

ANSI/AWS A5.26/A5.26M-97 (R2009)
An American National Standard



Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding



American Welding Society



Key Words—Filler metal specifications, low-alloy steel electrodes, carbon steel electrodes, welding electrodes, flux cored electrodes, electrogas welding electrodes

ANSI/AWS A5.26/A5.26M-97 (R2009)
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Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding

Supersedes ANSI/AWS A5.26-91

Prepared by the
American Welding Society (AWS) A5 Committee on Filler Metals

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

Classification requirements are specified for solid and composite (flux cored and metal cored) electrodes for electrogas welding. The requirements include chemical composition of the electrode for solid electrodes and of weld metal for composite (cored) electrodes, in addition to the mechanical properties and soundness of weld metal taken from a groove weld made with these electrodes using the prescribed welding procedure. Standard electrode sizes, marking, and packaging requirements are included.

This specification makes use of both U.S. Customary Units and the International System of Units (SI). Since these are not equivalent, each system must be used independently of the other.



American Welding Society

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Foreword

This foreword is not part of ANSI/AWS A5.26/A5.26M-97 (R2009), *Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding*, but is included for informational purposes only.

This document is the first of the A5.26 specifications which makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are not exact equivalents; therefore each system must be used independently of the other, without combining in any way. In selecting rational metric units the ANSI/AWS A1.1, *Metric Practice Guide for the Welding Industry*, and ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances and markings*, are used as guides. Tables and figures make use of both U.S. Customary and SI units, which with the application of the specified tolerances provide for interchangeability of products in both U.S. Customary and SI units.

Added Annex B (Informative), Guidelines for the Preparation of Technical Inquiries.

The current document is the second revision of this specification, as shown below:

Document Development

ANSI/AWS A5.26-78 *Specification for Consumables for Electrode Gas Welding of Carbon and High Strength Low-Alloy Steels*

ANSI/AWS A5.26-91 *Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding*

ANSI/AWS A5.26-97R *Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding*

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS A5 Committee on Filler Metals, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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Table of Contents

	Page No.
<i>Personnel (Reaffirmation)</i>	v
<i>Personnel (Original)</i>	vii
<i>Foreword</i>	ix
<i>List of Tables</i>	xii
<i>List of Figures</i>	xii
1. Scope	1
2. Classification	1
3. Acceptance	1
4. Certification	1
5. Units of Measure and Rounding-Off Procedure	1
6. Summary of Tests	5
7. Retest	5
8. Weld Test Assemblies	6
9. Chemical Analysis	6
10. Radiographic Test	6
11. Tension Test	7
12. Impact Test	8
13. Method of Manufacture	8
14. Standard Sizes	9
15. Finish and Uniformity	9
16. Standard Package Forms	10
17. Winding Requirements	10
18. Electrode Identification	13
19. Packaging	13
20. Marking of Packages	13
Annex A (Informative)—Guide to AWS Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding	17
Annex B (Informative)—Guidelines for the Preparation of Technical Inquiries	25
AWS Filler Metal Specifications by Material and Welding Process	27
AWS Filler Metal Specifications and Related Documents	29

List of Tables

Table	Page No.
1	Chemical Composition Requirements for Solid Electrodes2
2	A5.26 Tension Test Requirements (As Welded)2
2M	A5.26M Tension Test Requirements (As Welded)3
3	A5.26 Impact Test Requirements (As Welded)3
3M	A5.26M Impact Test Requirements (As Welded)3
4	Chemical Composition Requirements for Weld Metal from Composite Flux Cored and Metal Cored Electrodes4
5	Required Tests.....5
6	Base Metals for Test Assemblies9
7	Standard Sizes.....12
8	Standard Package Dimensions and Weights13
A.1	Comparisons of A5.26/A5.26M Classifications and Classifications in Other AWS Specifications and Proposed ISO Designations19
A.2	Discontinued Classifications.....22

List of Figures

Figure	Page No.
1	Groove Weld Test Assembly for Mechanical Properties and Soundness7
2	Weld Ingot.....9
3	Tension Test Specimen10
4	Radiographic Acceptance Standards11
5	Charpy V-Notch Impact Test Specimen.....12
6A	Dimensions of Standard 12 and 14 in. [300 and 350 mm] Spools14
6B	Dimensions of Standard 22, 24, and 30 in. [560, 610, and 760 mm] Spools (Reels).....15
A.1	Classification System.....18

Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding

1. Scope

This specification prescribes requirements for the classification of carbon and low-alloy steel electrodes for electrogas welding. It covers solid and composite (flux cored and metal cored) electrodes used with external gas shielding, and composite (self-shielded flux cored) electrodes used without external shielding.

Part A *General Requirements*

2. Classification

2.1 The *solid electrodes* covered by this specification are classified according to the chemical composition of the electrode, as specified in Table 1 and the mechanical properties of the weld metal as specified in Tables 2 and 3.

2.2 The *composite (flux cored and metal cored) electrodes* covered by this specification are classified according to the need for external shielding gas (Table 4) and the chemical composition and mechanical properties of the weld metal, as specified in Tables 2, 3, and 4.

2.3 Electrodes classified under one classification shall not be classified under any other classification in this specification, except as specifically permitted by Note (a) to Table 3.

2.4 The electrodes classified under this specification are intended for electrogas welding, but that is not to prohibit their use with any other process for which they are found suitable.

3. Acceptance

Acceptance¹ of the electrodes shall be in accordance with the provisions of ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*².

4. 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.³

5. Units of Measure and Rounding-Off Procedure

5.1 This specification makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are not exact equivalents; therefore each system must be used independently of the other without combining in any way. The specification with the designation A5.26 uses U.S. Customary units. The specification A5.26M uses SI units. The latter are shown in appropriate columns in tables or within brackets [] when used in the text.

¹ See Section A3 (in Annex A) for further information concerning acceptance, testing of the material shipped, and ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*.

² AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

³ See Section A4 (in Annex A) for further information concerning certification and the testing called for to meet this requirement.

Table 1
Chemical Composition Requirements for Solid Electrodes

AWS Classifi- cation ^c	UNS Number ^d	Weight Percent ^{a,b}											Other Elements, Total
		C	Mn	S	P	Si	Ni	Mo	Cu ^e	Ti	Zr	Al	
EGXXS-1	K01313	0.07– 0.19	0.90– 1.40	0.035	0.025	0.30– 0.50	—	—	0.35	—	—	—	0.50
EGXXS-2	K10726	0.07	0.90– 1.40	0.035	0.025	0.40– 0.70	—	—	0.35	0.05– 0.15	0.02– 0.12	0.05– 0.15	0.50
EGXXS-3	K11022	0.06– 0.15	0.90– 1.40	0.035	0.025	0.45– 0.75	—	—	0.35	—	—	—	0.50
EGXXS-5	K11357	0.07– 0.19	0.90– 1.40	0.035	0.025	0.30– 0.60	—	—	0.35	—	—	0.50– 0.90	0.50
EGXXS-6	K11140	0.06– 0.15	1.40– 1.85	0.035	0.025	0.80– 1.15	—	—	0.35	—	—	—	0.50
EGXXS-D2	K10945	0.07– 0.12	1.60– 2.10	0.035	0.025	0.50– 0.80	0.15	0.40– 0.60	0.35	—	—	—	0.50
EGXXS-G	—	Not Specified ^f											

^a The filler metal shall be analyzed for the specific elements for which values are shown in this table. If the presence of other elements is indicated, in the course of this work, the amount of those elements shall be determined to ensure that their total (excluding iron) does not exceed the limit specified for “Other Elements, Total” in the last column of the table.

^b Single values are maximums.

^c The letters “XX” as used in the AWS classification column of this table refer respectively to the designator for the tensile strength of the weld metals (see Tables 2 and 2M) and the designator for impact strength (see Tables 3 and 3M).

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

^e The copper limit includes copper that may be applied as a coating on the electrode.

^f Composition shall be reported; the requirements are those agreed to by the purchaser and the supplier.

Table 2
A5.26 Tension Test Requirements (As Welded)

AWS A5.26 Classification ^a	Tensile Strength (psi)	Yield Strength, min ^b (psi)	Elongation, min ^b (percent)
EG6ZX-X	60 000		
EG60X-X	to	36 000	24
EG62X-X	80 000		
EG7ZX-X	70 000		
EG70X-X	to	50 000	22
EG72X-X	95 000		
EG8ZX-X	80 000		
EG80X-X	to	60 000	20
EG82X-X	100 000		

^a The letters X-X as they are used in the AWS A5.26 Classification column in this table refer respectively to “S” or “T” (whether the electrode is solid or composite) replacing the first “X” and “1, 2, 3, 5, 6, D2, Ni1, NM2, W, or G” (designation for chemical composition and shielding gas requirements for composite electrodes only) replacing the second “X.”

^b Yield strength at 0.2 percent offset and elongation in 2 in. gage length.

Table 2M
A5.26M Tension Test Requirements (As Welded)

AWS A5.26M Classification ^a	Tensile Strength (MPa)	Yield Strength, min. ^b (MPa)	Elongation, min. ^b (percent)
EG43ZX-X EG432X-X EG433X-X	430 to 550	250	24
EG48ZX-X EG482X-X EG483X-X	480 to 650	350	22
EG55ZX-X EG552X-X EG553X-X	550 to 700	410	20

^a The letters X-X as they are used in the AWS A5.26M Classification column in this table refer respectively to “S” or “T” (whether the electrode is solid or composite) replacing the first “X” and “1, 2, 3, 5, 6, D2, Ni1, NM2, W, or G” (designation for chemical composition and shielding gas requirements) replacing the second “X.”

^b Yield strength at 0.2 percent offset and elongation in 50 mm gage length.

Table 3
A5.26 Impact Test Requirements
(As Welded)^a

AWS A5.26 Classification ^a	Average Impact Strength, min. ^b (ft·lbf)
EG6ZX-X EG7ZX-X EG8ZX-X	Not Specified
EG60X-X EG70X-X EG80X-X	20 @ 0°F
EG62X-X EG72X-X EG82X-X	20 @ -20°F

^a An electrode combination that meets the impact requirements at a given temperature also meets the requirement at all higher temperatures in this table. In this manner, EGX2X-X may also be classified as EGX0X-X and EGXZX-X and EGX0X-X may be classified as EGXZX-X.

^b Both the highest and the lowest of the five test values obtained shall be disregarded in computing the impact strength. Two of the remaining three values shall equal or exceed 20 ft·lbf and one of the three remaining values may be lower than 20 ft·lbf, but not lower than 15 ft·lbf. The average of the three shall not be less than the 20 ft·lbf specified.

Table 3M
A5.26M Impact Test Requirements
(As Welded)^a

AWS A5.26M Classification ^a	Average Impact Strength, min. ^b (J)
EG43ZX-X EG48ZX-X EG55ZX-X	Not Specified
EG432X-X EG482X-X EG552X-X	27 @ -20°C
EG433X-X EG483X-X EG553X-X	27 @ -30°C

^a An electrode combination that meets the impact requirements at a given temperature also meets the requirement at all higher temperatures in this table. In this manner, EGXX3X-X may also be classified as EGXX2X-X and EGXXZX-X and EGXX2X-X may be classified as EGXXZX-X.

