

MIL-E-22200/2D
19 September 1986
SUPERSEDING
MIL-E-22200/2C
15 June 1976
(See 6.5)

MILITARY SPECIFICATION

ELECTRODES, WELDING, COVERED (AUSTENITIC CHROMIUM-NICKEL STEEL)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers shielded metal arc welding covered electrodes, for manually depositing austenitic chromium-nickel steel weld metal. The use of this specification is limited to the acquisition of electrodes for the following applications:

- (a) Subsafe.
- (b) HY-80 steel welded to austenitic stainless steel for submarines and surface ships.
- (c) Other special applications when approved or specified by the command or agency concerned.

Applicable American Welding Society specifications are used for other applications of these types of electrodes.

1.2 Classification. Electrodes shall be of the types, classes, and sizes shown in table I, as specified (see 6.2.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N3943

FSC 3439

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TABLE I. Classification.

Type	Class	Positions of welding	Sizes (diameter) inch
MIL-308-15 } MIL-308-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-308Co-15 } MIL-308Co-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-308L-15 } MIL-308L-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-308CoL-15 2	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-308HC-15 } MIL-308HC-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-309-15 } MIL-309-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-309Co-15 } MIL-309Co-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-309L-15 } MIL-309L-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-309CoL-15 } MIL-309CoL-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-309Cb-15 } MIL-309Cb-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4

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TABLE I. Classification. - Continued

Type	Class	Positions of welding	Sizes (diameter) inch
MIL-310-15 } MIL-310-16 }	1 2 3	All Horizontal fillets and flat Flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4 5/16
MIL-312-15 } MIL-312-16 }	1 2 3	All Horizontal fillets and flat Flat	5/64, 3/32, 1/8, 5/32 3/16, 1/4 5/16
MIL-316-15 } MIL-316-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-316L-15 } MIL-316L-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-317-15 } MIL-317-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-318-15 } MIL-318-16 }	1 2	All Horizontal fillets and flat	3/32, 1/8, 5/32 3/16, 1/4
MIL-330-15 } MIL-330-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-347-15 } MIL-347-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-347Co-15 } MIL-347Co-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4

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TABLE I. Classification. - Continued

Type	Class	Positions of welding	Sizes (diameter) inch
MIL-347HC-15 } MIL-347HC-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-349-15 } MIL-349-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4
MIL-16.8.2-15 } MIL-16.8.2-16 }	1 2	All Horizontal fillets and flat	1/16, 5/64, 3/32, 1/8, 5/32 3/16, 1/4

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

MILITARY

MIL-W-10430 - Welding Rods and Electrodes; Packaging of.
MIL-E-22200 - Electrodes, Welding, Covered; General
Specification for.

STANDARDS

FEDERAL

FED-STD-151 - Metals; Test Methods.

MILITARY

MIL-STD-147 - Palletized Unit Loads.
MIL-STD-271 - Nondestructive Testing Requirements for Metals.

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

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.)

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

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

(Copies of specifications, standards, publications, and other Government documents 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 167 - Standard Specification for Stainless and Heat-Resisting
Chromium-Nickel Steel Plate, Sheet, and Strip.

(DoD adopted)

A 240 - Standard Specification for Heat-Resisting Chromium and
Chromium-Nickel Stainless Steel Plate, Sheet, and Strip
for Pressure Vessels. (DoD adopted)

A 666 - Standard Specification for Austenitic Stainless Steel,
Sheet, Strip, Plate, and Flat Bar for Structural
Applications. (DoD adopted)

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

AMERICAN WELDING SOCIETY (AWS)

A4.2 - Standard Procedures for Calibrating Magnetic Instruments
to Measure the Delta Ferrite Content of Austenitic
Stainless Steel Weld Metal. (DoD adopted)

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

Z49.1 - Safety in Welding and Cutting.

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

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NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT
National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., ATA TRAFFIC Dept., 2200 Mill Road, Alexandria, VA 22314.)

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 furnished under this specification shall conform to the requirements of MIL-E-22200, and as specified herein.

3.2 Coverings.

3.2.1 Composition. The chemical composition of the electrode covering material is optional with the manufacturer, subject to the requirements of MIL-E-22200. The total water content in the covering of each electrode shall be determined as a qualifying test, and the moisture result obtained thereby shall be used to establish the maximum moisture level for this electrode under this specification. The maximum moisture content established for each electrode shall be reported in the certification of quality conformance tests (see 6.2.2).

3.2.2 Extent of covering at arc ends. Tubular electrodes at the arc end may extend beyond the coating in excess of the 1/32-inch requirement specified in MIL-E-22200 provided the actual volume of the exposed electrode is not greater than the following:

$$1/32 \text{ inch} \times \pi \left(\frac{\text{Nominal diameter in inches}}{2} \right)^2$$

3.3 Groove welds.

3.3.1 Mechanical properties. The mechanical properties of groove welds shall be as specified in table II.

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TABLE II. Mechanical properties of deposited weld metal.

