S-2F flux shall not exceed 0.15 percent by weight.

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 MIL-E-23765 shall be used for these tests.

TABLE VI. Summary of tests required for qualification.

Schedule	MIL-type 6/	Flux packaging	7/ Cast	7/ Helix	Chemical	Tests required for qualification								Test procedure	Requirements
						Diffusible hydrogen	Radiography	Nondestructive	Tensile	Bend	Impact		Explosion bulge		
											Charpy V-notch	Dynamic tear			
A	All electrodes		X	X										MIL-E-23765	MIL-E-23765
					X									4.8 herein	Table I herein
	1/80S-1 1/80S-2 2/80S-3						X							MIL-E-23765 and figures 1 and 2 herein 5/	MIL-E-23765
									X	X	X			MIL-E-23765 and figures 1 and 2 herein 5/	Table IV herein
	3/100S-1 3/100S-2 3/120S-1						X							MIL-E-23765 and figure 3 herein 5/	MIL-E-23765 MIL-E-23765
								X	X		X			MIL-E-23765 and figure 3 herein 5/	3.5 and table III herein
												X		5/Figure 3 herein and ASTM E 604	Table III herein
						X								4.6 herein	3.6 herein

See footnotes at end of table.

TABLE VI. Summary of tests required for qualification. - Continued

Schedule	MIL-types 6/	Flux packaging	7/ Cast	7/ Helix	Chemical	Tests required for qualification								Test procedure	Requirements
						Diffusible hydrogen	Radiography	Nondestructive	Tensile	Bend	Impact		Explosion bulge		
											Charpy V-notch	Dynamic tear			
B	3/100S-1 3/100S-2 3/120S-1 3/120S-2						X							MIL-E-23765 and figure 3 herein 5/	MIL-E-23765
													X	MIL-STD-2149, and 4.5 herein	Table III herein
								X	X	X	X			Figure 3 herein 5/ and MIL-E-23765	3.5 and table III herein
												X		Figure 3 herein 5/ and ASTM E 604	Table III herein
A	4/100S-1F 4/100S-2F 4/120S-1F 4/120S-2F						X							MIL-E-23765 and figure 3 herein 5/	MIL-E-23765
								X	X		X			MIL-E-23765 and figure 3 herein 5/	3.5 and table III herein
												X		Figure 3 herein 5/ and ASTM E 604	Table III herein

See footnotes at end of table.

TABLE VI. Summary of tests required for qualification. - Continued

Schedule	MIL-types 6/	Tests required for qualification												Test procedure	Requirements
		Flux packaging	7/ Cast	7/ Helix	Chemical	Diffusible hydrogen	Radiography	Nondestructive	Tensile	Bend	Impact: Charpy V-notch	Impact: Dynamic tear	Explosion bulge		
		X												4.2.3.1 and 4.7 herein	3.7 herein
						X								4.6 herein	3.6 herein
B	4/100S-1F 4/100S-2F 4/120S-1F 4/120S-2F						X							MIL-E-23765 and figure 3 herein 5/	MIL-E-23765
													X	MIL-STD-2149, and 4.5 herein	Table III herein
								X	X	X	X			MIL-E-23765 and figure 3 herein 5/	3.5 and table III herein
												X		Figure 4 herein 5/ and ASTM E 604	Table III herein

See footnotes at top of next page.

1/ Use SAW with a qualified electrode to qualify these neutral granular flux types for the stress relieved condition.
2/ Use GMA with a shielding gas to qualify this electrode type for the stress relieved condition.
3/ The electrode sizes and welding processes used for qualification testing shall be in accordance with 4.2.2 herein.
4/ Use SAW with a qualified electrode to qualify these neutral granular flux types for the as-welded condition.
5/ And notes applying thereto.
6/ Alloy cored electrodes are designated by suffix C. The brand name of flux used in Schedule A and B testing shall be specified in the qualification test reports.
7/ Not applicable to Form 6.

4.2.1 MIL-80S-1, MIL-80S-1F, MIL-80S-2, MIL-80S-2F and MIL-80S-3. MIL-80S-1 and MIL-80S-2 electrodes shall be deposited by the SAW process in combination with MIL-80S-1F or MIL-80S-2F flux respectively. MIL-80S-3 electrodes shall be deposited by the GMA or GTA welding process. Weldment shall be tested in the stress relieved condition in accordance with 3.4.1 for both the 50-hour and 1-hour holding times.

4.2.2 MIL-100S-1, MIL-100S-2, MIL-120S-1, and MIL-120S-2. For MIL-100S-1, MIL-100S-2, MIL-120S-1 and MIL-120S-2 electrodes welding parameters shall be in accordance with figure 3 and table VII as specified below. The welding position and welding process shall be according to the electrode size tested as follows:

TABLE VII. Welding parameters.

Qualification electrode size (inches)	Welding process	Position	Size range qualified (inches)
0.045	Pulsed-arc GMA	Vertical up	0.020 - 0.045
1/16	Spray-arc GMA	Flat	0.052 - 5/64
1/8	SAW	Flat	3/32 - 1/4

Qualification of each of the above sizes will qualify all of the electrodes in each of the size ranges specified above. Weldment shall be tested in the as-welded condition without any post weld soak.

4.2.3 MIL-100S-1F, MIL-100S-2F, MIL-120S-1F and MIL-120S-2F. MIL-100S-1F, MIL-100S-2F, MIL-120S-1F and MIL-120S-2F flux types shall be used in combination with a corresponding MIL-type electrode to deposit weld metal by the SAW process, and the weldments tested in the as-welded condition.

