

Specification for Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods



American Welding Society®



Documents

Document Sharing Hub

AWS A5.22/A5.22M:2012
An American National Standard

Approved by the
American National Standards Institute
January 17, 2012

Specification for Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods

5th Edition

Supersedes AWS A5.22/A5.22M:2010

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

Classification and other requirements are specified for numerous grades of flux cored and metal cored stainless steel electrodes and rods.

Designations for the flux cored electrodes and rods indicate the chemical composition of the weld metal, the position of welding, and the external shielding gas required (for those classifications for which one is required). Designations for the metal cored electrodes indicate the chemical composition of the weld metal only.

The requirements include general requirements, testing and packaging. Annex A provides general application guidelines for individual alloys and other useful information about welding electrodes.



American Welding Society®
550 N.W. LeJeune Road, Miami, FL 33126



Documents
Document Sharing Hub

International Standard Book Number: 978-0-87171-800-6
American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126
© 2012 by American Welding Society
All rights reserved
Printed in the United States of America

Photocopy Rights. No portion of this standard may be reproduced, stored in a retrieval system, or transmitted in any form, including mechanical, photocopying, recording, or otherwise, without the prior written permission of the copyright owner.

Authorization to photocopy items for internal, personal, or educational classroom use only or the internal, personal, or educational classroom use only of specific clients is granted by the American Welding Society provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, tel: (978) 750-8400; Internet: <www.copyright.com>.

Statement on the Use of American Welding Society Standards

All standards (codes, specifications, recommended practices, methods, classifications, and guides) of the American Welding Society (AWS) are voluntary consensus standards that have been developed in accordance with the rules of the American National Standards Institute (ANSI). When AWS American National Standards are either incorporated in, or made part of, documents that are included in federal or state laws and regulations, or the regulations of other governmental bodies, their provisions carry the full legal authority of the statute. In such cases, any changes in those AWS standards must be approved by the governmental body having statutory jurisdiction before they can become a part of those laws and regulations. In all cases, these standards carry the full legal authority of the contract or other document that invokes the AWS standards. Where this contractual relationship exists, changes in or deviations from requirements of an AWS standard must be by agreement between the contracting parties.

AWS American National Standards are developed through a consensus standards development process that brings together volunteers representing varied viewpoints and interests to achieve consensus. While the AWS administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its standards.

AWS disclaims liability for any injury to persons or to property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this standard. AWS also makes no guarantee or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this standard available, AWS is neither undertaking to render professional or other services for or on behalf of any person or entity, nor is AWS undertaking to perform any duty owed by any person or entity to someone else. Anyone using these documents should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. It is assumed that the use of this standard and its provisions is entrusted to appropriately qualified and competent personnel.

This standard may be superseded by the issuance of new editions. This standard may also be corrected through publication of amendments or errata. It may also be supplemented by publication of addenda. Information on the latest editions of AWS standards including amendments, errata, and addenda are posted on the AWS web page (www.aws.org). Users should ensure that they have the latest edition, amendments, errata, and addenda.

Publication of this standard does not authorize infringement of any patent or trade name. Users of this standard accept any and all liabilities for infringement of any patent or trade name items. AWS disclaims liability for the infringement of any patent or product trade name resulting from the use of this standard.

The AWS does not monitor, police, or enforce compliance with this standard, nor does it have the power to do so.

On occasion, text, tables, or figures are printed incorrectly, constituting errata. Such errata, when discovered, are posted on the AWS web page (www.aws.org).

Official interpretations of any of the technical requirements of this standard may only be obtained by sending a request, in writing, to the appropriate technical committee. Such requests should be addressed to the American Welding Society, Attention: Managing Director, Technical Services Division, 550 N.W. LeJeune Road, Miami, FL 33126 (see Annex B). With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. These opinions are offered solely as a convenience to users of this standard, and they do not constitute professional advice. Such opinions represent only the personal opinions of the particular individuals giving them. These individuals do not speak on behalf of AWS, nor do these oral opinions constitute official or unofficial opinions or interpretations of AWS. In addition, oral opinions are informal and should not be used as a substitute for an official interpretation.

This standard is subject to revision at any time by the AWS A5 Committee on Filler Metals and Allied Materials. It must be reviewed every five years, and if not revised, it must be either reaffirmed or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are required and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS A5 Committee on Filler Metals and Allied Materials and the author of the comments will be informed of the Committee's response to the comments. Guests are invited to attend all meetings of the AWS A5 Committee on Filler Metals and Allied Materials to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

This page is intentionally blank.