^b Both the highest and the lowest of the five test values obtained shall be disregarded in computing the impact strength. Two of the remaining three values shall equal or exceed 27 J and one of the three remaining values may be lower than 27 J, but not lower than 20 J. The average of the three shall not be less than the 27 J specified.

Table 4
Chemical Composition Requirements for Weld Metal From Composite Flux Cored and Metal Cored Electrodes

AWS Classification ^c		UNS Number ^d	Shielding Gas	Weight Percent ^{a,b}										Other Elements, Total
A5.26	A5.26M			C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	
EG6XT-1	EG43XT-1	W06301	None	(e)	1.7	0.03	0.03	0.50	0.30	0.20	0.35	0.35	0.08	0.50
EG7XT-1	EG48XT-1	W07301	None	(e)	1.7	0.03	0.03	0.50	0.30	0.20	0.35	0.35	0.08	0.50
EG8XT-1	EG55XT-1	—	None	(e)	1.8	0.03	0.03	0.90	0.30	0.20	0.25–0.65	0.35	0.08	0.50
EG6XT-2	EG43XT-2	W06302	CO ₂	(e)	2.0	0.03	0.03	0.90	0.30	0.20	0.35	0.35	0.08	0.50
EG7XT-2	EG48XT-2	W07302	CO ₂	(e)	2.0	0.03	0.03	0.90	0.30	0.20	0.35	0.35	0.08	0.50
EGXXT-Ni1	EGXXXT-Ni1	W21033	CO ₂	0.10	1.0–1.8	0.03	0.03	0.50	0.70–1.10	—	0.30	0.35	—	0.50
EGXXT-NM1	EGXXXT-NM1	W22334	Ar/CO ₂ or CO ₂	0.12	1.0–2.0	0.02	0.03	0.15–0.50	1.5–2.0	0.20	0.40–0.65	0.35	0.05	0.50
EGXXT-NM2	EGXXXT-NM2	W22333	CO ₂	0.12	1.1–2.1	0.03	0.03	0.20–0.60	1.1–2.0	0.20	0.10–0.35	0.35	0.05	0.50
EGXXT-W	EGXXXT-W	W20131	CO ₂	0.12	0.50–1.3	0.03	0.03	0.30–0.80	0.40–0.80	0.45–0.70	—	0.30–0.75	—	0.50
EGXXT-G	EGXXXT-G	—	Not Specified ^f											

^a The weld metal shall be analyzed for the specific elements for which values are shown in this table. If the presence of other elements is indicated, in the course of this work, the amount of those elements shall be determined to ensure that their total (excluding iron) does not exceed the limit specified for “Other Elements, Total” in the last column of the table.

^b Single values are maximums.

^c The letters “XX” or “XXX” as used in the AWS classification column in this table refer respectively to the designator(s) for tensile strength of the weld metal (see Tables 2 and 2M) and the designator for impact strength (see Tables 3 and 3M). The single letter “X” as used in the AWS classification column refers to the designator for impact strength (see Tables 3 and 3M).

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

^e Composition range of carbon not specified for these classifications, but the amount shall be determined and reported.

^f Composition shall be reported; the requirements are those agreed to by the purchaser and supplier.

5.2 For the purpose of determining conformance with this specification, an observed or calculated value shall be rounded to the nearest 1000 psi [10 MPa] for tensile and yield strength, and to the “nearest unit” in the last right-hand place of figures used in expressing the limiting value for other quantities in accordance with the rounding-off method given in ASTM E29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*.⁴

Part B

Tests, Procedures, and Requirements

6. Summary of Tests

6.1 The tests required for each classification are specified in Table 5. The purpose of these tests is to determine

⁴ ASTM standards are published by the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

the chemical composition, the mechanical properties, and soundness of the weld. The base metal for the weld test assemblies, the welding and testing procedures to be employed, and the results required are given in Sections 8 through 12.

7. 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 one or two new test assemblies. 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

Table 5
Required Tests

AWS Classification ^a		Chemical Analysis				
A5.26	A5.26M	Electrode	Weld Metal	Radiographic Test	Tension Test	Impact Test
Solid Electrodes						
EG6ZS-X	EG43ZS-X	Required	Not Required	Required	Required	Not Required
EG60S-X	EG432S-X	Required	Not Required	Required	Required	Required
EG62S-X	EG433S-X	Required	Not Required	Required	Required	Required
EG7ZS-X	EG48ZS-X	Required	Not Required	Required	Required	Not Required
EG70S-X	EG482S-X	Required	Not Required	Required	Required	Required
EG72S-X	EG483S-X	Required	Not Required	Required	Required	Required
EG8ZS-X	EG55ZS-X	Required	Not Required	Required	Required	Not Required
EG80S-X	EG552S-X	Required	Not Required	Required	Required	Required
EG82S-X	EG553S-X	Required	Not Required	Required	Required	Required
Composite Flux Cored and Metal Cored Electrodes						
EG6ZT-X	EG43ZT-X	Not Required	Required	Required	Required	Not Required
EG60T-X	EG432T-X	Not Required	Required	Required	Required	Required
EG62T-X	EG433T-X	Not Required	Required	Required	Required	Required
EG7ZT-X	EG48ZT-X	Not Required	Required	Required	Required	Not Required
EG70T-X	EG482T-X	Not Required	Required	Required	Required	Required
EG72T-X	EG483T-X	Not Required	Required	Required	Required	Required
EG8ZT-X	EG55ZT-X	Not Required	Required	Required	Required	Not Required
EG80T-X	EG552T-X	Not Required	Required	Required	Required	Required
EG82T-X	EG553T-X	Not Required	Required	Required	Required	Required

^a The “-X” as it is used in the AWS Classification column of this table refers to “1, 2, 3, 5, 6, D2, Ni1, NM1, NM2, W, and G” (the designation for shielding gas and chemical composition requirements.)

weld test assembly or test specimens 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 prescribed procedures. In this case the requirement for doubling of the number of test specimens does not apply.

8. Weld Test Assemblies

8.1 At least one weld test assembly is required, and two may be required (depending on the electrode—solid as opposed to composite—and the manner in which the sample for chemical analysis is taken), as specified in Table 5. They are the following:

(1) The groove weld in Figure 1 for mechanical properties and soundness of the weld metal for both composite and solid electrodes

(2) The weld ingot in Figure 2 for chemical analysis of the weld metal from composite electrodes

For composite electrodes, the sample for chemical analysis may be taken from the groove weld in Figure 1 or from the reduced section of the fractured tension test specimen, thereby avoiding the need to make the weld ingot. In case of dispute, the weld ingot shall be the referee method for chemical analysis.

8.2 Preparation of each weld test assembly shall be as prescribed in 8.3 and 8.4. The base metal for each assembly shall be as required in Table 6 and shall meet the requirements of the appropriate ASTM specification shown there, or an equivalent specification. Testing of the assemblies shall be as prescribed in 9.2, 9.3, and Sections 10 through 12.

8.3 Groove Weld for Mechanical Properties and Soundness. A test assembly shall be prepared and welded as specified in Figure 1 using base metal of the appropriate type specified in Table 6. Testing of this assembly shall be as specified in Sections 10 through 12. The assembly shall be tested in the as-welded condition.

8.4 Weld Ingot. An ingot shall be prepared as specified in Figure 2 except when the alternative in 8.1 (taking the sample from the weld metal in the groove weld or from the tension test specimen) is selected.

9. Chemical Analysis

9.1 For *solid electrodes*, a sample of the electrode shall be prepared for chemical analysis. Solid electrodes, when analyzed for elements that are present in a coating (copper flashing, for example), shall be analyzed without removing the coating. When the electrode is analyzed for

elements other than those in the coating, the coating must be removed if its presence affects the results of the analysis for other elements.

9.2 Composite electrodes shall be analyzed in the form of weld metal, not electrode. The sample for analysis shall be taken from weld metal obtained with the electrode (and the shielding gas with which it is classified, for those classifications for which an external shielding gas is required). The sample shall come from an ingot (Figure 2), the reduced section of the fractured tension test specimen (Figure 3), or the groove weld in Figure 1.

When the ingot is used, the top surface of the ingot (described in 8.4 and shown in Figure 2) shall be removed and discarded and a sample for analysis shall be obtained from the underlying metal at a location at least 2 in. [50 mm] from both the start and crater ends of the ingot by any appropriate mechanical means. The sample shall be free of slag.

When the reduced section of the fractured tension test specimen or a sample from the groove weld in Figure 1 is used, the sample shall be prepared by any suitable mechanical means. The sample from the groove weld shall be taken at least 2 in. [50 mm] from both the start and crater ends of the weld.

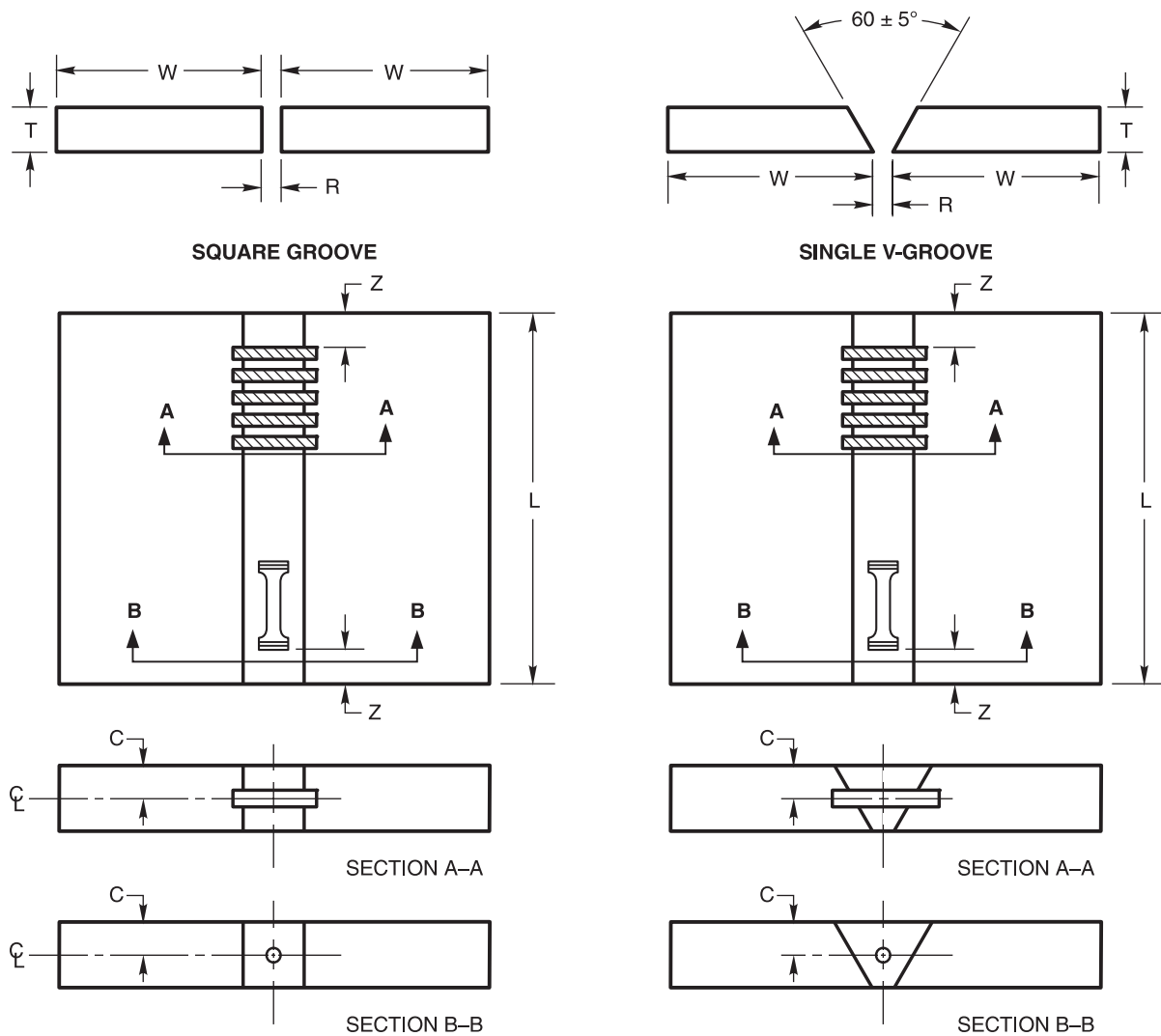
9.3 The sample shall be analyzed by accepted analytical methods. The referee method shall be ASTM Standard Method E350, *Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron and Wrought Iron*.