4.2.3.1 Sampling for qualification of flux packaging. The flux used to qualify flux packaging shall be from a lot sample package as defined in MIL-E-23765 and the following:

(a) The sample package shall be placed next to another package of the same type.
(b) The stack of packages shall be sprayed with water for not less than five minutes using a shower head attached to a garden hose. All exposed surfaces shall be wetted. The sample package shall be placed on top of the other package, wet side down.
(c) The stack shall be still air dried at room temperature for a period of seven days.
(d) All the flux from the sample package shall be mixed, then subdivided by successive quartering and by at least four passes through a riffle into the amount of flux required for the water content test of 4.7 herein. The flux water content shall meet the requirements of 3.7 herein.
(e) Any change in package material, type or method of construction shall be requalified. One retest is permitted. Results of both tests shall be reported.

4.3 Quality conformance inspection. Quality conformance inspection tests shall be performed in accordance with table VIII. The test samples of electrodes or rods selected in accordance with MIL-E-23765 shall be used for the tests specified in table VIII. The test sample of neutral granular flux selected in accordance with MIL-E-23765 shall be used for the tests specified in table VIII. When required, the stress relief treatment shall be in accordance with 3.4.1(a) or 3.4.1(b) as specified (see 6.2). Type 100S and 120S electrode lots meeting acceptance requirements in the stress relieved condition shall be identified with the suffix "SR".

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

MIL types (with suffix C)7/	Form 1/	Quality conformance tests										Test procedure	Requirements
		Cast	Helix	Chemical	Diffusible hydrogen	Radiography	Nondestructive	Tensile	Impact: Charpy V-notch	Impact: Dynamic tear	Alloy identity		
All electrodes	3a, 3b, 3c, 3d, 3e, 4	X	X									MIL-E-23765	MIL-E-23765
	All			X								7/ MIL-E-23765	Table I herein
											X	MIL-E-23765	MIL-E-23765
100S-1 100S-2 120S-1 120S-2	All				X							4.6 herein	3.6 herein
2/80S-1 2/80S-2 3/80S-3	All					X						MIL-E-23765 and figure 1 herein 6/	MIL-E-23765
								X				MIL-E-23765 and figure 1 herein 6/	Table IV herein
4/100S-1 4/100S-2 4/120S-1 4/120S-2	All					X						MIL-E-23765 and figure 3 herein 6/	MIL-E-23765
							X	X	X			Figure 3 herein 6/	3.5 and table III herein
										X		Figure 3 herein 6/ and ASTM E 604	Table III herein

See footnotes at end of table.

TABLE VIII. Summary of tests required for quality conformance inspection. - Continued

MIL types (with suffix C)7/	Form1/	Quality conformance tests										Test procedure	Requirements
		Cast	Helix	Chemical	Diffusible hydrogen	Radiography	Nondestructive	Tensile	Impact		Alloy identity		
									Charpy V-notch	Dynamic tear			
100S-1F 100S-2F 5/120S-1F 120S-2F	All					X						MIL-E-23765 and figure 3 herein 6/	MIL-E-23765
							X	X	X			Figure 3 herein 6/	3.5 and table III herein
										X		Figure 3 herein 6/ and ASTM E 604	Table III herein
					X							4.7 herein	3.6 herein

1/ When a heat of metal is processed into electrodes and rods, weld metal tests are required only with electrodes.
2/ Use SAW with qualified (by procedure qualification approval) MIL-80S-1F or MIL-80S-2F flux for quality conformance inspection of a lot of these qualified electrode types for the stress relieved condition.
3/ Use GMA for quality conformance inspection of a lot of these qualified electrode types for the stress relieved condition.
4/ Unless otherwise specified (see 6.2), a lot of electrodes shall be welded as specified in 4.3.1.2 herein and tested in the as-welded condition for quality conformance inspection.
5/ Use SAW with a qualified electrode for quality conformance inspection of a lot of these qualified neutral granular flux types. A lot of electrodes and a lot of qualified neutral granular flux can be quality conformance inspected by the same set of tests.
6/ And notes applying thereto.
7/ Alloy cored electrodes are designated by suffix C (see 4.3.2).

4.3.1 Bare solid electrodes.

4.3.1.1 Lot. For purposes of sampling and quality conformance inspection, a lot of electrodes or rods shall be the quantity of one size and type alloy produced as specified in MIL-E-23765.

4.3.1.2 Welding process. Unless otherwise specified (see 6.2), test weldments shall be made using the following welding processes according to electrode size:

Electrode size range inch	Welding process and position
0.020 through 0.045	Pulsed-arc GMA in vertical position
0.052 through 5/64	Spray-transfer GMA in flat position
3/32 through 1/4	SAW in flat position

4.3.2 Alloy cored electrodes.

4.3.2.1 Lot. For purposes of sampling and quality conformance inspection, a lot of alloy cored electrodes shall be the quantity of one size and type as specified in MIL-E-23765.

4.3.2.2 Welding process. Test weldments shall be made using the SAW process in the flat position using the same brand name flux as was used in qualification testing.

4.3.3 Flux.

4.3.3.1 Lot. For purposes of sampling and quality conformance, a lot shall be as defined in MIL-E-23765.

4.3.3.2 Welding process. Test weldments shall be made in combination with a corresponding MIL-type electrode using the SAW process in the flat position.

4.3.4 Lot sampling for diffusible hydrogen. Every lot of material offered for acceptance under this specification, except MIL-80 types, shall be tested for diffusible hydrogen content in accordance with 4.6 herein.

4.4 Base metal. Unless otherwise specified (see 6.2), the base metal steel used for the tests required herein shall be in accordance with table IX.

TABLE IX. Base metal requirements.

