MIL-E-19933E(SH)
5 August 1981
SUPERSEDING
MIL-E-19933D(SHIPS)
21 June 1967
(See 6.7)

MILITARY SPECIFICATION

ELECTRODES AND RODS - WELDING, BARE, CHROMIUM AND CHROMIUM-NICKEL STEELS

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 chromium and chromium-nickel alloy bare welding electrodes and cut-length rods for use with the inert-gas metal-arc (consumable electrode) and the tungsten-arc welding processes; and bare welding electrode in coils for submerged-arc welding process.

1.2 Classification.

1.2.1 Classes. Electrodes and rods shall be furnished in the following classes, as specified (see 6.1):

Class 1 - Spooled electrode (wire form).
- 1a - Large spool (12-inch flange).
- 1b - Small spool (4-inch flange).

Class 2 - Cut-length rods.

Class 3 - Coiled eletrode (with or without rim).
- 3a - 25-pound coil weight.
- 3b - 50-or 60-pound coil weight.
- 3c - Over 65-pound coil weight.

1.2.2 Types and sizes. Electrodes and rods shall be furnished in the types and sizes shown in table I, as specified (see 6.2).

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

TABLE I. Electrodes and rods, types and sizes.

Types	Diameter sizes (inch)	
	Classes 1a and 1b	Classes 2, 3a, 3b, and 3c
MIL-308		
MIL-308Co		
MIL-308L		
MIL-308CoL		
MIL-308HC		
MIL-309		0.045
MIL-309Co	0.020	1/16
MIL-310	.025	5/64
MIL-312	.030	3/32
MIL-316	.035	1/8
MIL-316L	.045	5/32
MIL-317	1/16	3/16
MIL-318	3/32	1/4
MIL-321		
MIL-347		
MIL-347Co		
MIL-349		
MIL-410		

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-W-10430 - Welding Rods and Electrodes; Preparation for Delivery of.
MIL-G-18455 - Argon, Technical.
MIL-I-45208 - Inspection System Requirements.

STANDARDS

FEDERAL

FED-STD-151 - Metals, Test Methods.

MILITARY

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

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND
NAVSEA 0900-LP-003-9000 - Radiographic Standards for Production and Repair Welds.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)
Z49.1 - Safety in Welding and Cutting.

(Application for copies should be addressed to American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
A240 - Heat-Resisting, Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels.

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

AMERICAN WELDING SOCIETY (AWS)
A4.2 - Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic Stainless Steel Weld Metal.
B4.0 - Standard Methods for Mechanical Testing of Welds.

(Application for copies should be addressed to the American Welding Society, Inc., 345 East 47th Street, New York, NY 10017.)

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

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

UNIFORM CLASSIFICATION COMMITTEE AGENT
Uniform Freight Classification Ratings, Rules, and Regulations.

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

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

3. REQUIREMENTS

3.1 Qualification. The electrodes and rods furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.4).

3.2 General requirements.

3.2.1 Finish. Electrodes and rods shall have a clean finish, free from slivers, depressions, scratches and scale that would adversely affect the welding characteristics or the operation of the equipment.

3.2.2 Chemical composition. The chemical composition of bare electrodes (wire form) and rods shall be as specified in table II.

3.2.3 Mechanical properties. The deposited weld metal shall exhibit mechanical properties specified in table III.

TABLE II. Chemical composition of bare electrodes and rods. 1/

Types MIL-	Carbon	Chromium	Nickel	Molybdenum	Columbium plus tantalum	Manganese	Silicon	Phosphorus	Sulphur	Tungsten	Cobalt
2/ 308	0.08	19.5-22.0	9.0-11.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
2/ 308Co	0.08	19.5-22.0	9.0-11.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	0.10
2/ 308L	0.03	19.5-22.0	9.0-11.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
2/ 308CoL	0.03	19.5-22.0	9.0-11.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	0.10
3/ 308HC	0.08-0.15	18.0-20.0	9.0-11.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
309	0.12	23.0-25.0	12.0-14.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
309Co	0.12	23.0-25.0	12.0-14.0	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	0.10
310	0.08-0.15	25.0-28.0	20.0-22.5	-----	-----	1.0-2.5	0.25-0.60	0.025	0.025	-----	-----
312	0.15	28.0-32.0	8.0-10.5	-----	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
316	0.08	18.0-20.0	11.0-14.0	2.0-3.0	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
316L	0.03	18.0-20.0	11.0-14.0	2.0-3.0	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
317	0.08	18.5-20.5	12.0-15.0	3.0-4.0	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
318	0.08	18.0-20.0	11.0-14.0	2.0-3.0	8 x C Min. to 1.0 Max.	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
2/4/ 321	0.08	18.5-20.5	9.0-10.5	0.5 Max.	-----	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
2/ 347	0.08	19.0-21.5	9.0-11.0	-----	10 x C Min. 5/ to 1.0 Max.	1.0-2.5	0.25-0.60	0.03	0.03	-----	-----
2/ 347Co	0.08	19.0-21.5	9.0-11.0	-----	10 x C Min. 5/ to 1.0 Max.	1.0-2.5	0.25-0.60	0.03	0.03	-----	0.10
6/ 349	0.07-0.13	19.0-21.5	8.0-9.5	0.35-0.65	1.0-1.4	1.0-2.5	0.25-0.60	0.03	0.03	1.25-1.75	-----
410	0.12	11.5-13.5	0.50	0.65	-----	0.30-0.60	0.30-0.50	0.030	0.030	-----	-----

See footnotes at top of next page.

