

**AWS A5.14/A5.14M:2018**  
**An American National Standard**

Specification for  
Nickel and Nickel-  
Alloy Bare Welding  
Electrodes and  
Rods



**AWS A5.14/A5.14M:2018**  
**An American National Standard**

**Approved by the**  
**American National Standards Institute**  
**October 30, 2017**

**Specification for**  
**Nickel and Nickel-Alloy**  
**Bare Welding Electrodes and Rods**

**11th Edition**

**Supersedes AWS A5.14/A5.14M:2011**

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**

The chemical compositions of 57 nickel and nickel-alloy welding electrodes and rods are specified, including six compositions not previously classified. Major topics include general requirements, testing, packaging, and application guidelines.

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.

This document is the fifth of the A5.14 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 the AWS A1.1, *Metric Practice Guide for the Welding Industry*, and International Standard ISO 544, *Welding Consumables — Technical Delivery Conditions for Filler Materials and Fluxes—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 U.S. Customary and SI Units. This document also relates its classifications to ISO 18274, *Welding Consumables — Solid Wire Electrodes, Solid Strip Electrodes, Solid Wires and Solid Rods for Fusion Welding of Nickel and Nickel Alloys — Classification*.

The first specification for bare nickel and nickel-alloy welding electrodes and rods was prepared by a joint committee of the American Society for Testing and Materials and the American Welding Society and was issued in 1956. Eight years later, the first revision was prepared by the joint committee. This is the eighth revision prepared exclusively by the AWS A5 Committee on Filler Metals and Allied Materials.

*Substantive changes are shown in Italic font in the body of this specification which includes new classifications ERNiCrCo-1, ERNiCrFe-15, ERNiFeCr-3, ERNiMoCr-1, ERNiCrCoMo-2, and ERNiCrMoWNB-1. Detailed packaging information has been replaced with the reference of AWS A5.02/A5.02M:2007. Chemical composition of ERNiCrMo-19 has been modified slightly.*

*The requester of the chemical composition change in ERNiCrMo-19 classification stated that this alloy is not patented in USA, but patented for VDM Metals in Germany (patent DE 59801333), France (patent FR 991788), and the UK (GB 991788). All of these were generated out of the European patent EP991788 and will expire on May 27, 2018.*

*NOTE: The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to the validity of any such claim or of any patent rights in connection therewith. If the patent holder has filed a statement of willingness to grant a license under these rights on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain such a license, then details may be obtained from the standard developer.*

### Document Development

ASTM B304-56T AWS A5.14-56T	<i>Tentative Specification for Nickel and Nickel-Base Alloy Bare Welding Filler Metals</i>
AWS A5.14-64T ASTM B304-64T	<i>Tentative Specification for Nickel and Nickel Alloy Bare Welding Rods and Electrodes</i>
AWS A5.14-69T ANSI W3.14-1973	<i>Specification for Nickel and Nickel-Alloy Bare Welding Rods and Electrodes</i>
ANSI/AWS A5.14-76	<i>Specification for Nickel and Nickel Alloy Bare Welding Rods and Electrodes</i>
ANSI/AWS A5.14-83	<i>Specification for Nickel and Nickel Alloy Bare Welding Rods and Electrodes</i>
ANSI/AWS A5.14-89	<i>Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods</i>



**Document Development (Continued)**

ANSI/AWS A5.14/A5.14M-97	<i>Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods</i>
AWS A5.14/A5.14M:2005	<i>Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods</i>
AWS A5.14/A5.14M:2009	<i>Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods</i>
AWS A5.14/A5.14M:2011	<i>Specification for Nickel and Nickel-Alloy Bare Welding 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, 8669 NW 36 St, # 130, Miami, FL 33166.

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# Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods

## 1. Scope

**1.1** This specification prescribes requirements for the classification of bare nickel and nickel-alloy welding electrodes, strip electrodes, and welding rods. It includes those compositions where the nickel content exceeds that of any other element.

**1.2** 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 A5.14 uses U.S. Customary Units. The specification A5.14M 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 A5.14 or A5.14M specifications.