MIL-types 1/	Base metal
80S-1, 80S-2, or 80S-3	NiCr-Mo steel in accordance with MIL-S-23194, composition A, ASTM A 508, class 2, or equivalent, or Mn-Ni-Mo steel in accordance with MIL-S-24238, composition A, ASTM A 302, ASTM A 533, grade B or C, class 1, or equivalent
2/ 100S-1 100S-1F	3/ HY-80 steel in accordance with MIL-S-16216
2/ 100S-2 100S-2F	3/ HY-80 steel in accordance with MIL-S-16216 or HSLA-80 in accordance with MIL-S-24645 when specified (see 6.2).
120S-1 120S-1F 120S-2 120S-2F	3/ HY-100 steel in accordance with MIL-S-16216 or HSLA-100 in accordance with MIL-S-24645 when specified (see 6.2).

1/ For quality conformance testing in the stress relieved condition to the requirements as specified in table IV, other base metal steels may be specified (see 6.2).

2/ For quality conformance testing, if specified (see 6.2), MIL-S-24645 or ASTM A 710 grade A steel may be specified for a second test weldment in addition to the HY-80 steel test weldment required (see 6.2).

3/ These grades of steel are required (see figures 1 through 3) when dynamic tear tests are to be conducted. Steel in the as-rolled condition as specified in MIL-S-16216 may be used as shown on figure 3 for quality conformance tests, when dynamic tear tests are not being conducted.

4.5 Explosion bulge.

4.5.1 Welding parameters. Fabrication of the weldments shall be as follows:

(a) The base plate shall be as specified in table IX.
(b) Dimensions of the test assemblies shall be as specified in MIL-STD-2149.
(c) The weldments shall be fabricated using the welding position and wire diameter specified in 4.2.2 herein. The number of weldments required shall be in accordance with footnote 10 of table III.
(d) The preheat and interpass temperature shall be 250 ± 25°F.
(e) The welding-heat input shall be as specified in notes to table III.

(f) Peening of weld beads shall not be permitted.
(g) The test assembly shall be prepared by using welding sequence and techniques recommended by the manufacturer which shall be reported.
(h) The joint surface shall not be clad or buttered.
(i) Welding may be continuous except for interpass cooling. No postweld heat treatments shall be employed. Time delay per pass beyond that necessary for interpass cooling shall be reported.

4.5.2 The two crack starter prolongations shall be as specified in MIL-STD-2149 and will be tested by the Naval Sea Systems Command (NAVSEA) in accordance with schedule B of table VI.

4.6 Diffusible hydrogen test.

4.6.1 Procedure. The diffusible hydrogen test shall be performed in accordance with AWS A4.3.

4.6.2 Acceptance criteria. Material shall meet the requirements of 3.6.

4.6.3 Retest. If results from the first test fail to meet the requirements of 3.6, one retest involving twice the number of specimens originally required may be permitted. The results of all tests shall comply with 3.6. The retest specimens shall be made using material from the same sample as the initial test. If the retest also fails to meet the requirements of 3.6, the material shall be rejected. The supplier shall inform in writing all agencies having procured lots of material delivered since the last successfully tested lot of the identity of the intervening lots.

4.7 Flux total water content. The total water content (both hygroscopic and absorbed) shall be determined as specified on figure 4 and the notes pertaining thereto.

4.8 Chemical analysis. Chemical analysis shall be performed as specified in MIL-E-23765. The chemical analysis sample of alloy cored products shall be melted using the GTAW process in an inert atmosphere in accordance with ASTM E 1010 or other approved technique.

4.9 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. The minimum quality conformance test result data required shall be in accordance with figure 5 and may be prepared in the format shown. The cause for any retest shall be reported for information and the results of all tests shall be reported. For alloy cored products only, the certification shall report the brand name of flux used in qualification testing.

4.10 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

5.1 Preparation for delivery of electrodes. Preparation for delivery of electrodes shall be as specified in MIL-E-23765.

5.2 Preparation for delivery of flux. Preparation for delivery of flux shall be as specified in MIL-E-23765.

5.2.1 Packing. Welding flux shall be packed in containers that meet or exceed the following requirements:

(a) Containers shall comply with the Uniform Freight Classification Rules or other carrier regulations applicable to the mode of transportation.
(b) Containers shall ensure safe delivery, acceptance at destination and they shall protect the stability of the flux during storage in accordance with 3.7 herein.
(c) Containers shall be qualified in accordance with 4.2.3.1 herein.

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

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

5.2.3 Use of polystyrene (loose-fill) material. The use of polystyrene (loose-fill) material for packing applications such as cushioning, filler and dunnage is prohibited.

6. NOTES

6.1 Intended use.

6.1.1 General. This specification is intended to cover low alloy steel solid bare welding electrodes and rods and alloy cored bare welding electrodes for depositing weld metal, that in the as-welded condition meets the mechanical properties specified herein when welded on the applicable base metals as specified in table IX using GMA, GTA, and SAW processes. This specification also is intended to cover low alloy steel solid bare welding electrodes for depositing weld metal, that in the stress-relieved condition meets the mechanical properties specified herein when welded on the applicable base metals as specified in table IX using either SAW welding processes employing a suitable neutral granular flux or GMA and GTA welding processes with a suitable shielding gas. MIL-types 100S-1, 100S-2, 120S-1 and 120S-2 or 100S-1F, 100S-2F, 120S-1F and 120S-2F, are intended only for as-welded applications. If they are conformance tested in the stress-relief condition and bear the SR suffix, they may be used for stress-relief applications as well.