Type	Tensile strength (minimum) (pounds per square inch)	Elongation ^{1/} in 2 inches (minimum) (percent)	Bend test condition		Bend test ^{2/3/4/} requirement fissures per specimen (maximum)
			As-welded	Heat-treated	
MIL-308-15 and 16	80,000	35	X	---	3
MIL-308Co-15 and 16	80,000	35	X	---	3
MIL-308L-15 and 16	75,000	35	X	---	2
MIL-308CoL-15	75,000	35	X	---	2
MIL-308HC-15 and 16	82,000	35	X	---	3
MIL-309-15 and 16	80,000	30	X	---	2
MIL-309Co-15 and 16	80,000	30	X	---	2
MIL-309L-15 and 16	75,000	30	X	---	2
MIL-309CoL-15 and 16	75,000	30	X	---	2
MIL-309Cb-15 and 16	80,000	30	X	---	2
MIL-310-15 and 16	80,000	30	X	---	4
MIL-312-15 and 16	95,000	22	X	---	1
MIL-316-15 and 16	75,000	30	X	---	3
MIL-316L-15 and 16	70,000	30	X	---	3
MIL-317-15 and 16	80,000	30	X	---	3
MIL-318-15 and 16	80,000	25	X	---	2
MIL-330-15 and 16	75,000	25	X	---	4
MIL-347-15 and 16	75,000 as-welded, and as heat-treated	30 as-welded, and 25 as heat-treated	X	X	2
MIL-347Co-15 and 16	80,000 as-welded, and as heat-treated	30 as-welded, and 25 as heat-treated	X	X	2
MIL-347HC-15 and 16	82,000 as-welded, and as heat-treated	30 as-welded, and 25 as heat-treated	X	X	3
MIL-349-15 and 16	100,000	25	X	---	3
MIL-16.8.2-15 and 16	80,000 as-welded, and as heat-treated	35 as-welded, and as heat-treated	X	X	2

1/ Elongation not required for transverse weld specimens.

2/ Bend test specimens or coupons shall be visually examined on the convex face by the unaided eye (corrected if necessary to 20/20 vision) and shall not exhibit more than the specified number of fissures after completion of bending. The presence of a single tear or fissure having a dimension larger than 1/16 inch measured in any direction shall be cause for rejection or failure under test.

3/ Fissures 1/64 inch and less shall not be counted.

4/ The corners of specimens shall not be considered when evaluating the results.

3.4 Chemical composition of deposited weld metal. Chemical composition of deposited weld metal shall be as specified in table III.

TABLE III. Chemical composition (percent) of deposited weld metal.^{1/}

Type	Percentage (single values are maximum)										
	Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Columbium	Tungsten	Colbalt
2/MIL-308- 15 and 16	0.08	0.5 - 2.5	0.04	0.03	0.90	18.0-21.0	9.0-11.0	---	---	---	---
2/MIL-308Co- 15 and 16	.08	.5 - 2.5	.04	.03	.90	18.0-21.0	9.0-11.0	---	---	---	0.10
2/MIL-308L- 15 and 16	.04	.5 - 2.5	.04	.03	.90	18.0-21.0	9.0-11.0	---	---	---	---
2/MIL-308CoL- 15	.04	.5 - 2.5	.04	.03	.90	18.0-21.0	9.0-11.0	---	---	---	0.10
3/MIL-308HC 15 and 16	.08-0.15	.5 - 2.5	.03	.03	4/ 0.90	18.0-21.0	9.0-11.0	---	---	---	---
2/MIL-309- 15 and 16	.10	.5 - 2.5	.04	.03	0.90	22.0-25.0	12.0-14.0	---	---	---	---
2/MIL-309Co- 15 and 16	.10	.5 - 2.5	.04	.03	.90	22.0-25.0	12.0-14.0	---	---	---	0.10
2/MIL-309L- 15 and 16	.04	.5 - 2.5	.04	.03	.90	22.0-25.0	12.0-14.0	---	---	---	---
2/MIL-309CoL- 15 and 16	.04	.5 - 2.5	.04	.03	.90	22.0-25.0	12.0-14.0	---	---	---	0.10

See footnotes at end of table.

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TABLE III. Chemical composition (percent) of deposited weld metal. 1/ - Continued

Type	Percentage (single values are maximum)										
	Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Columbium	Tungsten	Colbalt
2/MIL-309Cb-15 and 16	0.12	0.5 - 2.5	0.04	0.03	0.90	22.0-25.0	12.0-14.0	---	Cb+Ta 0.70-1.00	---	---
MIL-310-15 and 16	.20	1.0 - 2.5	.03	.03	.75	25.0-28.0	20.0-22.5	---	---	---	---
MIL-312-15 and 16	.15	0.5 - 2.5	.04	.03	.90	28.0-32.0	8.0-10.5	---	---	---	---
MIL-316-15 and 16	.08	.5 - 2.5	.04	.03	.90	17.0-20.0	11.0-14.0	2.0-2.5	---	---	---
MIL-316L-15 and 16	.04	.5 - 2.5	.04	.03	.90	17.0-20.0	11.0-14.0	2.0-2.5	---	---	---
MIL-317-15 and 16	.08	.5 - 2.5	.04	.03	.90	18.0-21.0	12.0-14.0	3.0-4.0	---	---	---
MIL-318-15 and 16	.08	.5 - 2.5	.04	.03	.90	17.0-20.0	11.0-14.0	2.0-2.5	5/	---	---
MIL-330-15 and 16	.25	1.0 - 2.5	.04	.03	.90	14.0-17.0	33.0-37.0	---	---	---	---
2/MIL-347-15 and 16	.08	0.5 - 2.5	.04	.03	.90	18.0-21.0	9.0-11.0	---	6/	---	---
2/MIL-347Co-15 and 16	.08	.5 - 2.5	.04	.03	.90	18.0-21.0	9.0-11.0	---	6/	---	0.10
MIL-347HC-15 and 16	.08-0.15	.5 - 2.5	.025	.025	4/	18.0-21.0	9.0-11.0	---	7/	---	---
MIL-349-15 and 16	.07- .13	.5 - 2.5	.03	.03	0.90	18.0-21.0	8.0-10.0	0.35-0.65	8/0.75-1.2	1.25-1.75	---
MIL-16.8.2-15 and 16	.10	.5 - 2.5	.03	.03	.50	14.5-16.5	7.5-9.5	1.0-2.0	---	---	---

