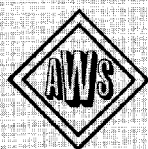


**Specification for
Carbon and Low Alloy Steel
Electrodes for Electrode Gas
Welding**



American Welding Society

Keywords — Filler metal specifications,
low alloy steel electrodes, carbon
steel electrodes, welding electrodes,
flux cored electrodes, electrogas
welding electrodes

ANSI/AWS A5.26-91
An American National Standard

Approved by
American National Standards Institute
February 14, 1991

Specification for Carbon and Low Alloy Steel Electrodes for Electrogas Welding

Supersedes AWS A5.26-78

Prepared by
AWS Committee on Filler Metal

Under the Direction of
AWS Technical Activities Committee

Approved by
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.



American Welding Society

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International Standard Book Number: 0-87171-364-0

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Foreword

(This Foreword is not a part of ANSI/ AWS A5.26-91, *Specification for Carbon and Low Alloy Steel Electrodes for Electrode Gas Welding*, but is included for information purposes only.)

This is the first 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

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, Filler Metal Committee, American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135.

Official interpretations of any of the technical requirements may be obtained by sending a request, in writing, to the Director, Technical Standards and Publications, American Welding Society. A formal reply will be issued after it has been reviewed by the appropriate personnel following established procedures.

Table of Contents

	Page No.
<i>Personnel</i>	iii
<i>Foreword</i>	v
<i>List of Tables</i>	vii
<i>List of Figures</i>	vii
1. Scope	1
<i>Part A—General Requirements</i>	
2. Classification	1
3. Acceptance	1
4. Certification	1
5. Units of Measure and Rounding-Off Procedure	1
<i>Part B—Tests, Procedures, and Requirements</i>	
6. Summary of Tests	3
7. Retest	3
8. Weld Test Assemblies	3
9. Chemical Analysis	5
10. Radiographic Test	7
11. Tension Test	8
12. Impact Test	8
<i>Part C—Manufacture, Identification, and Packaging</i>	
13. Method of Manufacture	10
14. Standard Sizes	10
15. Finish and Uniformity	10
16. Standard Package Forms	10
17. Winding Requirements	13
18. Electrode Identification	13
19. Packaging	13
20. Marking of Packages	13
<i>Appendix — Guide to AWS Specification for Carbon and Low Alloy Steel Electrodes for Electrode Gas Welding</i>	
A1. Introduction	15
A2. Classification System	15
A3. Acceptance	16
A4. Certification	16
A5. Ventilation During Welding	16
A6. Definition and Intended Use of Electrodes	17
<i>AWS Filler Metal Specifications and Related Documents</i>	(Inside Back Cover)

List of Tables

Table		Page No.
1	Chemical Composition Requirements for Solid Electrodes	2
2	Tension Test Requirements (As Welded)	3
3	Impact Test Requirements (As Welded)	3
4	Chemical Composition Requirements for Weld Metal from Composite Flux Cored and Metal Cored Electrodes	4
5	Required Tests	5
6	Base Metals for Test Assemblies	5
7	Standard Sizes	11
8	Standard Package Dimensions and Weights	11

List of Figures

Figure		Page No.
1	Groove Weld Test Assembly for Mechanical Properties and Soundness	6
2	Weld Ingot	7
3	Tension Test Specimen	8
4	Radiographic Acceptance Standards	9
5	Charpy V-Notch Impact Test Specimen	10
6	Standard Dimensions of 12 and 14 in. (300 and 350 mm) Spools	12
7	Standard Dimensions of 22, 24, and 30 in. (560, 610, and 760 mm) Spools (Reels)	12
A1	Classification System	16

Specification for Carbon and Low Alloy Steel Electrodes for Electrode Gas Welding

1. Scope

This specification prescribes requirements for the classification of carbon and low alloy steel electrodes for electrode gas welding. It covers solid and composite (flux cored and metal cored) electrodes used with external gas shielding, and flux cored electrodes (self-shielded) 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 electrode gas 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 U.S. Customary Units are the standard units of measure in this specification. The SI Units are given as equivalent values to the U.S. Customary Units. The standard sizes and dimensions in the two systems are not identical, and for this reason conversion from a standard

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

2. AWS Standards can be obtained from the American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135.

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

Table 1
Chemical Composition Requirements for Solid Electrodes

AWS Classi- fication ^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 – 0.70	—	—	0.35	—	—	—	0.50
EGXXS-5	K11325	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	0.07 – 0.15	1.40 – 1.85	0.035	0.025	0.80 – 1.15	—	—	0.35	—	—	—	0.50
EGXXS-D2 ^f	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 ^g											

Notes:

- 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.
- Single values are maximums.
- The letters "XX" as used in the AWS classification column of this table refer respectively to "6", "7", or "8" (tensile strength of the weld metal—see Table 2) and a "Z", "Q", or "2" (impact strength—see Table 3).
- SAE/ASTM Unified Numbering System for Metals and Alloys.
- The copper limit includes copper that may be applied as a coating on the electrode.
- Formerly EGXXS-1B.
- Composition shall be reported; the requirements are those agreed to by the purchaser and the supplier.

