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مدیریت پژوهش و فنآوری

امورتدوین استانداردها

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Covered Electrodes, Series(60,70,80,90,100,110,120)for Shield Metal Arc Welding

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مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۹۷۶ مورخ ۱۴۰۱/۰۵/۲۳ هیات مدیره، نامه شماره گ۹/۰۰۰/۶۹۹۶۷ مورخ ۱۴۰۱/۰۵/۱۸ آن مدیریت درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

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Foreword

This standard specification is intended to be mainly used by N.I.G.C. and contractors, and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals about this standard, and may revise this document accordingly based on the received feedbacks.

General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.

2- "COMPANY": refers to National Iranian Gas Company (NIGC).

3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.

4- "SHALL ": is used where a provision is mandatory.

5- "SHOULD": is used where a provision is advised only.

6- "MAY": is used where a provision is completely discretionary.

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1. SCOPE

This standard specification provides NIGC'S requirements for material, manufacturing, inspection, testing and packing of low- alloy steel and carbon steel electrode for shielded metal arc welding including (60, 70, 80,90, 100,110 and 120 series).

2. REFERENCES

Throughout this standard specification, the following standards & codes are referred to, the edition of these standards & codes those are in effect at the time of issuing of this standard specification.

The latest edition and changes in standards & codes that occur after the date of standards that referred shall be used.

2.1. Normative references:

2.1.1. ANSI/AWS A5.5 (2014): Specification for low-alloy steel Electrodes for shielded metal arc welding (for 70.80.90 Series).

2.1.2. ANSI/AWS A5.1 (2012): Specification for carbon steel Electrodes for shielded metal arc welding (for 60 Series).

2.1.3. ANSI/AWS A5.01 (2013): welding Consumables-Procurement of Filler Metals and Fluxes

2.1.4. ANSI/AWS A5.02 (2013): Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes.

2.1.5. NACE MR 0175: Standard Material Requirements. Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment

2.2. Informative references:

2.2.1 ANSI Z49.1: Safety in Welding, Cutting, and Allied Processes.

2.2.2-JIS G 3503: Wire rode analysis (SWRY 11, SWRY 21)

3. TERMS AND DEFINITIONS:

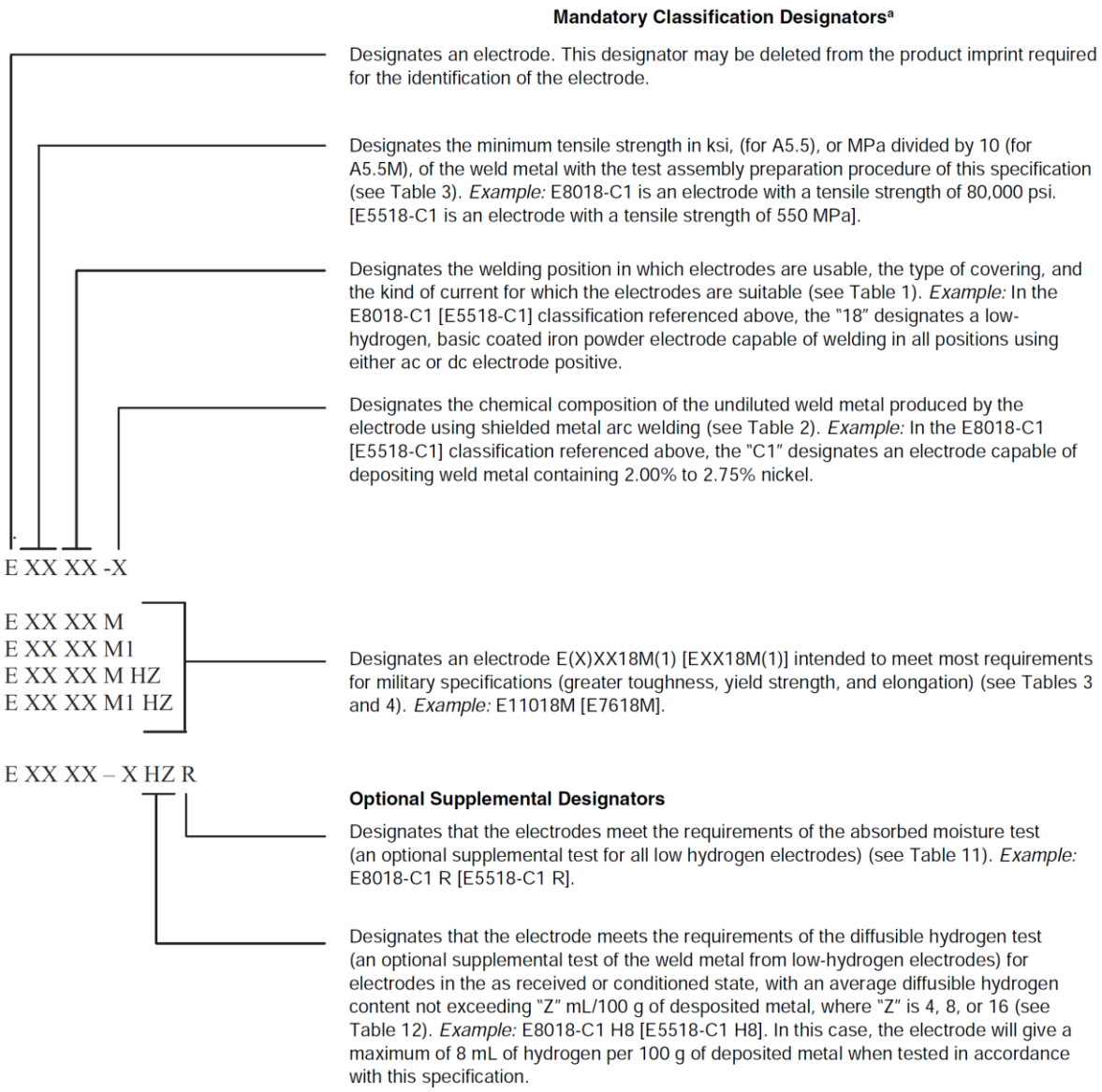
According to AWS A3.0: standard welding terms and definitions.

4. CLASIFICATION:

The welding electrodes covered by this standard utilize a classification system, shown in fig 1, based on U.S. Customary Units and the international system of units (SI) respectively, and are classified according to:

(1) Type of current, Type of covering, welding position (see Table 1).
(2) Chemical composition of the weld metal (see Table 2).
(3) Mechanical properties of the weld metal in the as-welded, post weld heat treated or aged condition (see Tables 3).

(4) Impact test requirement (see Table 4).
(5) Required tests (see Table 5).



[a] The combination of these designators constitutes the electrode classification.

Source: AWS A5.5/A5.5M:2006, Figure 9

Figure 1—Order of Electrode Mandatory and Optional Supplemental Designators

Table 1
Electrode Classification

AWS Classification[a]				
A5.5	A5.5M	Type of Covering	Welding Positions for Classification[b]	Type of Current[c]
E7010-X	E4910-X	High cellulose sodium	F, V, OH, H	dcep
E7011-X	E4911-X	High cellulose potassium	F, V, OH, H	ac or dcep
E7015-X[d,e]	E4915-X[d,e]	Low hydrogen sodium	F, V, OH, H	dcep
E7016-X[d,e]	E4916-X[d,e]	Low hydrogen potassium	F, V, OH, H	ac or dcep
E7018-X[d,e]	E4918-X[d,e]	Low hydrogen potassium, iron powder [f]	F, V, OH, H	ac or dcep
E7020-X	E4920-X	High iron oxide	H-fillets F	ac or dcen ac, dcep, or dcen
E7027-X	E4927-X	High iron oxide, iron powder[f]	H-fillets F	ac or dcen ac, dcep, or dcen
E8010-X	E5510-X	High cellulose sodium	F, V, OH, H	dcep
E8011-G	E5511-G	High cellulose potassium	F, V, OH, H	ac or dcep
E8013-G	E5513-G	High titania potassium	F, V, OH, H	ac, dcep, or dcen
E8015-X[d,e]	E5515-X[d,e]	Low hydrogen sodium	F, V, OH, H	dcep
E8016-X[d,e]	E5516-X[d,e]	Low hydrogen potassium	F, V, OH, H	ac or dcep
E8018-X[d,e]	E5518-X[d,e]	Low hydrogen potassium, iron powder [f]	F, V, OH, H	ac or dcep
E8045-P2[d,e]	E5545-P2[d,e]	Low hydrogen sodium	F, OH, H, V-down	dcep
E9010-G	E6210-G	High cellulose sodium	F, V, OH, H	dcep
E9010-X	E6210-X	High cellulose sodium	F, V, OH, H	dcep
E9011-G	E6211-G	High cellulose potassium	F, V, OH, H	ac or dcep
E9013-G	E6213-G	High titania potassium	F, V, OH, H	ac, dcep, or dcen
E9015-X[d,e]	E6215-X[d,e]	Low hydrogen sodium	F, V, OH, H	dcep
E9016-X[d,e]	E6216-X[d,e]	Low hydrogen potassium	F, V, OH, H	ac or dcep
E9018-X[d,e]	E6218-X[d,e]	Low hydrogen potassium, iron powder [f]	F, V, OH, H	ac or dcep
E9018M[d,e]	E6218M[d,e]	Iron powder, low hydrogen [f]	F, V, OH, H	dcep
E9045-P2[d,e]	E6245-P2[d,e]	Low hydrogen sodium	F, OH, H, V-down	dcep

a) The letter “X” as used in this table, and elsewhere in this specification, stands for any allowable value of the designator it replaces in the classification.

b) The abbreviations, F, V, V-down, OH, H, and H-fillets indicate the welding position; as follows:

F = Flat, H = Horizontal, H-fillets = Horizontal fillets

V = Vertical (For electrodes 3/16 in [5.0 mm] and under, except 5/32 in [4.0 mm] and under for classification E(X)XX15-X, E(X)XX16-X,E(X)XX18-X, and E(X)XX18M(1).