9.4 The results of the analysis shall meet the requirements of Table 1 for solid electrodes and Table 4 for composite electrodes, for the classification of electrode under test.

10. Radiographic Test

10.1 The groove weld described in 8.3 and shown in Figure 1 shall be radiographed to evaluate the soundness of the weld metal. In preparation for radiography, both surfaces of the weld may be machined or ground smooth and flush with the original surfaces of the base metal or with a uniform reinforcement not exceeding 3/32 in. [2.5 mm]. Both surfaces of the test assembly, in the area of the weld, shall be smooth enough to avoid difficulty in interpreting the radiograph.

10.2 The weld shall be radiographed in accordance with ASTM E142, *Standard Method for Controlling Quality of Radiographic Testing*. The quality level of inspection shall be 2-2T.



(SEE NOTES ON NEXT PAGE)

Figure 1—Groove Weld Test Assembly for Mechanical Properties and Soundness

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

- (1) No cracks, no incomplete fusion, and
- (2) No rounded indications in excess of those permitted by the radiographic standards in Figure 4.

In evaluating the radiograph, 2-1/2 in. [65 mm] of the weld on each end of the test assembly shall be disregarded.

10.3.1 A rounded indication is an indication (on the radiograph) whose length is no more than three times its width. Rounded indications may be circular, elliptical, conical, 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.

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

11. Tension Test

11.1 One all-weld-metal tension test specimen shall be machined from the groove weld described in 8.3 and shown in Figure 1. The dimensions of the specimen shall be as shown in Figure 3.

Electrode Type	Gas Shielded		Gas Shielded		Self-Shielded	
Shielding Gas	Argon-CO ₂		CO ₂		None	
Groove Type	Square Groove		Square Groove ^a		Square Groove	
	in.	mm	in.	mm	in.	mm
Electrode Size	5/64	2.0	3/32 or 1/8	2.4, 2.5, or 3.0	0.120	3.0
Dimensions:						
L, Length, min.	15	380	15	380	15	380
W, Width, min.	12	300	12	300	12	300
T, Thickness	1	25	1	25	1	25
Z, Discard, min.	2-1/2	65	2-1/2	65	2-1/2	65
R, Root Opening	5/8	16	5/8 ^a	16 ^a	3/4	19
C, Distance to the Center of Specimen	1/2	12.5	1/2	12.5	1/2	12.5
Current, dcep:						
Amperes	400 ± 50		500 ± 50		650 ± 40 ^b	
Volts	36 ± 2		36 ± 2		41 ± 2	
Wire Feed Speed	—		—		350 ± 20 ^b	

^a Single V-groove joint is optional for CO₂ gas shielded classifications only. In case of dispute, the square groove assembly is the referee method. Root opening, R, for single-V groove is 5/32 in. [4 mm].

^b Either wire feed speed or current shall be used as a control setting based on the design of the equipment.

Notes:

1. Weld test assembly shall be welded in the vertical position with upward progression.
2. Fixturing of the test assembly shall be based on the manufacturer's recommendations. Water-cooled copper shoes shall be used except when using consumable guide tubes. For welding with consumable guide tubes, follow the manufacturer's recommendations regarding the use of water-cooled shoes. When using water cooling, the outgoing water temperature shall not exceed 180°F [80°C] near the exit point.
3. If the manufacturer does not make the electrode size specified, the nearest size may be used. For sizes other than that shown, the manufacturer's recommended procedure shall be used.
4. Welding shall begin with the assembly at room temperature, 65°F [18°C] minimum. No external heat shall be applied during welding. Starting and run-off tabs are not required if the test assembly without weld tabs is sufficient to provide the required test specimens.
5. The weld shall be completed in one pass.
6. A postweld heat treatment shall not be applied to the test assembly.

**Figure 1 (Continued)—Groove Weld Test Assembly
for Mechanical Properties and Soundness**

11.2 The specimen shall be tested in the manner described in the tension test section of ANSI/AWS B4.0, *Standard Methods for Mechanical Testing of Welds*.

11.3 The results of the tension test shall meet the requirements specified in Table 2, or Table 2M, as applicable.

remaining three values shall equal, or exceed, the specified 20 ft·lbf [27 J] energy level. One of the three may be lower, but not lower than 15 ft·lbf [20 J], and the average of the three shall be not less than the required 20 ft·lbf [27 J] energy level.

12. Impact Test

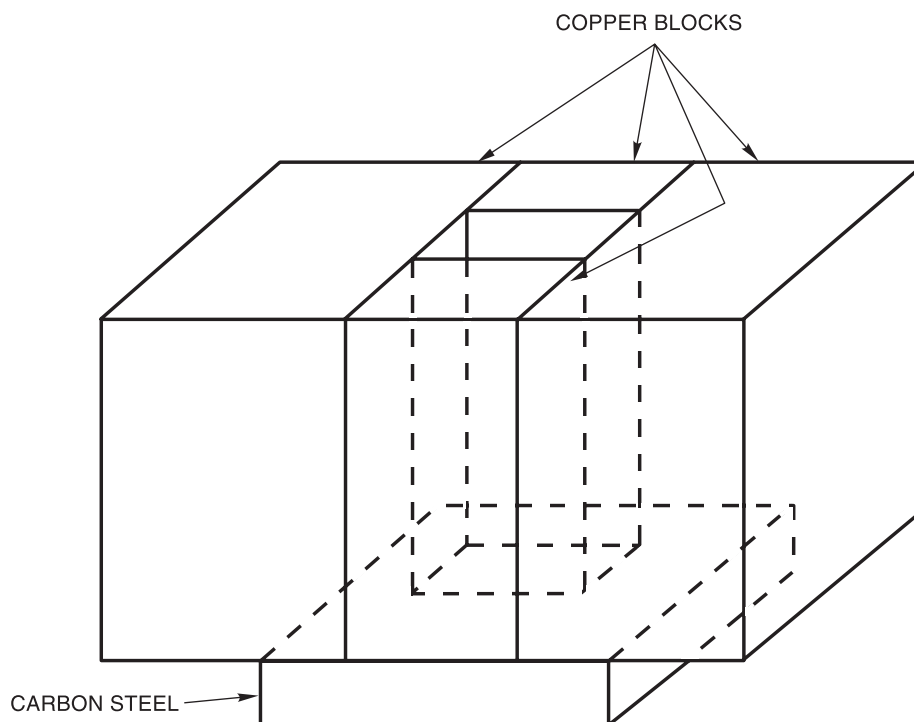
12.1 Five Charpy V-notch impact test specimens (Figure 5) shall be machined from the test assembly shown in Figure 1, for those classifications for which impact testing is required in Table 5. The five specimens shall be tested in accordance with the fracture toughness test section of ANSI/AWS B4.0. The test temperature and the test results shall be those specified in Table 3 or Table 3M, as applicable, for the classification under test.

12.2 In evaluating the test results, the lowest and the highest values obtained shall be disregarded. Two of the

Part C **Manufacture, Identification, and Packaging**

13. Method of Manufacture

The electrodes classified according to this specification may be manufactured by any method that will produce material that meets the requirements of this specification.



Notes:

1. Weld ingot shall be deposited by arc welding in a water-cooled copper mold using welding conditions shown in Figure 1.
2. The ingot shall be of any convenient shape that provides weld metal with approximately 1 in.² [625 mm²] of cross-section.
3. The ingot shall be started on a carbon steel base of sufficient size as to avoid complete fusion, and the copper mold shall be of a size sufficient to avoid contamination of the ingot by molten copper.
4. The sample for chemical analysis shall be taken at least 2 in. [50 mm] above the bottom of the ingot, and at least 2 in. [50 mm] below the crater.

Figure 2—Weld Ingot

Table 6 Base Metals for Test Assemblies		
AWS Classification		
A5.26	A5.26M	Base Metal
EG6XT-X EG6XS-X	EG43XT-X EG43XS-X	ASTM A36
EG7XT-X EG7XS-X	EF48XT-X EG48XS-X	ASTM A242 Type 2, or A572 Grade 50
EG8XT-X EG8XS-X	EG55XT-X EG55XS-X	ASTM A537 Class 2, A572 Grade 60 or 65, or A633 Grade E
The following classifications are exceptions to the above general requirements:		
EGXXT-W	EGXXXT-W	ASTM A588

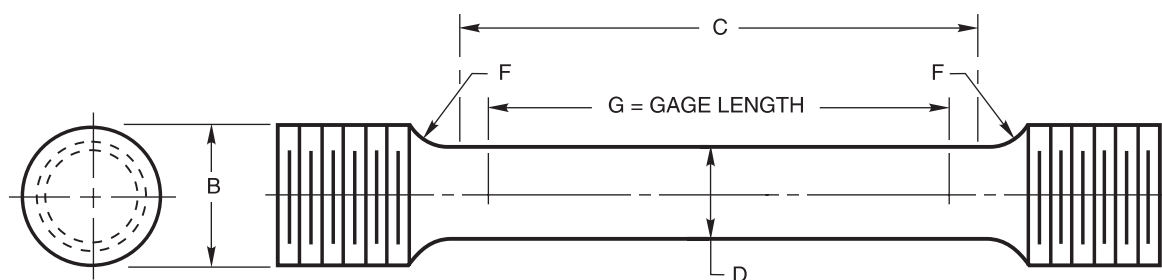
14. Standard Sizes

Standard sizes for electrodes in the different package forms (coils with support, coils without support, spools and drums) are shown in Table 7.

15. Finish and Uniformity

15.1 All electrodes shall have a smooth finish that is free from slivers, depressions, scratches, scale, seams or laps (exclusive of the longitudinal joint in composite electrodes), and foreign matter that would adversely affect the welding characteristics, the operation of the welding equipment, or the properties of the weld metal.