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- 1/ Analysis shall be made for the elements for which specific values are shown in the table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements, except iron, is not present in excess of 0.70 percent.
- 2/ Ferrite number shall be from 4 to 10 as determined by an instrument calibrated in accordance with AWS A4.2 (see figure 1).
- 3/ Ferrite number shall not exceed 4 as determined by an instrument calibrated in accordance with AWS A4.2 (see figure 1).
- 4/ Silicon shall be not more than 5 times actual carbon present.
- 5/ Columbium (combined Cb+Ta) shall be not less than 6 times actual carbon present but not more than 1.00 percent.
- 6/ Columbium (combined Cb+Ta) shall be not less than 8 times actual carbon present but not more than 1.00 percent. Tantalum shall not exceed 0.10 percent.
- 7/ Columbium (combined Cb+Ta) shall be not less than 8 times actual carbon present but not more than 1.4 percent.
- 8/ Titanium shall be limited to 0.15 percent maximum.

3.5 Electrode identification. Electrodes shall be identified as specified in MIL-E-22200.

3.5.1 Heat and lot identification. When specified (see 6.2.1), each electrode shall be marked with heat or lot identification as specified in MIL-E-22200.

3.6 Production line purge. Straighten and cut machines, extrusion wire feeders, and the extrusion area or dip coating area shall be purged of all material used for a production run of one type of electrode which is not intended for use in a subsequent production run of a different type of electrode. The purge shall be conducted prior to starting a production run of a different type of electrode. For all other operations where the material is physically segregated and positively identified, or where the individual electrode is positively identified, the purge shall not be required.

3.7 Nominal lengths. The nominal lengths of electrodes shall be in accordance with table IV.

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TABLE IV. Nominal lengths.

Sizes (inch)	Electrode lengths end grips (inches)
1/16, 5/64	⁹
3/32	$\frac{1}{9}$ or 12
1/8	$\frac{1}{9}$ or 14
5/32 to 1/4 inclusive	14
5/16	18

1/ As specified (see 6.2.1).

3.8 Core wire alloy identity. The core wire (or strip) alloy identity requirements shall be as specified in MIL-E-22200.

3.9 Covered electrode alloy identity. When specified (see 6.2.1), the covered electrode alloy identity requirements shall be as specified in MIL-E-22200.

3.10 Groove weld soundness. The soundness of groove welds shall meet the requirements of class I of NAVSEA 0900-LP-003-9000.

4. QUALITY ASSURANCE PROVISIONS

4.1 The quality assurance provisions shall be in accordance with MIL-E-22200 and as specified herein.

4.2 Qualification tests. Qualification tests shall be as specified in MIL-E-22200 and table V herein.

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TABLE V. Summary of weld tests required for qualification.^{1/}

Weld test no.	Electrode type	Diameter sizes										Welding position ^{2/}	Tests					Test procedures	Requirements	
		1/16		5/64		3/32		1/8		5/32			3/16		1/4		5/16			
		1	5	1	5	1	5	1	5	1	5		1	5	1	5	1			5
3	All types	-	-	X	X	X	X	X	X	X	X	F	X	-	-	-	-	Figure 2 herein	3.10 herein	
6	All types	X	X	-	-	-	-	-	-	-	-	V	X	-	-	-	-	Figure 3 herein	3.10 herein	
														-	X	-	-	Figure 3 herein	Table II herein	
														-	-	-	X	-	Table III herein	
																			Table III herein	
8a	All types	-	-	X	X	X	X	X	X	X	X	V	X	-	-	-	-	Figure 4 herein	3.10 herein	
4	MIL-308 MIL-308Co MIL-308L MIL-308CoL MIL-308HC MIL-309 MIL-309Co MIL-309L MIL-309CoL MIL-309Cb MIL-347 MIL-347Co	-	-	-	-	-	-	-	-	-	-	F	X ^{4/}	-	-	-	-	Figure 1 herein	Table III herein	

See footnotes at top of next page.

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- 1/ For qualification testing of the electrodes, all electrode types shall be tested using direct current (dc) reverse polarity. In addition, MIL-XXX-16 electrode types shall be tested using alternating current (ac). For quality conformance inspection, all electrode types shall be tested using dc reverse polarity.
- 2/ P = flat V = vertical
- 3/ Instead of the weld pad specified in MIL-E-22200, chemical analysis samples may be taken from milling chips from ruptured ends of tensile specimens or from the ferrite test pad number (for those electrodes requiring ferrite determination).
- 4/ When both tests (3 and 8a) are applicable, radiography of test no. 3 will satisfy the requirement for test no. 8a for 3/16, 1/4, and 5/16 size electrodes. If test no. 3 is radiographed, test no. 8a may be eliminated for 3/16, 1/4, and 5/16 size electrodes.

4.3 Quality conformance inspection.

4.3.1 Lot. A lot of electrodes shall be as specified in MIL-E-22200 for inspection level A.

4.3.2 Sampling for quality conformance inspection. Sampling for quality conformance inspection shall be in accordance with MIL-E-22200.

4.3.3 Inspection. The samples selected in accordance with 4.3.2 shall be subjected to the tests specified in table VI (see 6.2.2).