Table 2
Tension Test Requirements (As Welded)

AWS Classification ^a	Tensile Strength		Yield ^b Strength (Min.)		Elongation ^b Percent, Min.
	psi	MPa	psi	MPa	
EG6ZX-X	60 000 to	(420)	36 000	(250)	24
EG60X-X		to			
EG62X-X	80 000	(550)	50 000	(350)	22
EG7ZX-X	70 000	(490)			
EG70X-X	to	to			
EG72X-X	95 000	(650)			
EG8ZX-X	80 000	(550)	60 000	(420)	20
EG80X-X	to	to			
EG82X-X	100 000	(690)			

Notes:

- a. The letters "X-X" as they are used in the AWS Classification column in this table refer respectively to "S" or "T" (whether the electrode is solid or composite), and "1, 2, 3, 4, 5, 6, D2, Ni1, NM1, NM2, W, or G" (the designation for shielding gas and chemical composition requirements).
- b. Yield strength at 0.2 percent offset and elongation in 2 in. (51 mm) gage length.

Table 3
Impact Test Requirements^a
(As Welded)

AWS Classification	Average Impact Strength ^b Minimum
EG6ZX-X	Not specified
EG7ZX-X	Not specified
EG8ZX-X	Not specified
EG60X-X	20 ft-lb at 0° F (27J @ -18° C)
EG70X-X	20 ft-lb at 0° F (27J @ -18° C)
EG80X-X	20 ft-lb at 0° F (27J @ -18° C)
EG62X-X	20 ft-lb at -20° F (27J @ -29° C)
EG72X-X	20 ft-lb at -20° F (27J @ -29° C)
EG82X-X	20 ft-lb at -20° F (27J @ -29° C)

Notes:

- a. An electrode combination that meets impact requirements at a given temperature also meets the requirements 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 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-lb; one of the three remaining values may be lower than 20 ft-lb but not lower than 15 ft-lb. The average of the three shall not be less than the 20 ft-lb specified.

size or dimension in one system will not always coincide with a standard size or dimension in the other. Suitable conversions, encompassing standard sizes of both, can be made, however, if appropriate tolerances are applied in each case.

5.2 For the purpose of determining conformance with this specification, an observed or calculated value shall be rounded to the nearest 1000 psi 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 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.

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:

4. ASTM Standards can be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

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

AWS Classi- fication ^c	UNS ^d Number	Shielding Gas	Weight, Percent ^{a,b}										Other Elements, Total
			C	Mn	P	S	Si	Ni	Cr	Mo	Cu	V	
EG6XT-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	W07301	None	(e)	1.7	0.03	0.03	0.50	0.30	0.20	0.35	0.35	0.08	0.50
EG6XT-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	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 ^g	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 ^h	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 ⁱ	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 ^j	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	—	—	Not Specified ^f										

Notes:

- 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.
- Single values are maximums.
- The letters "XX", as used in the AWS classification column in this table refers respectively to "6", "7", or "8" (tensile strength of the weld metal—see Table 2) and a "Z", "0", or "2" (impact strength—see Table 3). The single letter "X" as used in the AWS classification column refers to a "Z", "0", or "2" (impact strength—see Table 3).
- SAE/ASTM Unified Numbering System for Metals and Alloys.
- Composition range of carbon not specified for these classifications, but the amount shall be determined and reported.
- Composition shall be reported; the requirements are those agreed to by the purchaser and supplier.
- Formerly EGXXT-3.
- Formerly EGXXT-4.
- Formerly EGXXT-6.
- Formerly EGXXT-5.

(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 Specifica-

tion 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.