Personnel

AWS A5 Committee on Filler Metals and Allied Materials

H. D. Wehr, Chair	<i>Arcos Industries, LLC</i>
J. J. DeLoach Jr., 1st Vice Chair	<i>Naval Surface Warfare Center</i>
R. D. Fuchs, 2nd Vice Chair	<i>Böhler Welding Group USA, Incorporated</i>
R. K. Gupta, Secretary	<i>American Welding Society</i>
T. Anderson	<i>ESAB Welding and Cutting Product</i>
J. M. Blackburn	<i>Naval Sea Systems Command</i>
J. C. Bundy	<i>Hobart Brothers Company</i>
D. D. Crockett	<i>Consultant</i>
R. V. Decker	<i>Weldstar</i>
D. A. DelSignore	<i>Consultant</i>
J. DeVito	<i>ESAB Welding & Cutting Products</i>
H. W. Ebert	<i>Consulting Welding Engineer</i>
D. M. Fedor	<i>The Lincoln Electric Company</i>
J. G. Feldstein	<i>Foster Wheeler North America</i>
S. E. Ferree	<i>ESAB Welding & Cutting Products</i>
D. A. Fink	<i>The Lincoln Electric Company</i>
G. L. Franke	<i>Naval Surface Warfare Center</i>
R. M. Henson	<i>J. W. Harris Company, Incorporated</i>
S. D. Kiser	<i>Special Metals</i>
P. J. Konkol	<i>Concurrent Technologies Corporation</i>
D. J. Kotecki	<i>Damian Kotecki Welding Consultants</i>
L. G. Kvidahl	<i>Northrop Grumman Shipbuilding</i>
A. Y. Lau	<i>Canadian Welding Bureau</i>
J. S. Lee	<i>Chevron</i>
T. Melfi	<i>The Lincoln Electric Company</i>
K. M. Merlo	<i>EWI</i>
M. T. Merlo	<i>RevWires LLC</i>
B. Mosier	<i>Polymet Corporation</i>
A. K. Mukherjee	<i>Siemens Power Generation, Incorporated</i>
T. C. Myers	<i>American Bureau of Shipping</i>
C. L. Null	<i>Consultant</i>
B. A. Pletcher	<i>CB&I, Incorporated</i>
K. C. Pruden	<i>Hydril Company</i>
K. Roossinck	<i>Northrop Grumman Ship Systems</i>
P. K. Salvesen	<i>Det Norske Veritas (DNV)</i>
K. Sampath	<i>Consultant</i>
W. S. Severance	<i>ESAB Welding and Cutting Products</i>
M. J. Sullivan	<i>NASSCO—National Steel and Shipbuilding</i>
R. C. Sutherlin	<i>ATI Wah Chang</i>
R. A. Swain	<i>Euroweld, Limited</i>
K. P. Thornberry	<i>Care Medical, Incorporated</i>
M. D. Tumuluru	<i>U.S. Steel Corporation</i>

Advisors to the AWS A5 Committee on Filler Metal and Allied Material

R. L. Bateman	<i>Soldaduras West Arco Limitada</i>
J. E. Beckham	<i>Chrysler LLC</i>
R. A. Daemen	<i>Consultant</i>
C. E. Fuerstenau	<i>Lucas-Milhaupt, Incorporated</i>
J. P. Hunt	<i>Special Metals</i>
S. Imaoka	<i>Kobe Steel Limited</i>
W. A. Marttila	<i>WAMcom Consulting LLC</i>
R. Menon	<i>Stoody Company</i>
D. R. Miller	<i>ABS Americas Materials Department</i>
M. P. Parekh	<i>Consultant</i>
M. A. Quintana	<i>The Lincoln Electric Company</i>
E. S. Surian	<i>National University of Lomas de Zamora</i>
H. J. White	<i>HAYNES International</i>

AWS A5D Subcommittee on Stainless Steel Filler Metals

D. J. Kotecki, Chair	<i>Damian Kotecki Welding Consultants</i>
F. B. Lake, Vice Chair	<i>ESAB Welding & Cutting Products</i>
R. K. Gupta, Secretary	<i>American Welding Society</i>
R. E. Cantrell	<i>Constellation Energy Group</i>
R. V. Decker	<i>Weldstar</i>
D. A. DelSignore	<i>Consultant</i>
J. G. Feldstein	<i>Foster Wheeler North America</i>
R. D. Fuchs	<i>Böhler Welding Group USA, Incorporated</i>
S. R. Jana	<i>Select Arc, Incorporated</i>
S. J. Knostman	<i>Hobart Brothers</i>
G. A. Kurisky	<i>Consultant</i>
M. T. Merlo	<i>RevWires LLC</i>
S. J. Merrick	<i>Techalloy Welding Products</i>
R. A. Swain	<i>Euroweld, Limited</i>
J. G. Wallin	<i>Stoody Company</i>
H. D. Wehr	<i>Arcos Industries LLC</i>
J. M. Zawodny	<i>Avesta Welding LLC</i>

Advisors to the AWS A5D Subcommittee on Stainless Steel Filler Metals

F. S. Babish	<i>Sandvik Materials Technology</i>
K. K. Gupta	<i>Westinghouse Electric Corporation</i>
C. H. Herberg	<i>Alaskan Copper Works</i>
J. P. Hunt	<i>Special Metals</i>
S. Imaoka	<i>Kobe Steel Limited</i>
I. K. Ishizaki	<i>Kobelco Welding of America</i>
J. S. Ogborn	<i>The Lincoln Electric Company</i>

Foreword

This foreword is not part of [AWS A5.22/A5.22M: 2012](#), *Specification for Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods*, but is included for informational purposes only.

This document is the second of the A5.22 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 values in any way. In selecting rational metric units, [AWS A1.1](#), *Metric Practice Guide for the Welding Industry*, and ISO 544: *Welding consumables — Technical delivery conditions for welding filler metals — 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.

New filler metal classification E2307TX-X has been added in this edition. In this edition, analysis for bismuth (Bi) is required to be reported if intentionally added, or if it is known to be present at levels greater than 0.002%.