15.2 Each continuous length of electrode shall be from a single lot of material, and welds, when present, shall



Dimensions of Specimen, in.					Approximate Area, in. ²
D	G	C	B	F, min.	
0.500 ± 0.010	2.000 ± 0.005	2-1/4	3/4	0.375	0.2
Dimensions of Specimen, mm					Approximate Area, mm ²
D	G	C	B	F, min.	
12.5 ± 0.2	50.0 ± 0.1	55	20	10	123

Notes:

1. Dimensions G and C shall be as shown, but ends may be of any shape to fit the testing machine holders as long as the load is axial.
2. The diameter of the specimen within the gage length shall be slightly smaller at the center controlling dimension than at the ends. The difference shall not exceed one percent of the diameter.
3. When the extensometer is required to determine yield strength, dimension C may be modified. However, the percent of the elongation shall be based on dimension G.
4. The surface finish within the C dimension shall be no rougher than 63 μ in. [1.6 μ m].

Figure 3—Tension Test Specimen

have been made so as not to interfere with the uniform, uninterrupted feeding of the electrode on automatic equipment.

15.3 The core ingredients in composite electrodes shall be distributed with sufficient uniformity throughout the length of the electrode so as not to adversely affect the performance of the electrode or the properties of the weld metal.

15.4 A suitable protective coating may be applied to any of the electrodes in this specification.

16. Standard Package Forms

16.1 Standard package forms are coils with support, coils without support, spools, and drums. Standard package dimensions and weights for each form are given in Table 8 and Figures 6A and 6B provide dimensions for standard spools. Package forms, sizes and weights other than these shall be as agreed between purchaser and supplier.

16.2 The liners in coils with support shall be designed and constructed to prevent distortion of the coil during

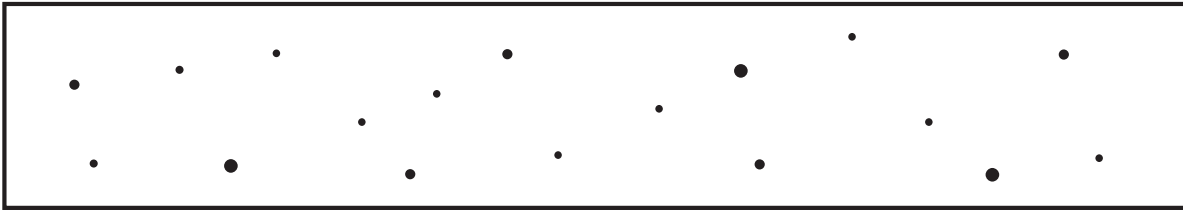
normal handling and use and shall be clean and dry enough to maintain the cleanliness of the electrode.

16.3 Spools shall be designed and constructed to prevent distortion of the electrode during normal handling and use and shall be clean and dry enough to maintain the cleanliness of the electrode.

17. Winding Requirements

17.1 Electrodes shall be wound so that kinks, waves, sharp bends, overlapping, or wedging are not encountered, leaving the electrode free to unwind without restriction. The outside end of the electrode (the end with which welding is to begin) shall be identified so it can be located readily, and shall be fastened to avoid unwinding.

17.2 The cast and helix of electrode in coils, spools and drums shall be such that the electrode will feed in an uninterrupted manner on automatic equipment.

**(A) ASSORTED ROUNDED INDICATIONS**

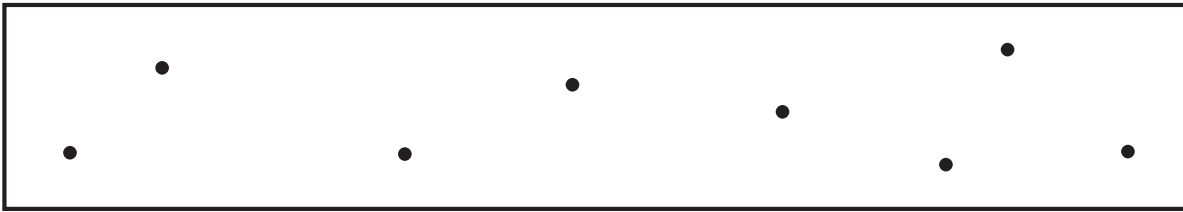
SIZE 1/64 in. TO 1/16 in. [0.4 TO 1.6 mm] DIAMETER OR IN LENGTH.

MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in. [150 mm] OF WELD = 18, WITH THE FOLLOWING RESTRICTIONS:

MAXIMUM NUMBER OF LARGE 3/64 TO 1/16 in. [1.2 TO 1.6 mm] DIAMETER AND/OR LENGTH INDICATIONS = 3.

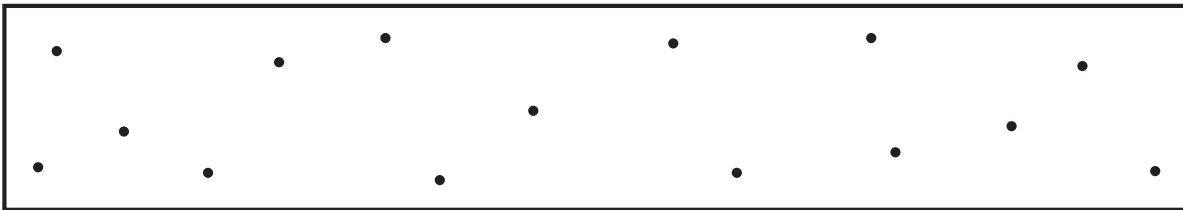
MAXIMUM NUMBER OF MEDIUM 1/32 TO 3/64 in. [0.8 TO 1.2 mm] DIAMETER AND/OR LENGTH INDICATIONS = 5.

MAXIMUM NUMBER OF SMALL 1/64 TO 1/32 in. [0.4 TO 0.8 mm] DIAMETER AND/OR LENGTH INDICATIONS = 10.

**(B) LARGE ROUNDED INDICATIONS**

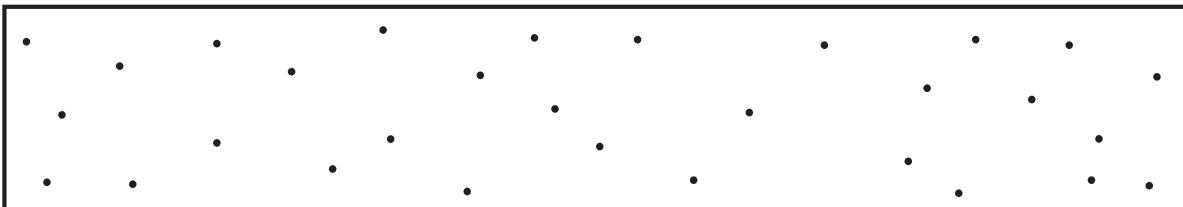
SIZE 3/64 TO 1/16 in. [1.2 TO 1.6 mm] DIAMETER AND/OR LENGTH.

MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in. [150 mm] OF WELD = 8.

**(C) MEDIUM ROUNDED INDICATIONS**

SIZE 1/32 TO 3/64 in. [0.8 TO 1.2 mm] DIAMETER AND/OR LENGTH.

MAXIMUM NUMBER OF INDICATIONS IN ANY 6 in. [150 mm] OF WELD = 15.

**(D) SMALL ROUNDED INDICATIONS**

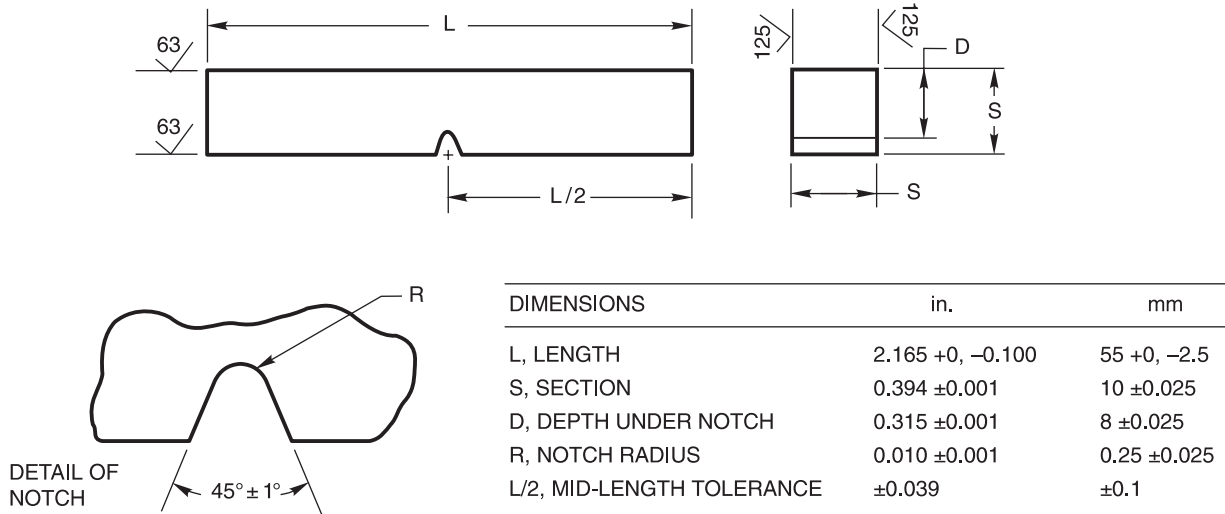
SIZE 1/64 TO 1/32 in. [0.4 TO 0.8 mm] DIAMETER AND/OR LENGTH.

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 porosity and/or inclusions present in the test specimen radiograph shall be used for determining conformance to these radiographic standards.
2. Since these are test welds specifically 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 smaller than 1/64 in. [0.4 mm] shall be disregarded.

Figure 4—Radiographic Acceptance Standards



Notes:

1. The notched surface and the surface to be struck shall be parallel within 0.002 in. [0.05 mm] and have at least 63 μ in. [1.6 μ m] finish. The other two surfaces shall be square with the notched or struck surface within ± 10 minutes of the degree and have at least 125 μ in. [3.2 μ m] finish.
2. The notch shall be smoothly cut by mechanical means and shall be square with the longitudinal edge of the specimen within one degree.
3. The geometry of the notch shall be measured on at least one specimen in a set of five specimens. Measurement shall be done at minimum 50 times magnification on either a shadowgraph or a metallograph.
4. The correct location of the notch shall be verified by etching before or after machining.
5. If a specimen does not break upon being struck, the value for energy absorbed shall be reported as the capacity of the impact testing machine followed by a plus sign (+).

Figure 5—Charpy V-Notch Impact Test Specimen**Table 7
Standard Sizes^a**

Standard Package Forms	A5.26			A5.26M		
	Diameter		Tolerance	Diameter		Tolerance
	in.	Solid ±in.	Cored ±in.	mm	Solid ±mm	Cored ±mm
Coils with support, Coils without support, Drums, and Spools	1/16	0.062	0.002	1.6	0.05	0.05
	5/64	0.078	0.003	2.0	0.05	0.08
	3/32	0.094	0.003	2.4	0.05	0.08
				2.5	0.05	0.08
		0.120	0.003	3.0	0.08	0.08
	1/8	0.125	0.003	3.2	0.08	0.08
	5/32	0.156	0.003	4.0	0.08	0.08

^a Dimensions, tolerances, and package forms other than those shown shall be as agreed between purchaser and supplier.