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

Type	Required tests			Test procedures	Requirements
	Chemical analysis	Ferrite content	Nondestructive (X-ray)		
MIL-308	X	X	X	<div>For chemical analysis</div> MIL-E-22200	Table III herein
MIL-308Co	X	X	X		
MIL-308L	X	X	X		
MIL-308Co1	X	X	X		
MIL-308HC	X	X	X		
MIL-309	X	X	X		
MIL-309Co	X	X	X		
MIL-309L	X	X	X		
MIL-309CoL	X	X	X		
MIL-309Cb	X	X	X	<div>For ferrite content</div> Figure 1 herein	Table III herein
MIL-310	X	-	X		
MIL-312	X	-	X		
MIL-316	X	-	X		
MIL-316L	X	-	X		
MIL-317	X	-	X		
MIL-318	X	-	X		
MIL-330	X	-	X		
MIL-347	X	X	X		
MIL-347Co	X	X	X	<div>For nondestructive test</div> Figure 4 herein	3.10 herein
MIL-347HC	X	-	X		
MIL-349	X	-	X		
MIL-16.8.2	X	-	X		

4.3.3.1 Unsatisfactory test results. If the results of the first tests are determined to be unsatisfactory, two retests shall be permitted. The results of both retests shall be satisfactory for lot acceptance.

4.4 Other tests. Table VII summarizes other tests, in addition to those specified in tables V and VI for qualification inspection and quality conformance inspection of electrodes, as applicable.

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TABLE VII. Summary of other tests.

Tests	Procedures	Requirements
Diameter and length of core wire	MIL-E-22200	MIL-E-22200 and 3.7 herein
Concentricity	MIL-E-22200	MIL-E-22200
Dielectric strength ^{1/}	MIL-E-22200	MIL-E-22200
Covering, flaking, and cracking ^{1/}	MIL-E-22200	MIL-E-22200
Covering moisture ^{1/2/}	MIL-E-22200	3.2.1 herein
Alloy identity - core wire	MIL-E-22200	3.8 herein
Alloy identity - finished electrode ^{3/}	MIL-E-22200	3.9 herein

^{1/} Required for qualification inspection only.

^{2/} Moisture content established at qualification inspection shall be reported in certification of the quality conformance inspection (see 6.2.2).

^{3/} Required when specified (see 6.2.1).

4.5 Alloy identity certification. When specified (see 6.2.1), the Government representative will affix his stamp and date on the container, containing electrodes conforming to MIL-E-22200. The letters "AT", to indicate alloy tested, shall be affixed to the container adjacent to the date.

4.5.1 The identification of melts, heats, or lots; the general requirements for test specimens; the rejection of nonconforming lots or specimens; and the retest and resubmittal of nonconforming lots shall be in accordance with FED-STD-151.

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

5. PACKAGING

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

5.1 Packaging. Packaging of electrodes shall be level A or C, as specified (see 6.2.1).

5.1.1 Level A. Electrodes shall be packaged in class 1a or 1b unit containers as specified (see 6.2.1), in accordance with MIL-W-10430.

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5.1.1.1 Special instructions. When electrodes are required to be packaged in class 1a unit containers in accordance with MIL-W-10430, fiberboard or other cushioning material shall be inserted in each end of the unit container to restrict the end-wise movement of the electrodes. The cushioning materials shall be dry and in equilibrium with the electrode covering. The cushioning media may be omitted upon the successful completion of the drop test of MIL-W-10430.

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 for time periods as specified in MIL-E-22200.

5.1.2.1 Electrodes shall be packaged in class 1 or 2 containers of MIL-W-10430, as specified (see 6.2.1). Unit container weight shall be in accordance with the manufacturer's commercial practice.

5.2 Packing. Packing of electrodes shall be level A, B, or C, as specified (see 6.2.1).

5.2.1 Levels A and B. Electrodes shall be packed level A or B in accordance with MIL-W-10430, except that for levels A and B packing, palletization for other than cylindrical cans shall be in accordance with MIL-STD-147.

5.2.2 Level C. Packing shall be accomplished in a manner which will ensure acceptance by 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 Rules, National Motor Freight Classification Rules, or other carrier regulations as applicable to the mode of transportation.

5.3 Marking.

5.3.1 Interior packages. Shipment marking information shall be provided on interior packages in accordance with the manufacturer's commercial practice. In addition to the lot identification as specified in MIL-E-22200, the information shall include MIL type, size, specification number, manufacturer's or distributor's name, date of manufacture (month/year), and manufacturer's or distributor's brand or type designation. Packages, or the smallest integral unit with a shipping container, shall carry the following warning label, as a minimum, prominently displayed in legible type on the package:

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

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

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

Keep your head out of the fumes.

Use enough ventilation, 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, 550 NW LeJeune Road, P.O. Box 351040, Miami, FL 33135; OSHA Safety and Health Standards, 29 CFR 1910, available from the U.S. Department of Labor, Washington, DC 20210.

DO NOT REMOVE THIS LABEL"

Significant toxic constituents when present in the electrode in greater than trace amounts shall be identified on the caution label so that normal ventilation can be increased accordingly. These constituents include but are not limited to those specified in AWS Z49.1.

5.3.2 Exterior shipping containers and palletized unit loads. Shipment marking information shall be provided on exterior shipping containers and palletized unit loads in accordance with the manufacturer's commercial practice. In addition to the information required for interior packages as specified in 5.3.1, the information shall include shipping destination, stock number as listed by contract, and customer's order number, customer's item number, and customer's name. Each class 1b container on the container end adjacent to the electrode grip end shall be marked "OPEN THIS END".

6. NOTES

6.1 Intended use.

6.1.1 MIL-308-15 and 16. These electrodes are intended for the general welding of 18 percent chromium, 8 percent nickel, corrosion-resistant (stainless) steels.

6.1.2 MIL-308Co-15 and 16. These electrodes are intended for the welding applications of 6.1.1 requiring a limited cobalt content.