6.1.1.1 MIL-type 80S-1, 80S-2, and 80S-3. MIL-type 80S-1 and 80S-2 electrodes are suitable for welding MIL-S-23194, composition A steels; MIL-S-24238, composition A steels; ASTM A 508, class 2 or 3 steels; and ASTM A 533 or A 302 steels using the SAW process. MIL-type 80S-3 is suitable for welding the same steels using the GMA and GTA processes.

6.1.1.2 Type MIL-100S-1. Type MIL-100S-1 electrode is suitable for welding HY-80 steel.

6.1.1.2.1 Type MIL-100S-2. Type MIL-100S-2 electrode is suitable for welding HY-80 steel, especially for approved reduced preheat applications.

6.1.1.3 Type MIL-120S-1. Type MIL-120S-1 electrode is suitable for welding HY-100 steel.

6.1.1.4 Type MIL-120S-2. Type MIL-120S-2 electrode is suitable for welding HY-100 steel, especially for approved reduced preheat application.

6.1.1.5 Types MIL-100S-1F, MIL-100S-2F, MIL-120S-1F and MIL-120S-2F. MIL-100S-1F, MIL-100S-2F, MIL-120S-1F and MIL-120S-2F are the designations of neutral granular flux to be used with the corresponding type of weld wire.

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

6.1.1.7 Special types MIL-120S-1X and MIL-120S-2X. MIL-120S-1X and MIL-120S-2X electrodes are suitable for welding HY-100 steel with the SAW process using ac current only.

6.1.1.8 MIL-types with suffix C. MIL-types with suffix C designate alloy cored electrodes. Only the specific brand name of flux used during qualification and quality conformance testing is suitable for welding with alloy cored electrodes to this specification.

6.2 Ordering data. Electrodes or flux intended for stress-relief applications shall be so specified in the acquisition documents. Acquisition documents should also specify the following in addition to the ordering data required in MIL-E-23765:

(a) Whether the copper content should be restricted (see table I and 6.1.1.6).
(b) The required mechanical properties for type MIL-120S-1 test welds which have been stress-relieved (see footnote 3 to table IV).
(c) Time at the stress relief temperature (see 3.4.1 and 4.3).
(d) Whether type 100S or 120S weld metal test plates should be tested for conformance with stress-relieved requirements (see 3.4.1, note 6 to figures 1 and 2).
(e) Whether a lot of electrodes under 3/32-inch diameter should be deposited using the SAW process and tested in the as-welded condition (see footnote 4 of table VIII).
(f) Whether a lot of electrodes 3/32-inch diameter and larger should be deposited using the GMA process and tested in the as-welded condition (see 4.3.1.2 and footnote 4 of table VIII).

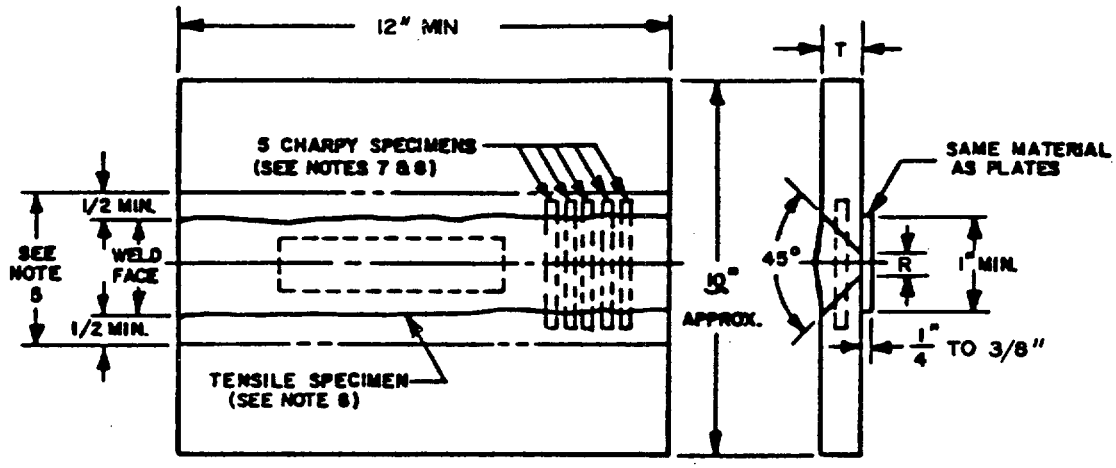
(g) Other base metal steel for use in testing in the stress relieved condition, if required (see 4.4, table IX and footnote 1 thereof).
(h) Whether a second test weldment is required for quality conformance testing in the as-welded condition (see footnote 2 of table IX).
(i) Whether bags and drums shall be palletized for shipment (see 5.2.1.1).
(j) Whether figures 1 and 2 apply to types MIL-100S-1, 100S-2, 120S-1, and 120S-2 (see note 10 to figure 1 and note 8 to figure 2).
(k) Which sizes may be quality conformance tested using the submerged-arc process (see footnote 1 of figure 3).
(l) Whether test weldments shall be tested in the as-welded condition (see note 8 to figure 3).