Table 8
Standard Package Dimensions and Weights^a

Type of Package	Package Size OD ^d		Net Weight of Electrode ^b	
	in.	mm	lb	kg
Coils without supports	Not specified ^c		Not specified ^c	
Spools	12	300	5, 30, and 35	10 and 15
	14	350	50 and 60	20 and 25
	22	560	250	100
	24	610	300	150
	30	760	600, 750, and 1000	250, 350, and 450
Drums	15-1/2	400	Not specified ^c	
	20	500	Not specified ^c	
	23	600	300 and 600	150 and 300

Coils with Support—Standard Dimensions and Weights^a

Electrode Size	Coil Net Weight ^b		Coil Dimensions			
			Inside Dia. of Lining		Width of Wound Electrodes	
	lb	kg	in.	mm	in., max.	mm, max.
All	60 and 65	20, 25, and 30	12 ± 1/8	300 +3, -10	4-5/8	120
	150 and 200	75 and 100	23-1/2 ± 1/4	600 +3, -10	5	125

^a Sizes and net weights other than those specified shall be as agreed between supplier and purchaser.

^b Tolerance on net weight shall be ±10%.

^c As agreed by supplier and purchaser.

^d OD = outside diameter.

18. Electrode Identification

18.1 The product information and the precautionary information required in Section 20, Marking of Packages, shall also appear on each coil, spool and drum.

18.2 Coils without support shall have a tag containing this information, securely attached to the electrode at the inside end of the coil.

18.3 Coils with support shall have the information securely affixed in a prominent location on the support.

18.4 Spools shall have the information securely affixed in a prominent location on the outside of at least one flange of the spool.

18.5 Drums shall have the information securely affixed in a prominent location on the side of the drum.

19. Packaging

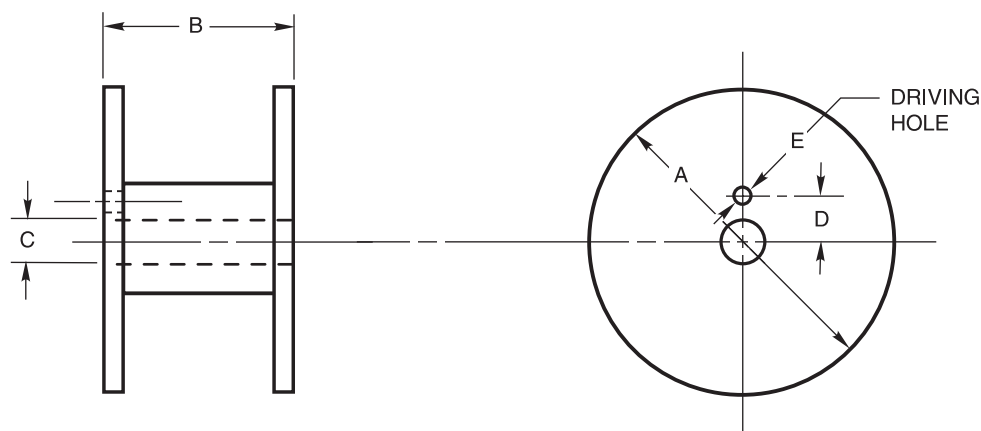
Electrodes shall be suitably packaged to ensure against damage during shipment and storage under normal conditions.

20. Marking of Packages

20.1 The following product information (as a minimum) shall be legibly marked so as to be visible from the outside of each unit package.

- (1) AWS specification and classification (year of issue may be excluded)
- (2) Supplier's name and trade designation
- (3) Size and net weight
- (4) Lot, control, or heat number

20.2 The following precautionary information (as a minimum) shall be prominently displayed in legible print on all packages of electrodes including individual unit packages enclosed within a larger package.



DIMENSIONS

		12 in. [300 mm] Spools		14 in. [350 mm] Spools	
		in.	mm	in.	mm
A	Diameter, max.	12	305	14	355
B	Width	4.0 ± 0.06	$103 -3, +0$	4.0 ± 0.6	$103 -3, +0$
C	Diameter	$2.03 -0, +0.06$	$50.5 -0, +2.5$	$2.03 -0, +0.06$	$50.5 -0, +2.5$
D	Distance Between Axes	1.75 ± 0.02	44.5 ± 0.5	1.75 ± 0.02	44.5 ± 0.5
E	Diameter (Note 3)	$0.44 + 0, -0.06$	$10 -0, +1$	$0.44 + 0, -0.06$	$10 -0, +1$

Notes:

1. Outside diameter of barrel shall be such as to permit feeding of the filler metals.
2. Inside diameter of the barrel shall be such that swelling of the barrel or misalignment of the barrel and flanges will not result in the inside of the diameter of the barrel being less than the inside diameter of the flanges.
3. Holes are provided on each flange, but they need not be aligned.

Figure 6A—Dimensions of Standard 12 and 14 in. [300 and 350 mm] Spools**WARNING:**

PROTECT yourself and others. Read and understand this information.

FUMES AND GASES can be hazardous to your health.

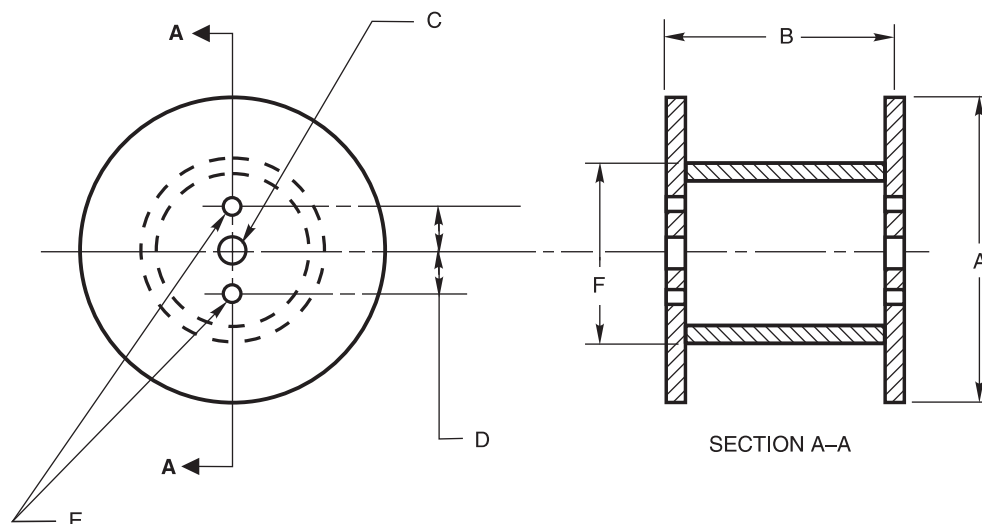
ARC RAYS can injure eyes and burn skin.

ELECTRIC SHOCK can KILL.

- Read and understand the manufacturer's instructions, the Material Safety Data Sheets (MSDSs), and your employer's safety practices.
- Keep your head out of the fumes.

- Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases away 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 ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126; and *OSHA Safety and Health Standards*, 29 CFR 1910, published by the U.S. Government Printing Office, Washington, DC 20402.

DO NOT REMOVE THIS INFORMATION



DIMENSIONS

		22 in. [560 mm] Spools		24 in. [610 mm] Spools		30 in. [760 mm] Spools	
		in.	mm	in.	mm	in.	mm
A	Diameter, max.	22	560	24	610	30	760
B	Width, max.	12	305	13.5	345	13.5	345
C	Diameter	1.31 +0.13, -0	35.0 ± 1.5	1.31 +0.13, -0	35.0 ± 1.5	1.31 +0.13, -0	35.0 ± 1.5
D	Distance, Ctr. to Ctr.	2.5 ± 0.1	63.5 ± 1.5	2.5 ± 0.1	63.5 ± 1.5	2.5 ± 0.1	63.5 ± 1.5
E	Diameter (Note 3)	0.69 +0, -0.06	16.7 ± 0.7	0.69 +0, -0.06	16.7 ± 0.7	0.69 +0, -0.06	16.7 ± 0.7

Notes:

1. Outside diameter of barrel, dimension F, shall be such as to permit feeding of the filler metals.
2. Inside diameter of the barrel shall be such that swelling of the barrel or misalignment of the barrel and flanges will not result in the inside of the diameter of the barrel being less than the inside diameter of the flanges.
3. Two holes are provided on each flange and shall be aligned on both flanges with the center hole.

Figure 6B — Dimensions of Standard 22, 24, and 30 in. [560, 610, and 760 mm] Spools (Reels)

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Annex A (Informative)

Guide to AWS Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding

This annex is not part of ANSI/AWS A5.26/A5.26M-97 (R2009), *Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding*, but is included for informational purposes only.

A1. Introduction

The purpose of this annex is to correlate the electrode classifications with their intended applications so the specification can be used effectively. Reference to appropriate base metal specifications is made whenever that can be done and when it would be helpful. Such references are intended only as examples rather than complete listings of the base metals for which each filler metal is suitable.

A2. Classification System

A2.1 The system for identifying the electrode classifications in this specification follows the standard pattern used in other AWS filler metal specifications (see Figure A.1). The letters “EG” at the beginning of each classification designation shows that the electrode is intended for use with the electrode gas welding process.

In the case of the designations for A5.26, this is followed by a single digit (6, 7, or 8) representing the minimum tensile strength of the weld metal in units of 10 000 psi. For the designations of A5.26M, the “EG” is followed by two digits (43, 48, or 55) representing the minimum tensile strength in units of 10 MPa (see Table 2M).

The digit that follows is a number or the letter “Z.” The number designates the temperature at which (and/or above which) the weld metal meets or exceeds the required 20 ft-lbf [27 J] Charpy V-notch impact strength. The letter “Z” indicates that no impact strength requirement is specified.

The next letter, either S or T, indicates that the electrode is solid (S) or composite (flux cored or metal cored) (T). The designator (digits or letters) following the hyphen in the classification indicates the chemical

composition (of weld metal for the composite electrodes and of the electrode itself for solid electrodes) and the type or absence of shielding gas required in the case of composite electrodes only.

A2.2 “G” Classification

A2.2.1 This specification includes filler metals classified as EGXXT-G or EGXXS-G. The last “G” indicates that the filler metal is of a general classification. It is “general” because not all of the particular requirements specified for each of the other classifications are specified for this classification. The intent in establishing this classification is to provide a means by which filler metals that differ in one respect or another (chemical composition, for example) from all other classifications (meaning that the composition of the filler metal, in the case of the example, does not meet the composition specified for any of the classifications in the specification) can still be classified according to the specification. The purpose is to allow a useful filler metal—one that otherwise would have to await a revision of the specification—to be classified immediately, under the existing specification. This means, then, that two filler metals, each bearing the same “G” classification, may be quite different in some certain respect (chemical composition, again, for example).