The first AWS specification for stainless steel electrodes for flux cored arc welding was issued in 1974 and approved by the American National Standards Institute a year later. The revision history is shown below:

AWS A5.22-74	<i>Specification for Flux Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes</i>
ANSI W3.22-1975	
AWS A5.22-80	<i>Specification for Flux Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes</i>
ANSI/AWS A5.22-95	<i>Specification for Stainless Steel Electrodes for Flux Cored Arc Welding and Stainless Steel Flux Cored Rods for Gas Tungsten Arc Welding</i>
AWS A5.22/A5.22M:2010	<i>Specification for Stainless Steel Flux Cored and Metal Cored Electrodes and Rods</i>

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

This page is intentionally blank.

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
2. Normative References	1
3. Classification	2
4. Acceptance	9
5. Certification	9
6. Rounding-Off Procedure	10
7. Summary of Tests	10
8. Retest	10
9. Test Assemblies	10
10. Chemical Analysis	19
11. Radiographic Test	19
12. Tension Test	22
13. Bend Test	22
14. Impact Test	23
15. Fillet Weld Test	23
16. Method of Manufacture	23
17. Standard Sizes	23
18. Finish and Uniformity	24
19. Standard Package Forms	24
20. Winding Requirements	25
21. Filler Metal Identification	25
22. Packaging	25
23. Marking of Packaging	25
Annex A (Informative)—Guide to AWS <i>Specification for Stainless Steel Flux Cored and Metal Cored</i> <i>Welding Electrodes and Rods</i>	27
Annex B (Informative)—Guidelines for the Preparation of Technical Inquiries	51
AWS Filler Metal Specifications by Material and Welding Process	53
AWS Filler Metal Specifications and Related Documents	55

List of Tables

Table	Page No.
1FC Chemical Composition Requirements for Flux Cored Electrodes for Undiluted Weld Metal	3
1MC Chemical Composition Requirements for Metal Cored Electrodes for Undiluted Weld Metal	6
2 Required Shielding Medium, Polarity, and Welding Process	9
3 Examples of Potentially Occurring Dual Classified Electrodes	9
4 Required Tests.....	10
5 Preheat and Interpass Temperature Requirements for Groove Weld Test Assemblies	17
6 Tension Test Requirements	18
A.1 Comparison of A5.22/A5.22M Classifications with AWS A5.4/A5.4M , AWS A5.9/A5.9M , and ISO 17633	31
A.2 Variations of Alloying Elements for Submerged Arc Welding.....	37
A.3 Discontinued Classifications.....	49

List of Figures

Figure	Page No.
1 Pad for Chemical Analysis of Undiluted Weld Metal.....	11
2 Groove Weld Test Assembly for Tension, Impact, and Radiographic Tests.....	12
3A Groove Weld Test Assembly for Face Bend Test	13
3B Groove Weld Test Assembly for Root Bend Test	14
4 Preparation of Fillet Weld Test Specimen.....	15
5A Rounded Indication Standards for Radiographic Test—1/2 in [12 mm] Plate	20
5B Rounded Indication Standards for Radiographic Test—3/4 in [20 mm] Plate	21
6 Orientation and Location of Impact Test Specimen	23
7 Fillet Weld Test Specimen and Dimensional Requirements.....	24
A.1 Classification Systems	28
A.2 WRC-1992 Diagram for Stainless Steel Weld Metal	35

Specification for Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods

1. Scope

This specification prescribes requirements for the classification of flux cored stainless steel electrodes for flux cored arc welding, flux cored stainless steel rods for root pass welding with the gas tungsten arc process, and metal cored stainless steel electrodes for gas metal arc welding, gas tungsten arc welding, plasma arc welding, submerged arc welding, and any other process to which they may be applied.¹

The chromium content of undiluted weld metal from these electrodes and rods is not less than 10.5% nominal and the iron content exceeds that of any other element. For purposes of classification, the iron content shall be derived as the balance element when all other elements are considered to be set at their specified minimum values.

Safety and health issues are beyond the scope of this standard and, therefore, are not fully addressed herein. Some safety and health information can be found in 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*, and applicable state and federal regulations.

This specification uses 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 A5.22 uses U.S. Customary Units. The specification A5.22M uses SI Units. The latter are shown within brackets ([]) or in appropriate columns in tables. Standard dimensions based on either system may be used for sizing of filler metals or packaging or both under A5.22 or A5.22M specifications.

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 referred to applies.

2.1 The following AWS standards² are referenced in the mandatory sections of this document:

[AWS A5.01M/A5.01](#) (ISO 14344 MOD), *Procurement Guidelines for Consumables—Welding and Allied Processes—Flux and Gas Shielded Electrical Welding Processes*

[AWS A5.02/A5.02M:2007](#), *Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes*

[AWS A5.32/A5.32M](#) (ISO 14175:2008 MOD), *Welding Consumables—Gases and Gas Mixtures for Fusion Welding and Allied Processes*

¹ Metal cored electrodes, currently also classified in A5.9/A5.9M, will be deleted from the next revision of that specification.

