

Specification for Nickel-Alloy Flux Cored and Metal Cored Welding Electrodes



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An American National Standard

Approved by the
American National Standards Institute
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Specification for Nickel-Alloy Flux Cored and Metal Cored Welding Electrodes

3rd Edition

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 prescribes requirements for the classification of flux cored and metal cored nickel-alloy electrodes. For flux cored electrodes, testing determines the chemical composition, mechanical properties, soundness of the weld metal, and the welding position usability characteristics of the electrode using the specified shielding gas. For metal cored electrodes, testing determines the chemical composition, using the chemical compositions specified in AWS A5.14/A5.14M. This specification includes those compositions in which the nickel content exceeds that of any other element, but excludes nickel-base alloy compositions intended for the joining of cast irons. The electrodes classified herein are commonly used in open arc, submerged arc, and electroslag welding processes. 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 this standard, but is included for informational purposes only.

Substantive changes in this revision includes adding the new filler metal classification ENiCrMo23Tx-y which is shown in Italic font. An ENiG-Tx-y designation has been established for electrodes that do not meet the chemical composition of any designation listed in Table 1. This specification now permits the classification of metal cored electrodes. Metal cored electrodes are classified based on chemical composition, as found in AWS A5.14/A5.14M, Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods.

Document Development

The evolution of this specification took place as follows:

AWS A5.34/A5.34M:2007, *Specification for Nickel-Alloy Electrodes for Flux Cored Arc Welding*

AWS A5.34/A5.34M:2013, *Specification for Nickel-Alloy Electrodes for Flux Cored Arc Welding*

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, A5 Committee on Filler Metals and Allied Materials, American Welding Society, 8669 NW 36 St. # 130, Miami, FL 33166.

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Specification for Nickel-Alloy Flux Cored and Metal Cored Electrodes

1. Scope

1.1 This specification prescribes requirements for the classification of nickel-alloy flux cored electrodes for flux cored arc welding *and the classification of nickel-alloy metal cored electrodes which may be used with various welding processes. See AWS A3.0M/A3.0 for the definitions of both types of electrodes.* It includes alloy compositions in which the nickel content exceeds that of any other element, but excludes nickel-base alloy compositions intended for the joining of cast irons.

1.2 This specification makes use of both U.S. Customary Units and the International System of Units (SI), according to the guidelines in AWS A1.1. 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. SI units 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 the A5.34 or A5.34M specification.

1.3 *Safety and health issues and concerns are beyond the scope of this standard; some safety and health information is provided, but such issues 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 the following sources:

American Welding Society:

- (1) *ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes*
- (2) *AWS Safety and Health Fact Sheets*
- (3) *Other safety and health information on AWS website*

Material or Equipment Manufacturers:

- (1) *Safety Data Sheets supplied by materials manufacturers*
- (2) *Operating Manuals supplied by equipment manufacturers*

Applicable federal and state regulations:

Work performed in accordance with this standard may involve the use of materials that have been deemed hazardous, and may involve operations or equipment that may cause injury or death. This standard does not purport to address all safety and health risks that may be encountered. The user of this standard should establish an appropriate safety program to address such risks as well as to meet applicable regulatory requirements. ANSI Z49.1 should be considered when developing the safety program.

2. Normative References

2.1 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.

2.2 The following AWS standards are referenced in the mandatory clauses of this document:

AWS A1.1, *Metric Practice Guide for the Welding Industry*

AWS A3.0M/A3.0, *Standard Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*

AWS A5.01M/A5.01 (ISO 14344 MOD), *Welding Consumables—Procurement of Filler Metals and Fluxes*

AWS A5.02/A5.02M, *Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes*

AWS A5.14/A5.14M, *Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods*

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

AWS B4.0 or AWS B4.0M, *Standard Methods for Mechanical Testing of Welds*

2.3 The following ANSI standard is referenced in the mandatory clauses of this document:

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

2.4 The following ASTM International standards are referenced in the mandatory clauses of this document:

ASTM A131/A131M *Standard Specification for Structural Steel for Ships*

ASTM A240/A240M *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

ASTM A285/A285M *Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength*

ASTM A515/A515M *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service*

ASTM A516/A516M *Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service*

ASTM A666 *Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar*

ASTM B166 *Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696), Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617), and Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674) Rod, Bar, and Wire*

ASTM B168 *Standard Specification for Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696), Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617), and Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674) Plate, Sheet, and Strip*

ASTM B333 *Standard Specification for Nickel-Molybdenum Alloy Plate, Sheet, and Strip*

ASTM B435 *Standard Specification for UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Plate, Sheet, and Strip*

ASTM B443 *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip*

ASTM B446 *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar*

ASTM B575 *Standard Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten, and Low-Carbon Nickel-Molybdenum-Chromium Alloy Plate, Sheet, and Strip*

ASTM E29 *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*

ASTM E354 *Standard Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys*

ASTM E1019 *Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques*

ASTM E1032 *Standard Test Method for Radiographic Examination of Weldments*

ASTM E1473 *Standard Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys*

2.5 The following ISO standards are referenced in the mandatory clauses of this document:

ISO 544, *Welding Consumables—Technical Delivery Conditions for Welding Filler Materials—Type of Product, Dimensions, Tolerances, and Markings*

ISO 80000-1, *Quantities and Units—Part 1: General (Corrected by ISO 80000-1:2009/Cor 1:2011)*

3. Classification

3.1 The electrodes covered by the A5.34/A5.34M specifications are classified using a system that is independent of U.S. Customary Units and the International System of Units (SI). Classification of electrodes for flux cored welding is according to the chemical composition of the undiluted weld metal, the shielding gas employed during welding, and the welding position, as specified in Tables 1 and 2. *Classification of metal cored electrodes is according to the chemical composition of the electrodes, based on the chemical compositions specified in AWS A5.14/A5.14M.*

3.2 Electrodes classified under one classification may be classified under any other classification of this specification provided they meet all the requirements for those classifications.

4. Acceptance

Acceptance¹ of the electrodes 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.²

6. Rounding Procedure

For the purpose of determining compliance with the requirements of this standard, the actual test values obtained shall be subjected to the rounding rules of ASTM E29 or Rule A in Clause B.3 of ISO 80000-1 (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. If an average value is to be compared to the specified limit, rounding shall be done only after calculating the average. An observed or calculated value shall be rounded to the nearest 1 000 psi (1 ksi) for tensile strength for A5.34 or to the nearest 10 MPa for tensile strength for A5.34M; and to the nearest unit in the last right-hand place of figures used in expressing the limiting values for other quantities. The rounded results shall fulfill the requirements for the classification under test.

¹ See Clause A3, Acceptance (in Annex A), for further information concerning acceptance, testing of the material shipped, and AWS A5.01M/A5.01 (ISO 14344 MOD).

² See Clause A4, Certification (in Annex A), for further information concerning certification and the testing called for to meet this requirement.