V-down = vertical, with downward progression

OH = overhead (For electrodes 3/16 in [5.0 mm] and under, except 5/32 in [4.0 mm] and under for classifications E(X)XX15-X, E(X)XX16-X,E(X)XX18-X), and E(X)XX18M(1).

c) The term “DCEP” refers to direct current, electrode positive (dc, reverse polarity). The term “DCEN” refers to direct current, electrode negative (dc, straight polarity).

d) Electrodes classified as E(X)XX15-X, E(X)XX16-X, E(X)XX18-X, E(X)XX18M(1) or E(X)XX45-P2 which meet supplemental absorbed moisture requirements in Table 11 may be further identified as shown in Table 11 and Figure 1 of AWS A5.5-2014 .

e) Electrodes classified as E(X)XX15-X, E(X)XX16-X, E(X)XX18-X, E(X)XX18M(1) or E(X)XX45-P2 which produce weld metal that meets the maximum average level of diffusible hydrogen in Table 12 may be further identified as specified in Table 12 and Figure 1 of AWS A5.5-2014.

f) Use of the term “iron powder” is intended to include other metal powders added to the Covering for alloying of the weld metal (See A6.14 of Annex A, AWS A5.5-2014).

Table 1
Electrode Classification

AWS Classification				
A5.1	A5.1M	Type of Covering	Welding Position[a]	Type of Current[b]
E6010	E4310	High cellulose sodium	F, V, OH, H	dcep
E6011	E4311	High cellulose potassium	F, V, OH, H	ac or dcep
E6012	E4312	High titania sodium	F, V, OH, H	ac or dcen
E6013	E4313	High titania potassium	F, V, OH, H	ac, dcep, or dcen
E6018[c]	E4318[c]	Low-hydrogen potassium, iron powder	F, V, OH, H	ac or dcep
E6019	E4319	Iron oxide titania potassium	F, V, OH, H	ac, dcep, or dcen
E6020	E4320	High iron oxide	H-fillet F	ac or dcen ac, dcep, or dcen
E6022[d]	E4322[d]	High iron oxide	F, H-fillet	ac or dcen
E6027	E4327	High iron oxide, iron powder	H-fillet F	ac or dcen ac, dcep, or dcen
E7014	E4914	Iron powder, titania	F, V, OH, H	ac, dcep, or dcen
E7015	E4915	Low-hydrogen sodium	F, V, OH, H	dcep
E7016[c]	E4916[c]	Low-hydrogen potassium	F, V, OH, H	ac or dcep
E7018[c]	E4918[c]	Low-hydrogen potassium, iron powder	F, V, OH, H	ac or dcep
E7018M	E4918M	Low-hydrogen iron powder	F, V, OH, H	dcep
E7024[c]	E4924[c]	Iron power, titania	H-fillet, F	ac, dcep, or dcen
E7027	E4927	High iron oxide, iron powder	H-fillet F	ac or dcen ac, dcep, or dcen
E7028[c]	E4928[c]	Low-hydrogen potassium, iron powder	H-fillet, F	ac or dcep
E7048	E4948	Low-hydrogen potassium, iron powder	F, OH, H, V-down	ac or dcep

a) The abbreviations, F, H, H-fillet, V, V-down, and OH indicate the welding positions as follows:

F = Flat, H = Horizontal, H-fillet = Horizontal fillet, V = Vertical, progression upwards (for electrodes 3/16 in [5.0 mm] and under, except 5/32 in [4.0 mm] and under for classifications E6018 [E4318], E7014 [E4914], E7015 [E4915], E7016 [E4916], E7018 [E4918], E7018M [E4918M], E7048 [E4948]). V-down = Vertical, progression downwards (for electrodes 3/16 in [5.0 mm] and under, except 5/32 in [4.0 mm] and under for classifications E6018 [E4318], E7014 [E4914], E7015 [E4915], E7016 [E4916], E7018 [E4918], E7018M [E4918M], E7048 [E4948]), OH = Overhead (for electrodes 3/16 in [5.0 mm] and under, except 5/32 in [4.0 mm] and under for classifications E6018 [E4318], E7014 [E4914], E7015 [E4915], E7016 [E4916], E7018 [E4918], E7018M [E4918M], E7048 [E4948]).

b) The term “DCEP” refers to direct current electrode positive (dc, reverse polarity). The term “DCEN” refers to direct current electrode negative (dc, straight polarity).

c) Electrodes with supplemental elongation, notch toughness, absorbed moisture, and diffusible hydrogen requirements may be further identified as shown in Tables 2, 3, 10, and 11 of AWS A5.1-2012.

d) Electrodes of the E6022 [E4322] classification are intended for single-pass welds only.

5. Summary of Tests (AWS A5.5-2014 and AWS A5.1-2012).

The tests required for each classification are specified in Table 5. The purpose of these tests is to determine the chemical composition, mechanical properties, and soundness of the weld metal; the usability of the electrode; and the moisture content of the low-hydrogen electrode covering. The base metal for the weld test assemblies, the welding and testing procedures to be employed, and the results required are given in Clauses 9 through 15 (AWS A5.5-2014). The supplemental tests for absorbed moisture (see Clause 16 of AWS A5.5-2014) and for diffusible hydrogen (see Clause 17 of AWS A5.5-2014) are not required for classification of the low-hydrogen electrodes (see Note i of Table 5).

Table 2
Chemical Composition Requirements for Undiluted Weld Metal

AWS Classification[c]		Weight Percent[a,b]									Additional Elements[e,f]	
A5.5	A5.5M	Number[d]	C	Mn	Si	P	S	Ni	Cr	Mo	Type	Amt.
Pipeline Steel Electrodes												
E7010-P1	E4910-P1	W17110	0.20	1.20	0.60	0.03	0.03	1.00	0.30	0.50	V	0.10
E8010-P1	E5510-P1	W18110	0.20	1.20	0.60	0.03	0.03	1.00	0.30	0.50	V	0.10
E9010-P1	E6210-P1	W19110	0.20	1.20	0.60	0.03	0.03	1.00	0.30	0.50	V	0.10
E8018-P2	E5518-P2	W18218	0.12	0.90–1.70	0.80	0.03	0.03	1.00	0.20	0.50	V	0.05
E9018-P2	E6218-P2	W19218	0.12	0.90–1.70	0.80	0.03	0.03	1.00	0.20	0.50	V	0.05
E8045-P2	E5545-P2	W18245	0.12	0.90–1.70	0.80	0.03	0.03	1.00	0.20	0.50	V	0.05
E9045-P2	E6245-P2	W19245	0.12	0.90–1.70	0.80	0.03	0.03	1.00	0.20	0.50	V	0.05
E10045-P2	E6945-P2	W10245	0.12	0.90–1.70	0.80	0.03	0.03	1.00	0.20	0.50	V	0.05
General Low-Alloy Steel Electrodes												
E(X)XX10-G[i]	EXX10-G[i]	–	–	1.00 min.[j]	0.80 min.[j]	0.03	0.03	0.50 min.[j]	0.30 min.[j]	0.20 min.[j]	V Cu	0.10 min.[j] 0.20 min.[j]
E(X)XX11-G[i]	EXX11-G[i]	–	–	1.00 min.[j]	0.80 min.[j]	0.03	0.03	0.50 min.[j]	0.30 min.[j]	0.20 min.[j]	V Cu	0.10 min.[j] 0.20 min.[j]
E(X)XX13-G[i]	EXX13-G[i]	–	–	1.00 min.[j]	0.80 min.[j]	0.03	0.03	0.50 min.[j]	0.30 min[j]	0.20 min.[j]	V Cu	0.10 min.[j] 0.20 min.[j]
E(X)XX15-G[i]	EXX15-G[i]	–	–	1.00 min.[j]	0.80 min.[j]	0.03	0.03	0.50 min.[j]	0.30 min[j]	0.20 min.[j]	V Cu	0.10 min.[j] 0.20 min.[j]
E(X)XX16-G[i]	EXX16-G[i]	–	–	1.00 min.[j]	0.80 min.[j]	0.03	0.03	0.50 min.[j]	0.30 min.[j]	0.20 min.[j]	V Cu	0.10 min.[j] 0.20 min.[j]
E(X)XX18-G[i]	EXX18-G[i]	–	–	1.00 min.[j]	0.80 min.[j]	0.03	0.03	0.50 min.[j]	0.30 min.[j]	0.20 min.[j]	V Cu	0.10 min.[j] 0.20 min.[j]

a) Single values are maxima, except where specified otherwise.

b) Weld metal shall be analyzed for those elements for which specific values are shown. Other elements listed without specified values shall be reported, if intentionally added. The total of these latter unspecified elements and all other elements not intentionally added shall not exceed 0.50%.

c) The suffixes A1, B3, C3, etc. designate the chemical composition of the electrode classification.

d) SAE-HS–1086/ASTM DS–56, Metals & Alloys in the Unified Numbering System.

e) Analysis for boron is required to be reported for any weld metal if it has been intentionally added or is known to be present at levels greater than 0.0010%.

f) Analysis for cobalt is required to be reported if intentionally added, or if it is known to be present at levels greater than 0.20%.

g) Mn + Ni shall be 1.40% max.

h) The E90XX-B91 [E62XX-B91] classifications were formerly classified as E90XX-B9 [E62XX-B9] in AWS A5.5/A5.5M:2006.

i) The letters “(X)XX” [“XX”] used in the classification designations for all electrodes in this table stand for the various tensile strength levels (70, 80, 90, 100, 110, and 120 ksi [49, 55, 62, 69, 76, and 83 MPa x 10]), of weld metals.

j) In order to meet the alloy requirements of the “G” group, the undiluted weld metal shall have the minimum of at least one of the elements listed in this table. Additional chemical requirements may be agreed upon between the purchaser and supplier.

k) These classifications are intended to be similar to types of electrodes covered by military specifications MIL-E–22200/1 and MIL-E–22200/10.

Table 2(Continued)

Chemical Composition Requirements for Weld Metal

AWS Classification			Weight Percent[b]									
A5.1	A5.1M	UNS[a] Number	C	Mn	Si	P	S	Ni	Cr	Mo	V	Combined Limit for Mn + Ni + Cr + Mo + V
E6010	E4310	W06010	0.20	1.20	1.00	N.S.	N.S.	0.30	0.20	0.30	0.08	N.S.
E6011	E4311	W06011										
E6012	E4312	W06012										
E6013	E4313	W06013										
E6019	E4319	W06019										
E6020	E4320	W06020										
E6027	E4327	W06027										
E6018	E4318	W06018	0.03	0.60	0.40	0.025	0.015	0.30	0.20	0.30	0.08	N.S.
E7015	E4915	W07015	0.15	1.25	0.90	0.035	0.035	0.30	0.20	0.30	0.08	1.50
E7016	E4916	W07016	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	1.75
E7018	E4918	W07018	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	1.75
E7014	E4914	W07014	0.15	1.25	0.90	0.035	0.035	0.30	0.20	0.30	0.08	1.50
E7024	E4924	W07024	0.15	1.25	0.90	0.035	0.035	0.30	0.20	0.30	0.08	1.50
E7027	E4927	W07027	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	1.75
E7028	E4928	W07028	0.15	1.60	0.90	0.035	0.035	0.30	0.20	0.30	0.08	1.75
E7048	E4948	W07048										
E7018M	E4918M	W07018	0.12	0.40 to 1.60	0.80	0.030	0.020	0.25	0.15	0.35	0.05	N. S.