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

[AWS B4.0](#), *Standard Methods for Mechanical Testing of Welds*

[AWS B4.0M](#), *Standard Methods for Mechanical Testing of Welds*

2.2 The following ANSI standard³ is referenced in the mandatory sections of this document.

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

2.3 The following ASTM standards⁴ are referenced in the mandatory sections of this document:

[ASTM A 36/A 36M](#), *Standard Specification for Carbon Structural Steel*

ASTM A 240, *Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications*

[ASTM A 285](#), *Pressure Vessel Plates, Carbon steel, Low- and Intermediate-Tensile Strength*

ASTM A 515, *Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service*

[ASTM E 23](#), *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*

[ASTM E 29](#), *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specification*

[ASTM E 353](#), *Chemical Analysis of Stainless, Heat-Resisting, Maraging and Other Similar Chromium-Nickel-Iron Alloys*

[ASTM E 1032](#), *Standard Test Methods for Radiographic Examination of Weldments*

2.4 The following ISO standard⁵ is referenced in the normative sections of this document:

ISO 80000-1, *Quantities and units*

3. Classification

The welding electrodes and rods covered by A5.22/A5.22M utilize a classification system that is independent of U.S. Customary Units and the International System of Units (SI). Classifications for the flux cored electrodes and rods indicate the chemical composition of the undiluted weld metal, as specified in Table 1FC, the position of welding, and the external shielding gas required (for those classifications for which one is required), as specified in Table 2. Classifications for the metal cored electrodes indicate the chemical composition of the undiluted weld metal only, as specified in Table 1MC.

Electrodes and rods may not be classified under more than one classification in this specification, except on the basis of carbon content and shielding gas used provided they meet all the requirements of those classifications as specified in Table 1FC and Table 1MC. More than one classification based upon any element other than carbon is not permitted. Table 3 lists a number of examples of possible dual classification.

The flux cored electrodes and rods classified under this specification are intended for flux cored arc welding and for root pass welding with the gas tungsten arc process, but this does not prohibit their use with any other process for which they are found suitable. The metal cored electrodes and rods classified under this specification are intended for gas metal arc welding, gas tungsten arc welding, plasma arc welding, and submerged arc welding, but this does not prohibit their use with any other process for which they are found suitable.

³ This ANSI standard is published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

⁴ ASTM standards are published by ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

⁵ ISO standards are published by International Organization of Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland.

Table 1FC
Chemical Composition Requirements for Flux Cored Electrodes for Undiluted Weld Metal

AWS Classification ^c	UNS Number ^d	Weight Percent ^{a, b}											
		C	Cr	Ni	Mo	Nb Plus Ta	Mn	Si	P	S	N	Cu	Other ^e
E307TX-X	W30731	0.13	18.0–20.5	9.0–10.5	0.5–1.5	—	3.30–4.75	1.0	0.04	0.03	—	0.75	—
E308TX-X	W30831	0.08	18.0–21.0	9.0–11.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308HTX-X	W30831	0.04–0.08	18.0–21.0	9.0–11.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308LTX-X	W30835	0.04	18.0–21.0	9.0–11.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308MoTX-X	W30832	0.08	18.0–21.0	9.0–11.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308LMoTX-X	W30838	0.04	18.0–21.0	9.0–12.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309TX-X	W30931	0.10	22.0–25.0	12.0–14.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309HTX-X	W30931	0.04–0.10	22.0–25.0	12.0–14.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LTX-X	W30935	0.04	22.0–25.0	12.0–14.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309MoTX-X	W30939	0.12	21.0–25.0	12.0–16.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LMoTX-X	W30938	0.04	21.0–25.0	12.0–16.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LNiMoTX-X	W30936	0.04	20.5–23.5	15.0–17.0	2.5–3.5	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LNbTX-X	W30932	0.04	22.0–25.0	12.0–14.0	0.75	0.70–1.00	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E310TX-X	W31031	0.20	25.0–28.0	20.0–22.5	0.75	—	1.0–2.5	1.0	0.03	0.03	—	0.75	—
E312TX-X	W31331	0.15	28.0–32.0	8.0–10.5	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E316TX-X	W31631	0.08	17.0–20.0	11.0–14.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E316HTX-X	W31631	0.04–0.08	17.0–20.0	11.0–14.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E316LTX-X	W31635	0.04	17.0–20.0	11.0–14.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E317LTX-X	W31735	0.04	18.0–21.0	12.0–14.0	3.0–4.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E347TX-X	W34731	0.08	18.0–21.0	9.0–11.0	0.75	8 × C min. – 1.0 max.	0.5–2.5	1.0	0.04	0.03	—	0.75	
E347HTX-X	W34731	0.04–0.08	18.0–21.0	9.0–11.0	0.75	8 × C min. – 1.0 max.	0.5–2.5	1.0	0.04	0.03	—	0.75	
E409TX-X	W40931	0.10	10.5–13.5	0.60	0.75	—	0.80	1.0	0.04	0.03	—	0.75	Ti = 10 × C min. – 1.5 max.
E409NbTX-X	W40957	0.10	10.5–13.5	0.6	0.5	8 × C min. – 1.5 max.	1.2	1.0	0.04	0.03	—	0.5	—

(Continued)

Table 1FC (Continued)
Chemical Composition Requirements for Flux Cored Electrodes for Undiluted Weld Metal