1/ Single values are maximum.
2/ Ferrite number shall be from 4 to 10 as determined by an instrument calibrated in accordance with AWS A4.2 (see figure 3).
3/ Ferrite number shall not exceed 4 as determined by an instrument calibrated in accordance with AWS A4.2 (see figure 3).
4/ Titanium = 9 x C minimum to 1.0 maximum.
5/ Tantalum shall not exceed 0.10 percent.
6/ Titanium = 0.10 to 0.30.

TABLE III. Mechanical properties.

Type	All weld metal tensile strength (min.)	Elongation in 2 inches (min.)	Ductility (full capacity of jig)	Fissures per specimen tested (none linear) (max.)
	lb/in^2	Percent		
MIL-308	80,000	35	Face bends	3
MIL-308Co	80,000	35	Face bends	3
MIL-308L	75,000	35	Face bends	2
MIL-308CoL	75,000	35	Face bends	2
MIL-308HC	80,000	35	Face bends	3
MIL-309	80,000	30	Face bends	2
MIL-309Co	80,000	30	Face bends	2
MIL-310	80,000	30	Face bends	4
MIL-312	95,000	22	Face bends	1
MIL-316	80,000	30	Face bends	3
MIL-316L	75,000	30	Face bends	3
MIL-317	80,000	30	Face bends	3
MIL-318	80,000	25	Face bends	2
MIL-321	80,000	30	Face bends	3
MIL-347	80,000 as welded and as heat treated	30 as welded and 25 as heat treated	Face bends as welded as heat treated	2
MIL-347Co	80,000 as welded and as heat treated	30 as welded and 25 as heat treated	Face bends as welded as heat treated	2
MIL-349	100,000	25	Bend tests are not required	--
1/ MIL-410	75,000	20	Bend tests are not required	--

1/ Stress-relieved at 1425°F ± 25° for 8 hours, furnace cooled at a rate no greater than 100°F per hour to 1100°F, air cooled.

3.2.4 Soundness. Radiographs of groove welds shall reveal no evidence of cracking. Porosity shall not be in excess of that shown for grade 1 of NAVSEA 0900-LP-003-9000.

3.2.5 Each end of rod or wire to be spliced during processing shall be tested for alloy identity just prior to splicing at the process station (see 3.2.5), except when splicing is done to repair a wire break without removing the wire from the process line.

3.2.5.1 Both ends of each coil drawn to final size shall be tested for alloy identity (see 4.6.2) before rewinding, spooling, or straightening and cutting into rods or electrodes.

3.2.5.1.1 For continuous process operation where rod coil is drawn to finish size, straightened and cut to length without removal from the machine, both ends of each rod coil shall be alloy tested immediately prior to the start of the continuous processing operation.

3.2.5.1.2 When rod coils are to be spliced during continuous processing operations, each end of each rod coil to be spliced shall be alloy identity tested at the process station just prior to splicing. In addition, the leading end of the first coil and the tail end of the last coil for each continuous process run shall be alloy identity tested. When alloy identity testing is accomplished in accordance with 3.2.5.1.1 herein, these requirements are satisfied as well.

3.3 Class 1 - Spooled electrode.

3.3.1 Tolerance (diameter size). Tolerances in diameter sizes for spooled electrode shall be:

0.035 inch and smaller diameters, plus or minus 0.001.
0.045 inch and larger diameters, plus or minus 0.002.

3.3.2 Weight. The weights of spooled electrodes shall be as specified in table IV.

TABLE IV. Spooled electrode weights.

Class	Electrode diameter	Electrode weight	Weight tolerance
	(Inch)	(Pounds)	(Percent)
1a	0.020	5	±10
	0.025		
1a	0.030	10 or 15	±10
1a	0.035	10 or 15	±10
1a	0.045 and larger	25	±10
1b	All	2	±10

3.3.3 Winding. Each spool shall contain electrode in one continuous length made from a single heat of material. The electrode shall be wound closely in layers in such a manner that it shall be free to unwind without restriction caused by overlapping or wedging, and shall not produce kinks, waves or sharp bends, or in any way jam the wire-feed mechanism of the welding equipment. The starting end shall be firmly fastened and identified so that it is readily visible to the welding operator and both ends shall be easily accessible for inspection purposes.

3.3.4 Cast and helix - class 1a.

3.3.4.1 Cast. Sufficient electrode wire shall be taken from the spool to form one complete circle. This wire, when laid on a flat surface, shall form a circle not less than 15 inches and not greater than 30 inches in diameter.

3.3.4.2 Helix. The electrode shall not exhibit a tendency toward spiraling that interferes with welding performance. The vertical separation between turns of the released specimen in 3.3.4.1 shall not exceed 1 inch.

3.3.5 Temper - class 1b. The electrode shall possess a suitable temper for assuring uniform feeding in welding equipment.

3.3.6 Identification. Mil type designation, size, and lot-control number of the spooled electrode shall be clearly shown on the spool flange exposed to view when the spooled electrode is properly installed for welding in the equipment.

3.4 Class 2. Cut length rods.

3.4.1 Tolerance (diameter size). Rods shall not vary from the nominal diameter to more than plus 0.002 inch, minus 0.003 inch.