[a] SAE/ASTM Unified Numbering System for Metals and Alloys.
[b] Single values are maximum. N. S. means Not Specified.
[c] *Analysis for boron is required to be reported if intentionally added, or if it is known to be present at levels greater than 0.0010%.*

Table 3
Tension Test Requirements[a,b]

AWS Classification[c]		Tensile Strength		Yield Strength, At 0.2% Offset		Elongation	
A5.5	A5.5M	ksi	MPa	ksi	MPa	Percent	Postweld Condition[d]
E7010-P1	E4910-P1	70	490	60	415	22	AW
E7010-A1	E4910-A1	70	490	57	390	22	PWHT
E7010-G	E4910-G	70	490	57	390	22	AW or PWHT
E7011-A1	E4911-A1	70	490	57	390	22	PWHT
E7011-G	E4911-G	70	490	57	390	22	AW or PWHT
E7015-X	E4915-X	70	490	57	390	22	PWHT
E7015-B2L	E4915-B2L	75	520	57	390	19	PWHT
E7015-G	E4915-G	70	490	57	390	22	AW or PWHT
E7016-X	E4916-X	70	490	57	390	22	PWHT
E7016-B2L	E4916-B2L	75	520	57	390	19	PWHT
E7016-G	E4916-G	70	490	57	390	22	AW or PWHT
E7018-X	E4918-X	70	490	57	390	22	PWHT
E7018-B2L	E4918-B2L	75	520	57	390	19	PWHT
E7018-C3L	E4918-C3L	70	490	57	390	22	AW
E7018-W1	E4918-W1	70	490	60	415	22	AW
E7018-G	E4918-G	70	490	57	390	22	AW or PWHT
E7020-A1	E4920-A1	70	490	57	390	22	PWHT
E7020-G	E4920-G	70	490	57	390	22	AW or PWHT
E7027-A1	E4927-A1	70	490	57	390	22	PWHT
E7027-G	E4927-G	70	490	57	390	22	AW or PWHT
E8010-P1	E5510-P1	80	550	67	460	19	AW
E8010-G	E5510-G	80	550	67	460	19	AW or PWHT
E8011-G	E5511-G	80	550	67	460	19	AW or PWHT
E8013-G	E5513-G	80	550	67	460	16	AW or PWHT
E8015-X	E5515-X	80	550	67	460	19	PWHT
E8015-B3L	E5515-B3L	80	550	67	460	17	PWHT
E8015-G	E5515-G	80	550	67	460	19	AW or PWHT
E8016-X	E55516-X	80	550	67	460	19	PWHT
E8016-C3	E5516-C3	80	550	68 to 80[e]	470 to 550[e]	24	AW
E8016-C4	E5516-C4	80	550	67	460	19	AW
E8016-G	E5516-G	80	550	67	460	19	AW or PWHT
E8018-X	E5518-X	80	550	67	460	19	PWHT
E8018-B3L	E5518-B3L	80	550	67	460	17	PWHT
E8018-C3	E5518-C3	80	550	68 to 80[e]	470 to 550[e]	24	AW
E8018-C4	E5518-C4	80	550	67	460	19	AW
E8018-NM1	E5518-NM1	80	550	67	460	19	AW
E8018-P2	E5518-P2	80	550	67	460	19	AW
E8018-W2	E5518-W2	80	550	67	460	19	AW
E8018-G	E5518-G	80	550	67	460	19	AW or PWHT
E8045-P2	E5545-P2	80	550	67	460	19	AW
E9010-P1	E6210-P1	90	620	77	530	17	AW
E9010-G	E6210-G	90	620	77	530	17	AW or PWHT
E9011-G	E6211-G	90	620	77	530	17	AW or PWHT
E9013-G	E6213-G	90	620	77	530	14	AW or PWHT
E9015-X	E6215-X	90	620	77	530	17	PWHT
E9015-G	E6215-G	90	620	77	530	17	AW or PWHT
E9016-X	E6216-X	90	620	77	530	17	PWHT
E9016-G	E6216-G	90	620	77	530	17	AW or PWHT
E9018M	E6218M	90	620	78 to 90[e]	540 to 620[e]	24	AW
E9018-NM2	*E6218-NM2*	*90*	*620*	*77*	*530*	*17*	*PWHT*
E9018-P2	E6218-P2	90	620	77	530	17	AW

a) See Table 5 for sizes to be tested.

b) Single values are minimal, except as otherwise specified.

c) The letter suffix “X” as used in this table represents the suffixes (A1, B1, B2, etc.) which are tested in the PWHT condition only.

d) “AW” signifies as-welded, which may or may not be aged, at the manufacturer’s option (see 12.2). “PWHT” signifies post - weld heat treated as specified in 9.4.1.1 and in Table 7, except that the “G” designated classifications, marked as “AW or PWHT” in this table, may have weld metal tested with or without PWHT as agreed upon between the purchaser and supplier. (see AWS A5.5-2014)

e) For 3/32 in [2.5 mm] electrodes, the upper value for the yield strength may be 5 ksi [35 MPa] higher than the indicated value.

Table 3 (Continued)(AWS A5.1-2012)
Tension Test Requirements[a, b, c]

AWS Classification		Tensile Strength		Yield Strength at 0.2% Offset		Elongation Percentage in 4x Diameter Length
A5.1	A5.1M	A5.1 (ksi)	A5.1M (MPa)	A5.1 (ksi)	A5.1M (MPa)	
E6010	E4310	60	430	48	330	22
E6011	E4311	60	430	48	330	22
E6012	E4312	60	430	48	330	17
E6013	E4313	60	430	48	330	17
E6018	E4318	60	430	48	330	22
E6019	E4319	60	430	48	330	22
E6020	E4320	60	430	48	330	22
E6022[d]	E4322[d]	60	430	Not Specified		Not Specified
E6027	E4327	60	430	48	330	22
E7014	E4914	70	490	58	400	17
E7015	E4915	70	490	58	400	22
E7016	E4916	70	490	58	400	22
E7018	E4918	70	490	58	400	22
E7024	E4924	70	490	58	400	17[e]
E7027	E4927	70	490	58	400	22
E7028	E4928	70	490	58	400	22
E7048	E4948	70	490	58	400	22
E7018M	E4918M	Note f	Note f	53–72[g]	370–500[g]	24

[a] See Table 4 for sizes to be tested.
[b] Requirements are in the as-welded condition with aging as specified in 12.2.
[c] Single values are minimum.
[d] A transverse tension test, as specified in 12.5 and a longitudinal guided bend test, as specified in Clause 13 are required.
[e] Weld metal from electrodes identified as E7024-1 [E4924-1] shall have elongation of 22% minimum.
[f] Tensile strength of this weld metal is a nominal 70 ksi [490 MPa].
[g] For 3/32 in [2.4 mm] electrodes, the maximum yield strength shall be 77 ksi [530 MPa].

Table 4
Charpy V-Notch Impact Requirements

AWS Classification		Limits for 3 out of 5 Specimens[a,b,c]	
A5.5	A5.5M	Average, min.[d]	Single Value, min.[d]
E7010-P1	E4910-P1		
E8010-P1	E5510-P1		
E8018-P2	E5518-P2		
E8045-P2	E5545-P2	20 ft•lbf at –20°F [27 J at –30°C]	15 ft•lbf at –20°F [20 J at –30°C]
E9010-P1	E6210-P1		
E9018-P2	E6218-P2		
E9018-NM2[f]	*E6218-NM2*[f]		
E9045-P2	E6245-P2		
E10045-P2	E6945-P2		

EXXXX-A1 EXXXX-BX EXXXX-BXL E(X)XXXX-G	20 ft*.lbf at -20° F [27 J at -30° C]	15 ft*.lbf at -20° F [20 J at -30° C]

Table 4 Continued
Charpy V-Notch Impact Requirements

AWS Classification		Limits for 3 out of 5 Specimens[a]	
A5.1	A5.1M	Average, Min.	Single Value, Min.
E6010, E6011, E6018 E6027, E7015, E7016[b], E7018[b], E7027, E7048	E4310, E4311, E4318 E4327, E4915, E4916[b], E4918[b], E4927, E4948	20 ft·lbf at –20°F [27 J at –30°C]	15 ft·lbf at –20°F [20 J at –30°C]
E6019 E7028	E4319 E4928	20 ft·lbf at 0°F [27 J at –20°C]	15 ft·lbf at 0°F [20 J at –20°C]
E6012, E6013, E6020, E6022, E7014, E7024[b]	E4312, E4313 E4320, E4322 E4914, E4924[b]	Not Specified	Not Specified
AWS Classification		Limits for 5 out of 5 Specimens[c]	
A5.1	A5.1M	Average, Min.	Single Value, Min.
E7018M	E4918M	50 ft·lbf at –20°F [67 J at –30°C]	40 ft·lbf at –20°F [54 J at –30°C]

[a] Both the highest and lowest test values obtained shall be disregarded in computing the average. Two of these remaining three values shall equal or exceed 20 ft·lbf [27 J].
[b] Electrodes with the following optional supplemental designations shall meet the lower temperature impact requirements specified below:

AWS Classification		Electrode Designation		Charpy V-Notch Impact Requirements, Limits for 3 out of 5 specimens (Refer to Note a above)	
A5.1	A5.1M	A5.1	A5.1M	Average, Min.	Single Value, Min.
E7016 E7018	E4916 E4918	E7016-1 E7018-1	E4916-1 E4918-1	20 ft·lbf at –50°F [27 J at –45°C]	15 ft·lbf at –50°F [20 J at –45°C]
E7024	E4924	E7024-1	E4924-1	20 ft·lbf at 0°F [27 J at –20°C]	15 ft·lbf at 0°F [20 J at –20°C]

[c] All five values obtained shall be used in computing the average. Four of the five values shall equal, or exceed, 50 ft·lbf [67 J].