Table 5
Required Tests

AWS Classification*	Chemical Analysis		Radiographic Test	Tension Test	Impact Test
	Electrode	Weld Metal			
Solid Electrodes					
EG6ZS-X	Required	Not Required	Required	Required	Not Required
EG60S-X	Required	Not Required	Required	Required	Required
EG62S-X	Required	Not Required	Required	Required	Required
EG7ZS-X	Required	Not Required	Required	Required	Not Required
EG70S-X	Required	Not Required	Required	Required	Required
EG72S-X	Required	Not Required	Required	Required	Required
EG8ZS-X	Required	Not Required	Required	Required	Not Required
EG80S-X	Required	Not Required	Required	Required	Required
EG82S-X	Required	Not Required	Required	Required	Required
Composite Flux Cored and Metal Cored Electrodes					
EG6ZT-X	Not Required	Required	Required	Required	Not Required
EG60T-X	Not Required	Required	Required	Required	Required
EG62T-X	Not Required	Required	Required	Required	Required
EG7ZT-X	Not Required	Required	Required	Required	Not Required
EG70T-X	Not Required	Required	Required	Required	Required
EG72T-X	Not Required	Required	Required	Required	Required
EG8ZT-X	Not Required	Required	Required	Required	Not Required
EG80T-X	Not Required	Required	Required	Required	Required
EG82T-X	Not Required	Required	Required	Required	Required

Notes:

* The “-X” as it is used in the AWS Classification column of this table refers to “1, 2, 3, 4, 5, 6, D2, Ni1, NM1, NM2, W, and G” (the designation for shielding gas and chemical composition requirements.)

Table 6
Base Metals for Test Assemblies

AWS Classification	Base Metal
EG6XT-X EG6XS-X	ASTM A36
EG7XT-X EG7XS-X	ASTM A242 Type 2, A441, or A572 Grade 50
EG8XT-X EG8XS-X	ASTM A537 Class 2, A572 Grade 60 or 65, or A633 Grade E

9. Chemical Analysis

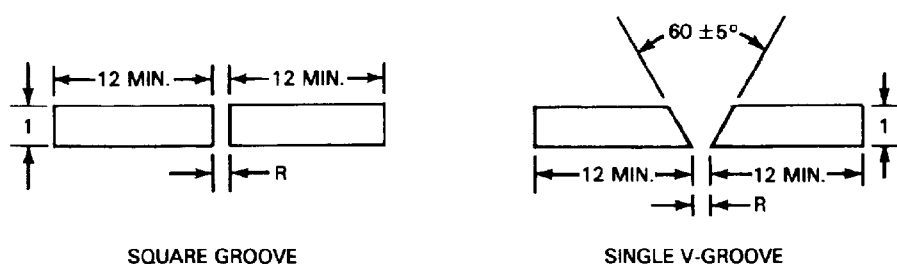
9.1 For *solid electrodes*, a sample of the electrode shall be prepared for chemical analysis. Solid electrodes, when analyzed for elements that are present in a coating (copper flashing, for example), shall be analyzed without removing the coating. When the electrode is ana-

lyzed 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.

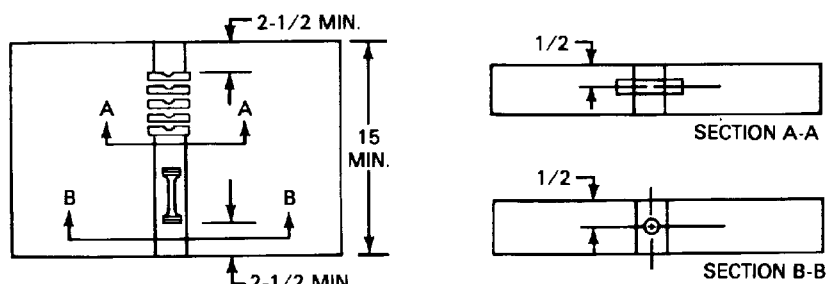
When the ingot is used, the top surface of the ingot (described in 8.3 and shown in Figure 2) shall be removed and discarded and a sample for analysis shall be obtained from the underlying metal at a location at least 2 in. (50 mm) from both the start and crater ends of the ingot by any appropriate mechanical 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



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in.	mm
5/64	2.0
3/32	2.4
1/8	3.2
.120	3.0
5/32	4.
1/2	12.5
5/8	16
3/4	19
1	25
2-1/2	65
12	305
15	380