AWS Classification ^c	UNS Number ^d	Weight Percent ^{a, b}											
		C	Cr	Ni	Mo	Nb Plus Ta	Mn	Si	P	S	N	Cu	Other ^e
E410TX-X	W41031	0.12	11.0–13.5	0.60	0.75	—	1.2	1.0	0.04	0.03	—	0.75	—
E410NiMoTX-X	W41036	0.06	11.0–12.5	4.0–5.0	0.40–0.70	—	1.0	1.0	0.04	0.03	—	0.75	—
E430TX-X	W43031	0.10	15.0–18.0	0.60	0.75	—	1.2	1.0	0.04	0.03	—	0.75	—
E430NbTX-X	W43057	0.10	15.0–18.0	0.6	0.5	0.5–1.5	1.2	1.0	0.04	0.03	—	0.5	—
E2209TX-X	W39239	0.04	21.0–24.0	7.5–10.0	2.5–4.0	—	0.5–2.0	1.0	0.04	0.03	0.08–0.20	0.75	—
E2307TX-X	S82371	0.04	22.5–25.5	6.5–10.0	0.8	—	2.0	1.0	0.03	0.02	0.10–0.20	0.50	—
E2553TX-X	W39533	0.04	24.0–27.0	8.5–10.5	2.9–3.9	—	0.5–1.5	0.75	0.04	0.03	0.10–0.25	1.5–2.5	—
E2594TX-X	W39594	0.04	24.0–27.0	8.0–10.5	2.5–4.5	—	0.5–2.5	1.0	0.04	0.03	0.20–0.30	1.5	W=1.0
EGTX-X ^g		Not Specified											
E307T0-3	W30733	0.13	19.5–22.0	9.0–10.5	0.5–1.5	—	3.30–4.75	1.0	0.04	0.03	—	0.75	—
E308T0-3	W30833	0.08	19.5–22.0	9.0–11.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308HT0-3	W30833	0.04–0.08	19.5–22.0	9.0–11.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308LT0-3	W30837	0.04	19.5–22.0	9.0–11.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308MoT0-3	W30839	0.08	18.0–21.0	9.0–11.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E308HMoT0-3	W30830	0.07–0.12	19.0–21.5	9.0–10.7	1.8–2.4	—	1.25–2.25	0.25–0.80	0.04	0.03	—	0.75	—
E308LMoT0-3	W30838	0.04	18.0–21.0	9.0–12.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309T0-3	W30933	0.10	23.0–25.5	12.0–14.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LT0-3	W30937	0.04	23.0–25.5	12.0–14.0	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309MoT0-3	W30939	0.12	21.0–25.0	12.0–16.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LMoT0-3	W30938	0.04	21.0–25.0	12.0–16.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E309LNbT0-3	W30934	0.04	23.0–25.5	12.0–14.0	0.75	0.70–1.00	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E310T0-3	W31031	0.20	25.0–28.0	20.0–22.5	0.75	—	1.0–2.5	1.0	0.03	0.03	—	0.75	—
E312T0-3	W31231	0.15	28.0–32.0	8.0–10.5	0.75	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E316T0-3	W31633	0.08	18.0–20.5	11.0–14.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E316LT0-3	W31637	0.04	18.0–20.5	11.0–14.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E316LKT0-3 ^f	W31630	0.04	17.0–20.0	11.0–14.0	2.0–3.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—

(Continued)

Table 1FC (Continued)
Chemical Composition Requirements for Flux Cored Electrodes for Undiluted Weld Metal

AWS Classification ^c	UNS Number ^d	Weight Percent ^{a, b}											
		C	Cr	Ni	Mo	Nb Plus Ta	Mn	Si	P	S	N	Cu	Other ^e
E317LT0-3	W31737	0.04	18.5–21.0	13.0–15.0	3.0–4.0	—	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E347T0-3	W34733	0.08	19.0–21.5	9.0–11.0	0.75	8 × C min. – 1.0 Max.	0.5–2.5	1.0	0.04	0.03	—	0.75	—
E409T0-3	W40931	0.10	10.5–13.5	0.60	0.75	—	0.80	1.0	0.04	0.03	—	0.75	Ti = 10 × C min. – 1.5 max.
E410T0-3	W41031	0.12	11.0–13.5	0.60	0.75	—	1.0	1.0	0.04	0.03	—	0.75	—
E410NiMoT0-3	W41036	0.06	11.0–12.5	4.0–5.0	0.40–0.70	—	1.0	1.0	0.04	0.03	—	0.75	—
E430T0-3	W43031	0.10	15.0–18.0	0.60	0.75	—	1.0	1.0	0.04	0.03	—	0.75	—
E2209T0-3	W39239	0.04	21.0–24.0	7.5–10.0	2.5–4.0	—	0.5–2.0	1.0	0.04	0.03	0.08–0.20	0.75	—
E2307T0-3	S82371	0.04	22.5–25.5	6.5–10.0	0.8	—	2.0	1.0	0.03	0.02	0.10–0.20	0.50	—
E2553T0-3	W39533	0.04	24.0–27.0	8.5–10.5	2.9–3.9	—	0.5–1.5	0.75	0.04	0.03	0.10–0.25	1.5–2.5	—
E2594T0-3	W39594	0.04	24.0–27.0	8.0–10.5	2.5–4.5	—	0.5–2.5	1.0	0.04	0.03	0.20–0.30	1.5	W = 1.0
EGTX-3 ^g		Not Specified											
R308LT1-5	W30835	0.03	18.0–21.0	9.0–11.0	0.75	—	0.5–2.5	1.2	0.04	0.03	—	0.75	—
R309LT1-5	W30935	0.03	22.0–25.0	12.0–14.0	0.75	—	0.5–2.5	1.2	0.04	0.03	—	0.75	—
R316LT1-5	W31635	0.03	17.0–20.0	11.0–14.0	2.0–3.0	—	0.5–2.5	1.2	0.04	0.03	—	0.75	—
R347T1-5	W34731	0.08	18.0–21.0	9.0–11.0	0.75	8 × C min. – 1.0 max.	0.5–2.5	1.2	0.04	0.03	—	0.75	—
RGT1-5 ^g		Not Specified											

^a The weld metal shall be analyzed for the specific elements 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 0.50%.