Note: for general series electrode (G series) impact test shall be applied same as pipeline electrode series (P series).

a) The test temperature for the five specimens shall be at or below the temperature listed. The actual temperature used shall be listed on the certification documentation when issued.

b) Both the highest and the lowest test values obtained shall be disregarded in computing the average value. Two of the three remaining values shall equal or exceed the minimum average value listed; one of these three remaining values may be lower than minimum average value, but shall not be less than the minimum single value listed. The average of the three remaining values shall not be less than the minimum average value listed.

c) Impact test specimens are tested without thermal treatment, except as noted.

d) Impact test values shall be recorded to “nearest whole unit” of energy absorbed in accordance with the rounding method specified in Clause 6 (AWS A5.5-2014).

e) These classifications are tested in the post weld heat treated condition, as specified in 9.4.1.1 and in Table 7 (AWS A5.5-2014).

Table 5
Required Tests[a]

AWS Classification[b]			Electrode Size[c]		Welding Position for Test Assembly				
A5.5	A5.5M	Type of Current[d]	in	mm	Chemical Analysis[e]	Soundness Test & All Weld Metal Tension Test[f, g]	Impact Test[h]	Fillet Weld Test[i, j]	Moisture Test[k]
E7010-X	E4910-X	dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR	NR[m]	NR
E8010-X	E5510-X		5/32	4.0	F	F	NR	V, OH	NR
E9010-X	E6210-X		3/16	5.0	NR[m]	F	NR	V, OH	NR
E10010-G	E6910-G		7/32	–	NR[m]	NR[m]	NR	NR[m]	NR
E11010-G	E7610-G		1/4	6.0	F	F	NR	H	NR
E12010-G	E8310-G								
E7011-X	E4911-X	ac and dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR	NR[m]	NR
E8011-G	E5511-G		5/32	4.0	F	F	NR	V, OH	NR
E9011-G	E6211-G		3/16	5.0	NR[m]	F	NR	V, OH	NR
E10011-G	E6911-G		7/32	–	NR[m]	NR[m]	NR	NR[m]	NR
E11011-G	E7611-G		1/4	6.0	F	F	NR	H	NR
E12011-G	E8311-G								
E8013-G	E5513-G	ac, dcen, and dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR	NR[m]	NR
E9013-G	E6213-G		5/32	4.0	F[l]	F[l]	NR	V, OH	NR
E10013-G	E6913-G		3/16	5.0	NR[m]	F[l]	NR	V, OH	NR
E11013-G	E7613-G								
E12013-G	E8313-G								
E7015-X	E4915-X	dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E8015-X	E5515-X		5/32	4.0	F	F	F	V, OH	Req'd
E9015-X	E6215-X		3/16	5.0	NR[m]	F	F	H	NR[m]
E10015-X	E6915-X		7/32	–	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E11015-G	E7615-G		1/4	6.0	F	F	F	H	Req'd
E12015-G	E8315-G								
E7016-X	E4916-X	ac and dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E8016-X	E5516-X		5/32	4.0	F	F	F	V, OH	Req'd
E9016-X	E6216-X		3/16	5.0	NR[m]	F	F	H	NR[m]
E10016-X	E6916-X		7/32	–	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E11016-G	E7616-G		1/4	6.0	F	F	F	H	Req'd
E12016-G	E8316-G								

Table 5 (Continued)
Required Tests[a]

AWS Classification[b]			Electrode Size[c]		Welding Position for Test Assembly				
A5.5	A5.5M	Type of Current[d]	in	mm	Chemical Analysis[e]	Soundness Test & All Weld Metal Tension Test[f, g]	Impact Test[h]	Fillet Weld Test[i, j]	Moisture Test[k]
E8045-P2	E5545-P2	dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E9045-P2	E6245-P2		5/32	4.0	F	F	F	V-down, OH	Req'd
E10045-P2	E6945-P2		–	4.5	F	F	F	V-down, OH	Req'd
E7018-X	E4918-X	ac and dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E8018-X	E5518-X		5/32	4.0	F	F	F	V, OH	Req'd
E9018-X	E6218-X		3/16	5.0	NR[m]	F	F	H	NR[m]
E10018-X	E6918-X		7/32	–	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E11018-G	E7618-G		1/4	6.0	F	F	F	H	Req'd
E12018-G	E8318-G								
E7020-X	E4920-X	For H-fillets: ac and dcen. For flat position: ac, dcen, and dcep	1/8	3.2	NR[m]	NR[m]	NR[m]	NR[m]	NR
E7027-X	E4927-X		5/32	4.0	F[l]	F[l]	NR	H	NR
			3/16	5.0	NR[m]	F[l]	NR	H	NR
			7/32	–	NR[m]	NR[m,n]	NR	NR[m]	NR
			1/4	6.0	F[l]	F[l,n]	NR	H	NR
			5/16	8.0	NR[m]	F[l,n]	NR	NR	NR
E9018M	E6218M	dcep	3/32, 1/8	2.5, 3.2	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E10018M	E6918M		5/32	4.0	F	F	F	V, OH	Req'd
E11018M	E7618M		3/16	5.0	NR[m]	F	F	H	NR[m]
E12018M	E8318M		7/32	–	NR[m]	NR[m]	NR[m]	NR[m]	NR[m]
E12018M1	E8318M1		1/4	6.0	F	F	F	H	Req'd

[a] NR means "not required."
[b] The letter suffix "X" as used in this table is defined in Note a of Table 1.
[c] Electrodes manufactured in sizes not shown shall be tested to the requirement of the nearest standard size.
[d] The abbreviations, F, H, H-fillets, V, V-down, and OH, are defined in Note b of Table 1. The terms "dcep" and "dcen" are defined in Note c of Table 1.
[e] See Clause 10.
[f] See Clause 11.
[g] See Clause 12.
[h] See Clause 13. Impact tests are required for classifications listed in Table 4.
[i] Progression for tests performed in the vertical position shall be upward, except for E(X)XX10-X electrodes which may be tested in either upward or downward progression and the E(X)XX45-P2, which is tested vertically down only.
[j] See Clause 14.
[k] The moisture test given in Clause 15 is the required test for measurement of moisture content of the covering. The absorbed moisture test, in Clause 16, and the diffusible hydrogen test, in Clause 17, are supplemental tests required only when their corresponding optional supplemental designators are to be used with the classification designators.
[l] When dcep and dcen are specified, only dcen need be tested.
[m] Standard electrode sizes not requiring this specific test can be classified provided at least two other sizes of that classification have passed the tests required for them, or the size to be classified meets specification requirements by having been tested in accordance with Clauses 8 through either 13, 14, 15, or 16, depending on the electrode being classified.
[n] Electrodes longer than 18 in [450 mm] will require a double length test assembly in accordance with Note 1 of Figure 3, to ensure uniformity of the entire electrode.

Table 5 (Continued)(AWS A5.1-2012)
Required Tests[a]

AWS Classification			Electrode Size		Welding Position for Test Assembly[b]				
A5.1	A5.1M	Current and Polarity[a]	A5.1 (in)	A5.1M (mm)	Chemical[c] Analysis	Radiographic Test[d] All-Weld-Metal Tension Test[e]	Impact Test[f]	Fillet Weld Test[g]	Moisture Test[i]
E6010	E4310	dcep	3/32, 1/8 5/32, 3/16 7/32 1/4 5/16	2.4, 2.5, 3.2 4.0, 4.8, 5.0 5.6 6.0, 6.4 8.0	NR F NR F NR	NR F NR F F	NR F NR F NR	NR V & OH NR H-fillet NR	NR NR NR NR NR
E6011	E4311	ac and dcep	3/32, 1/8 5/32, 3/16 7/32 1/4 5/16	2.4, 2.5, 3.2 4.0, 4.8, 5.0 5.6 6.0, 6.4 8.0	NR F NR F NR	NR F NR F F	NR F NR F NR	NR V & OH NR H-fillet NR	NR NR NR NR NR
E6012	E4312	ac and dcen	1/16 to 1/8 inc. 5/32, 3/16 7/32 1/4, 5/16	1.6 to 3.2 inc. 4.0, 4.8, 5.0 5.6 6.0, 6.4, 8.0	NR F NR F	NR F[h] NR F[h]	NR NR NR NR	NR V & OH NR H-fillet	NR NR NR NR
E6013	E4313	ac, dcep, and dcen	1/16 to 1/8 inc. 5/32, 3/16 7/32 1/4, 5/16	1.6 to 3.2 inc. 4.0, 4.8, 5.0 5.6 6.0, 6.4, 8.0	NR F NR F	NR F[k] NR F[k]	NR NR NR NR	NR V & OH NR H-fillet	NR NR NR NR
E6018	E4318	ac and dcep	3/32,1/8 5/32 3/16 7/32 1/4 5/16	2.4, 2.5, 3.2 4.0 4.8, 5.0 5.6 6.0, 6.4 8.0	NR F NR NR F NR	NR F F NR F F	NR F F NR F NR	NR V & OH H-fillet NR H-fillet NR	NR Reqd. NR NR Reqd. NR
E6019	E4319	ac, dcep, and dcen	5/64 to 1/8 inc. 5/32, 3/16 7/32 1/4, 5/16	2.0 to 3.2 inc. 4.0, 4.8, 5.0 5.6 6.0, 6.4, 8.0	NR F NR F	NR F[k] NR F[k]	NR F[l] NR F[l]	NR V & OH NR H-fillet	NR NR NR NR
E6020	E4320	For H-fillet, ac and dcen; For flat position, ac, dcep, and dcen	1/8 5/32, 3/16 7/32 1/4 5/16	3.2 4.0, 4.8, 5.0 5.6 6.0, 6.4 8.0	NR F NR F NR	NR F[k] NR F[k] F[k]	NR NR NR NR NR	NR H-fillet NR H-fillet NR	NR NR NR NR NR
E6022	E4322	ac and dcen	1/8 5/32 to 7/32 inc.	3.2 4.0 to 5.6 inc.	NR NR	F[k,j] F[k,j]	NR NR	NR NR	NR NR
E6027	E4327	For H-fillet, ac and dcen; For flat position, ac, dcep, and dcen	1/8 5/32, 3/16 7/32 1/4 5/16	3.2 4.0, 4.8, 5.0 5.6 6.0, 6.4 8.0	NR F NR F NR	NR F[k,l] NR F[k,l] F[k,l]	NR F[k] NR F[k] NR	NR H-fillet NR H-fillet NR	NR NR NR NR NR
E7014	E4914	ac, dcep, and dcen	3/32, 1/8 5/32 3/16 7/32 1/4 5/16	2.4, 2.5, 3.2 4.0 4.8, 5.0 5.6 6.0, 6.4 8.0	NR F[k] NR NR F[k] NR	NR F[k] F[k] NR F[k] F[k]	NR NR NR NR NR NR	NR V & OH H-fillet NR H-fillet H-fillet	NR NR NR NR NR NR