3.4.2 Length. The length of rods shall be 12, 18 or 36 inches plus or minus 1/2 inch as specified (see 6.2). In the case of 36 inch rods, up to 10 percent of rods in any container may be shorter than 36 inches, but not shorter than 24 inches.

3.4.3 Identification. Cut-length rods shall be identified by positive and legible methods such as imprinting or indenting the applicable type designation number (see table II) at one or more locations on the rod surface approximately 1 inch from rod end, or shall be identified by pressure-sensitive, plastic-coated tape imprinted with applicable type number at one or more locations and attached to the rod 1 inch from its end. Imprints on rods or on tape shall be with fade-proof ink and shall be resistant to oils, solvents and all atmospheric conditions and to normal wear and tear encountered in shipping and handling.

3.4.4 Production equipment inspection. When a change is made in a production run of one MIL-type rod to another, inspection shall be performed prior to starting the new run to assure that equipment and process lines are purged of material from the previous production run. This inspection shall be performed for all equipment used in manufacturing operations where the material is not segregated and positively identified, e.g., cutting to length.

3.5 Class 3 - coils.

3.5.1 Tolerance (diameter size). Coiled electrode shall not vary from the nominal diameter by more than plus or minus 0.002 inch.

3.5.2 Winding. All coils shall be level and layer wound, free from cross winding or waves and sharp bends or kinks that would interfere with continuous operation. The coil shall be one continuous length made from a

single heat of material. Both ends shall be easily accessible for inspection purposes.

3.5.3 Cast and helix. Sufficient electrode to form one complete circle shall be taken from the coil and laid on a flat surface to form a circle of which the diameter is not less than the original inside coil nor more than 2-1/2 times the outside diameter of the original coil. The vertical separation between turns of this specimen shall not exceed 2 inches.

3.5.3.1 Operability. The electrode shall not exhibit a tendency toward spiralling that interferes with welding.

3.5.4 Coil weight and dimensions. Coiled electrode shall be furnished in weights specified in 1.2. Coil dimensions shall be in accordance with table V.

3.5.5 Identification. Coils without rims shall be identified by tagging each end of the filler metal. Each tag shall bear the type number assigned to the alloy and shall be so designed and fastened that the identification is not readily effaced or removed. Coils with rims shall have the identification applied to the inside face of the rim.

TABLE V. Coil weight and dimensions.

Electrode size	Weight	Width (max.)	Outside diameter (max.)	Inside diameter	Ties 1/	Liner 2/
	(Pounds)	(Inches)	(Inches)	(Inches)		
All	25 ± 2	2-1/4	16-1/2	12-1/8 ± 1/4	4	Required
All	50 to 75	4-1/2	17	12-1/8 ± 1/4	4	Required
		4-1/2	31-1/2	22-1/2 min.	4	Required
All	150 ± 10 200 ± 25	4-1/2	31-1/2	22-1/2 min.	4	Required

1/ Equally spaced ties shall be two turns of soft galvanized or coppered steel binding wire, 16 or 18 gauge or steel straps 3/8 inch minimum width and 0.015 inch minimum thickness.

2/ Liner shall be either of good commercial grade chipboard or double kraft lined fiberboard 0.08 inch thick minimum and approximately 4 inches wide.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities

suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

4.1.2 Certificate of tests. A certificate of quality conformance of the tests specified in 4.6 containing actual quantitative test results including the process and range of amperage employed in making the required weld test for quality conformance inspection for each accepted lot including a particular shipment shall be furnished to the consignee with the shipment. The quality conformance test result data shall be submitted on the form shown as figure 4.

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

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

4.3 Qualification inspection. Qualification inspection will be authorized only to manufacturers of welding electrodes and rods. The manufacturer is defined as the actual processor of the welding electrodes and rods, engaged in the final cleaning, spooling, cutting to length, affixing rod identification, marking and packaging operations. Qualification tests shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA). Qualification tests shall consist of the tests specified in table VI and making all necessary examinations to verify conformance to all specification requirements not involving tests.

4.3.1 Sample for qualification tests. The electrode selected for testing shall be one spool of class 1a, 1/16-inch diameter size of the alloy for which the manufacturer desires to qualify, provided this size and class is representative of the cleaning method used for all sizes and classes of that alloy. If more than one cleaning method is used for various other diameter sizes and classes of any electrode alloy, qualification applications shall give complete details. The manufacturer shall furnish one spool of class 1a electrode of the alloy to be qualified. The sample shall be selected in the presence of the Government inspector.

4.3.1.1 Approval obtained on the class 1a, 1/16-inch diameter size electrode of a specific alloy will include qualification of all classes and sizes of electrodes and rods of that alloy.

TABLE VI. Summary of required tests.