A2.2.2 Request for Filler Metal Classification

(1) When a filler metal cannot be classified according to some classification other than a “G” classification, the manufacturer may request that a classification be established for that filler metal. The manufacturer may do this by following the procedure given here. When the manufacturer elects to use the “G” classification, the Committee on Filler Metals recommends that the manufacturer still request that a classification be established for that

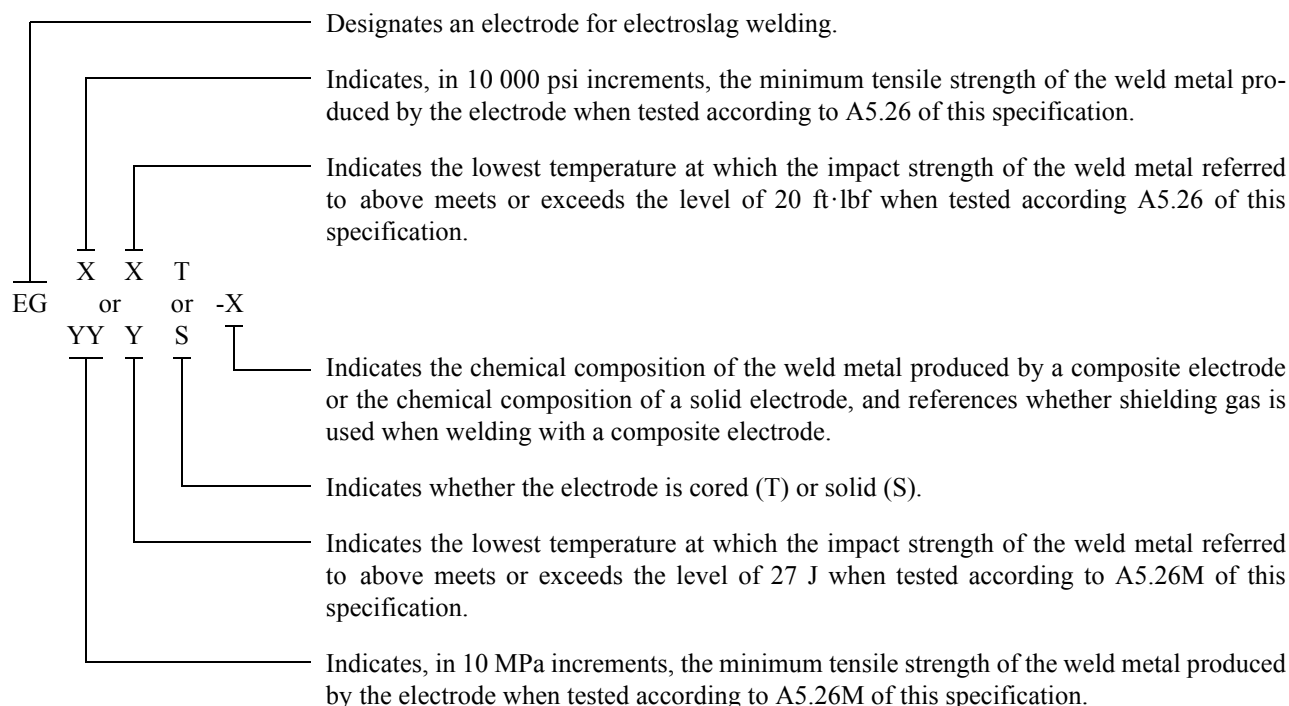


Figure A.1—Classification System

filler metal, as long as the filler metal is of commercial significance.

(2) A request to establish a new filler metal classification must be a written request and it needs to provide sufficient detail to permit the Committee on Filler Metals or the Subcommittee to determine whether the new classification or the modification of an existing classification is more appropriate to satisfy the need. The request needs to state the variables and their limits for such a classification or modification. The request should contain some indication of the time by which completion of the new classification or modification is needed.

(3) The request should be sent to the Secretary of the Committee on Filler Metals at AWS headquarters. Upon receipt of the request, the Secretary will:

(a) Assign an identifying number to the request. This number will include the date the request was received.

(b) Confirm receipt of the request and give the identification number to the person who made the request.

(c) Send a copy of the request to the Chairman of the Committee on Filler Metals and the Chairman of the particular Subcommittee involved.

(d) File the original request.

(e) Add the request to the log of outstanding requests.

(4) All necessary action on each request will be completed as soon as possible. If more than 12 months lapse, the Secretary shall inform the requestor of the status of

the request, with copies to the Chairmen of the Committee and of the Subcommittee. Requests still outstanding after 18 months shall be considered not to have been answered in a “timely manner” and the Secretary shall report these to the Chairman of the Committee on Filler Metals for action.

(5) The Secretary shall include a copy of the log of all requests pending and those completed during the preceding year with the agenda for each Committee on Filler Metals meeting. Any other publication of requests that have been completed will be at the option of the American Welding Society, as deemed appropriate.

A2.3 Terms ‘Not Specified’ and ‘Not Required.’ The point of difference (although not necessarily the amount of the difference) referred to above will be readily apparent from the use of the words “not required” and “not specified” in the specification. The use of these words is as follows:

Not Specified is used in those areas of the specification that refer to the results of some particular test. It indicates that the requirements for that test are not specified for that particular classification.

Not Required is used in those areas of the specification that refer to the test that must be conducted in order to classify a filler metal. It indicates that the test is not required because the requirements (results) for the test have not been specified for that particular classification.

Restating the case, when a requirement is not specified, it is not necessary to conduct the corresponding test to classify a filler metal to that classification. When a purchaser wants the information provided by that test, in order to consider a particular product of that classification for a certain application, the purchaser will have to arrange for that information with the supplier of the product. The purchaser will have to establish with that supplier just what the testing procedure and the acceptance requirements are to be for that test. The purchaser may want to incorporate that information (via ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*) in the purchase order.

A2.4 An international system for designating welding filler metals is under development by the International Institute of Welding (IIW) for use in future specifications to be issued by the International Standards Organization (ISO). Table A.1 shows the proposed designations for the type of filler metal. In that system the initial letter “S” designates a mild or low-alloy steel wire, followed by a four-digit number. If the filler metal is a metal cored wire, the initial letter is “C”; if a flux cored wire, the initial letter is “T.”

A3. Acceptance

Acceptance of all welding materials classified under this specification is in accordance with ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*, as the spec-

ification states. Any testing a purchaser requires of the supplier, for material shipped in accordance with this specification, shall be clearly stated in the purchase order, according to the provisions of ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*. In the absence of any such statement in the purchase order, the supplier may ship the material with whatever testing is normally conducted on material of that classification, as specified in Schedule F, Table 1, of ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*. Testing in accordance with any other Schedule in that Table must be specifically required by the purchase order. In such cases, acceptance of the material shipped shall be in accordance with those requirements.

A4. Certification

The act of placing the AWS Specification and Classification designations 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 of the requirements of the specification.

The only testing requirement implicit in this certification is that the manufacturer actually has 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.

Table A.1
Comparisons of A5.26/A5.26M Classifications and Classifications in Other AWS Specifications and Proposed ISO Designations

AWS A5.26/A5.26M Classification	Similar Classifications ^a					Proposed ISO Designation ^b
	AWS A5.17	AWS A5.18	AWS A5.23	AWS A5.25	AWS A5.28	
EGXXS-1	—	—	—	—	—	—
EGXXS-2	—	ER70S-2	—	EM5K-EW	—	S2134
EGXXS-3	EM13K	ER70S-3	—	EM13K-EW	—	S2030
EGXXS-5	—	ER70S-5	—	—	—	S2022
EGXXS-6	EH11K	ER70S-6	—	EH11K-EW	—	S3031
EGXXS-D2	—	—	EA3K	EH10Mo-EW	ER80S-D2	S3020-A3

^a Classifications are similar but not necessarily identical in composition:

ANSI/AWS A5.17 *Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding*
 ANSI/AWS A5.18 *Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding*
 ANSI/AWS A5.23 *Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding*
 ANSI/AWS A5.25 *Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding*
 ANSI/AWS A5.28 *Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding*

^b IIW Doc. XII-1232-91 (also see Section A2.5).

“Certification” is not 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 conducted. 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,” in ANSI/AWS A5.01.

A5. Ventilation During Welding

A5.1 Five major factors govern the quantity of fumes in the atmosphere to which welders and welding operators are exposed during welding:

- (1) Dimensions of the space in which welding is done (with special regard to the height of the ceiling)
- (2) Number of welders and welding operators working in that space
- (3) Rate of evolution of fumes, gases, or dust, according to the materials and processes used
- (4) The proximity of the welders or welding operators to the fumes as the fumes issue from the welding zone, and to the gases and dusts in the space in which they are working
- (5) The ventilation provided to the space in which the welding is done

A5.2 American National Standard ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes* (published by the American Welding Society), discusses the ventilation that is required during welding and should be referred to for details. Attention is drawn particularly to the section on protection of personnel and the general area and ventilation in that document.

A6. Welding Considerations

A6.1 Electrode gas welding is an arc welding process that uses solid electrodes with gas shielding, composite cored electrodes with gas shielding, or composite cored electrodes without gas shielding (self-shielded). Operating on direct current, the electrode deposits filler metal in the cavity formed by the water-cooled backing shoe(s) that bridges the groove between the joint members. The joint normally is made in a single pass, though with special fixturing multipass joints have been welded.

A6.2 Flux cored electrodes used with the electrode gas welding process are designed specifically for compatibility with the process. The flux produces a thin layer of slag between the weld metal and copper backing shoes without accumulating excessive slag above the weld pool. The nonmetallic content of the flux core is lower

than that of conventional gas shielded and self-shielded flux cored electrodes.

A6.3 Because of the large volume of molten weld metal produced in electrode gas welding and the necessity to contain it, the process is used for welding in the essentially vertical position. Joints are readily welded in plate assemblies that are as much as 15 degrees from the vertical, or where the joint in vertical plate assemblies may be as much as 15 degrees from vertical, or both.

A6.4 The entire assembly, including electrode, copper shoes, wire-feeding mechanism, controls, and oscillator, generally moves vertically during operation. When consumable guide tubes are used, vertical movement of the equipment may not be required. The length of vertical travel is unlimited and is dependent upon the design of the equipment used.

A6.5 The standard joint geometry is a simple square groove in a butt joint. Joint geometries other than square grooves in butt joints can be used.

A6.6 Certain classifications can be used with consumable guide tubes. These guide tubes are generally AISI Grades 1008 to 1020 carbon steel tubing. In some applications, the guide tubes are covered with a flux which provides a protective slag and insulates the tube should it contact the side wall or copper backing shoes. Other applications use ceramic fusible insulators in the shape of washers affixed to the tubes. The manufacturer should be consulted for specific recommendations regarding consumable guide tubes.

The effect of the consumable guide tubes is generally to dilute the alloy content of the weld metal. Consumable guide tubes are not classified per this specification; therefore, weld metal strength and toughness should be tested by the user.

A6.7 The specification requires the use of certain base metals for classification purposes. This does not signify any restriction on the application of the process for joining other base metals, but rather to provide a means for obtaining reproducible results. Electrode gas welding is a “high-dilution” process, meaning that the base metal forms a significant portion of the weld metal. The type of base metal, especially given the wide variety of available low-alloy structural steels, will influence the mechanical and other properties of the joint and weld procedure qualification tests, as distinguished from filler metal classification tests, should be used for assessing the properties of welds for a given application.

A6.8 Electrode gas welding is generally a high-deposition process, especially when applied to thick plates. Since it usually is operated as a single-pass process, the weld metal and heat-affected zone are subject to no subse-

quent weld thermal cycles, such as is common with conventional multipass arc welding of thick materials. The relatively wide heat-affected zone (HAZ) on thick plates is often characterized by large grains. On these types of applications, the as-welded mechanical properties of the weld and HAZ may, therefore, be somewhat lower than the base metal, and should be adequately tested and evaluated for the intended application.