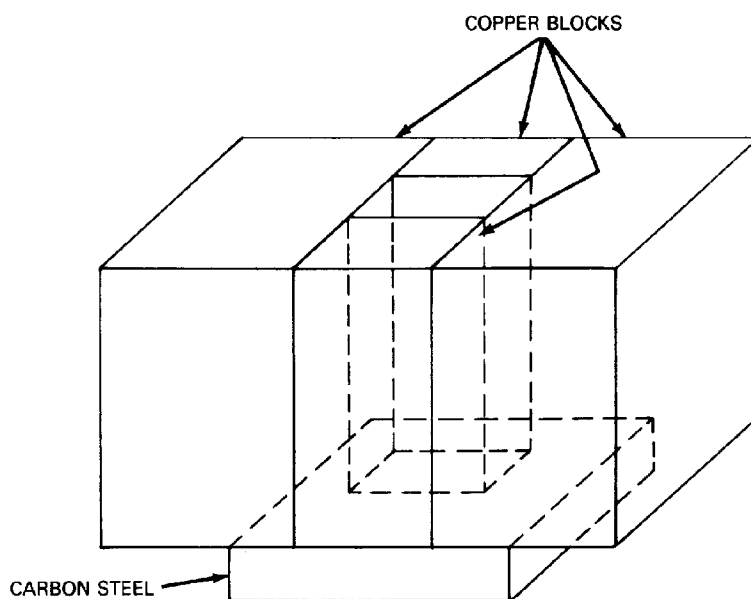
NOTE: ALL DIMENSIONS IN INCHES EXCEPT ANGLES.

Electrode Type	Gas Shielded			Self-Shielded
	Argon-CO ₂	CO ₂		None
Groove Type	Square groove	Square groove	Single V-groove ^h	Square groove
Root Opening, R, (in.)	5/8	5/8	5/32 min.	3/4
Electrode Size, (in.) ^c	5/64	3/32 or 1/8		.120
Wire Feed Speed, in./min.	—	—		350 ± 20 ^d
Current, amps dcep	400 ± 50	500 ± 50		650 ± 40 ^d
Arc Volts	36 ± 2	36 ± 2		41 ± 2

Notes to Figure 1:

- Test assembly shall be welded in the vertical position, with upward progression.
- Fixturing of the test assembly shall be based on the manufacturer's recommendations. Water cooled copper backing 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 backing shoes. When using water cooling, the outgoing water temperature shall not exceed 180°F (82°C) near the exit point.
- If the manufacturer does not produce the electrode of the size specified, the nearest size produced shall be used. For sizes other than those shown, the manufacturer's recommended procedure shall be followed.
- Either wire feed speed or current shall be used as a control setting based on the design of the equipment.
- 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 weld tabs are not required if the test assembly without the weld tabs is sufficient to provide the required test specimens.
- The weld shall be completed in one pass.
- A postweld heat treatment shall not be applied to the test assembly.
- Single V-groove joint is optional for CO₂ gas shielded classifications only. In case of dispute, the square groove assembly is the referee method.

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



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 sq. in. (625 sq. mm) 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.

Figure 2 — Weld Ingot

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.

(2.4 mm). Both surfaces of the test assembly, in the area of the weld, shall be smooth enough to avoid difficulty in interpreting the radiograph.

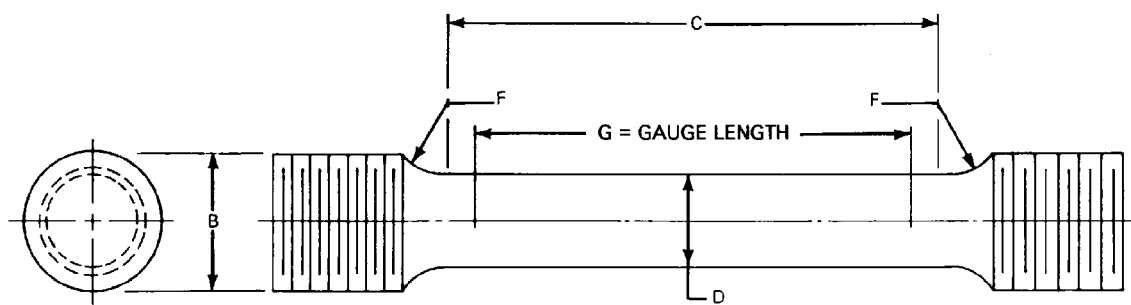
10.2 The weld shall be radiographed in accordance with ASTM E142, *Standard Method for Controlling Quality of Radiographic Testing*. The quality level of inspection shall be 2-2T.

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
- (2) No 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.



Dimensions of Specimen, in.					
D	G	C	B	F, min.	Approximate Area, in. ²
0.500 ± 0.010	2.000 ± 0.005	2-1/4	3/4	0.375	0.2

Dimensions of Specimen, mm					
D	G	C	B	F, min.	Approximate Area, mm ²
12.7 ± 0.25	50.8 ± 0.13	57	19	9.5	130

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 gauge length shall be slightly smaller at the center 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

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.