Types MIL-	Class	Size	Test procedure	Test								
				Cast	Helix	X-Ray	Tensile 1/	Bend 1/	Chemical	Ferrite content 2/	Alloy identity	Requirements
Qualification tests												
All	All	All	4.6.2.1, 4.6.2.2	--	--	--	--	--	--	--	X	3.2.5, 3.2.5.1
All	1a	see 4.3.1	---------	X	X	--	--	--	--	--	--	3.3.4.1, 3.3.4.2
All	1a	see 4.3.1	Figures 1 and 2 and notes	--	--	X	X	X	--	--	--	Table III, 3.2.4
All	1a	see 4.3.1	3/	--	--	--	--	--	X	--	--	Table II
308, 308L, 308Co, 308CoL, 308HC, 321, 347, 347Co	1a	see 4.3.1	Figure 3 and notes	--	--	--	--	--	--	X	--	Table II, note 2 or 3 as applicable
Quality conformance tests												
All	All	All	4.6.2.1, 4.6.2.2	--	--	--	--	--	--	--	X	3.2.5, 3.2.5.1
All	1a	All	---------	X	X	--	--	--	--	--	--	3.3.4.1, 3.3.4.2
All	3a, 3b, 3c	All	---------	X	X	--	--	--	--	--	--	3.5.3
All	All	All	3/	--	--	--	--	--	X	--	--	Table II
308, 308L, 308Co, 308CoL, 308HC, 321, 347, 347Co	1a, 1b, 2	All	Figure 3 and notes	--	--	--	--	--	--	X	--	Table II note 2 or 3 as applicable

1/ Two tensile and two bend specimens required for all types of electrodes except MIL-347, MIL-347Co, MIL-349 and MIL-410 welds. For MIL-347 and MIL-347Co type, four tensile and four bend (face only) specimens shall be prepared; two tensiles and two bends shall be tested in as welded condition and the remaining shall be heat treated before testing. For MIL-349 and MIL-410 type, two tensile specimens shall be prepared.

2/ Delta ferrite content determinations are required for classes 1a, and 1b spooled electrodes and class 2 cut-length rods but not for class 3 coiled electrodes for submerged-arc welding process. Delta ferrite content of weld metal shall be determined by a Magne-Gage or equivalent calibrated against specimens having known delta ferrite content.

3/ Chemical composition shall be determined as specified in FED-STD-151.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the tests specified in table VI.

4.4.1 Sampling for quality conformance inspection.

4.4.1.1 Lot. For the purposes of sampling and inspection, a lot of spooled electrode, coiled electrode, or cut-length rod is defined as the quantity of one type and size produced from the same heat of metal. the lot size shall be expressed in pounds of rod or of electrode.

4.4.1.2 Sampling for inspection of filled containers. Unit packages and shipping containers shall be sampled and inspected in accordance with MIL-W-10430.

4.4.1.3 Sampling for examination of cut rods and electrode. Sample rods and electrode shall be selected either from the production line immediately prior to packaging or from filled unit packages. If selected from the production line, the total sample shall be in accordance with table VII and the electrodes or rods shall be selected throughout the "run" so that all parts of the "run" are represented. If selection is made after the packaging operation, the total sample shall be in accordance with table VII and approximately the same number of electrodes or rods shall be selected from each of the sample unit packages: 5 cut-lengths (rods) of each package; 3 feet of each small spool, and sufficient electrode to form one complete circle shall be taken from each large spool or from each coil.

4.4.1.3.1 Any sample coil, spool, or box which contains any non-conforming material shall be counted as defective. If in any sample the number of coils, spools, or boxes which do not conform to this specification exceeds the acceptance number in table VII this shall be cause for rejection of the lot.

TABLE VII. Sampling for examination of cut rods and electrode.

Lot size in pounds	Class 1a - spools Class 3a, 3b, and 3c coils		Class 1b spools		Class 2 - rods 10-pound - boxes		Class 2 - rods 50-pound - boxes	
	Sample size	Acceptance number	Sample size	Acceptance number	Sample size	Acceptance number	Sample size	Acceptance number
Up to 25	All	---	5	0	2	0	---	---
26 to 50	All	---	7	0	3	0	1	---
51 to 180	2	0	10	0	5	0	1	---
181 to 300	3	0	15	1	8	0	2	0
301 to 500	5	0	25	1	13	0	3	0
501 to 800	7	0	35	2	18	1	5	0
801 to 1300	10	0	50	3	25	1	7	0
1301 to 3200	15	1	75	4	35	2	10	0

4.4.1.4 Sampling for tests of cast and helix. Specimens of class 1a and class 3 electrode shall be cut from the spools and coils selected in accordance with table VII and tested to determine conformance with 3.3.4.1 and 3.3.4.2 or 3.5.3. If any specimen fails in either test, both tests shall be performed in every class 1a spool and class 3 coil.

4.4.1.5 Sampling for chemical analysis. One specimen for chemical analysis shall be selected from the lot (see 4.4.1.1). Failure to comply with chemical composition requirement of 3.2.2 shall be cause for rejection of the lot.

4.4.1.6 Quality conformance tests. The tests specified in table VI labeled "quality conformance tests" shall be performed on samples selected in accordance with 4.4.1.4 and 4.4.1.5.

4.5 Inspection procedures.

4.5.1 Visual and dimensional examination. The sample lengths and pieces selected in accordance with 4.4.1.3 shall be examined or measured to verify conformance to 3.2.1, 3.3.1, 3.3.3, 3.3.6, 3.4.1 through 3.4.3, 3.5.1, 3.5.2 and 3.5.5, as applicable.

4.6 Test procedures.

4.6.1 Summary of tests. Table VI summarizes the tests required for qualifying electrodes (see details under "qualification tests" and for quality conformance inspection under "quality conformance tests") of all filler metal types, classes and sizes.