A7. Description and Intended Use of Electrodes

This specification contains classifications that describe three categories of electrodes: solid electrodes for use with gas shielding, composite (flux cored or metal cored) electrodes for use with gas shielding, and self-shielded composite (flux cored) electrodes which require no external gas shielding.

A7.1 Solid Electrodes. The classifications for solid electrodes contained in this specification are very similar in electrode chemical composition to, or, in many cases, identical in electrode chemical composition to classifications contained in ANSI/AWS A5.18-93, *Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding*, and ANSI/AWS A5.28-96, *Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding*. The user should be aware that the mechanical properties obtained when using these electrodes with the electrogas welding process will differ from those obtained when using them with the gas metal or gas tungsten arc welding processes.

Weld metal mechanical properties obtained with the use of solid electrodes with the electrogas welding process are very dependent on the type of gas employed. The change from one gas type or blend to another (either more reactive or less reactive) will affect the chemical composition of the weld metal and the resulting mechanical properties. In some cases, this change in mechanical properties may be significant enough to necessitate a change in the electrode classification. For this reason, care should be taken to test the electrode with the gas or gas blend which will be used in production.

A7.2 Cored Electrodes. The classifications for composite (flux cored and metal cored) electrodes contained in this specification are based on weld metal chemical composition and the type of, or absence of, an external shielding gas, as shown in Table 4. Once again, it is important for the user to remember that the change from one gas type or blend to another (either more reactive or less reactive) will affect the chemical composition of the weld metal and the resulting mechanical properties.

It should be noted that the EGXXT-1 and EGXXT-2 classifications in this specification are totally different from the EXXT-1 and EXXT-2 classifications contained in ANSI/AWS A5.20, *Specification for Carbon Steel Electrodes for Flux Cored Arc Welding*, and ANSI/AWS A5.29, *Specification for Low Alloy Steel Electrodes for Flux Cored Arc Welding*.

A7.2.1 EGXXT-1 Classification. Electrodes of the EGXXT-1 (and EGXXT-1) classifications are self-shielded electrodes which require no external shielding gas. Electrodes of these classifications are designed for the core materials to provide a slag cover, along with the appropriate alloys, deoxidizers, denitrifiers, and shielding materials. These often consist of fluorides, metallic alloys, and alkali and alkali earth oxides and carbonates. EGXXT-1 electrodes are designed for welding many structural steels such as ASTM A 36, A 572 and A 515, as well as many grades used in ship construction. Typical applications include bases for heavy equipment, storage tanks, ship hulls, structural members and pressure vessels.

A7.2.2 EGXXT-2 Classification. Electrodes of the EGXXT-2 (and EGXXT-2) classifications are gas shielded electrodes designed for use with carbon dioxide shielding gas. Typical applications would be similar to those of EGXXT-1 electrodes, except the use of an external shielding gas would normally confine their use to a shop environment.

A7.2.3 EGXXT-Ni1 Classification. Electrodes of the EGXXT-Ni1 (and EGXXT-Ni1) classifications are gas shielded electrodes designed for use with carbon dioxide shielding gas. These electrodes are similar to EGXXT-2 electrodes except they produce weld metal with approximately 1% nickel.

A7.2.4 EGXXT-NM1 and -NM2 Classifications. Electrodes of the EGXXT-NM1 (EGXXT-NM1) and EGXXT-NM2 (EGXXT-NM2) classifications are gas shielded electrodes designed for use with carbon dioxide shielding gas (or an argon/carbon dioxide blend in the case of EGXXT-NM2). These electrodes produce weld metal alloyed with various levels of nickel and molybdenum.

A7.2.5 EGXXT-W Classification. Electrodes of the EGXXT-W (and EGXXT-W) classifications are gas shielded electrodes designed for use with carbon dioxide shielding gas. These electrodes produce weld metal which is intended for use on bare exposed applications of weathering steels, such as ASTM A 242 and A 588.

A7.2.6 EGXXT-G Classification. Electrodes of the EGXXT-G (and EGXXT-G) classifications are those electrodes not included in the preceding classifications, and for which only mechanical property requirements are specified. The electrode supplier should be consulted for the composition, properties, characteristics, and intended

use of electrodes of this classification. (See A2.2 for further information.)

A8. Discontinued Classifications

The classifications shown in Table A.2 have been discontinued over the life of this specification:

Table A.2
Discontinued Classifications

Discontinued Classification	Last Published	Replaced by
EGXXS-1B	1978	EGXXS-D2 in A5.26-91
EGXXS-GB	1978	EGXXS-G in A5.26-91
EGXXT3	1978	EGXXS-Ni1 in A5.26-91
EGXXT4	1978	EGXXT-NM1 in A5.26-91
EGXXT5	1978	EGXXT-W in A5.26-91

A9. Safety Considerations

A9.1 Burn Protection. Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting and allied processes. These can cause burns if precautionary measures are not used. Workers should wear protective clothing made of fire-resistant material. Pant cuffs, open pockets, or other places on clothing that can catch and retain molten metal or sparks should not be worn. High-top shoes or leather leggings and fire-resistant gloves should be worn. Pant legs should be worn over the outside of high-top shoes. Helmets or hand shields that provide protection for the face, neck, and ears, and a protective head covering should be used. In addition, appropriate eye protection should be used.

When welding overhead or in confined spaces, ear plugs to prevent weld spatter from entering the ear canal should be worn in combination with goggles, or the equivalent, to give added eye protection. Clothing should be kept free of grease and oil. Combustible materials should not be carried in pockets. If any combustible substance has been spilled on clothing, a change to clean, fire-resistant clothing should be made before working with open arcs or flames. Aprons, cape-sleeves, leggings, and shoulder covers with bibs designed for welding service should be used. Where welding or cutting of unusually thick base metal is involved, sheet metal shields should be used for extra protection. Mechanization of highly hazardous processes or jobs should be considered. Other personnel in the work area should be protected by the use of noncombustible screens or by the use of appropriate protection as described in the previous paragraph.

Before leaving a work area, hot work pieces should be marked to alert other persons of this hazard. No attempt should be made to repair or disconnect electrical equipment when it is under load; disconnection under load produces arcing of the contacts and may cause burns or shock, or both. (Note: Burns can be caused by touching hot equipment such as electrode holders, tips, and nozzles. Therefore, insulated gloves should be worn when these items are handled, unless an adequate cooling period has been allowed before touching.)

The following sources are for more detailed information on personal protection:

(1) American National Standards Institute. ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*. New York: American National Standards Institute.⁵

(2) American National Standards Institute. ANSI Z41.1, *Safety-Toe Footwear*. New York, N.Y.: American National Standards Institute.

(3) American Welding Society. ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*. Miami, Fla.: American Welding Society.⁶

(4) OSHA. *Code of Federal Regulations*, Title 29—Labor, Chapter XVII, Part 1910. Washington, D.C.: U.S. Government Printing Office.⁷

A9.2 Electrical Hazards. Electric shock can kill. However, it can be avoided. Live electrical parts should not be touched. The manufacturer's instructions and recommended safe practices should be read and understood. Faulty installation, improper grounding, and incorrect operation and maintenance of electrical equipment are all sources of danger.

All electrical equipment and the workpieces should be grounded. The workpiece lead is not a ground lead; it is used only to complete the welding circuit. A separate connection is required to ground the workpiece.

The correct cable size should be used, since sustained overloading will cause cable failure and result in possible electrical shock or fire hazard. All electrical connections should be tight, clean, and dry. Poor connections can overheat and even melt. Further, they can produce dangerous arcs and sparks. Water, grease, or dirt should not be allowed to accumulate on plugs, sockets, or electrical units. Moisture can conduct electricity. To prevent shock, the work area, equipment, and clothing should be kept

⁵ ANSI standards are published by the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036.

⁶ AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

⁷ OSHA standards are published by the U.S. Government Printing Office, Washington, DC 20402.

dry at all times. Welders should wear dry gloves and rubber soled shoes, or stand on a dry board or insulated platform. Cables and connections should be kept in good condition. Improper or worn electrical connections may create conditions that could cause electrical shock or short circuits. Worn, damaged, or bare cables should not be used. Open circuit voltage should be avoided. When several welders are working with arcs of different polarities, or when a number of alternating current machines are being used, the open circuit voltages can be additive. The added voltages increase the severity of the shock hazard.

In case of electric shock, the power should be turned off. If the rescuer must resort to pulling the victim from the live contact, nonconducting materials should be used. If the victim is not breathing, cardiopulmonary resuscitation (CPR) should be administered as soon as contact with the electrical source is broken. A physician should be called and CPR continued until breathing has been restored, or until a physician has arrived. Electrical burns are treated as thermal burns; that is, clean, cold (iced) compresses should be applied. Contamination should be avoided; the area should be covered with a clean, dry dressing; and the patient should be transported to medical assistance.

Recognized safety standards such as ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*; and NFPA No. 70, *National Electrical Code*⁸, should be followed.

A9.3 Fumes and Gases. Many welding, cutting, and allied processes produce fumes and gases which may be harmful to health. Fumes are solid particles which originate from welding filler metals and fluxes, the base metal, and any coatings present on the base metal. Gases are produced during the welding process or may be produced by the effects of process radiation on the surrounding environment. Management, welders, and other personnel should be aware of the effects of these fumes and gases. The amount and composition of these fumes and gases depend upon the composition of the electrode and base metal, welding process, current level, arc length, and other factors.

The possible effects of overexposure range from irritation of eyes, skin, and respiratory system to more severe complications. Effects may occur immediately or at some later time.

Fumes can cause symptoms such as nausea, headaches, dizziness, and metal fume fever. The possibility of more serious health effects exists when especially toxic materials are involved. In confined spaces, the shielding

gases and fumes might displace breathing air and cause asphyxiation. One's head should always be kept out of the fumes. Sufficient ventilation, exhaust at the arc, or both, should be used to keep fumes and gases from your breathing zone and the general area.

In some cases, natural air movement will provide enough ventilation. Where ventilation may be questionable, air sampling should be used to determine if corrective measures should be applied.

More detailed information on fumes and gases produced by the various welding processes may be found in the following:

(1) The permissible exposure limits required by OSHA can be found in *Code of Federal Regulations*, Title 29—Labor, Chapter XVII Part 1910.

(2) The recommended threshold limit values for these fumes and gases may be found in *Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment*, published by the American Conference of Governmental Industrial Hygienists (ACGIH)⁹.

(3) The results of an AWS-funded study are available in a report entitled, *Fumes and Gases in the Welding Environment*.

A9.4 Radiation. Welding, cutting, and allied operations may produce radiant energy (radiation) harmful to health. One should become acquainted with the effects of this radiant energy.

Radiant energy may be ionizing (such as x-rays), or nonionizing (such as ultraviolet, visible light, or infrared). Radiation can produce a variety of effects such as skin burns and eye damage, depending on the radiant energy's wavelength and intensity, if excessive exposure occurs.

A9.4.1 Ionizing Radiation. Ionizing radiation is produced by the electron beam welding process. It is ordinarily controlled within acceptance limits by use of suitable shielding enclosing the welding area.