6.3 Subject term (key word) listing.

Electrodes, welding
Gas metal-arc (GMA)
Gas tungsten-arc (GTA)
Rods, welding
Steel, low alloy
Submerged-arc welding (SAW)

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-N571)



SH 7896A

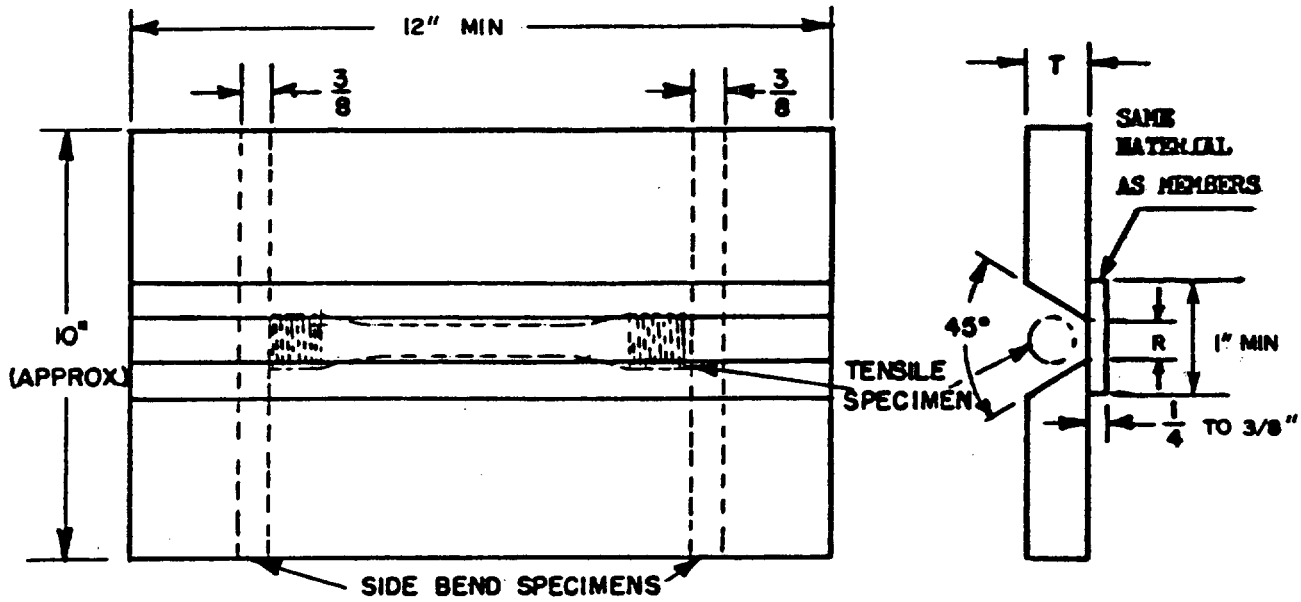
Weld test details.

Test classification	Form	Types	Diameter (inch)	T (inch)	R (inch)	Tensile specimen (inch diameter)	Welding process
Qualification	All	All	1/16	3/4	1/2	0.505	GMA and SAW

FIGURE 1. Weld joint for mechanical properties tests for types MIL-80S-1, MIL-80S-2, and MIL-80S-3, MIL-80S-1F, and MIL-80S-2F.

Notes to figure 1:

1. Base plate shall be as specified in table IX and welded in flat position.
2. For MIL-80S types, the minimum preheat and maximum interpass temperatures shall be 250 and 500°F, respectively. Should welding be interrupted, the assembly may be allowed to cool in still air at room temperature, and prior to resumption of welding, the assembly shall be reheated to the minimum preheat temperature.
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 for GMA welded electrodes. Argon plus 5 percent CO_2 may also be used for GMA welded electrodes. The argon and oxygen used for this test shall be in accordance with MIL-A-18455 and BB-O-925, respectively or equal. The neutral granular flux for the SAW process shall be in accordance with 4.2.1 or 4.2.3 herein which is consistent with MIL-type electrodes being tested.
5. After completion of the weld, it shall be allowed to cool, the weld reinforcement backing strip shall be removed flush with the base plate, and the weld radiographed, as specified in MIL-E-23765. The backing strip may be removed by the air carbon arc gouging process. The weld shall be cut as shown resulting in a tensile coupon suitable for 0.505 inch diameter specimen and 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. Prior to machining specimens, type 80S test weldments and, when specified (see 6.2), types 100S and 120S test weldments shall be stress relieved in accordance with 3.4.1.
7. The tensile coupon shall be machined into a 0.505-inch tensile specimen and tested as specified in MIL-E-23765. Center of specimen shall be approximately at T/2.
8. 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 five specimens shall be obtained at test temperatures specified in table III or IV, as applicable, plus or minus 3°F.
10. When specified (see 6.2), figure 1 shall also apply to types MIL-100S-1, MIL-100S-2, MIL-120S-1 and MIL-120S-2.



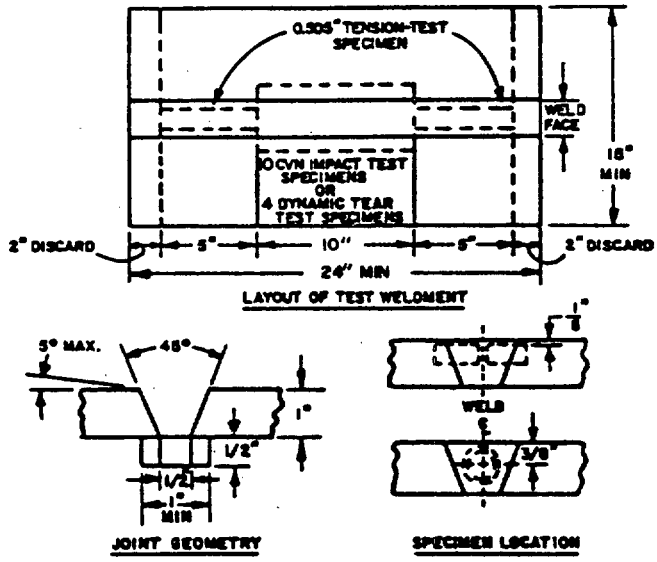
SH 5986A

Test classification	Types	Diameter (inch)	T (inch)	R (inch)	Tensile specimen (inch diameter)	Welding process
Qualification	All	1/16	3/4	1/2	0.505	GMA and SAW
Quality conformance inspection	All	All	1/2 to 3/4	1/4 1/2	.358 .505	GMA and SAW
Quality conformance inspection	All	All	1/2	1/4	.358	GTA

FIGURE 2. Weld joint for soundness and for mechanical tests for types MIL-80S-1, MIL-80S-2, and MIL-80S-3, MIL-80S-1F, and MIL-80S-2F.