4.6.2 Alloy identity.

4.6.2.1 Procedure. The alloy identity test method may include chemical analysis, metal sorting devices, other approved methods or a combination of methods. The test method shall be submitted for approval to NAVSEA.

4.6.2.2 Acceptance criteria. If the test demonstrates that the material is not of the type specified, the material shall be rejected.

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

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.6.)

5.1 Packaging. Packaging shall be level A or level C as specified (see 6.1).

5.1.1 Level A. Electrodes and rods furnished in accordance with 1.2.1 shall be packaged level A in accordance with MIL-W-10430. In lieu of bundles for cut length rods as required by MIL-W-10430, class 2 rods may be

packed in snug fitting fiber tubes minimum wall thickness .050 inches or snug fitting fiberboard boxes minimum grade 275.

5.1.2 Level C. Packaging shall be sufficient to afford adequate protection against deterioration and physical damage during shipment from the supply source to the using activity, and until early use.

5.2 Packing. Packing shall be level A, B, or C as specified (see 6.1).

5.2.1 Levels A and B. Electrodes and rods shall be packed level A or B as specified (see 6.2) in accordance with MIL-W-10430.

5.2.2 Level C. Packing shall be accomplished in a manner which will insure acceptance by a common carrier and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity. The shipping containers or method of packing shall conform to the Uniform Freight Classification Ratings, Rules, and Regulations or other carrier regulations as applicable to the mode of transportation.

5.3 Marking.

5.3.1 Interior packages. In addition to the manufacturer's commercial marking practice, interior packages shall be marked in accordance with MIL-W-10430 and the following:

(a) Spools and containers shall be marked with the symbol assigned to the actual manufacturer by NAVSEA. This symbol shall appear on the label as a suffix to the lot or control number. It is used to identify the actual manufacturer of rebranded products.

(b) All packages, or the smallest integral unit within a shipping container, shall carry the following warning label, or equal, as a minimum, prominently displayed in legible type on the package:

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

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

Read and understand the manufacturer's instructions and your employer's safety practices.
Keep your head out of the fumes.
Use enough general ventilation or exhaust at the arc or both to keep fumes and gases from your breathing zone, and the general area.
Wear correct eye, ear and body protection.
Do not touch live electrical parts.
See American National Standard Z49.1 "Safety in Welding and Cutting" published by the American Welding Society, 2501 N.W. 7th St., Miami. FL, 33125; OSHA Safety and Health Standards, 29 CFR 1910, are for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

DO NOT REMOVE THIS LABEL

Significant toxic constituents when present in the electrode in greater than trace amounts shall be identified on the warning label so that normal ventilation can be increased accordingly. These constituents include but are not limited to those itemized in sections 8.5 through 8.11 of ANSI Z49.1.

5.3.2 Exterior shipping containers and palletized unit loads. In addition to the contractor's commercial marking practice, exterior shipping containers and palletized unit loads shall be marked in accordance with MIL-W-10430 and the following:

(a) Shipping destination.
(b) National stock number.
(c) Customer's order number.
(d) Customer's item number.
(e) Customer's name.

6. NOTES

6.1 Intended use.

6.1.1 MIL-308. This type is intended for the general welding of 18 percent chromium, 8 percent nickel, corrosion-resistant (stainless) steels.

6.1.2 MIL-308L. This type is intended for the general welding of 18 percent chromium, 8 percent nickel extra low carbon corrosion-resistant steel, used where intergranular corrosion should be limited but where corrosive conditions are not the most severe.

6.1.3 MIL-308HC. This type is intended for applications where low magnetic permeability is of prime importance and where corrosion is not a factor.

6.1.4 MIL-309. This type is intended for the joining of the 18-8 grades of corrosion-resistant steel to mild steel; special treatment steel, class B armor and other low alloy air-hardening steels, when specified; and carbon and straight chromium steels to austenitic grades. This type is al for deposition of a corrosion-resistant overlay on carbon and low alloy steels.

6.1.5 MIL-310. This type is intended for the welding of 25 percent chromium, 20 percent nickel heat-resistant alloy steels used in high temperature service; special treatment steel, class B armor, and other low-alloy air-hardening steels, where specified; and carbon and straight chromium steels to austenitic grades. This type is also intended for deposition of a corrosion-resistant overlay on carbon and low alloy steels.

6.1.6 MIL-312. This type is intended for the joining of the "super-alloys" to low-alloy (chromium-molybdenum, and chromium-nickel-molybdenum) steels.

6.1.7 MIL-316. This type is intended for the joining of corrosion-resistant alloys of similar designations. The molybdenum content imparts increased resistance to corrosive effect of many organic acids, brine, sulfurous, and sulfuric acid.

6.1.8 MIL-316L. This type is intended for the welding of type 316L corrosion-resisting steel and under conditions similar to those under which type MIL-318 could be used.

6.1.9 MIL-317. This type is intended for welding of alloys of similar composition for increased corrosion-resistance to sulfuric and sulfurous acid and their salts.

6.1.10 MIL-318. This type is intended for the welding of type 318 corrosion-resisting steel. Generally, uses are similar to those of type MIL-316 electrode, except that, where elevated temperatures and corrosive conditions favor intergranular corrosion and type 318 alloy is used, choice of stabilized type MIL-318 electrode is indicated.