(Continued)

Table 5 (Continued)(AWS A5.1-2012)
Required tests [a]

AWS Classification			Electrode Size		Welding Position for Test Assembly[b]				
A5.1	A5.1M	Current and Polarity[a]	A5.1 (in)	A5.1M (mm)	Chemical[c] Analysis	Radiographic Test[d] All-Weld-Metal Tension Test[e]	Impact Test[f]	Fillet Weld Test[g]	Moisture Test[i]
E7015	E4915	dcep	3/32, 1/8	2.4, 2.5, 3.2	NR	NR	NR	NR	NR
			5/32	4.0	F	F	F	V & OH	Reqd.
			3/16	4.8, 5.0	NR	F	F	H-fillet	NR
			7/32	5.6	NR	NR	NR	NR	NR
			1/4	6.0, 6.4	F	F	F	H-fillet	Reqd.
			5/16	8.0	NR	F	NR	NR	NR
E7016	E4916	ac and dcep	3/32, 1/8	2.4, 2.5, 3.2	NR	NR	NR	NR	NR
			5/32	4.0	F	F	F	V & OH	Reqd.
			3/16	4.8, 5.0	NR	F	F	H-fillet	NR
			7/32	5.6	NR	NR	NR	NR	NR
			1/4	6.0, 6.4	F	F	F	H-fillet	Reqd.
			5/16	8.0	NR	F	NR	NR	NR
E7018	E4918	ac and dcep	3/32, 1/8	2.4, 2.5, 3.2	NR	NR	NR	NR	NR
			5/32	4.0	F	F	F	V & OH	Reqd.
			3/16	4.8, 5.0	NR	F	F	H-fillet	NR
			7/32	5.6	NR	NR	NR	NR	NR
			1/4	6.0, 6.4	F	F	F	H-fillet	Reqd.
			5/16	8.0	NR	F	NR	NR	NR
E7018M[m]	E4918M[m]	dcep	3/32 to 5/32 inc.	2.4 to 4.0 inc.	F	V	V	NR	Reqd.
			3/16 to 5/16 inc.	4.8 to 8.0 inc.	F	F	F	NR	Reqd.
E7024	E4924	ac, dcep, and dcen	3/32, 1/8	2.4, 2.5, 3.2	NR	NR	NR[n]	NR	NR
			5/32	4.0	F[j]	F[k,l]	F[n]	H-fillet	NR
			3/16	4.8, 5.0	NR	F[k,l]	F[n]	H-fillet	NR
			7/32	5.6	NR	NR	NR[n]	NR	NR
			1 / 4	6.0, 6.4	F[j]	F[k,l]	F[n]	H-fillet	NR
			5/16	8.0	NR	F[k,l]	NR[n]	NR	NR
E7027	E4927	For H-fillet, ac and dcen For flat position, ac, dcep, and dcen	1/8	3.2	NR	NR	NR	NR	NR
			5/32	4.0	F[j]	F[k,l]	F[j]	H-fillet	NR
			3/16	4.8, 5.0	NR	F[k,l]	F[j]	H-fillet	NR
			7/32	5.6	NR	NR	NR	NR	NR
			1/4	6.0, 6.4	F[j]	F[k,l]	F[j]	H-fillet	NR
			5/16	8.0	NR	F[k,l]	NR	NR	NR
E7028	E4928	ac and dcep	1/8	3.2	NR	NR	NR	NR	NR
			5/32	4.0	F	F[l]	F	H-fillet	Reqd.
			3/16	4.8, 5.0	NR	F[l]	F	H-fillet	NR
			7/32	5.6	NR	NR	NR	NR	NR
			1/4	6.0, 6.4	F	F[l]	F	H-fillet	Reqd.
			5/16	8.0	NR	F[l]	NR	NR	NR
E7048	E4948	ac and dcep	1/8	3.2	NR	NR	NR	NR	NR
			5/32	4.0	F	F	F	V-down & OH	Reqd.
			3/16	4.8, 5.0	NR	F	F	V-down & H-fillet	NR

[a] NR means "not required." The abbreviations, F, H-fillet, V-down, V, and OH are defined in Note a of Table 1. The terms "dcep" and "dcen," are defined in Note b of Table 1.
[b] Standard electrode sizes not requiring this specific test can be classified provided at least two other sizes of that classification have passed the tests required for them, or the size to be classified meets specification requirements by having been tested in accordance with Figures 1, 2, and 3 and Table 6.
[c] See Clause 10.
[d] See Clause 11.
[e] See Clause 12.
[f] See Clause 14.
[g] See Clause 15.
[h] A radiographic test is not required for this classification.
[i] The moisture test given in Clause 16 is the required test for moisture content of the covering. In Clauses 17 and 18 are supplemental tests required only when their corresponding optional supplemental designators are to be used with the classification designators.
[j] An all-weld-metal tension test is not required for E6022 [E4322] electrodes. Instead, a transverse tension test (see 12.5) and a longitudinal guided bend test (see Clause 13) are required for classification of 5/32 in, 3/16 in, and 7/32 in [4.0 mm, 5.0 mm, and 6.0 mm] E6022 [E4322] electrodes.
[k] When dcep and dcen are shown, only dcen need be tested.
[l] Electrodes longer than 18 in [450 mm] will require a double length test assembly in accordance with Note 1 of Figure 2, to ensure uniformity of the entire electrode.
[m] Tests in Clause 17, and in Clause 18, are required for all sizes of E7018M [E4918M].
[n] Electrodes identified as E7024-1 [E4924-1] shall be impact tested (see Note b of Table 3).

Note1: electrode size less than 4mm, all tests should be performed in the same size as 4 mm.

Note2: for sour service, related test such as HIC and SCC test shall be performed according to NACE standards.

Note3: diffusible hydrogen test should be done as agreed between purchaser and manufacture According to clause 17 of AWS A5.5 or clause 18 of AWS A5.1.

6. ACCEPTANCE

Acceptance of the welding electrode shall be in accordance with the provisions of ANSI/AWS A5.01 (2013): welding Consumables-Procurement of Filler Metals and Fluxes.

6.1 General

Identification of consumable inserts, brazing and braze welding filler metals, solid electrode wire and strip, rods, core wire for covered electrodes, and the sheath (strip or tubing) of tubular cored electrodes and rods shall be applied as listed in 6.2 to 6.5.

6.2 Heat number

Solid wire, electrode core wire, rod, strip, brazing filler metals, and consumable inserts, identified by heat number, shall consist of material from a single heat of metal.

6.3 Controlled chemical composition (jis g3503)

Solid wire, electrode core wire, rod, strip, brazing and braze welding filler metals, and consumable inserts identified by controlled chemical composition, rather than by heat number, shall consist of mill coils of one or more heats from which samples have been taken for chemical analysis. The results of the analysis of each sample shall be within the manufacturer’s composition limits for that material. Coils from mills that do not permit spliced-coil practice need be sampled on only one end. Coils from mills that permit spliced-coil practice shall be sampled on both ends and shall have no more than a single splice per coil.

6.4 Covering mix

In the production of covered electrodes, the covering mix shall be identified in one of the following two manners:

a) Wet mix: a covering identified by wet mix shall consist of a single wet mix for each lot of electrodes.

b) Controlled chemical composition: a covering identified by controlled chemical composition (rather than by wet mix) shall consist of one or more wet mixes and be subjected to sufficient tests to assure that all wet mixes within the lot are equivalent.

These tests shall include chemical analysis, the results of which shall fall within the manufacturer's acceptance limits. The identification of the test procedure and the results of the tests shall be recorded.

6.5 Lot classification for Covered electrodes:

1- Class C1

A Class C1 lot of covered electrodes is the manufacturer's standard lot, as defined in the manufacturer's quality assurance program.

2- Class C2

A Class C2 lot of covered electrodes is the quantity, not exceeding 45000 kg [100 000 lb.], of any one size and classification produced in 24 h of consecutively scheduled production (i.e., consecutive normal work shifts).

3- Class C3

A Class C3 lot of covered electrodes is the quantity, not exceeding 45000 kg [100 000 lb], of any one size and classification produced in 24 h of consecutively scheduled production (i.e., consecutive normal work shifts).Class C3 electrodes shall be produced from covering identified by wet mix [6.4 a)] or controlled chemical composition [6.4 b)] and core wire identified by heat number (6.2) or controlled chemical composition (6.3).

4- Class C4

A Class C4 lot of covered electrodes is the quantity of any one size and classification produced from one wet mix [6.4 a)] and one heat of core wire (6.2).

5- Class C5

A Class C5 lot of covered electrodes is the quantity of one size and classification produced from one dry blend of covering mixture (6.4) and one heat of core wire (6.2).

6.6 Level of testing

6.6.1 General

The level of the testing schedule shall be selected by the purchaser from those listed in Table 6. If no level of testing schedule is specified, the level shall be Schedule1or F.

Table 6

Testing Schedules

Schedule[a]	Requirements	Reference Clause
1 or F	The manufacturer's standard testing schedule	6.2
2 or G	Tests from production runs of the product within 12 months preceding the date of the purchase order	6.3
3 or H	Chemical analysis only, for each lot shipped	6.4
4 or I	Tests called for by Table 2, for each lot shipped	6.5
5 or J	All tests which the classification called for in the pertinent AWS, ISO or other welding consumable standard, for each lot shipped	6.6
6 or K	All tests specified by the purchaser for each lot shipped	6.7

[a] Either the numeric or alphabetic designations may be used interchangeably.