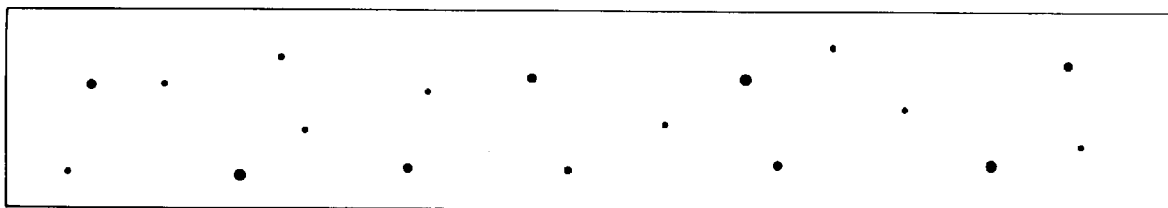
11.2 The specimen shall be tested in the manner described in the tension test section of ANSI/AWS B4.0, *Standard Methods for Mechanical Testing of Welds*.

11.3 The results of the tension test shall meet the requirements specified in Table 2.

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, 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 remaining three values shall equal, or exceed, the specified 20 ft-lb (27 J) energy level. One of the three may be lower, but not lower than 15 ft-lb (20 J), and the average of the three shall be not less than the required 20 ft-lb (27 J) energy level.

**(A) ASSORTED POROSITY AND/OR INCLUSIONS**

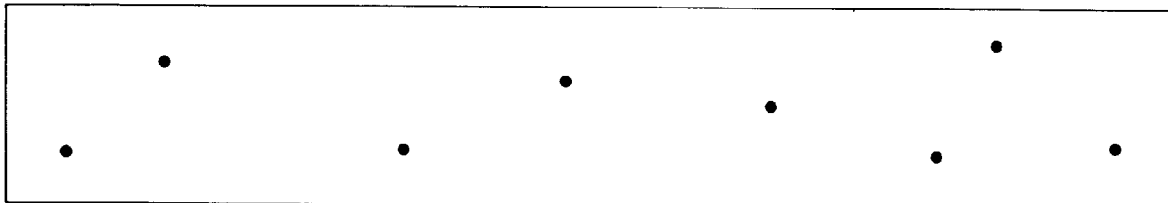
Size 1/64 in. (0.4 mm) to 1/16 in. (1.6 mm) diameter or in length.

Maximum number of indications in any 6 in. (150 mm) of weld = 18, with the following restrictions:

Maximum number of large 3/64 in. (1.2 mm) to 1/16 in. (1.6 mm) diameter and/or length indications = 3

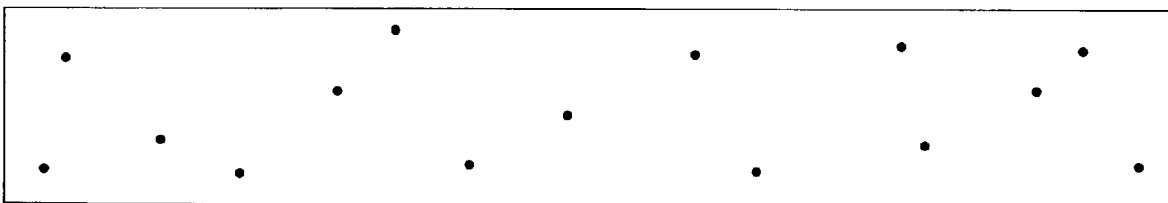
Maximum number of medium 1/32 in. (0.8 mm) to 3/64 in. (1.2 mm) diameter and/or length indications = 5

Maximum number of small 1/64 in. (0.4 mm) to 1/32 in. (0.8 mm) diameter and/or length indications = 10

**(B) LARGE POROSITY AND/OR INCLUSIONS**

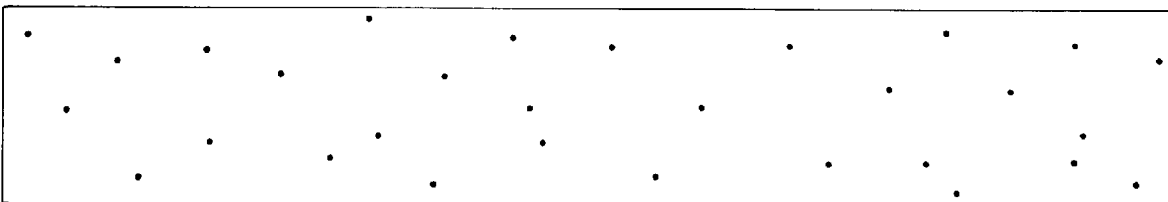
Size 3/64 in. (1.2 mm) to 1/16 in. (1.6 mm) diameter and/or length

Maximum number of indications in any 6 in. (150 mm) of weld = 8

**(C) MEDIUM POROSITY AND/OR INCLUSIONS**

Size 1/32 (0.8 mm) to 3/64 in. (1.2 mm) diameter and/or length.