6.1.3 MIL-308L-15 and 16. These electrodes are 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.

6.1.4 MIL-308CoL-15. These electrodes are intended for the welding applications of 6.1.3 requiring a limited cobalt content.

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6.1.5 MIL-308HC-15 and 16. These electrodes are intended for applications where low magnetic permeability is of prime importance and where corrosion is not a factor.

6.1.6 MIL-309-15 and 16. These electrodes are 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. These electrodes are also for deposition of a corrosion-resistant overlay on carbon and low alloy steels.

6.1.7 MIL-309Co-15 and 16. These electrodes are intended for the welding applications of 6.1.6 requiring a limited cobalt content.

6.1.8 MIL-309L-15 and 16. These electrodes are intended for similar applications as MIL-309-15 and 16 types, but where added resistance to intergranular corrosion is desired.

6.1.9 MIL-309CoL-15 and 16. These electrodes are intended for the welding applications of 6.1.8 requiring a limited cobalt content.

6.1.10 MIL-309Cb-15 and 16. These electrodes are intended for similar applications as the MIL-309-15 and 16 types, but where expected corrosive conditions are more severe, or higher strength at elevated temperature is desirable.

6.1.11 MIL-310-15 and 16. These electrodes are 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. These electrodes are also intended for deposition of a corrosion-resistant overlay on carbon and low alloy steels.

6.1.12 MIL-312-15 and 16. These electrodes are intended for the joining of the super-alloys to low-alloy (chromium-molybdenum and chromium-nickel-molybdenum) steels.

6.1.13 MIL-316-15 and 16. These electrodes are intended for the joining of corrosion-resistant alloys of similar designations. The molybdenum content imparts increased resistance to the corrosive effect of many organic acids, brine, sulfurous, and sulfuric acid.

6.1.14 MIL-316L-15 and 16. These electrodes are intended for the welding of type 316L corrosion-resisting steel and under conditions similar to those under which type MIL-318 could be used.

6.1.15 MIL-317-15 and 16. These electrodes are intended for welding of alloys of similar composition for increased corrosion-resistance to sulfuric and sulfurous acid and their salts.

6.1.16 MIL-318-15 and 16. These electrodes are 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.

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6.1.17 MIL-330-15 and 16. These electrodes are used in repair of alloy castings and welding of cast and wrought alloys of similar compositions which are generally used for heat-resisting properties of high temperatures.

6.1.18 MIL-347-15 and 16. These electrodes are intended for the general welding of 18-8 corrosion-resisting steels stabilized by columbium, which are used where conditions of welding or service make unstabilized base metals susceptible to carbide precipitation, with consequent intergranular corrosion. Use of these electrodes will not prevent intergranular corrosion alongside a weld in unstabilized 18-8 chromium-nickel base metals.

6.1.19 MIL-347Co-15 and 16. These electrodes are intended for the welding applications of 6.1.18 requiring a limited cobalt content.

6.1.20 MIL-347HC-15 and 16. These electrodes are intended for applications where low magnetic permeability or heat resistance is of prime importance and where corrosion is not a factor.

6.1.21 MIL-349-15 and 16. These electrodes are intended for the joints of the super-alloys for applications requiring high strength at elevated temperatures.

6.1.22 MIL-16.8.2-15 and 16. These electrodes are intended for use in welding 316, 317, and 347 alloys for corrosion-resisting and high temperature service in the as-welded or stress-relieved condition.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type, class, and size (see 1.2).
- (c) Whether heat or lot identification is required for individual electrodes (see 3.5.1).
- (d) For 3/32 size electrode, the length required (see table IV).
- (e) For 1/8 size electrode, the length required (see table IV).
- (f) Whether alloy identity testing of the core wire of each covered electrode after final marking is required (see 3.9).
- (g) Whether alloy identity testing and certification is required for each finished electrode (see table VII and 4.5).
- (h) Levels of packaging and packing required (see 5.1 and 5.2).
- (i) Unit container classes required (see 5.1.1 and 5.1.2.1).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

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<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.2.1 and 4.3.3	Certification data for level I material	UDI-T-23191	---

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., Vol. I, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.2.3 Electrodes should be ordered by the pound.

6.3 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, MIL-308CoL, MIL-309, MIL-309Co, MIL-309L, MIL-309CoL, MIL-309Cb, MIL-347 and MIL-347Co, the consignee or user activity may consider the following delta ferrite test result limits acceptable:

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

Test results should meet the specified 4 to 10 ferrite number range. For type MIL-308HC, the user activity may consider a maximum of ferrite number 5 acceptable, while the contractor should meet the specified ferrite number 4 as the maximum.

6.4 Subject term (key word) listing.

Alloy identity
Austenitic chromium-nickel steel
Electrodes
Welding
Weld metal

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6.5 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.

Custodians:

Army - AL
Navy - SH
Air Force - 20

Preparing activity:

Navy - SH
(Project 3439-0593)