^b Single values shown are maximum.

^c In this table, the “X” following the “T” refers to the position of welding (1 for all-position operation or 0 for flat or horizontal operation) and the “X” following the dash refers to the shielding medium (-1 or -4) as shown in the AWS Classification column in Table 2).

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

^e Analysis for Bi is required to be reported if intentionally added, or if it is known to be present at levels greater than 0.002%. See A8.1.4 for more information.

^f This alloy is designed for cryogenic applications.

^g See A2.2.7 and A2.2.8.

Notes:

1. Cb has been changed to Nb.

2. Classifications E502TX-X and E505TX-X have been moved from this revision to AWS A5.29/5.29M as new classifications E8XTX-B6/E8XTX-B6L and E8XTX-B8/E8XTX-B8L respectively.

Table 1MC
Chemical Composition Requirements for Metal Cored Electrodes for Undiluted Weld Metal

AWS Classification	UNS Number ^c	Weight Percent ^{a, b}											Other ^e
		C	Cr	Ni	Mo	Nb Plus Ta	Mn	Si ^d	P	S	N	Cu	
EC209	S20980	0.05	20.5–24.0	9.5–12.0	1.5–3.0	—	4.0–7.0	0.90	0.03	0.03	0.10–0.30	0.75	V = 0.10–0.30
EC218	S21880	0.10	16.0–18.0	8.0–9.0	0.75	—	7.0–9.0	3.5–4.5	0.03	0.03	0.08–0.18	0.75	—
EC219	S21980	0.05	19.0–21.5	5.5–7.0	0.75	—	8.0–10.0	1.00	0.03	0.03	0.10–0.30	0.75	—
EC240	S24080	0.05	17.0–19.0	4.0–6.0	0.75	—	10.5–13.5	1.00	0.03	0.03	0.10–0.30	0.75	—
EC307	S30780	0.04–0.14	19.5–22.0	8.0–10.7	0.5–1.5	—	3.30–4.75	0.30–0.65	0.03	0.03	—	0.75	—
EC308	S30880	0.08	19.5–22.0	9.0–11.0	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC308Si	S30881	0.08	19.5–22.0	9.0–11.0	0.75	—	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—
EC308H	S30880	0.04–0.08	19.5–22.0	9.0–11.0	0.50	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC308L	S30883	0.03	19.5–22.0	9.0–11.0	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC308LSi	S30888	0.03	19.5–22.0	9.0–11.0	0.75	—	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—
EC308Mo	S30882	0.08	18.0–21.0	9.0–12.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC308LMo	S30886	0.04	18.0–21.0	9.0–12.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC309	S30980	0.12	23.0–25.0	12.0–14.0	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC309Si	S30981	0.12	23.0–25.0	12.0–14.0	0.75	—	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—
EC309L	S30983	0.03	23.0–25.0	12.0–14.0	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC309LSi	S30988	0.03	23.0–25.0	12.0–14.0	0.75	—	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—
EC309Mo	S30982	0.12	23.0–25.0	12.0–14.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC309LMo	S30986	0.03	23.0–25.0	12.0–14.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC310	S31080	0.08–0.15	25.0–28.0	20.0–22.5	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC312	S31380	0.15	28.0–32.0	8.0–10.5	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC316	S31680	0.08	18.0–20.0	11.0–14.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC316Si	S31681	0.08	18.0–20.0	11.0–14.0	2.0–3.0	—	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—
EC316H	S31680	0.04–0.08	18.0–20.0	11.0–14.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC316L	S31683	0.03	18.0–20.0	11.0–14.0	2.0–3.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC316LSi	S31688	0.03	18.0–20.0	11.0–14.0	2.0–3.0	—	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—

(Continued)

Table 1MC (Continued)
Chemical Composition Requirements for Metal Cored Electrodes for Undiluted Weld Metal