Notes to figure 2:

1. Base plate shall be as specified in table IX and welded in flat position.
2. The minimum preheat and maximum interpass temperatures shall be 250 and 500°F, respectively. Should welding be interrupted, the assembly may be allowed to cool in still air at room temperature and, prior to resumption of welding, the assembly shall be reheated to the minimum preheat temperature.
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 for GMA welded electrodes. Argon plus 5 percent CO_2 may also be used for GMA welded electrodes. The argon and oxygen used for this test shall be in accordance with MIL-A-18455 and BB-O-925, respectively or equal. The neutral granular flux for the SAW process shall be in accordance with 4.2.1 or 4.2.3 herein which is consistent with MIL-type electrodes being tested.
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 backing strip may be removed by the air carbon arc gouging process. The weld shall be cut as shown resulting in a tensile coupon suitable for 0.505-inch diameter specimens (or 0.250-inch diameter specimen when 1/2 inch plate thickness is used) and two side bend coupons. The side bend coupons are used only for the qualification test. 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. Prior to machining specimens, type 80S test weldments and, when specified (see 6.2), types 100S and 120S test weldments shall be stress relieved in accordance with 3.4.1.
7. The tensile coupon shall be machined into a 0.505-inch tensile specimen (or 0.358-inch diameter specimen when 1/2-inch plate thickness is used); two side bend specimens prepared and tested as specified in MIL-E-23765. The center of the tensile specimen shall be at T/2 approximately.
8. When specified (see 6.2), figure 2 shall also apply to types MIL-100S-1, MIL-100S-2, MIL-120S-1, and MIL-120S-2.



SH 10572

Gas metal-arc welding 3/, 4/ and 5/							
Electrode size (diameter-inch)	0.020	0.025	0.030	0.035	0.045	1/16	5/64
Wire feed speed (inches/minute)							
55 Kj/in	2/	2/	2/	2/	165	230	165
110 Kj/in	2/	2/	2/	450	250	230	165
Submerged-arc welding 3/ and 5/							
Electrode size (diameter-inch)	1/1/16	1/5/64	3/32	1/8	5/32	3/16	-
55 Kj/in	400	400	525	500	500	2/	-
110 Kj/in 6/	500	500	600	600	600	2/	-

1/ These sizes may be quality conformance tested by using the submerged-arc process when specified (see 6.2).
2/ Not specified. Supplier shall report parameters used on the certification.
3/ Notes 3 and 5 to figure 3 apply. The specified parameters are required for MIL-100 types only. Suppliers shall report parameters used in testing MIL-120 types on the certification.
4/ Supplier shall report power source used, average current and other controllable parameters on the certification.
5/ Supplier shall report voltage, electrical stick out and other controllable parameters on the certification.
6/ For alloy cored products, supplier shall report parameters used on the certification.

FIGURE 3. Flat groove-weld metal test for MIL-100S-1, MIL-100S-2, MIL-120S-1 and MIL-120S-2 electrodes, or MIL-100S-1F, MIL-100S-2F, MIL-120S-1F or MIL-120S-2F flux.

Notes to figure 3:

1. Base plate shall be as specified in table IX.
2. The preheat and interpass temperature shall be 250 ± 25°F, except for MIL-S-24645 or ASTM A 710 steel which shall be 60 to 150°F.
3. The welding-heat input shall be as specified in table III. The welding current or wire feed speed shall be within plus or minus 10 percent of the values as specified on figure 3.
4. Welding may be continuous except for interpass cooling. Time delay per pass beyond that necessary for interpass cooling shall be reported.
5. Shielding gas shall be argon for GTA welding and argon plus 2 percent oxygen for the GMA process. Argon plus 5 percent CO_2 may be used for GMA process. The argon and oxygen used for this test shall be in accordance with MIL-A-18455 and BB-O-925, respectively or equal. When tests are to be conducted in the as-welded condition, a qualified type MIL-100S-1F, MIL-100S-2F, or MIL-120S-1F neutral granular flux shall be used for the SAW process unless otherwise specially approved by NAVSEA. The welding position and the welding process for qualification testing shall be in accordance with 4.2.2 herein and for quality conformance testing shall be as follows:

   (a) Sizes 0.020 through 0.045, vertical using pulsed arc GMA.
   (b) Sizes 0.052 through 5/64, flat using spray transfer GMA.
   (c) Sizes 3/32 through 1/4, flat using SAW.

6. When 48 hours have elapsed after completion of welding, the weldment shall have the reinforcement and backing strip removed flush with the base plate on both surfaces and shall be examined nondestructively. The backing strip may be removed by the air carbon arc gouging process. Both surfaces of the weld shall be magnetic particle inspected in accordance with MIL-STD-271 for compliance with the applicable requirements as specified in 3.5 herein. The weld shall be inspected radiographically according to level 2-2T as specified in MIL-STD-271 for compliance with the applicable requirements as specified in 3.5 herein.
7. The weldment shall be cut as shown resulting in two tensile coupons and one impact coupon. 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.
8. Unless otherwise specified (see 6.2), test weldments shall be tested in the as-welded condition. When specified, test weldments shall be stress relieved in accordance with 3.4.1 and tested to the requirements herein.
9. Tension test specimens shall be machined and tested in accordance with AWS B4.0. Tension testing shall be conducted at room temperature. Each specimen shall be tested in accordance with table III.
10. Charpy V-notch impact testing, if selected, shall have specimens machined and tested in accordance with AWS B4.0. Five Charpy V-notch specimens shall be tested at minus 60 and 0°F. The average of the five test results shall be greater than the minimum average value specified. No two specimens shall have test results below the minimum average value specified. One specimen can have test results 10 foot-pounds below the minimum average specified.
11. Dynamic tear testing, if selected, shall have specimens machined and tested in accordance with ASTM E 604. Two dynamic tear specimens shall be tested at the applicable temperatures as specified in table III.