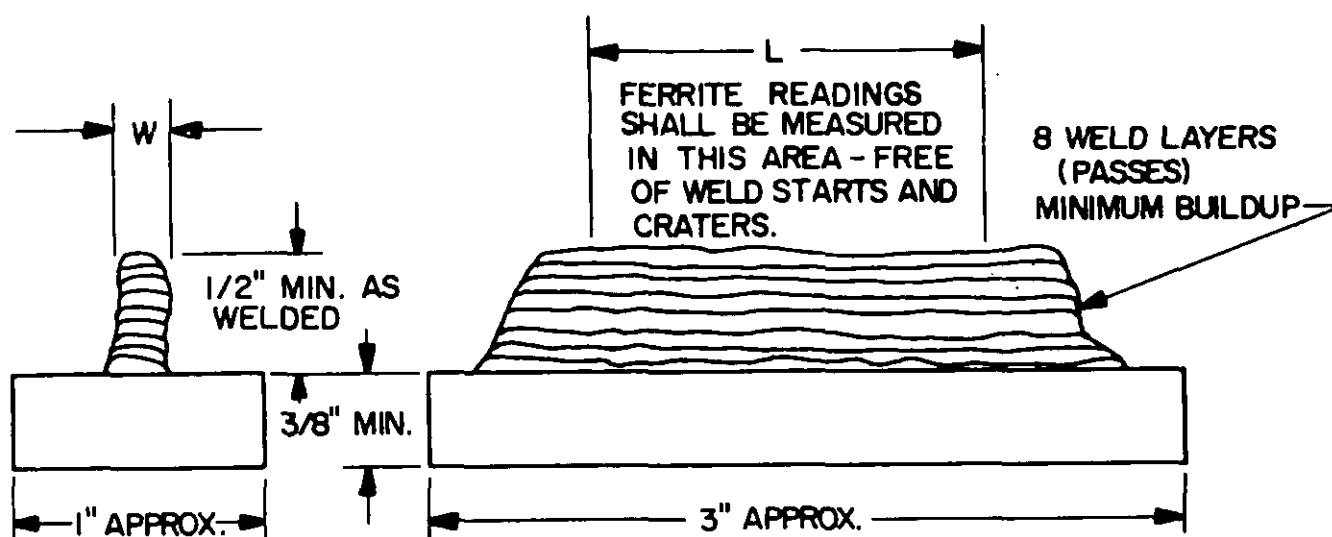
Review activity:

DLA - GS

User activities:

Army - AR
Navy - MC, OS, YD

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SH 9635A

Electrode diameter (inch)	Width (W) minimum (inch)	Length (L) minimum (inch)	Welding current (amperes)	Arc voltage (volts)
1/16	1/4	3/4	35 to 45	See note 3
5/64	1/4	3/4	45 to 55	
3/32	1/4	1	65 to 80	
1/8	5/16	1	90 to 110	
1/3	5/16	1-1/2	120 to 140	
3/16	5/16	1-1/2	150 to 170	
1/4	5/16	1-1/2	180 to 210	

NOTES:

1. The base material for the weld pad shall be types 301, 302, or 304 conforming to ASTM A 167, ASTM A 240, or ASTM A 666.
2. 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 and a minimum of eight layers. The weld bead layers shall be deposited with a maximum weave width (electrode manipulation) of 2-1/2 times the core wire diameter, except the first several layers may be deposited with a wider weave. The minimum width and approximate length of the weld buildup free of the weld arc starts and craters shall conform to the above table.
3. The welding amperages shall conform to the above table. The weld starts and stops shall be located at the ends of the weld buildup. The arc length shall be as short as practicable and the voltage recorded for reference only.
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.

FIGURE 1. Ferrite weld specimen (see weld test No. 4 of table V).

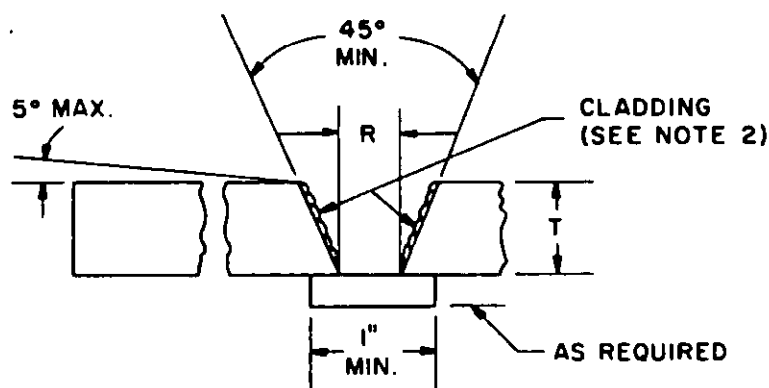
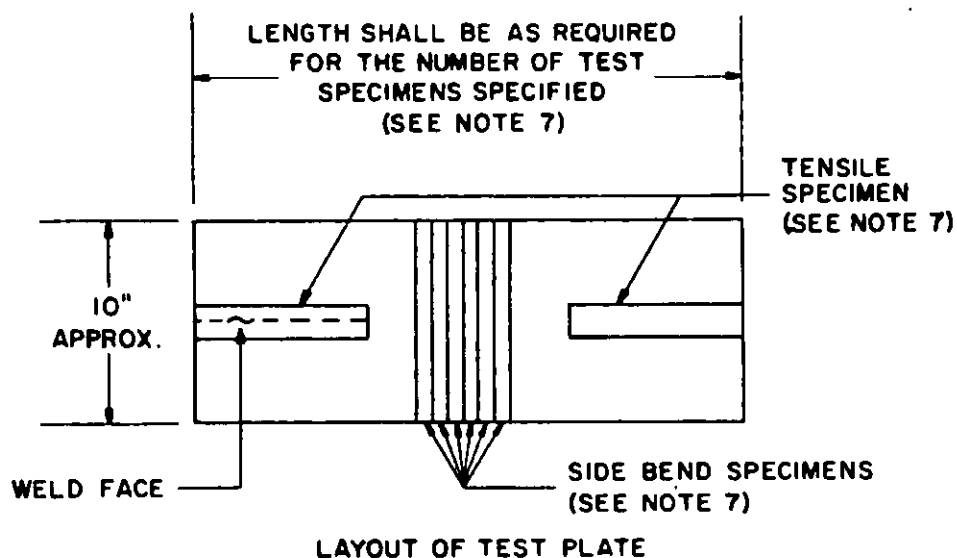
MIL-E-22200/2D

Notes to figure 1: - Continued

6. After welding, the weld buildup shall be surface ground to 64 root mean square (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 shall 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 A4.2. Instrument calibration shall be verified not less than once per 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.