6.6.2 Schedule 1 or F

The level of testing shall be the manufacturer's standard. A statement, "the product supplied will meet the requirements of the applicable AWS/ISO standard (or other welding consumable standard), when tested in accordance with that standard" and a summary of the typical properties of the material, when tested in that manner, shall be supplied upon written request. The class of each lot will be the manufacturer's standard.

6.6.3 Schedule 2 or G

Test results shall be supplied from any production run of the product made within the twelve months preceding the date of the purchase order. This shall include the results of all tests prescribed for that classification in the AWS/ISO or other applicable standard. The class of each lot is the manufacturer' standard.

6.6.4 Schedule 3 or H

Chemical analysis of each lot shipped shall be supplied by the manufacturer. The analysis shall include those elements prescribed for that classification in the AWS/ISO or other applicable standard. The class of each lot shall be specified by the purchaser from those listed in Clause 5 of this standard (ANSI/AWS A5.01-2013).

6.6.5 Schedule 4 or I

Results of the tests called for in Table 2 of (ANSI/AWS A5.01-2013) shall be supplied by the manufacturer for each lot shipped. These tests represent a consensus of those frequently requested for consumables certification; however, they do not necessarily include all tests required for Schedule 5 or J. The tests shall be performed as prescribed for that classification in the AWS/ISO or other applicable standard. The

class of each lot shall be specified by the purchaser from those listed in Table 7(Clause 5 of ANSI/AWS A5.01-2013).

6.6.6 Schedule 5 or J

Results of all of the tests prescribed for that classification in the AWS/ISO or other applicable standard shall be supplied by the manufacturer for each lot shipped. The class of each lot shall be specified by the purchaser from those listed in Clause 5 of (ANSI/AWS A5.01-2013) .

6.6.7 Schedule 6 or K

In addition to, or in place of, any of the tests called for in the AWS/ISO or other applicable standard, the purchaser may require other tests (such as testing after a specified heat treatment). In all such cases, the purchaser shall identify on the purchase order the specific tests that are to be conducted, the procedures to be followed, the requirements that shall be met and the results to be reported by the manufacturer. The class of each lot shall be specified by the purchaser from those listed in Clause5 of (ANSI/AWS A5.01-2013).

Table7

Schedule 4 or I—Required Tests a, b, c

Product Type	Carbon Steel	Low Alloy Steel
Covered Solid and Metal Cored (Composite) Electrodes for SMAW	(A5.1) 1, 2, 3, 4, 5[d]	(A5.5) 1, 2, 3, 4, 5[d]

a) Designations in parentheses refer to the AWS filler metal specification.
b) Tests called for in this table shall be performed only when they are required by the applicable AWS specification for the particular classification involved. Tests shall be performed in the manner prescribed by the applicable specification. Testing to one current and polarity shall be adequate.
c) Test Designations are as follows:
1 Chemical analysis, 2 Tensile, 3 Impact, 4 Soundness (x-ray),
5 Moisture test, 6 Bend (face, side, or both), 7 Spattering characteristics
8 Sieve analysis, 9 Bead-on-plate weld test
d) Low hydrogen electrodes only

7. Certification

By affixing the AWS specification and classification designations to the packaging, or the classification to the product, the manufacturer certifies that the product meets the requirements of this specification.

The act of placing the AWS specification and classification designations, and optional designators, if applicable, on the packaging enclosing the product, or the classification on the product itself, constitutes the supplier's (manufacturer's) certification that the product meets all the requirements of the specification. The only testing requirement implicit in this certification is that the manufacturer has actually conducted the tests required by the specification on material that is representative of that being shipped and that the material met the requirements of the specification. Representative material, in this case, is any production run of that classification using the same formulation. Certification is not to be construed to mean that tests of any kind were necessarily conducted on samples of the specific material shipped. Tests on such material may or may not have been made. The basis for the certification required by the specification is the classification test of representative material cited above, and the Manufacturer's Quality Assurance Program as defined in AWS A5.01M/A5.01 (ISO 14344 MOD) Table 8.

Table 8
Summary of Types of Certificates

Certificate of Compliance	A statement of compliance	
Certificate of Conformance	A statement of compliance	plus results of actual tests of classification requirements on representative material
Certified Material Test Report (CMTR)	A statement of compliance	plus results of actual tests on the material supplied

8. Retest

If the results of any test fail to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens for retest may be taken from the original test assembly or from a new test assembly. For chemical analysis, retest need be only for those specific elements that failed to meet the test requirement. If the results of one or both retests fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this specification for that classification.

In the event that, during preparation or after completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the weld test assembly or in conducting the test, the test shall be considered invalid,

without regard to whether the test was actually completed, or whether test results met, or failed to meet, the requirement. That test shall be repeated, following proper prescribed procedures. In this case, the requirement for doubling the number of test specimens does not apply.

9. Weld Test Assemblies

9.1-for carbon steel electrode refer to clause 9 of AWS A5.1- 2012.

9.2- for Low-Alloy steel electrode refer to clause 9 of AWS A5.5-2014.

10. Chemical Analysis

10.1-for carbon steel electrode refer to clause 10 of AWS A5.1- 2012.

10.2- for Low-Alloy steel electrode refer to clause 10 of AWS A5.5-2014.

11. Radiographic Test

11.1 When required in Table 5, the groove weld described in 9.4.1 and shown in Figure 3 or 5 (of AWS A5.5-2014) shall be radiographed to evaluate the soundness of the weld metal. In preparation for radiography, the backing shall be removed and both surfaces of the weld shall be machined or ground smooth and flush with the original surfaces of the base metal or with a reasonably uniform reinforcement not exceeding 3/32 in [2.5 mm]. It is permitted on both sides of the test assembly to remove base metal to a depth of 1/16 in [1.5 mm] nominal below the original base metal surface in order to facilitate backing and/or buildup removal. Thickness of the weld metal shall not be reduced by more than 1/16 in [1.5 mm] less than the nominal base metal thickness. Both surfaces of the test assembly, in the area of the weld, shall be smooth enough to avoid difficulty in interpreting the radiograph.

11.2 The weld shall be radiographed in accordance with ASTM E1032. The quality level of inspection shall be 2–2T.

11.3 The soundness of the weld metal meets the requirements of this specification if the radiograph shows:

(1) No cracks, no incomplete fusion, and no incomplete penetration, and

(2) No slag inclusions longer than 1/4 in [6.5 mm] or 1/3 of the thickness of the weld, whichever is greater, or no groups of slag inclusions in line that have an aggregate length greater than the thickness of the weld in a length 12 times

the thickness of the weld, except when the distance between the successive inclusions exceeds six times the length of the longest inclusion in the group, and

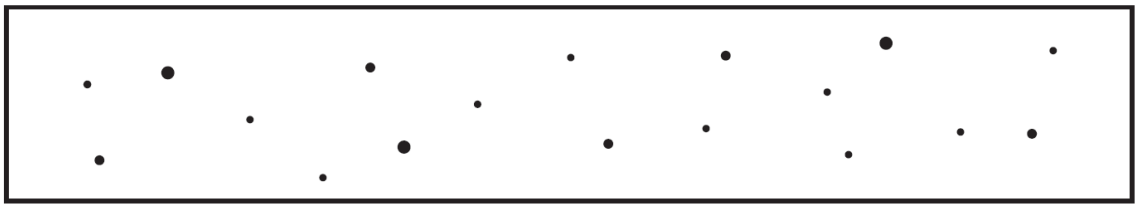
(3) No rounded indications in excess of those permitted by the radiographic standards in Figure 2 or Figure 3 according to the grade specified in Table 9 of AWS A5.5-2014

In evaluating the radiograph, 1 in [25 mm] of the weld on each end of the test assembly shall be disregarded.

11.4 A rounded indication is an indication (on the radiograph) whose length is no more than three times its width.

Rounded indications may be circular or irregular in shape, and they may have tails. The size of a rounded indication is the largest dimension of the indication, including any tail that may be present.

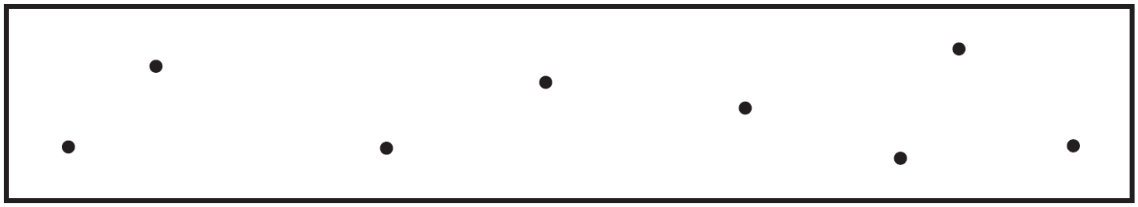
The indication may be porosity or slag. Indications whose largest dimension does not exceed 1/64 in [0.4 mm] shall be disregarded. Test assemblies with indications larger than the large indications permitted in the radiographic standards do not meet the requirements of this specification.



(A) ASSORTED ROUNDED INDICATIONS

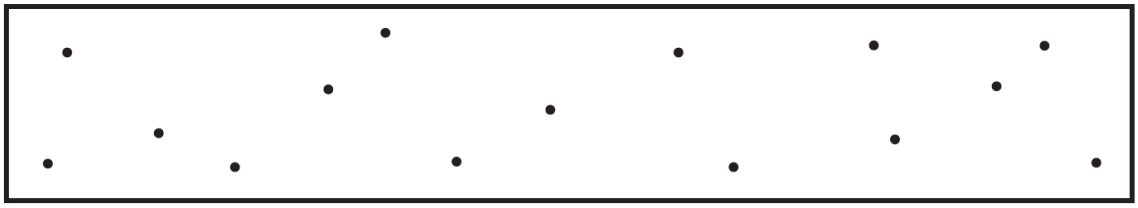
SIZE: 1/64 in [0.4 mm] TO 1/16 in [1.6 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 18, WITH THE FOLLOWING RESTRICTIONS:

MAXIMUM NUMBER OF LARGE (3/64 in [1.2 mm] TO 1/16 in [1.6 mm] IN DIAMETER OR IN LENGTH) INDICATIONS = 3.
MAXIMUM NUMBER OF MEDIUM (1/32 in [0.8 mm] TO 3/64 in [1.2 mm] IN DIAMETER OR IN LENGTH) INDICATIONS = 5.
MAXIMUM NUMBER OF SMALL (1/64 in [0.4 mm] TO 1/32 in [0.8 mm] IN DIAMETER OR IN LENGTH) INDICATIONS = 10.