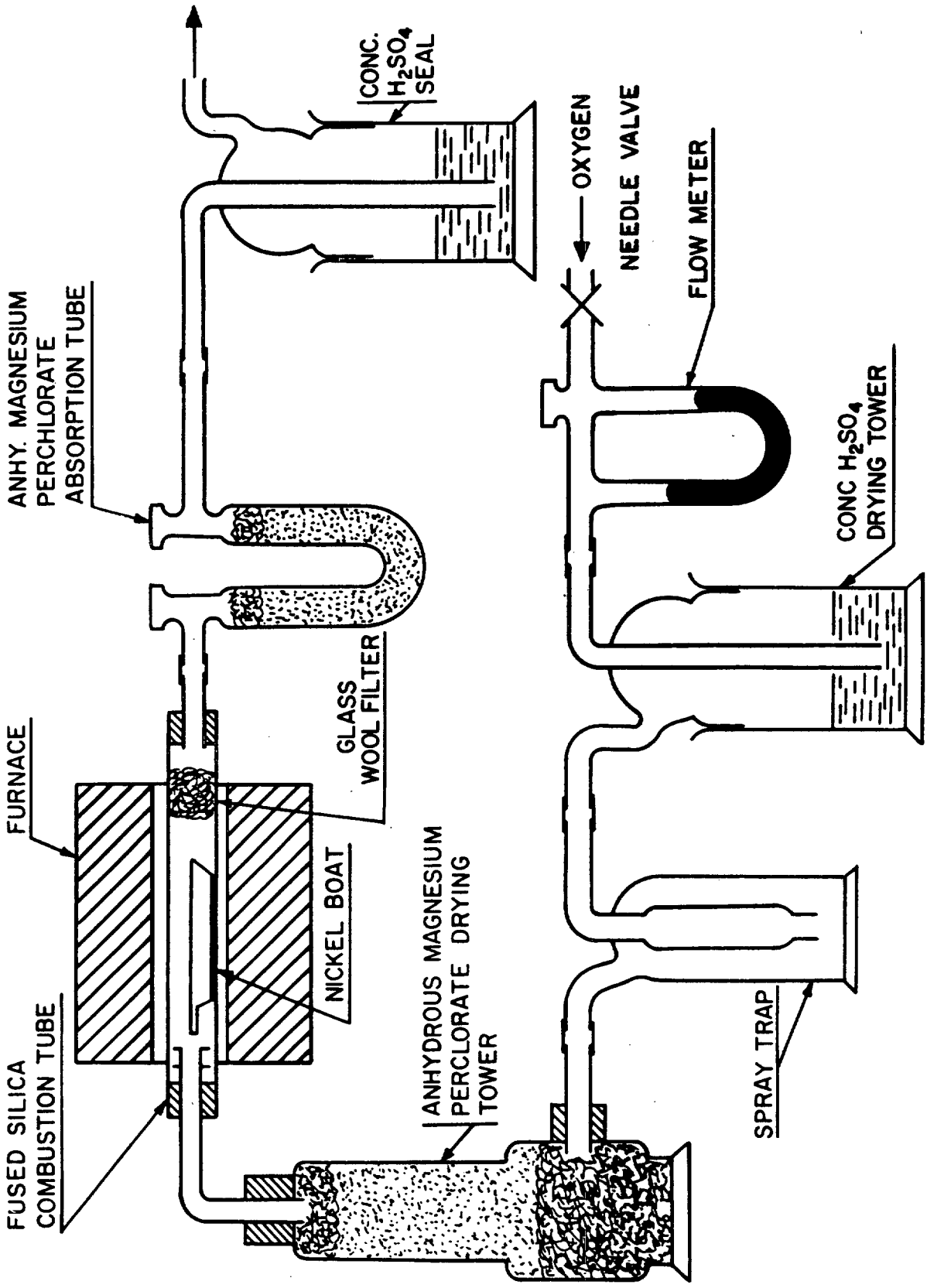


FIGURE 4. Schematic drawing of train for moisture determination.

METHOD OF DETERMINING TOTAL WATER CONTENT OF FLUX

Notes to figure 4:

1. Apparatus.

   (a) Furnace: Tube furnace capable of furnishing temperatures to 2000°F within the combustion tube is satisfactory. The length of the heating element shall be sufficient to heat 8 - 10 inches of the middle portion of the combustion tube to the required temperature. Furnace shall be equipped with a temperature controller and pyrometer.
   (b) Oxygen supply: The oxygen supply should be free of organic matter. If organic matter is present, oxygen should be purified by passing it through a small combustion tube lightly packed with asbestos or copper oxide, heated to a temperature of 1100 to 1200°F.
   (c) Oxygen drying train: This consists of a pressure reducing valve on the oxygen supply, a needle valve and oxygen flow meter to regulate the flow of oxygen, a wash bottle containing concentrated sulfuric acid (96 percent), a spray trap and a drying tower filled with anhydrous magnesium perchlorate.
   (d) Combustion tube: A fused silica combustion tube, open at both ends, with a devitrification point above 2000°F shall be used. About 6 inches of the tube shall project from either side of the furnace. A plug of fine glass wool is inserted into the outlet end of the combustion tube to filter the gases. It shall be inserted far enough into the tube so that it is heated to 400 to 500°F.
   (e) Water absorption train: The water driven from the sample is collected in a U-tube absorber (Schwartz) filled with anhydrous magnesium perchlorate. A gas-sealing bottle containing concentrated sulfuric acid (96 percent) is attached to the outlet end of the moisture U-tube absorber.