6.1.11 MIL-321. This type of electrode contains titanium for stabilizing the carbon. It is intended for the general welding of 18-8 corrosion-resisting steels stabilized by either titanium or columbium, which used where conditions of welding or service make unstabilized base metals susceptible to carbide precipitation, with consequent intergranular corrosion. Use of this electrode will not prevent intergranular corrosion alongside a weld in unstabilized 18-8 chromium-nickel base metals. This type of electrode is suitable for use with the gas metal arc welding process. It is not suitable for use with the submerged arc welding process because only a small portion of the titanium will be recovered in the weld metal.

6.1.12 MIL-347. This type of electrode contains columbium plus tantalum for stabilizing the carbon. It is intended for the general welding of 18-8 corrosion-resisting steels stabilized by either titanium or columbium to avoid carbide precipitation with consequent intergranular corrosion.

6.1.13 MIL-349. This type of electrode is intended for the joining of the "super-alloys" for applications requiring high strength at elevated temperatures.

6.1.14 MIL-410. This 12 percent chromium alloy classification is an air-hardening steel, and, therefore, requires preheat and postheat treatments in order to achieve welds of adequate ductility for most engineering purposes. The most common application of filler metal of this type is for welding alloys of similar composition. It is also used for deposition of overlays on carbon steels to resist corrosion, erosion or abrasion, such as occurs in valve seats and other valve parts.

6.2 Ordering data. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Class, type and size (see 1.2).
(c) Whether 12, 18 or 36 inch rods are desired (see 3.4.2).
(d) Levels of packaging and packing required (see 5.1 and 5.2).
(e) Quantity-total number of pounds.
(f) Whether alloy identity testing of each electrode or rod after final marking is required (see 3.2.5.2).

6.3 It is the responsibility of the consignee to determine whether or not the filler metals are suitable for intended application particularly when out-of-position welding is involved.

6.4 Inspection after delivery. Post delivery inspection of electrodes to determine conformity to this specification and for acceptance thereof is the responsibility of the consignee. When receipt inspection testing types MIL-308, MIL-308Co, MIL-308L, and MIL-308CoL, the consignee or user activity may consider the following delta ferrite test result limits acceptable:

(a) A maximum of 12 percent delta ferrite.
(b) An average minimum level of 3 percent delta ferrite with no individual inspection level of less than 2 percent delta ferrite.

Contractor test results shall meet the specified 4 to 9 percent delta ferrite content.

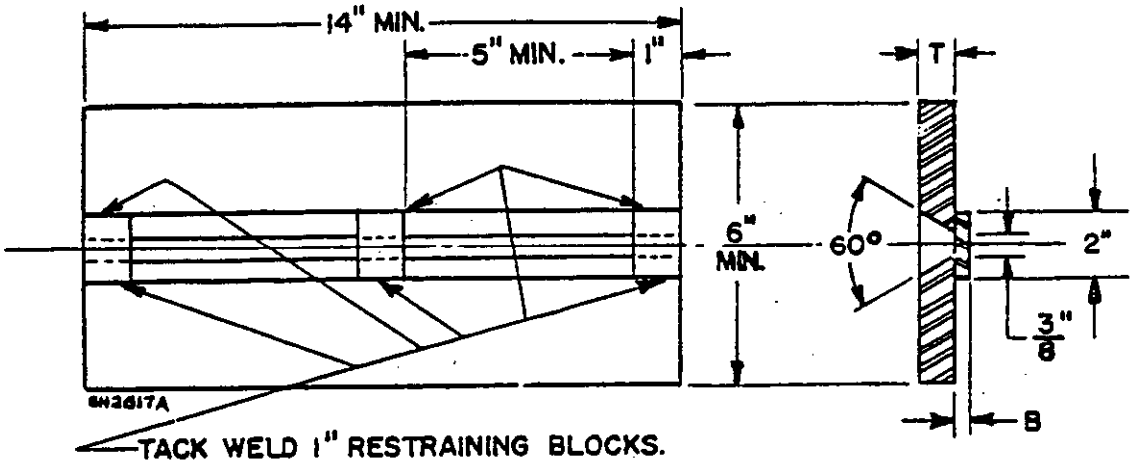
6.5 With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List QPL 19933 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is Naval Sea Systems Command, SEA 3112, Department of the Navy, Washington, DC 20362, and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.4.1).

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

6.6 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.7 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-N398)



DIMENSIONS			
ELECTRODE DIMENSIONS	B	T	SIZE TENSILE
INCH	INCH	INCH	INCH
.035 TO .045	1/4	3/8	.250
ALL OTHERS	3/8	3/4	.505