Maximum number of indications in any 6 in. (150 mm) of weld = 15

**(D) SMALL POROSITY AND/OR INCLUSIONS**

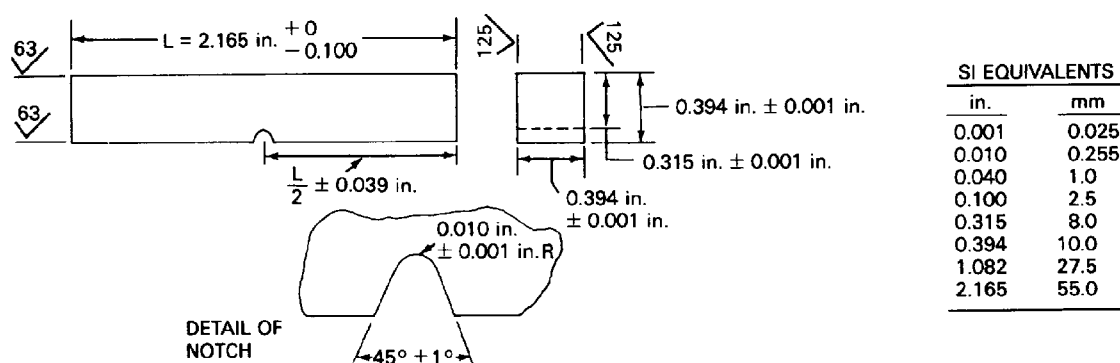
Size 1/64 in. (0.4 mm) to 1/32 in. (0.8 mm) diameter and/or length.

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

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.

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 elec-

trodes), 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 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 6 and 7. 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.

Table 7
Standard Sizes*

Standard Package Form	Diameter		Tolerance		
	in.	mm	in.	mm	
Coils with support	{	1/16 (.062)	{	± 0.002	± 0.05
		5/64 (.078)			
Coils without support	{	3/32 (.094)	{	± 0.003	± 0.08
		.120			
Drums	{	1/8 (.125)	{	± 0.004	± 0.10
Spools		5/32 (.156)			

*Dimensions, tolerances and package forms other than those shown shall be as agreed by purchaser and supplier.

Table 8
Standard Package Dimensions and Weights^a

Type of Package	Package Size		Net Weight of Electrode ^b	
	in.	mm	lb	kg
Coils without support	Not specified ^c		Not specified ^c	
Spools	12	300 OD ^d	25, 30, and 35	11, 14, and 16
	14	360 OD	50 and 60	23 and 27
	22	560 OD	250	110
	24	610 OD	300	140
Drums	30	760 OD	600 and 750	270 and 340
	15-1/2	400 OD	Not specified ^c	
	20	500 OD	Not specified ^c	
	23	600 OD	300 and 600	140 and 270

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	50 and 60	23 and 27	12 ± 1/8	305 ± 3	4-5/8	120
	150 and 200	68 and 91	23-1/2 ± 1/4	600 ± 6	5	125

Notes:

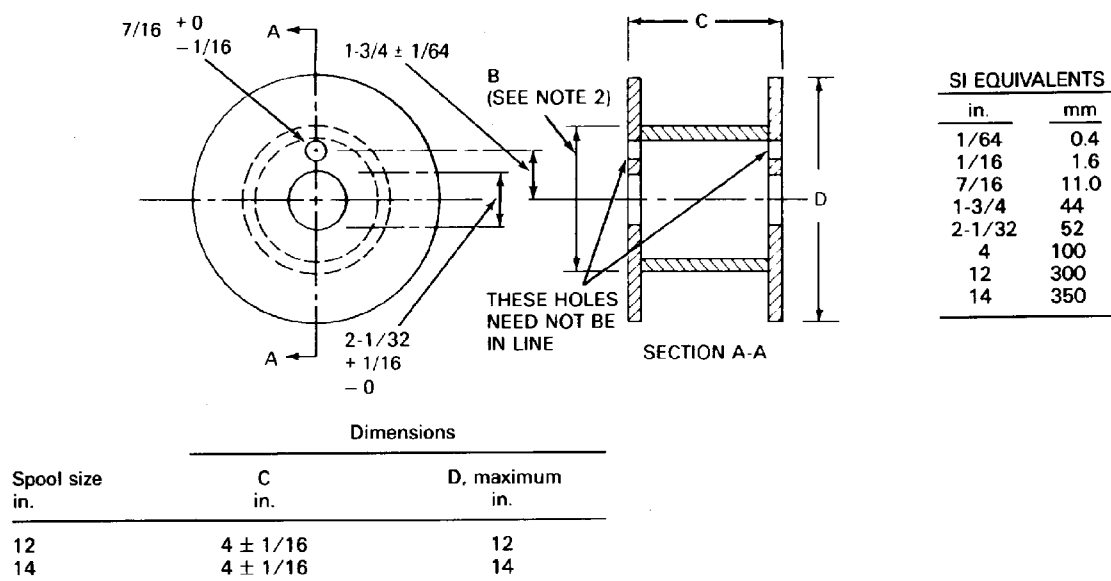
a. Sizes and net weights other than those specified shall be as agreed between supplier and purchaser.