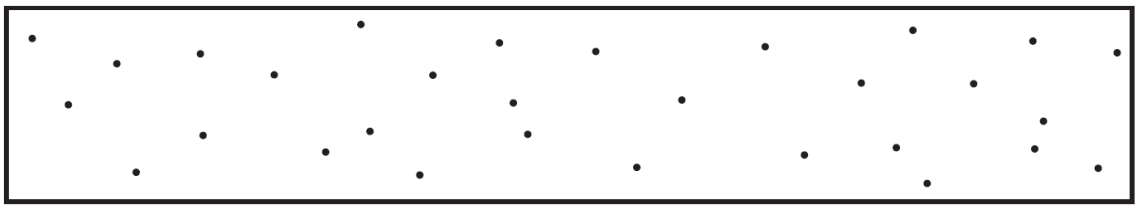
(B) LARGE ROUNDED INDICATIONS

SIZE: 3/64 in [1.2 mm] TO 1/16 in [1.6 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 8.



(C) MEDIUM ROUNDED INDICATIONS

SIZE: 1/32 in [0.8 mm] TO 3/64 in [1.2 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 15.



(D) SMALL ROUNDED INDICATIONS

SIZE: 1/64 in [0.4 mm] TO 1/32 in [0.8 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 30.

Notes:
1. In using these standards, the chart which is most representative of the size of the rounded indications present in the test specimen radiograph, shall be used for determining conformance to these radiographic standards.
2. Since these are test welds specially made in the laboratory for classification purposes, the radiographic requirements for these test welds are more rigid than those which may be required for general fabrication.
3. Indications whose largest dimension does not exceed 1/64 in [0.4 mm] shall be disregarded.

Source: AWS A5.1/A5.1M:2004, ERRATA, Figure 7 on page 16.

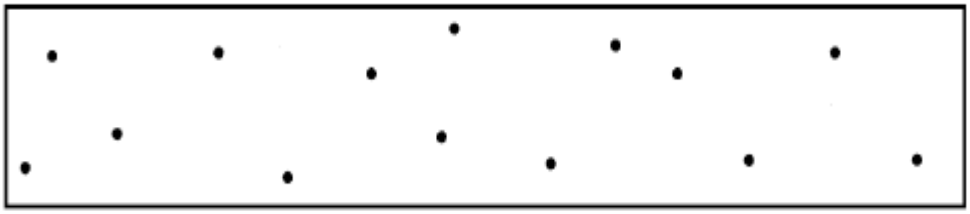
Radiographic Acceptance Standards for Rounded Indications (Grade 1)

Figure 2

(A) ASSORTED ROUNDED INDICATIONS

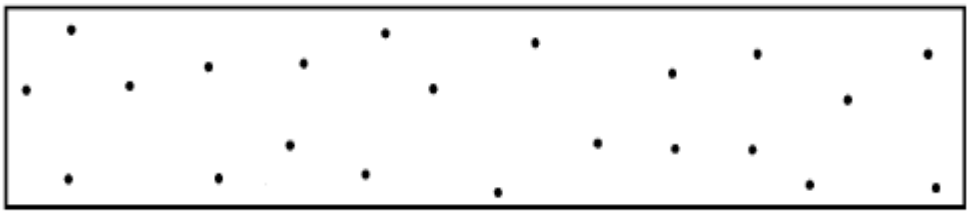
SIZE: 1/64 in [0.4 mm] TO 5/64 in [2.0 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 27, WITH THE FOLLOWING RESTRICTIONS:

MAXIMUM NUMBER OF LARGE (1/16 in [1,6 mm] TO 5/64 in [2,0 mm] IN DIAMETER OR IN LENGTH) INDICATIONS = 3,
MAXIMUM NUMBER OF MEDIUM (3/64 in [1,2 mm] TO 1/16 in [1,6 mm] IN DIAMETER OR IN LENGTH) INDICATIONS = 8,
MAXIMUM NUMBER OF SMALL (1/64 in [0,4 mm] TO 3/64 in [1,2 mm] IN DIAMETER OR IN LENGTH) INDICATIONS = 16.



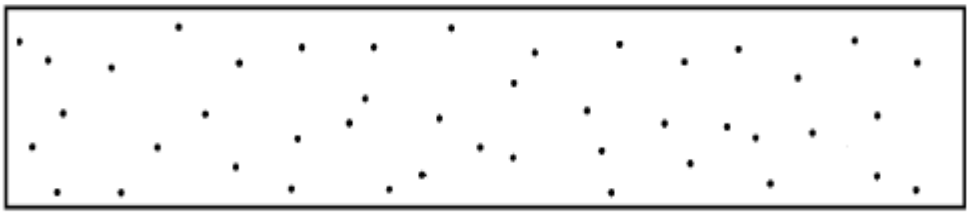
(B) LARGE ROUNDED INDICATIONS

SIZE: 1/16 in [1,6 mm] TO 5/64 in [2,0 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 14.



(C) MEDIUM ROUNDED INDICATIONS

SIZE: 3/64 in [1,2 mm] TO 1/16 in [1,6 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 22.



(D) SMALL ROUNDED INDICATIONS

SIZE: 1/64 in [0,4 mm] TO 3/64 in [1,2 mm] IN DIAMETER OR IN LENGTH.
MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in [150 mm] OF WELD = 44.

Notes:

1. In using these standards, the chart which is most representative of the size of the rounded indications present in the test specimen radiograph shall be used for determining conformance to these radiographic standards.
2. Since these are test welds specially made in the laboratory for classification purposes, the radiographic requirements for these test welds are more rigid than those which may be required for general fabrication.
3. Indications whose largest dimension does not exceed 1/64 in [0.4 mm] shall be disregarded.

Source: AWS A5.1/A5.1M:2004, ERRATA, Figure 7 on page 17.

Radiographic Acceptance Standards for Rounded Indications (Grade 2)

Figure 3

12. Tension Test

12.1 One all-weld-metal tension test specimen, as specified in the Tension Test section of AWS B4.0 or AWS B4.0M, shall be machined from the groove weld described in Clause 9 of AWS A5.1 and AWS A5.5. For specimens machined from 3/4 in [20 mm] or thicker weld assemblies, the all-weld-metal tension test shall have a nominal diameter of 0.500 in [12.5 mm]. For specimens machined from 1/2 in [12 mm] thick weld assemblies, the all-weld-metal tension test specimen shall have a nominal diameter of 0.250 in [6.5 mm]. The nominal gauge length-to-diameter ratio shall be 4:1 in each case.

12.2 After machining, but before testing, tension test specimens to be tested in the as-welded condition may be aged at 200°F to 220°F [90°C to 105°C] for up to 48 hours, then allowed to cool to room temperature. If the specimen is aged, that fact, together with the manner of aging, shall be recorded on the test certificate. Refer to A6.3 for a discussion on the purpose of aging. The purchaser may, by mutual agreement with the supplier, have the thermal aging of specimens prohibited for all mechanical testing done to Schedule I or J of AWS A5.01M/A5.01 (ISO 14344 MOD).

12.3 The aged and unaged specimens shall be tested in the manner described in the Tension Test section of AWS B4.0 or AWS B4.0M.

12.4 Results of the tension test shall meet the requirements specified in Tables 2 and 3 of AWS A5.1, A5.5.

13. Impact Test (AWS A5.5 – 2014)

13.1 Five full-size Charpy V-notch impact test specimens, as specified in the Fracture Toughness Test section of AWS B4.0 or AWS B4.0M, shall be machined from the test assembly shown in Figure 3 or 5, for those classifications for which impact testing is required in Table 5. The Charpy V-notch specimens shall have the notched surface and the struck surface parallel with each other within 0.002 in [0.05 mm]. The other two surfaces of the specimen shall be square with the notched or struck surfaces within 10 minutes of a degree. The notch shall be smoothly cut by mechanical means and shall be square with the longitudinal edge of the specimen within one degree.

The geometry of the notch shall be measured on at least one specimen in a set of five specimens. Measurement shall be done at a minimum 50X magnification on either a shadowgraph or metallograph. The correct location of the notch shall be verified by etching before or after machining.

13.2 The five specimens shall be tested in accordance with the Fracture Toughness Test section of AWS B4.0 or AWS B4.0M. The test temperature shall be at or below the temperature specified in Table 4 for the classification under test.

The actual temperature used shall be listed on the certification documentation when issued.

13.3 In evaluating the test results, the lowest and the highest values obtained shall be disregarded. Two of the remaining three values shall equal or exceed the specified 20 ft·lbf [27J] energy level. One of the three may be lower, but not lower than the single value indicated in Table 4, and the average of the three shall not be less than the required average energy level.

NOTE: for carbon steel electrode, see clause 14 of AWS A5.1-2012

14. Fillet Weld Test

The fillet weld test, when required in Table 5, shall be made in accordance with the requirements of:

14.1-for carbon steel electrode refer to clause 15 of AWS A5.1- the latest version.

14.2- for Low-Alloy steel electrode refer to clause 14 of AWS A5.5-2014-the latest version.

15. Moisture Test

The moisture content of the covering of the electrode, when required in Table 5 shall be made in accordance with the requirements of:

15.1- For carbon steel electrode refer to clause 16 of AWS A5.1- the latest version.

15.2- for Low-Alloy steel electrode refer to clause 15 of AWS A5.5-2014-the latest version.

16. Standard Sizes, Lengths, Packaging and Marking

16.1 Standard sizes (diameter of the core wire) and lengths of electrodes are shown in Table 9.

Table 9

Standard Sizes and Lengths

Core Wire Diameter[a]		Lengths[a, b]	
A5.1 (in)	A5.1M[c] (mm)	A5.1 (in)	A5.1M (mm)
1/16	1.6	9	225
5/64	2.0	9 or 12	225 or 300
3/32	—	12 or 14	—
—	2.5	—	300 or 350
1/8	3.2	14	350
5/32	4.0	14 or 18	350 or 450
3/16	—	14 or 18	—
—	5.0	—	350 or 450
7/32	—	14 or 18 or 28	—
—	6.0	—	350 or 450 or 700
1/4	—	18 or 28	—
5/16	8.0	18 or 28	450 or 700

[a] Lengths and sizes other than these shall be as agreed between purchaser and supplier.
[b] In all cases, end-gripped electrodes are standard.
[c] ISO 544 *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances and markings.* See 20.2 for tolerances on diameter and length.