AWS Classification	UNS Number ^c	Weight Percent ^{a, b}											Other ^e
		C	Cr	Ni	Mo	Nb Plus Ta	Mn	Si ^d	P	S	N	Cu	
EC316LMn	S31682	0.03	19.0–22.0	15.0–18.0	2.5–3.5	—	5.0–9.0	0.30–0.65	0.03	0.03	0.10–0.20	0.75	—
EC317	S31780	0.08	18.5–20.5	13.0–15.0	3.0–4.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC317L	S31783	0.03	18.5–20.5	13.0–15.0	3.0–4.0	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC318	S31980	0.08	18.0–20.0	11.0–14.0	2.0–3.0	8 × C min. – 1.0 max.	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC320	N08021	0.07	19.0–21.0	32.0–36.0	2.0–3.0	8 × C min. – 1.0 max.	2.5	0.60	0.03	0.03	—	3.0–4.0	—
EC320LR	N08022	0.025	19.0–21.0	32.0–36.0	2.0–3.0	8 × C min. – 0.40 max.	1.5–2.0	0.15	0.015	0.02	—	3.0–4.0	—
EC321	S32180	0.08	18.5–20.5	9.0–10.5	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	Ti = 9 × C min. – 1.0 max.
EC330	N08331	0.18–0.25	15.0–17.0	34.0–37.0	0.75	—	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC347	S34780	0.08	19.0–21.5	9.0–11.0	0.75	10 × C min. – 1.0 max.	1.0–2.5	0.30–0.65	0.03	0.03	—	0.75	—
EC347Si	S34788	0.08	19.0–21.5	9.0–11.0	0.75	10 × C min. – 1.0 max.	1.0–2.5	0.65–1.00	0.03	0.03	—	0.75	—
EC383	N08028	0.025	26.5–28.5	30.0–33.0	3.2–4.2	—	1.0–2.5	0.50	0.02	0.03	—	0.70–1.50	—
EC385	N08904	0.025	19.5–21.5	24.0–26.0	4.2–5.2	—	1.0–2.5	0.50	0.02	0.03	—	1.2–2.0	—
EC409	S40900	0.08	10.5–13.5	0.6	0.50	—	0.8	0.8	0.03	0.03	—	0.75	Ti = 10 × C min. – 1.5 max.
EC409Nb	S40940	0.08	10.5–13.5	0.6	0.50	10 × C min. – 0.75 max.	0.8	1.0	0.04	0.03	—	0.75	—
EC410	S41080	0.12	11.5–13.5	0.6	0.75	—	0.6	0.5	0.03	0.03	—	0.75	—
EC410NiMo	S41086	0.06	11.0–12.5	4.0–5.0	0.4–0.7	—	0.6	0.5	0.03	0.03	—	0.75	—
EC420	S42080	0.25–0.40	12.0–14.0	0.6	0.75	—	0.6	0.5	0.03	0.03	—	0.75	—
EC430	S43080	0.10	15.5–17.0	0.6	0.75	—	0.6	0.5	0.03	0.03	—	0.75	—
EC439	S43035	0.04	17.0–19.0	0.6	0.5	—	0.8	0.8	0.03	0.03	—	0.75	Ti = 10 × C min. – 1.1 max.

(Continued)

Table 1MC (Continued)
Chemical Composition Requirements for Metal Cored Electrodes for Undiluted Weld Metal

AWS Classification	UNS Number ^c	Weight Percent ^{a, b}											
		C	Cr	Ni	Mo	Nb Plus Ta	Mn	Si ^d	P	S	N	Cu	Other ^e
EC439Nb	S43035	0.04	17.0–20.0	0.6	0.5	8 × C min. – 0.75 max.	0.8	0.8	0.03	0.03	—	0.75	Ti = 0.10 – 0.75
EC446LMo	S44687	0.015	25.0–27.5	f	0.75–1.50	—	0.4	0.4	0.02	0.02	0.015	f	—
EC630	S17480	0.05	16.00–16.75	4.5–5.0	0.75	0.15–0.30	0.25–0.75	0.75	0.03	0.03	—	3.25–4.00	—
EC19–10H	S30480	0.04–0.08	18.5–20.0	9.0–11.0	0.25	0.05	1.0–2.0	0.30–0.65	0.03	0.03	—	0.75	Ti = 0.05
EC16-8-2	S16880	0.10	14.5–16.5	7.5–9.5	1.0–2.0	—	1.0–2.0	0.30–0.65	0.03	0.03	—	0.75	—
EC2209	S39209	0.03	21.5–23.5	7.5–9.5	2.5–3.5	—	0.50–2.00	0.90	0.03	0.03	0.08–0.20	0.75	—
EC2553	S39553	0.04	24.0–27.0	4.5–6.5	2.9–3.9	—	1.5	1.0	0.04	0.03	0.10–0.25	1.5–2.5	—
EC2594	S32750	0.03	24.0–27.0	8.0–10.5	2.5–4.5	—	2.5	1.0	0.03	0.02	0.20–0.30	1.5	W = 1.0
EC33-31	R20033	0.015	31.0–35.0	30.0–33.0	0.5–2.0	—	2.00	0.50	0.02	0.01	0.35–0.60	0.3–1.2	—
EC3556	R30556	0.05–0.15	21.0–23.0	19.0–22.5	2.5–4.0	—	0.50–2.00	0.20–0.80	0.04	0.015	0.10–0.30	—	Co = 16.0–21.0 W = 2.0–3.5 Nb = 0.30 Ta = 0.30–1.25 Al = 0.10–0.50 Zr = 0.001–0.100 La = 0.005–0.100 B = 0.02
ECG ^g		Not Specified											

^a Analysis shall be made for the elements for which specific 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 0.50%.

^b Single values shown are maximum percentages.

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

^d For special applications, electrodes may be purchased with less than the specified silicon content.

^e Analysis for Bi is required to be reported if intentionally added, or if it is known to be present at levels greater than 0.002%. See A8.1.4 for more information.

^f Total of Ni + Cu is 0.5 wt % maximum.

^g See A2.2.7 and A2.2.8.

Note: Classifications EC502 and EC505 have been discontinued. Classifications ECB6 and E80C-B6, which are similar to EC502, have been added to AWS A5.23 and AWS A5.28 respectively. Classifications ECB8 and E80C-B8, which are similar to EC505, have been added to AWS A5.23 and AWS A5.28, respectively.