FIGURE 1. Ferrite weld specimen (see weld test No. 4 of table V). - Continued

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GROOVE PREPARATION OF TEST PLATE

Electrode size (inch)	Minimum thickness (T) (inch)	Maximum root opening (R) (inch)	No. of layers ^{1/}		Current (minimum)	
			Minimum	Maximum	Dc (reverse-polarity) (amperes)	Ac (amperes)
3/32	1/2	1/4	1/	1/	75	85
1/8	1/2	1/4	1/	1/	95	105
5/32	3/4	1/2	7	9	135	150
3/16	3/4	1/2	7	9	155	170
1/4	3/4	1/2	7	9	245	265
5/16	3/4	1/2	7	9	345	365

^{1/} Pass and layer sequence shall be reported.

FIGURE 2. Welded joint for mechanical and bend tests (see test no. 3 of table V).

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Notes to figure 2:

1. The base material shall match the chemistry of the electrode (same type designation in most instances). When base material matching the chemistry of the electrode is not available, AISI type 304 and 347 material may be substituted for the fabrication of tension and bend specimens provided that for tension specimens, cladding or battering is accomplished. Base materials shall conform to ASTM A 167, ASTM A 240, or ASTM A 666.
2. If cladding is necessary, a minimum thickness of 1/8 inch shall be deposited on the plate edges comprising the groove. This may be done either prior to or after joint fit-up.
3. Preheat and interpass temperature shall not exceed 350°F.
4. Welding shall be accomplished in the flat position. Welds shall be deposited in layers using the 3 electrode core diameter maximum weave build up sequence. Layers shall be approximately 1/8-inch thick and shall be deposited in such a manner that the final layer includes a reinforcement of standard proportions (1/32 to 1/8 inch). Each layer shall be started at the finishing end of the preceding layer.
5. The weld reinforcement and backing strip shall be removed flush with base plate surfaces, after completion of welding. The assembly shall be radiographed in accordance with MIL-STD-271. Radiographs shall meet the acceptance requirements of 3.10.
6. Tensile specimens from 3/4-inch test plate shall be 0.505 inch diameter; those from 1/2-inch test plate shall be 0.250 inch diameter. For details of tensile specimens, see AWS B4.0.
7. The number and type of mechanical tests shall be as follows:

Electrode type	Size (inch)	Number of test specimens					
		Tensile ^{1/}				Side bend ^{1/}	
		0.250 inch		0.505 inch			
		AW ^{2/}	HT ^{2/3/}	AW ^{2/}	HT ^{2/3/}	AW ^{2/}	HT ^{2/3/}
MIL-347	3/32 and 1/8 5/32 to 5/16	2	2	-	-	3	3
MIL-347HC		-	-	2	2	3	3
MIL-16.8.2	3/32 and 1/8 5/32 to 5/16	2	-	-	-	3	-
All other		-	-	2	-	3	-

^{1/} Tensile and side bend tests shall be conducted in accordance with AWS B4.0.

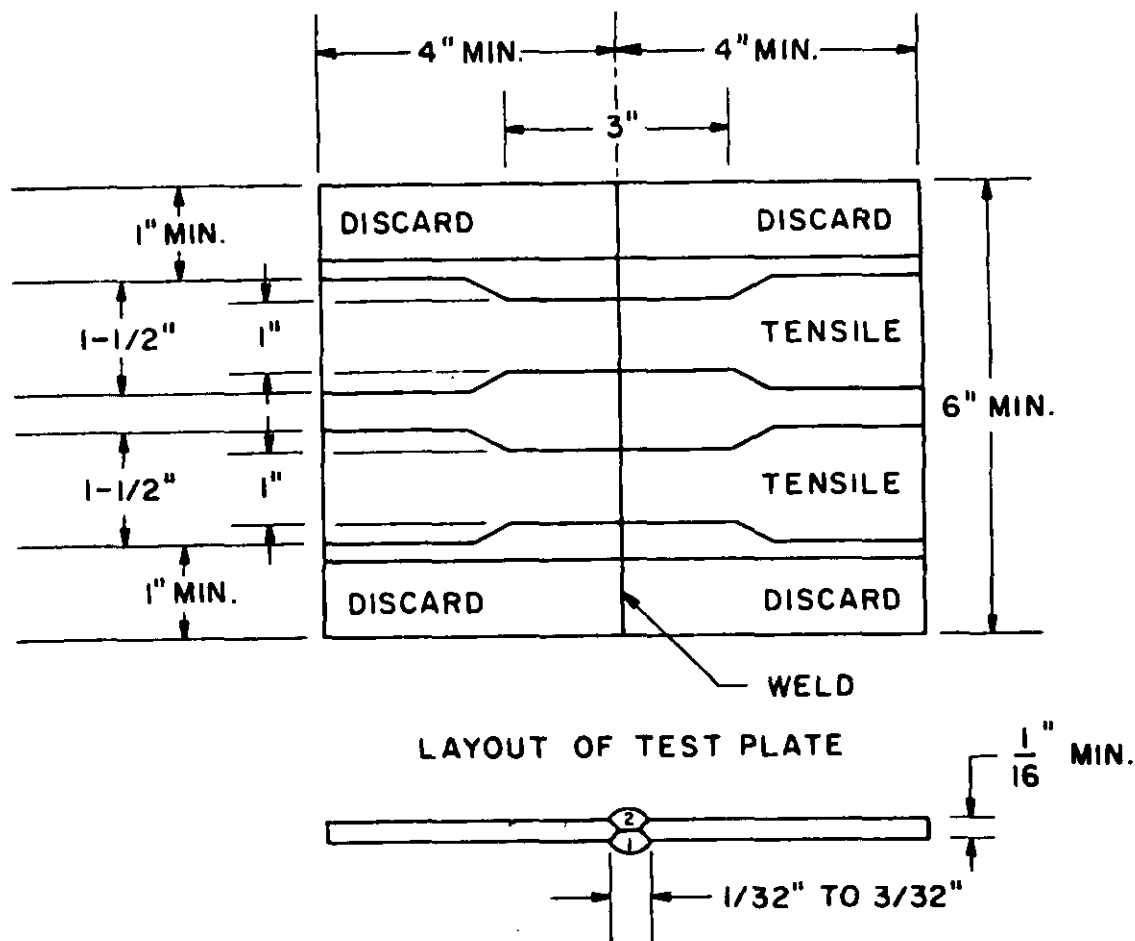
^{2/} AW = As welded, HT = heat treated.