2. Temperature.

   A temperature of 1800 $\pm$ 50°F shall be maintained within the combustion tube for the determination.

3. Preparation and handling of sample.

   The sample shall be immediately transferred to a dried, stoppered vial or sample bottle. The sample size used in each determination shall be approximately four grams; it shall be weighed directly on the balance dish and transferred to the boat weighing the sample to the nearest 0.001 gram.

4. Handling of combustion boat and absorption tube.

The ignited nickel boat after removal from the combustion tube shall be transferred to a Pyrex desiccator containing anhydrous magnesium perchlorate as a desiccant. The absorption tube shall be handled with lint-free gauze at all times and shall be stored in the balance case during the cooling period so that it assumes the temperature of the atmosphere in which it is to be weighed.

5. Dessicants.

The anhydrous magnesium perchlorate and sulfuric acid shall be removed often enough to ensure the best performance. In the case of the absorption tube this can be estimated roughly since it is known that anhydrous magnesium perchlorate will absorb at least 16 percent of its weight in water without any noticeable loss in drying efficiency.

6. Oxygen flow.

The flow of oxygen to the train shall be maintained at 200 to 250 mL/minute. Once the flow of oxygen is established it shall not be changed throughout the determination.

7. Combustion boats.

A nickel combustion boat which will hold a four-gram sample shall be used. (The ignited sample can be removed after the determination and the boat reused. A small amount of alumina in the heated zone of the combustion tube will prevent nickel boat from fusing with combustion tube).

8. Step by step procedure.

(a) Blank determination.

(1) With the furnace operating at a temperature of 1800°F, the oxygen flow shall be adjusted to 200 to 250 mL/minute. The nickel boat shall be placed in the middle of the heated zone of the combustion tube and the absorption U-tube attached to the train. A period of 30 minutes shall be employed to ignite the boat and "condition" the absorption U-tube.

(2) The moisture absorption U-tube shall be removed from the system and placed in the balance case and the nickel boat shall be removed from the combustion tube and placed in the desiccator. The combustion tube of the furnace shall be closed after removing the boat.

(3) After cooling for a period of 20 minutes, the absorption U-tube shall be weighed. The boat shall be removed from the desiccator and exposed for a period of time approximating the time required to transfer a sample from the balance pan to the boat in an actual determination.

(4) The combustion tube shall be opened, the moisture absorption U-tube placed in the system, the boat placed in the center of the combustion tube and the cover replaced.
(5) After a period of 30 minutes, the absorption U-tube shall be removed from the system and placed in the balance case and the boat shall be removed from the combustion tube and placed in a desiccator.
(6) The moisture absorption U-tube shall be weighed after a period of 20 minutes. The gain in weight is the blank.

(b) Moisture determination.
(1) Immediately after weighing the absorption U-tube in item 6 of the blank determination procedure, the sample shall be weighed out on the balance pan.
(2) The boat shall be removed from the desiccator and the sample quickly transferred from the balance pan to the boat.
(3) The combustion tube shall be opened, the moisture absorption U-tube placed in the line, the boat transferred to the center of the combustion tube and the cover replaced.
(4) After a period of 30 minutes, the absorption U-tube shall be removed from the system and placed in the balance case.
(5) The absorption U-tube shall be weighed after the 20-minute cooling period.
(6) If additional samples are to be run, the nickel boat may be removed from the combustion tube at step 4; the ignited sample is removed and the boat placed in the desiccator to cool. Since the same boat can be used for the following determination, it is not necessary to run a blank determination for each sample. Therefore, after item 5 another determination may be started immediately.

9. Calculation.

$$\text{Percent moisture} = \frac{A-B}{\text{Wt. of sample}} \times 100$$

A = gain in weight of absorption U-tube in moisture determination.
B = gain in weight of absorption U-tube in blank determination.

Manufacturer or distributor _____ Customer's name _____

Address _____ Customer's order no. _____

Mill order no. _____

Identification:

Specification MIL- _____ Type _____

Condition _____ Deposition process _____
(as deposited, stress relieved)

Form _____ Size _____ Coating _____

Lot no. _____ Heat 1/ _____ Melter 1/ _____

Alloy identity check: in process splice _____
at spooling _____

Chemical analysis:

Carbon _____
Manganese _____
Silicon _____
Phosphorus _____
Sulphur _____
Nickel _____
Molybdenum _____
Chromium _____
Vanadium _____
Aluminum _____
Titanium _____
Zirconium _____

Mechanical properties:

Ultimate tensile strength _____
Yield strength _____
Elongation _____
Charpy impact _____
Percent shear fracture _____
Guided bend _____
Dynamic tear _____
Cast _____

Helix _____

Radiography _____

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 _____

1/ See MIL-E-23765.

FIGURE 5. Certification of quality conformance.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-E-23765/2D(SH)	ELECTRODES AND RODS-WELDING, BARE, SOLID, OR ALLOYED CORED,

3a. NAME OF SUBMITTING ORGANIZATION LOW ALLOY STEEL

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

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