

AWS A5.1/A5.1M:2012
An American National Standard



Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding



American Welding Society®



**AWS A5.1/A5.1M:2012
An American National Standard**

**Approved by the
American National Standards Institute
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Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

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

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification establishes the requirements for classification of carbon steel electrodes for shielded metal arc welding. The requirements include mechanical properties of weld metal, weld metal soundness, and usability of electrode. Requirements for composition of the weld metal, moisture content of low-hydrogen electrode coverings, standard sizes and lengths, marking, manufacturing, and packaging are also included. A guide to the use of the standard is included in an annex.

Optional supplemental requirements include improved toughness and ductility, lower moisture contents, and diffusible hydrogen limits.

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.



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Foreword

This foreword is not part of AWS A5.1/A5.1M:2012, *Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding*, but is included for informational purposes only.

This specification is the latest revision of the first filler metal specification issued over 70 years ago. The initial 1940 document and the three revisions within the next five years were prepared by a joint committee of the American Society for Testing and Materials and the American Welding Society. However, they were issued with only an ASTM specification designation. The 1948 revision was the first specification issued with the AWS designation appearing on the document. The 1969 revision was the first time that the document was issued without the ASTM designation.

This document is the second of the A5.1 specifications which makes use of both U.S. Customary Units and the International System of Units (SI). The dimensions are not exact equivalents in the two systems. Previous A5.1 specifications showed an approximate conversion to SI units for informational purposes only. This practice is discontinued. Instead SI units used are hard conversions to rational units. In selecting rational metric units, AWS A1.1, *Metric Practice Guide for the Welding Industry*, and International Standard ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances and markings*, are used where suitable. Tables and figures make use of both U.S. Customary and SI Units, which, with the application of the specified tolerances, provides for interchangeability of products in both the U.S. Customary and SI Units.

Substantive changes in this revision include adding of boron reporting requirement in Table 7, and updating Clause 6, Rounding-Off Procedure. These changes are shown in *italic* font.

Document Development:

ASTM A 233-40T	<i>Tentative Specifications for Iron and Steel Arc-Welding Electrodes</i>
ASTM A 233-42T	<i>Tentative Specifications for Iron and Steel Arc-Welding Electrodes</i>
ASTM A 233-43T	<i>Tentative Specifications for Iron and Steel Arc-Welding Electrodes</i>
ASTM A 233-45T	<i>Tentative Specifications for Iron and Steel Arc-Welding Electrodes</i>
ASTM A 233-48T	<i>Tentative Specifications for Mild Steel Arc Welding Electrodes</i>
AWS A5.1-48T	
ASTM A 233-55T	<i>Tentative Specifications for Mild Steel Arc Welding Electrodes</i>
AWS A5.1-55T	
ASTM A 233-58T	<i>Tentative Specification for Mild Steel Arc Welding Electrodes</i>
AWS A5.1-58T	
AWS A5.1-64T	<i>Tentative Specification for Mild Steel Covered Arc Welding Electrodes</i>
ASTM A 233-64T	
AWS A5.1-69	<i>Specification for Mild Steel Covered Arc Welding Electrodes</i>
ANSI W3.1-1973	
ANSI/AWS A5.1-78	<i>Specification for Carbon Steel Covered Arc-Welding Electrodes</i>
ANSI/AWS A5.1-81	<i>Specification for Carbon Steel Covered Arc-Welding Electrodes</i>
ANSI/AWS A5.1-91	<i>Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding</i>
AWS A5.1/A5.1M:2004	<i>Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding</i>

Comments and suggestions for the improvement of this standard are welcomed. They should be sent to the Secretary, AWS A5 Committee on Filler Metals and Allied Materials, American Welding Society, 8669 Doral Blvd., Doral, FL 33166.