b. Tolerance on net weight shall be ± 10 percent.

c. As agreed by supplier and purchaser.

d. OD = outside diameter.

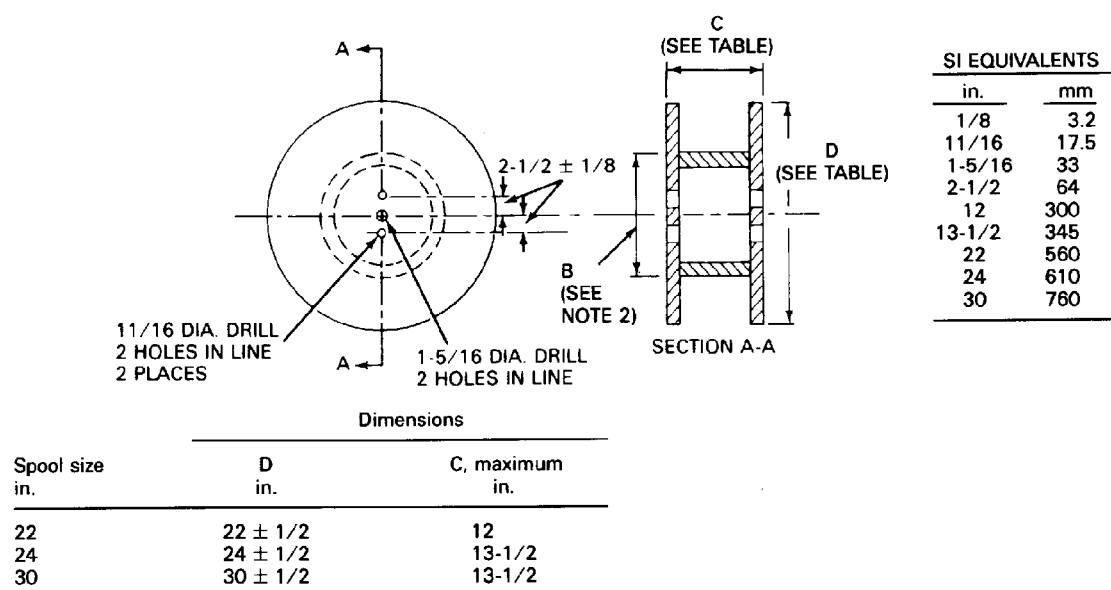
12



Notes:

1. All dimensions are in inches.
2. Dimension B, outside diameter of barrel, shall be such as to permit proper feeding of the electrode.

Figure 6—Standard Dimensions of 12 and 14 in. (300 and 350 mm) Spools



Notes:

1. All dimensions are in inches.
2. Dimension B, outside diameter of barrel, shall be such as to permit proper feeding of the electrode.

Figure 7—Standard Dimensions of 22, 24, and 30 in. (560, 610, and 760 mm) Spools (Reels)

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.

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.

WARNING:

PROTECT yourself and others. Read and understand this label.

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

- Before use, read and understand the manufacturer's instructions, 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 Z49.1, *Safety in Welding and Cutting*, published by the American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135 and OSHA Safety and Health Standards, 29 CFR 1910, available from the U.S. Government Printing Office, Washington, DC 20402.

DO NOT REMOVE THIS INFORMATION

Appendix

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

(This Appendix is not a part of ANSI/AWS A5.26-91, *Specification for Carbon and Low Alloy Steel Electrodes for Electrode Gas Welding*, but is included for information purposes only.)

A1. Introduction

The purpose of this guide 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. The letter "EG" at the beginning of each classification designation shows that the electrode is intended for use with the electrode gas welding process.

The first digit following "EG" represents the minimum tensile strength required of the weld metal in units of 10 000 psi. The second digit (or the letter Z, when impact tests are not required) refers to the impact strength of welds in accordance with the test assembly preparation section of this specification.

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.

A2.2 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).

A2.3 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.