AWS A5.5-2014

Standard Sizes and Lengths

Standard Size, (Core Wire Diameter[d])			Standard Length[a,b,c]			
			All Classifications except E7020-A1 [E4920-A1], E7020-G [E4920-G], E7027-A1 [E4927-A1], and E7027-G [E4927-G]		E7020-A1 [E4920-A1], E7020-G [E4920-G], E7027-A1 [E4927-A1], and E7027-G [E4927-G]	
in	in	mm	in	mm	in	mm
3/32[e]	*(0.093)*	—	12 or 14	300 or 350	12	300
—	*(0.098)*	*2.5*[e]	12 or 14	300 or 350	12	300
1/8	*(0.125)*	*3.2*	14	350	14	350
5/32	*(0.156)*	*4.0*	14	350	14	350
—	*(0.177)*	*4.5*[e]	14	350	—	—
3/16	*(0.187)*	—	14	350	14 or 18	350 or 450
—	*(0.197)*	*5.0*	14	350	14 or 18	350 or 450
7/32[e]	*(0.218)*	—	14 or 18	350 or 450	18 or 28	450 or 700
—	*(0.236)*	*6.0*	14 or 18	350 or 450	18 or 28	450 or 700
1/4[e]	*(0.250)*	—	18	450	18 or 28	450 or 700
5/16[e]	*(0.312)*	*8.0*[e]	—	—	18 or 28	450 or 700

[a] Tolerance on the length shall be ± 1/4 in [±10 mm].
[b] In all cases, end gripping is standard.
[c] Other lengths are acceptable and shall be as agreed upon between the purchaser and supplier.
[d] Tolerance on the core wire diameter shall be ± 0.002 in [±0.05 mm]. Electrodes produced in sizes other than those shown may be classified. Please See note c Table 5
[e] These diameters are not manufactured in all electrode classifications

(See Table 5)

16.2 The diameter of the core wire shall not vary more than ±0.002 in [±0.05 mm] from the diameter specified. The length shall not vary more than ±1/4 in [±10 mm] from that specified.

16.3 Core Wire and Covering

The core wire and covering shall be free of defects that would interfere with the uniform deposition of the electrode. The core and covering shall be concentric to the extent that the maximum core-plus-one-covering dimension shall not exceed the minimum core-plus-one-covering dimension by more than:

1) 7% of the mean dimension in sizes of 3/32 in [2.5 mm] and smaller,

2) 5% of the mean dimension in sizes larger than 3/32 in [2.5 mm] and smaller than 3/16 in [5 mm], and 3. 4% of the mean dimension in sizes 3/16 in [5 mm] and larger.

Concentricity may be measured by any suitable means.

16.4 Exposed Core

16.4.1 The grip end of each electrode shall be bare (free of covering) for a distance of not less than 1/2 in [12 mm] nor more than 1-1/4 in [30 mm] for electrodes 5/32 in [4.0 mm] and smaller, and not less than 3/4 in [20 mm] nor more than 1-1/2 in [40 mm] for electrodes 3/16 in [5 mm] and larger, to provide for electrical contact with the electrode holder.

16.4.2 The arc end of each electrode shall be sufficiently conductive, and the covering sufficiently tapered, to permit easy striking of the arc. The length of the conductive portion (measured from the end of the core wire to the location where the full cross section of the covering is obtained) shall not exceed 1/8 in [3 mm] or the diameter of the core wire, whichever is less. Electrodes with chipped coverings near the arc end, baring the core wire no more than the lesser of 1/4 in [6 mm] or twice the diameter of the core wire, meet the requirements of this Specification provided no chip uncovers more than 50% of the circumference of the core.

16.5 Electrode Identification

All electrodes shall be identified as follows:

16.5.1 At least one imprint of the electrode designation (Classification plus any optional designators) shall be applied to the electrode covering starting within 2-1/2 in [65 mm] of the grip end of the electrode. The prefix letter E in the classification may be omitted from the imprint.

16.5.2 The numbers and letters of the imprint shall be of bold block type of a size large enough to be legible.

16.5.3 The ink used for imprinting shall provide sufficient contrast with the electrode covering so that, in normal use, the numbers and letters are legible both before and after welding.

16.5.4 When an electrode is classified as meeting the requirements of A5.X and A5.XM, both electrode designations shall be applied.

16.5.5 If allowed by the specific A5 specification, in lieu of imprinting, electrodes may be identified by:

1. Attaching securely to the bare grip end of each electrode a tag bearing the classification number, or

2. Embossing the classification number on the bare grip end of each electrode. In this case a slight flattening of the grip end will be permitted in the area of the embossing.

16.6 Packaging

16.6.1 Electrodes shall be suitably packaged to protect them from damage during shipment and storage under normal conditions.

16.6.2 Standard package weights shall be as agreed upon between purchaser and supplier.

16.6.3 Hermetically Sealed Containers. When specified for one or more classifications, such as low hydrogen types requiring protection against atmospheric moisture absorption during shipment and storage, electrodes shall be packaged in one of the following manners.

16.6.3.1 Rigid Metal Package. The container may be of either steel or aluminum. Each steel container shall have its sides lock-seamed and soldered or seam- welded and the top and bottom mechanically seamed containing a suitable organic sealant. Aluminum containers shall be tubes formed in two sections, one flared slightly for a friction fit and the closure seam shall be sealed with a suitable pressure sensitive tape. Metal containers after loading at ambient pressure and sealing shall be capable of passing the leak test as follows:

Unit containers shall be immersed in water that is at a temperature of at least 50°F [10°C] above that of the packaged material (room temperature). The container shall be immersed so that the surface under observation is 1 in [25 mm] below the water surface and the greatest basic dimension of the container is parallel to the surface of the water. A leaker is indicated by a steady stream of air bubbles emanating from the container. A container with a stream that lasts for 30 seconds or more does not meet the requirements of this specification.

16.6.3.2 Vacuum Package. High density plastic pouches laminated with a suitable foil vapor barrier shall be heat sealed after filling and evacuating. The pouches shall be over packed with an outer container to protect it from damage that will cause loss of

vacuum. Packages which show the contents to be loose within the pouch do not meet the requirements of this specification.

16.6.3.3 Other Package Construction as agreed upon between purchaser and supplier, alternate packaging for protection of electrode coverings from absorption of moisture in excess of that specified by the classification shall be demonstrated by suitable tests, such as those described above.

16.7 Marking of Packages

16.7.1 The following product information (as a minimum) shall be legibly marked on the outside of each unit package:

1. AWS specification and classification designations along with applicable optional designators (year of issue may be excluded).
2. Supplier's name and trade designation.
3. Size and net weight.
4. Lot, control, or heat number.
5. Date of production.
6.Date of expiration. (suggested)

16.7.2 The appropriate precautionary information, as given in ANSI Z49.1, latest edition, (as a minimum) or its equivalent, shall be prominently displayed in legible print on all packages of electrodes, including individual unit packages enclosed within a larger package.

17. APPENDIXES:

Sample form Procurement

Suggested Procurement Detail Form for Covered Electrodes

I.	**General**	_____
	A. Quantity	_____
	B. AWS Specification	_____
	C. AWS Classification	_____
	D. Supplemental Designators if required	_____
	E. Diameter	_____
	F. Length	_____
	G. Unit Package Type and Weight	_____
	1. Carton	_____
	2. Can	_____
	3. Other	_____
II.	**Certification and Testing**	_____
	A. Lot Classification [a]	_____
	B. Level of Testing [a]	_____
III.	**Other Requirements**	_____

[a] Where specific information is not given (left blank), the requirements of the AWS specification apply (see the Certification and Acceptance clauses in the body and the explanation of each in the annex of the specification invoked in I.B above).

international system of units (SI)

Example of Use of the Procurement Detail Form for Covered Electrodes

	Examples			
	1	2	3	4
I. General				
A. Quality	450 kg	450 kg	450 kg	450 kg
B. AWS Specification	A5.1M	A5.1M	A5.1M	A5.1M
C. AWS Classification	E4918	E4918	E4918	E4918
D. Supplemental Designators		-1	H4	H4R
E. Diameter	5.0 mm	5.0 mm	5.0 mm	5.0 mm
F. Length	350 mm	350 mm	350 mm	450 mm
G. Unit Package Type and Weight				
1. Carton	25 kg			
2. Can		5 kg	5 kg	5 kg
3. Other				
II. Certification and Testing				
A. Lot Classification	C1	C1	C3	C2
B. Level of Testing	Schedule 1 or F	Schedule 4 or I	Schedule 5 or J	Schedule 6 or K
III. Other Requirements (Example No. 4M Only)	The lots of electrodes that are shipped must meet all classification test requirements of the specification. The strength and toughness of the weld metal must meet specification requirements after a postweld heat treatment at 650 ± 15°C for 12 hours. The heating and cooling rates above 300°C shall not exceed 100°C/hour.			

Customary Units (U.S.)

Example of Use of the Procurement Detail Form for Covered Electrodes

	Examples			
	1	2	3	4
I. General				
A. Quality	1000 lbs	1000 lbs	1000 lbs	1000 lbs
B. AWS Specification	A5.1	A5.1	A5.1	A5.1
C. AWS Classification	E7018	E7018	E7018	E7018
D. Supplemental Designators		–1	H4	H4R
E. Diameter	3/16 in	3/16 in	3/16 in	3/16 in
F. Length	14 in	14 in	14 in	18 in
G. Unit Package Type and Weight				
1. Carton	50 lb			
2. Can		10 lb	10 lb	10 lb
3. Other				
II. Certification and Testing				
A. Lot Classification	C1	C1	C3	C2
B. Level of Testing	Schedule 1 or F	Schedule 4 or I	Schedule 5 or J	Schedule 6 or K
III. Other Requirements (Example No. 4 Only)	The lots of electrodes that are shipped must meet all classification test requirements of the specification. The strength and toughness of the weld metal must meet specification requirements after a postweld heat treatment at 1200 ± 25°F for 12 hours. The heating and cooling rates above 600°F shall not exceed 200°F/hour.			