SH2617

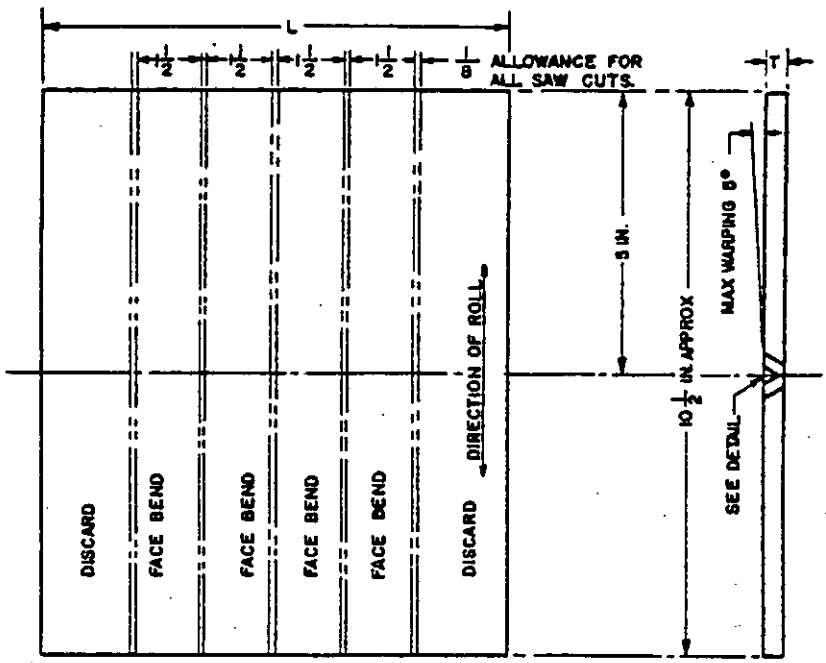
FIGURE 1. Test plate for all-weld-metal (0.505) specimens.

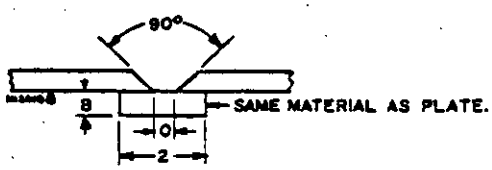
Notes to figure 1:

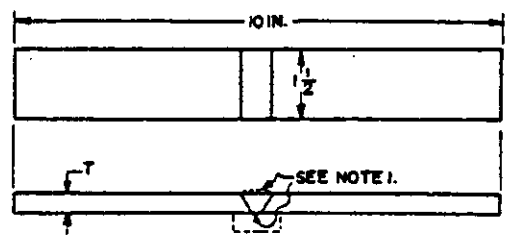
1. Qualified semi-automatic or machine inert gas shielded metal arc welding equipment shall be used in preparing welds.
2. Welding current may be supplied by either motor generator or a rectifier.
3. The shielding gas shall be argon or helium or mixtures thereof with or without 1 percent oxygen addition. Argon gas shall conform to MIL-G-18455; helium shall be of welding grade with similar water vapor content.
4. Base metal shall be of matching chemistry or 304 or 347 material properly cladded, except type MIL-349 and MIL-410 electrode shall be tested on base metal of composition conforming to that of the filler metal.
5. Joints shall be cleaned of all contaminants.
6. No preheat shall be used; interpass temperature shall not exceed 200°F, except for MIL-410, which shall be welded with a preheat and interpass temperature of 400°F ± 25°F.
7. Welds shall be made in the flat position using stringer bead technique.
8. In lieu of machined blocks designed to fit groove shown on figure 1, the assembly shall be restrained by welding or clamping to a rigid body in such a way that the plates of the assembly are not more than 5 degrees out of parallel after welding the required groove weld.

Notes to figure 1: - Continued

9. MIL-410 shall be stress relieved in accordance with footnote 1/ to table III without loss of minimum interpass temperature.
10. The weld reinforcement and backing strip shall be removed flush with the base plate on both surfaces and the weld examined by X-ray to determine compliance with 3.2.4, in accordance with requirements of MIL-STD-271, sensitivity level 2-2T. The radiograph shall meet the grade 1 X-ray requirements of MIL-STD-271, sensitivity level 2-2T. The radiograph shall meet the grade 1 X-ray requirements of NAVSEA 0900-LP-003-9000.
11. Tensile coupons shall be taken from the weld, heat treated, if required, and machined and tested in accordance with Method 211 of FED-STD-151 to determine compliance with 3.2.3 requirements.
12. Two tensile specimens required for all types with the exception of MIL-347.
13. Four tensile specimens required for MIL-347.
14. Two of the specimens shall be heat treated before testing as follows: Heat to 1550°F hold for one hour and cool. Heating and cooling rates shall not exceed 300°F per hour.
15. The other two specimens shall be tested as - welded.







(FACE BEND SPECIMEN)

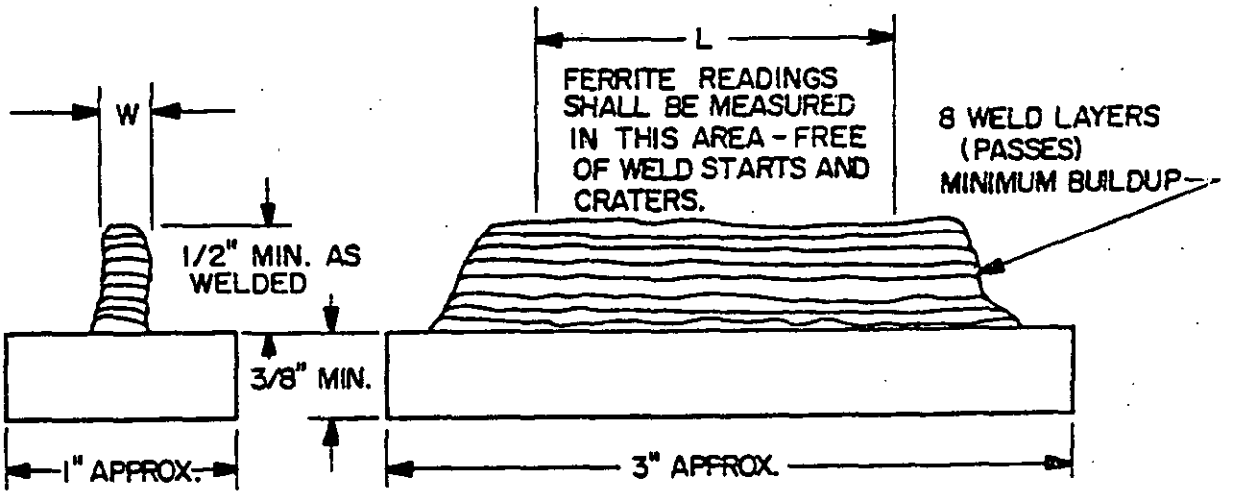
ELECTRODE DIAMETER	DIMENSIONS			
	LENGTH (L)	THICKNESS (T)	BACKING THICKNESS (B)	ROOT OPENING (O)
INCH	INCHES	INCH	INCH	INCH
.035 TO .045	10	1/4	1/4	1/8
.062 TO .094	10	3/8	3/8	3/8
.125	10	3/8	3/8	1/2