A9.4.2 Nonionizing Radiation. The intensity and wavelengths of nonionizing radiant energy produced depend on many factors, such as the process, welding parameters, electrode and base metal composition, fluxes, and any coating or plating on the base metal. Some processes such as resistance welding and cold pressure welding ordinarily produce negligible quantities of radiant energy. However, most arc welding and cutting processes (except submerged arc when used properly), laser beam welding and torch welding, cutting, brazing, or soldering

⁸ NFPA documents are published by the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269.

⁹ ACGIH documents are published by the American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634.

can produce quantities of nonionizing radiation such that precautionary measures are necessary.

Protection from possible harmful effects caused by nonionizing radiant energy from welding include the following measures:

(1) One should not look at welding arcs except through welding filter plates which meet the requirements of ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*. It should be noted that transparent welding curtains are not intended as welding filter plates, but rather are intended to protect passersby from incidental exposure.

(2) Exposed skin should be protected with adequate gloves and clothing as specified ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*.

(3) Reflections from welding arcs should be avoided, and all personnel should be protected from intense reflections. (Note: Paints using pigments of substantially zinc oxide or titanium dioxide have a lower reflectance for ultraviolet radiation.)

(4) Screens, curtains, or adequate distance from aisles, walkways, etc., should be used to avoid exposing passersby to welding operations.

(5) Safety glasses with UV-protective side shields have been shown to provide some beneficial protection from ultraviolet radiation produced by welding arcs.

A9.4.3 Ionizing radiation information sources include the following:

(1) American Welding Society. F2.1-78, *Recommended Safe Practices for Electron Beam Welding and Cutting*.

(2) Manufacturer's product information literature.

A9.4.4 Nonionizing radiation information sources include:

(1) American National Standards Institute. ANSI Z136.1, *Safe Use of Lasers*. New York, N.Y.: American National Standards Institute.

(2) American National Standards Institute. ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*. New York, N.Y.: American National Standards Institute.

(3) American Welding Society. ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*. Miami, Fla.: American Welding Society.

(4) Hinrichs, J. F. January 1978. Project committee on radiation — summary report. *Welding Journal* 57:62–65.

(5) Marshall, W. J., Sliney, D. H., et al. March 1980. Optical radiation levels produced by air-carbon arc cutting processes. *Welding Journal* 59:43–46.

(6) Moss, C. E., and Murray, W. E. September 1979. Optical radiation levels produced in gas welding, torch brazing, and oxygen cutting. *Welding Journal* 58:37–46.

(7) Moss, C. E. March 1979. Optical radiation transmission levels through transparent welding curtains. *Welding Journal* 58:69-s to 75-s.

(8) National Technical Information Service. Nonionizing radiation protection special study No. 42-0053-77, *Evaluation of the Potential Hazards from Actinic Ultraviolet Radiation Generated by Electric Welding and Cutting Arcs*. Springfield, Va.: National Technical Information Service.¹⁰

(9) National Technical Information Service. Nonionizing radiation protection special study No. 42-0312-77, *Evaluation of the Potential Retina Hazards from Optical Radiation Generated by Electrical Welding and Cutting Arcs*. Springfield, Va.: National Technical Information Service.

¹⁰ National Technical Information documents are published by the National Technical Information Service, Springfield, VA 22161.

Annex B (Informative)

Guidelines for the Preparation of Technical Inquiries

This annex is not part of ANSI/AWS A5.26/A5.26M-97 (R2009), *Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding*, but is included for informational purposes only.

B1. Introduction

The American Welding Society (AWS) Board of Directors has adopted a policy whereby all official interpretations of AWS standards are handled in a formal manner. Under this policy, all interpretations are made by the committee that is responsible for the standard. Official communication concerning an interpretation is directed through the AWS staff member who works with that committee. The policy requires that all requests for an interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the complexity of the work and the procedures that must be followed, some interpretations may require considerable time.

B2. Procedure

All inquiries shall be directed to:

Managing Director
Technical Services Division
American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

All inquiries shall contain the name, address, and affiliation of the inquirer, and they shall provide enough information for the committee to understand the point of concern in the inquiry. When the point is not clearly defined, the inquiry will be returned for clarification. For efficient handling, all inquiries should be typewritten and in the format specified below.

B2.1 Scope. Each inquiry shall address one single provision of the standard unless the point of the inquiry

involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the inquiry along with the edition of the standard that contains the provision(s) the inquirer is addressing.

B2.2 Purpose of the Inquiry. The purpose of the inquiry shall be stated in this portion of the inquiry. The purpose can be to obtain an interpretation of a standard's requirement or to request the revision of a particular provision in the standard.

B2.3 Content of the Inquiry. The inquiry should be concise, yet complete, to enable the committee to understand the point of the inquiry. Sketches should be used whenever appropriate, and all paragraphs, figures, and tables (or annex) that bear on the inquiry shall be cited. If the point of the inquiry is to obtain a revision of the standard, the inquiry shall provide technical justification for that revision.

B2.4 Proposed Reply. The inquirer should, as a proposed reply, state an interpretation of the provision that is the point of the inquiry or provide the wording for a proposed revision, if this is what the inquirer seeks.

B3. Interpretation of Provisions of the Standard

Interpretations of provisions of the standard are made by the relevant AWS technical committee. The secretary of the committee refers all inquiries to the chair of the particular subcommittee that has jurisdiction over the portion of the standard addressed by the inquiry. The subcommittee reviews the inquiry and the proposed reply to determine what the response to the inquiry should

be. Following the subcommittee's development of the response, the inquiry and the response are presented to the entire committee for review and approval. Upon approval by the committee, the interpretation is an official interpretation of the Society, and the secretary transmits the response to the inquirer and to the *Welding Journal* for publication.

B4. Publication of Interpretations

All official interpretations will appear in the *Welding Journal* and will be posted on the AWS web site.

B5. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The AWS Board of Directors' policy requires that all AWS staff members respond to a tele-

phone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained only through a written request. Headquarters staff cannot provide consulting services. However, the staff can refer a caller to any of those consultants whose names are on file at AWS Headquarters.

B6. AWS Technical Committees

The activities of AWS technical committees regarding interpretations are limited strictly to the interpretation of provisions of standards prepared by the committees or to consideration of revisions to existing provisions on the basis of new data or technology. Neither AWS staff nor the committees are in a position to offer interpretive or consulting services on (1) specific engineering problems, (2) requirements of standards applied to fabrications outside the scope of the document, or (3) points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.

AWS Filler Metal Specifications by Material and Welding Process

	OFW	SMAW	GTAW GMAW PAW	FCAW	SAW	ESW	EGW	Brazing
Carbon Steel	A5.2	A5.1	A5.18	A5.20	A5.17	A5.25	A5.26	A5.8, A5.31
Low-Alloy Steel	A5.2	A5.5	A5.28	A5.29	A5.23	A5.25	A5.26	A5.8, A5.31
Stainless Steel		A5.4	A5.9, A5.22	A5.22	A5.9	A5.9	A5.9	A5.8, A5.31
Cast Iron	A5.15	A5.15	A5.15	A5.15				A5.8, A5.31
Nickel Alloys		A5.11	A5.14	A5.34	A5.14	A5.14		A5.8, A5.31
Aluminum Alloys		A5.3	A5.10					A5.8, A5.31
Copper Alloys		A5.6	A5.7					A5.8, A5.31
Titanium Alloys			A5.16					A5.8, A5.31
Zirconium Alloys			A5.24					A5.8, A5.31
Magnesium Alloys			A5.19					A5.8, A5.31
Tungsten Electrodes			A5.12					
Brazing Alloys and Fluxes								A5.8, A5.31
Surfacing Alloys	A5.21	A5.13	A5.21	A5.21	A5.21			
Consumable Inserts			A5.30					
Shielding Gases			A5.32	A5.32			A5.32	

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AWS Filler Metal Specifications and Related Documents

Designation	Title
FMC	<i>Filler Metal Comparison Charts</i>
IFS	<i>International Index of Welding Filler Metal Classifications</i>
UGFM	<i>User's Guide to Filler Metals</i>
A4.2M (ISO 8249:2000 MOD)	<i>Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal</i>
A4.3	<i>Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding</i>
A4.4M	<i>Standard Procedures for Determination of Moisture Content of Welding Fluxes and Welding Electrode Flux Coverings</i>
A5.01M/A5.01 (ISO 14344:2002 MOD)	<i>Procurement Guidelines for Consumables—Welding and Allied Processes—Flux and Gas Shielded Electrical Welding Processes</i>
A5.02/A5.02M	<i>Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes</i>
A5.1/A5.1M	<i>Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding</i>
A5.2/A5.2M	<i>Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding</i>
A5.3/A5.3M	<i>Specification for Aluminum and Aluminum-Alloy Electrodes for Shielded Metal Arc Welding</i>
A5.4/A5.4M	<i>Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding</i>
A5.5/A5.5M	<i>Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding</i>
A5.6/A5.6M	<i>Specification for Copper and Copper-Alloy Electrodes for Shielded Metal Arc Welding</i>
A5.7/A5.7M	<i>Specification for Copper and Copper-Alloy Bare Welding Rods and Electrodes</i>
A5.8/A5.8M	<i>Specification for Filler Metals for Brazing and Braze Welding</i>
A5.9/A5.9M	<i>Specification for Bare Stainless Steel Welding Electrodes and Rods</i>
A5.10/A5.10M	<i>Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods</i>
A5.11/A5.11M	<i>Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding</i>
A5.12/A5.12M	<i>Specification for Tungsten and Tungsten-Alloy Electrodes for Arc Welding and Cutting</i>
A5.13	<i>Specification for Surfacing Electrodes for Shielded Metal Arc Welding</i>
A5.14/A5.14M	<i>Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods</i>
A5.15	<i>Specification for Welding Electrodes and Rods for Cast Iron</i>
A5.16/A5.16M	<i>Specification for Titanium and Titanium Alloy Welding Electrodes and Rods</i>
A5.17/A5.17M	<i>Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding</i>
A5.18/A5.18M	<i>Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding</i>
A5.19	<i>Specification for Magnesium Alloy Welding Electrodes and Rods</i>
A5.20/A5.20M	<i>Specification for Carbon Steel Electrodes for Flux Cored Arc Welding</i>
A5.21	<i>Specification for Bare Electrodes and Rods for Surfacing</i>
A5.22	<i>Specification for Stainless Steel Electrodes for Flux Cored Arc Welding and Stainless Steel Flux Cored Rods for Gas Tungsten Arc Welding</i>
A5.23/A5.23M	<i>Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding</i>
A5.24/A5.24M	<i>Specification for Zirconium and Zirconium Alloy Welding Electrodes and Rods</i>
A5.25/A5.25M	<i>Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding</i>
A5.26/A5.26M	<i>Specification for Carbon and Low-Alloy Steel Electrodes for Electrode Gas Welding</i>
A5.28/A5.28M	<i>Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding</i>
A5.29/A5.29M	<i>Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding</i>
A5.30/A5.30M	<i>Specification for Consumable Inserts</i>
A5.31	<i>Specification for Fluxes for Brazing and Braze Welding</i>
A5.32/A5.32M	<i>Specification for Welding Shielding Gases</i>
A5.34/A5.34M	<i>Specification for Nickel-Alloy Electrodes for Flux Cored Arc Welding</i>

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