Table 2
Required Shielding Medium, Polarity, and Welding Process

AWS Classification ^a	External Shielding Gas ^b	Welding Polarity	Welding Process
EXXXTX-1	CO ₂ ^d	DCEP	FCAW
EXXXTX-3	none (self-shielded)	DCEP	FCAW
EXXXTX-4	75%–80% Argon/remainder CO ₂ ^e	DCEP	FCAW
RXXXT1-5	100% Argon ^f	DCEN	GTAW
EXXXTX-G	Not Specified ^c	Not Specified ^c	FCAW
RXXXT1-G	Not Specified ^c	Not Specified ^c	GTAW
ECXXX	Argon with up to 2% O ₂ ^g	DCEP	GMAW
	100% Argon ^f	DCEN	GTAW

^a The letters “XXX” stand for the designation of the chemical composition (see Table 1). The “X” after the “T” designates the position of operation. A “0” indicates flat or horizontal operation; a “1” indicates all position operation. Refer to Figure A.1 and Clause A2 for a complete description of this classification system.

^b The requirement for the use of a specified external shielding gas shall not be construed to restrict the use of any other medium for which the electrodes are found suitable, for any application other than the classification tests.

^c See A2.2.7 to A2.2.9 for additional information.

^d [AWS A5.32/A5.32M](#) Class C1.

^e [AWS A5.32/A5.32M](#) Class M21.

^f [AWS A5.32/A5.32M](#) Class I1.

^g [AWS A5.32/A5.32M](#) Class I1 or M13.

Table 3
Examples of Potentially Occurring Dual Classified Electrodes

Primary Classification	Alternate Classification
E308HT1-1	E308T1-1
E308LT0-1	E308T0-1
E308LT0-3	E308T0-3
E308LT1-1	E308LT1-4
EC308L	EC308

4. Acceptance

Acceptance⁶ of the material shall be in accordance with the provisions of [AWS A5.01M/A5.01](#) (ISO 14344 MOD).

5. 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.⁷

⁶ See Annex Clause A3 for further information concerning acceptance, testing of material shipped, and [AWS A5.01M/A5.01](#) (ISO 14344 MOD).

⁷ See Annex Clause A4 for further information concerning acceptance and testing called for to meet this requirement.

6. Rounding-Off Procedure

For the purpose of determining conformance with the requirements of this standard, the actual test values obtained shall be subjected to the rounding-off rules of [ASTM E 29](#) or ISO 80000-1, Annex B, Rule A (the results are the same). If the measured values are obtained by equipment calibrated in units other than those of the specified limit, the measured values shall be converted to the units of the specified limit before rounding off. If an average value is to be compared to the specified limit, rounding off shall be done only after calculating the average. An observed or calculated value shall be rounded to the nearest 1000 psi for tensile strength for U.S. Customary Unit standard [to the nearest 10 MPa for tensile strength for S.I. Unit standard] and to the nearest unit in the last right-hand place of figures used in expressing the limiting values for other quantities. The rounded-off results shall fulfill the requirements of the appropriate table for the classification under test.

7. Summary of Tests

The tests required for each classification are specified in Table 4. The purpose of these tests is to determine the chemical composition, the mechanical properties, the usability, and the soundness of the weld metal. The base metal for the weld test assemblies, the welding and testing procedures to be employed and the results required are given in [Clauses 9 through 15](#).

Chemical analysis is required for each size of electrode and rod. The tests for mechanical properties and soundness are conducted on weld metal from the 1/16 in [1.6 mm] size of electrode and rod. In any case in which that size is not manufactured, the size closest to it that is manufactured shall be used for the classification tests. The bend tests are conducted on the largest size manufactured. When required by Table 4, the fillet weld tests shall be conducted on the largest size and smallest size manufactured.

8. Retest

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

In the event that, during preparation or after completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the weld test assembly or test specimen(s) or test sample(s), or in conducting the

Table 4
Required Tests

Classification ^a	Chemical Analysis	Radiographic Test	Tension Test	Face Bend Test	Root Bend Test	Impact Test	Fillet Weld Test
E2XXXT0-X	Required	Required	Required	NR ^b	NR ^b	NR ^b	NR ^b
E3XXT0-X	Required	Required	Required	Required	NR ^b	NR ^{b,c}	NR ^b
E316LKT0-3	Required	Required	Required	Required	NR ^b	Required	NR ^b
E4XXT0-X	Required	Required	Required	NR ^b	NR ^b	NR ^b	NR ^b
E2XXXT1-X	Required	Required	Required	NR ^b	NR ^b	NR ^b	Required
E3XXT1-X	Required	Required	Required	Required	NR ^b	NR ^{b,c}	Required
E4XXT1-X	Required	Required	Required	NR ^b	NR ^b	NR ^b	Required
R3XXT1-5	Required	Required	Required	NR ^b	Required	NR ^b	NR ^b
ECXXX	Required	NR ^b	NR ^b	NR ^b	NR ^b	NR ^b	NR ^b

^a In the table, the "X" at the end of the "EXXXXT0-X" classifications refers to the shielding medium (-1, -3, -4, or -G) the "X" at the end of the "EXXXXT1-X" classifications refers to the shielding medium (-1, -4, or -G).

^b NR = not required (see A2.2.8)

^c Impact testing is required when the optional supplemental designator "J" is added to the classification. See Figure A.1.