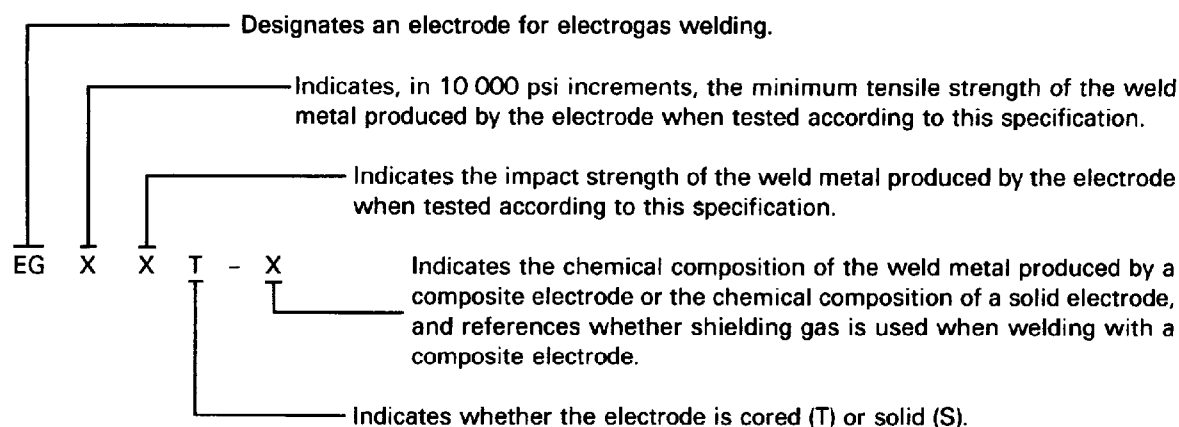


Figure A1 — Classification System

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, that information should be forwarded to the supplier of that product. The purchaser also will have to establish with the supplier the testing procedure and the acceptance requirements required for that test. This information may be incorporated (via ANSI/AWS A5.01 *Filler Metal Procurement Guidelines*) in the purchase order.

A3. Acceptance

Acceptance of all welding materials classified under this specification is in accordance with ANSI/AWS A5.01 as the Specification 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. 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. 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 the 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. "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 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 Z49.1, *Safety in Welding and Cutting* (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 of that document on Health Protection and Ventilation.

A6. Description and Intended Use of Electrodes

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 non-metallic 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° from the vertical, or where the joint in vertical plate assemblies may be as much as 15° 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 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.

A6.7 The specification requires the use of certain base metals for classification purposes. This not to 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 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.

AWS Filler Metal Related Documents

AWS Designation	Title
FMC	Filler Metal Comparison Charts
A4.2	Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic Stainless Steel Weld Metal
A4.3	Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding
A5.01	Filler Metal Procurement Guidelines
A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
A5.2	Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding
A5.3	Specification for Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
A5.4	Specification for Covered Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes
A5.5	Specification for Low Alloy Steel Covered Arc Welding Electrodes
A5.6	Specification for Covered Copper and Copper Alloy Arc Welding Electrodes
A5.7	Specification for Copper and Copper Alloy Bare Welding Rods and Electrodes
A5.8	Specification for Filler Metals for Brazing
A5.9	Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored and Stranded Welding Electrodes and Welding Rods
A5.10	Specification for Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
A5.11	Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding
A5.12	Specification for Tungsten and Tungsten Alloy Electrodes for Welding and Cutting
A5.13	Specification for Solid Surfacing Welding Rods and Electrodes
A5.14	Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods
A5.15	Specification for Welding Electrodes and Rods for Cast Iron
A5.16	Specification for Titanium and Titanium Alloy Welding Electrodes and Rods
A5.17	Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
A5.18	Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding
A5.19	Specification for Magnesium Alloy Welding Rods and Bare Electrodes
A5.20	Specification for Carbon Steel Electrodes for Flux Cored Arc Welding
A5.21	Specification for Composite Surfacing Welding Rods and Electrodes
A5.22	Specification for Flux Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes
A5.23	Specification for Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
A5.24	Specification for Zirconium and Zirconium Alloy Welding Electrodes and Rods
A5.25	Specification for Carbon and Low Alloy Steel Electrodes and Fluxes for Electroslag Welding
A5.26	Specification for Carbon and Low Alloy Steel Electrodes for Electrogas Welding
A5.27	Specification for Copper and Copper Alloy Rods for Oxyfuel Gas Welding
A5.28	Specification for Low Alloy Steel Filler Metals for Gas Shielded Arc Welding
A5.29	Specification for Low Alloy Steel Electrodes for Flux Cored Arc Welding
A5.30	Specification for Consumable Inserts

For additional information, contact the Order Department, American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135.