5HZ6-18

FIGURE 2. Groove weld for bend test.

Notes to figure 2:

1. Notes 1 through 6 and note 8 to figure 1 apply to this test.
2. Backing strip and weld reinforcement shall be removed by machining transverse to direction of welding; grinding of machined surfaces shall follow.
3. Corners on tension side of the specimens shall be slightly broken by filing.
4. All specimens shall be plainly identified by marking the ends.
5. Guided face bend tests shall be conducted in accordance with AWS B4.0.
6. All specimens shall be tested in the as-welded condition with exception of MIL-347 welds, two of which specimens shall be heat treated as specified in note 14 to figure 1 before testing.



SH9635A

FIGURE 3. Ferrite weld specimen.

Notes to figure 3:

1. The base material for the weld pad shall be types 301, 302, or 304 conforming to ASTM A167 or ASTM A240.
2. The gas tungsten-arc (GTA) welding process shall be used for rods. The gas metal-arc (GMA) welding process shall be used for electrodes. The weld stops and starts for each process shall be located at the ends of the weld buildup.
3. The weld pad shall be built up by depositing single bead layers one on top of the other to a minimum height of 1/2 inch. The GTA weld bead layers shall be deposited with a maximum bead width of 2-1/2 times the rod diameter, except the first few layers may be deposited with a wider bead width. The GMA weld bead layers shall be deposited in string beads using the welding parameters recommended by the manufacturer. The actual bead width and welding parameters (i.e., amperage, arc voltage and arc travel speed) used in the test shall be reported.
4. The weld pad shall be cooled between passes by water quenching immediately after each pass, except the last two weld passes shall be air cooled below 800°F prior to water quenching.
5. Each weld pass shall be cleaned prior to depositing the next weld bead.

Notes to figure 3: - Continued

6. After welding, the weld buildup shall be surface ground to 64 RMS finish to provide sufficient finished surface to make the required ferrite readings. The ground area need not be continuous along the specimen. The weld buildup shall be continuously water cooled during the grinding operation. The finished ground surface shall be approximately parallel with the plate surface and shall be located within the last two passes or layers of weld buildup. Machining and metallographic polishing sufficient to remove the cold working produced by machining may be used in lieu of surface grinding. The weld buildup should be water cooled during the machining operation.
7. Ferrite readings shall be made in terms of ferrite numbers as determined by an instrument calibrated in accordance with AWS A4.0. Instrument calibration shall be verified not less than once each month and more frequently if necessary.
8. A total of six ferrite readings shall be taken on the finished surface along the longitudinal axis of the weld bead. The readings shall not be taken on either end where the weld craters (stop and start areas) are located. Readings shall be taken on rather flat areas having dimensions at least 5/32-inch wide. The six readings obtained shall be averaged to a single value for conversion to the ferrite number.

CERTIFICATION OF QUALITY CONFORMANCE TESTS

Manufacturer or Distributor _____

Address _____

Specification MIL- _____

Type MIL- _____

Class _____

Diameter _____

Length _____

Electrode or Rod Lot No. _____

Customer's Name _____

Customer's Order No. _____

Wire Heat No. _____

Cast (inches) _____

Helix (inch) _____

Chemical Analysis
(Complete)

Carbon _____
Chromium _____
Nickel _____
Molybdenum _____
Columbium plus Tantalum _____

Maganese _____

Silicon _____
Phosphorus _____
Sulfur _____
Tungsten _____

Tantalum _____
Cobalt _____
Titanium _____

Delta ferrite:
Ferrite number _____

Deposit:
Method used _____
Bead width _____
Amperage _____
Electrode speed _____
Arc travel speed _____

Alloy identity test:
Coil drawn to finished size _____
Each electrode or rod (if required) _____

We hereby certify that the above material has been tested in accordance with the listed specification and is in conformance with all requirements.

_____

NOTES:

1. Items not applicable to the type electrode involved or exempted by the procurement document shall be marked N/A.
2. This form is applicable to the quality conformance tests required for each lot. One copy of the quality conformance certificate (figure 4) shall be forwarded for each lot that is included in the shipment.

FIGURE 4. Certification of quality conformance tests.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION *(Mark one)*

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

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

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*

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

DD FORM 1426, 82 MAR

PREVIOUS EDITION IS OBSOLETE.