Table of Contents

	Page No.
<i>Personnel</i>	v
<i>Foreword</i>	vii
<i>List of Tables</i>	x
<i>List of Figures</i>	x
1. Scope	1
Part A—General Requirements	1
2. Normative References	1
3. Classification	2
4. Acceptance	2
5. Certification	2
6. Rounding-Off Procedure	3
Part B—Tests, Procedures, and Requirements	4
7. Summary of Tests	4
8. Retest	4
9. Weld Test Assemblies	5
10. Chemical Analysis	13
11. Radiographic Test	13
12. Tension Test	19
13. Bend Test	20
14. Impact Test	20
15. Fillet Weld Test	20
16. Moisture Test	22
17. Absorbed Moisture Test	22
18. Diffusible Hydrogen Test	24
Part C—Manufacture, Identification, and Packaging	25
19. Method of Manufacture	25
20. Standard Sizes and Lengths	25
21. Core Wire and Covering	26
22. Exposed Core	26
23. Electrode Identification	26
24. Packaging	26
25. Marking of Packages	27
Annex A (Informative)—Guide to AWS Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding	29
Annex B (Informative)—Guidelines for the Preparation of Technical Inquiries	45
AWS Filler Metal Specifications by Material and Welding Process	47
AWS Filler Metal Specifications and Related Documents	49

List of Tables

Table	Page No.
1 Electrode Classification	3
2 Tension Test Requirements	4
3 Charpy V-Notch Impact Requirements	5
4 Required Tests	6
5 Base Metal for Test Assemblies	14
6 Requirements for Preparation of Fillet Weld Test Assemblies	14
7 Chemical Composition Requirements for Weld Metal	16
8 Radiographic Soundness Requirements	19
9 Dimensional Requirements for Fillet Weld Usability Test Specimens	21
10 Moisture Content Limits for Electrode Coverings	23
11 Diffusible Hydrogen Limits for Weld Metal	24
12 Standard Sizes and Lengths	25
A.1 Canadian Electrode Classifications Similar to AWS Classifications	30
A.2 Comparison of Equivalent Classifications	32
A.3 Typical Storage and Drying Conditions for Covered Arc Welding Electrodes	35
A.4 Typical Amperage Ranges	37
A.5 Discontinued Electrode Classifications	43

List of Figures

Figure	Page No.
1 Pad for Chemical Analysis of Undiluted Weld Metal	8
2 Groove Weld Test Assembly for Mechanical Properties and Soundness of Weld Metal Produced by Using All Electrode Classifications Except E6022 [E4322] and E7018M [E4918M] Electrodes	9
3 Fillet Weld Test Assembly	10
4 Test Assembly for Transverse Tension and Longitudinal Guided Bend Tests for Welds Made with E6022 [E4322] Electrodes	11
5 Groove Weld Test Assembly for Mechanical Properties and Soundness of Weld Metal Produced by Using E7018M [E4918M] Electrodes	12
6 Welding Positions for Fillet Weld Test Assemblies	15
7 Radiographic Acceptance Standards for Rounded Indications (Grades 1 and 2)	17
8 Dimensions of Fillet Welds	21
9 Alternative Methods for Facilitating Fracture of the Fillet Weld	22
10 Order of Mandatory and Optional Supplemental Designators	27

Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

1. Scope

1.1 This specification prescribes requirements for the classification of carbon steel electrodes for shielded metal arc welding.

1.2 Safety and health issues and concerns are beyond the scope of this standard and, therefore, are not fully addressed herein. Some safety and health information can be found in Informative Annex Clauses A5 and A10. Safety and health information is available from other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*,¹ and applicable federal and state regulations.

1.3 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 when referring to material properties. The specification with the designation A5.1 uses U.S. Customary Units. The specification A5.1M uses SI Units. The latter are shown within brackets ([]) or in appropriate columns in tables and figures. Standard dimensions based on either system may be used for sizing of filler metal or packaging or both under A5.1 or A5.1M specifications.

Part A *General Requirements*

2. Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this AWS standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However parties to agreement based on this AWS standard are encouraged to investigate the possibility of applying the most recent editions of the documents shown below. For undated references, the latest edition of the standard referenced applies.

The following documents are referenced in the mandatory sections of this document:

(1) ASTM E29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*²

(2) ASTM E350, *Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron*

(3) ASTM E1032, *Standard Test Method for Radiographic Examination of Weldments*

¹ ANSI Z49.1 is published by the American Welding Society, 8669 Doral Blvd., Doral, FL 33166.

² ASTM standards are published by ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.