^{3/} Heat treatment shall be as specified in note 8.

8. When heat treatment is required, the test specimens shall be heated to 1550°F, held for 1 hour, and cooled. Heating and cooling rates shall not exceed 300°F per hour.

FIGURE 2. Welded joint for mechanical and bend tests
(see no. 3 of table V). - Continued

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WELD JOINT PREPARATION

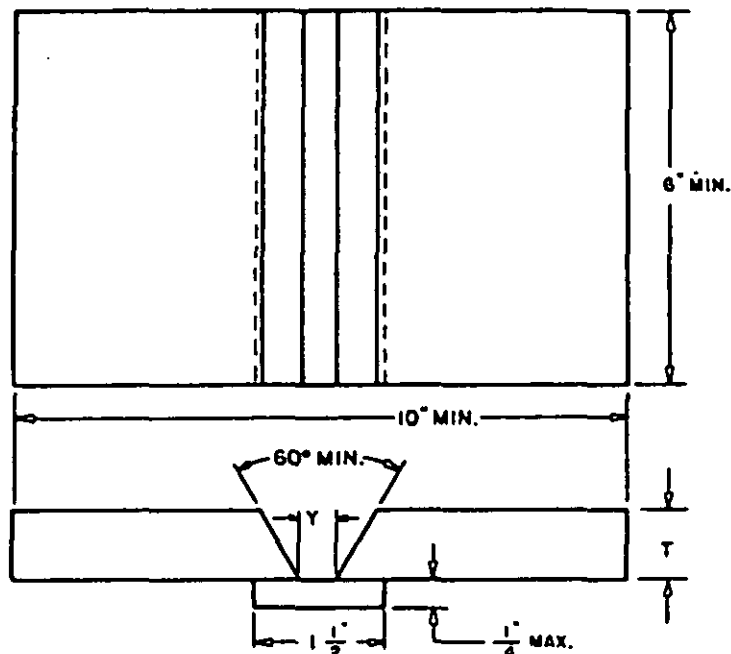
SH 9388

NOTES:

1. Welding shall be done in the vertical position. Weld deposition shall be as shown. The backside of weld no. 1 shall be cleaned by grinding prior to depositing weld bead no. 2. Welding inter-pass temperature shall be 350°F maximum.
2. The weld reinforcement shall be removed flush with the base material on both surfaces and the assembly shall be radiographed in accordance with MIL-STD-271. The radiograph shall meet the acceptance requirements of 3.10.
3. Two transverse weld tensile specimens shall be prepared as shown and tested in the as-welded condition in accordance with AWS B4.0. Failure may be in weld or base material; however, to be acceptable the strength shall be equal to or greater than that specified in table II for the type electrode being tested.

FIGURE 3. Transverse weld tensile test for 1/16-inch and 5/64-inch electrode (see test no. 6 of table V).

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Electrode size	3/32 (inch)	1/8 (inch)	5/32 (inch)	3/16-5/16 (inch)
Thickness (T) ^{1/}	1/4	3/8	1/2	1/2
Root opening (Y) ^{2/}	1/4	5/16	3/8	1/2
Weld bead width (max)	3/8	1/2	5/8	3/4

^{1/} Minimum.^{2/} Tolerance plus or minus 1/16 inch.

NOTES:

1. Welding shall be accomplished with the test plate in the vertical or flat position as specified in table V. Welding current shall be in accordance with the manufacturer's recommendations and the actual values shall be recorded and reported.
2. Base metal shall be in accordance with any of the following AISI types: 304, 316, 316L, and 347 conforming to ASTM A 167, ASTM A 240, or ASTM A 666.
3. The bevel edge preparation shall be machined or ground.
4. Welds shall be deposited in approximately 1/8-inch thick layers. Weld bead widths shall be as shown above. Each bead shall contain a start in the area to be evaluated.
5. The reinforcement shall be 3/16 inch maximum.
6. Preheat and interpass temperature shall be 60°F minimum and 350°F maximum.
7. After completion of the weld, the weld reinforcement and backing strip shall be X-rayed in accordance with MIL-STD-271.
8. The radiographs shall meet the acceptance requirements of 3.10.

FIGURE 4. Groove weld usability test (see test no. 8a of table V).

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER MIL-E-22200/2D		2. DOCUMENT TITLE ELECTRODES, WELDING, COVERED (AUSTENITIC CHROMIUM-NICKEL STEEL)	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR	
		<input type="checkbox"/> USER	
		<input type="checkbox"/> MANUFACTURER	
		<input type="checkbox"/> 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)	

TO DETACH THIS FORM, CUT ALONG THIS LINE.)