**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
- (3) 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

The documents listed below are referenced within this publication and are mandatory to the extent specified herein. For undated references, the latest edition of the referenced standard shall apply. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

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

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

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

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

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

**2.2** The following ANSI standard is referenced in the mandatory sections of this document:

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

**2.3** The following ASTM standards 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) ASTM E76, *Standard Test Methods for Chemical Analysis of Nickel-Copper Alloys*

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

(4) 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*

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

**2.4** The following ISO standards are referenced in the mandatory sections of this document

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

(2) ISO 18274, *Welding consumables — Wire and Strip Electrodes, Wires and Rods for Arc Welding of Nickel and Nickel Alloys — Classifications*

(3) ISO 80000-1, *Quantities and Units — Part 1: General*

**2.5** The following MIL standard is referenced in the mandatory sections of this document:

MIL-E-21562 *Military Specification—Electrodes and Rods—Welding, Bare, Nickel Alloy*

### 3. Classification

**3.1** The welding filler metals covered by this A5.14/A5.14M:2018 specification are classified using a system that is independent of U.S. Customary Units and the International System of Units (SI). Classification is according to the chemical composition of the filler metal, as specified in Table 1.

**3.2** A filler metal classified under one classification shall not be classified under any other classification in this specification.

**3.3** The filler metals classified under this specification are intended for use with the plasma arc, gas metal arc, gas tungsten arc, and submerged arc welding processes, but this is not to prohibit their use with any other process for which they are found suitable.

### 4. Acceptance

Acceptance<sup>1</sup> of the filler metal shall be in accordance with the provisions of AWS A5.01M/A5.01 (ISO 14344 MOD).

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

**Table 1**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Weight Percent <sup>a,b</sup>													Other Elements Total			
		C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta		Mo	V	W
ERNi-1 <sup>f</sup>	N02061	0.15	1.0	1.0	0.03	0.015	0.75	0.25	93.0 min.	—	1.5	2.0 to 3.5	—	—	—	—	—	0.50
ERNiCu-7 <sup>f</sup>	N04060	0.15	4.0	2.5	0.02	0.015	1.25	Rem	62.0 to 69.0	—	1.25	1.5 to 3.0	—	—	—	—	—	0.50
ERNiCu-8 <sup>f</sup>	N05504	0.25	1.5	2.0	0.03	0.015	1.00	Rem	63.0 to 70.0	—	2.0 to 4.0	0.25 to 1.00	—	—	—	—	—	0.50
ERNiCr-3 <sup>f,g</sup>	N06082	0.10	2.5 to 3.5	3.0	0.03	0.015	0.50	0.50	67.0 min.	(h)	—	0.75	18.0 to 22.0	2.0 to 3.0 <sup>i</sup>	—	—	—	0.50
ERNiCr-4	N06072	0.01 to 0.10	0.20	0.50	0.02	0.015	0.20	0.50	Rem	—	—	0.3 to 1.0	42.0 to 46.0	—	—	—	—	0.50
ERNiCr-6 <sup>f</sup>	N06076	0.08 to 0.15	1.00	2.00	0.03	0.015	0.30	0.50	75.0 min.	—	0.40	0.15 to 0.50	19.0 to 21.0	—	—	—	—	0.50
ERNiCr-7 <sup>j</sup>	N06073	0.03	0.50	1.0	0.02	0.015	0.30	0.30	Rem	1.0	0.75 to 1.20	0.25 to 0.75	36.0 to 39.0	0.25 to 1.00	0.50	—	—	0.50
ERNiCrCo-1 <sup>v</sup>	N07740	0.01 to 0.06	1.0	3.0	0.03	0.015	1.0	0.50	Rem	15.0 to 22.9	0.5 to 2.0	0.8 to 2.5	23.5 to 25.5	0.5 to 2.5	2.0	—	—	0.50
ERNiCrCoMo-1	N06617	0.05 to 0.15	1.0	3.0	0.03	0.015	1.0	0.50	Rem	10.0 to 15.0	0.8 to 1.5	0.60 to 24.0	20.0 to 24.0	—	8.0 to 10.0	—	—	0.50

(Continued)

**Table 1 (Continued)**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Weight Percent <sup>a,b</sup>														Other Elements Total		
		C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta	Mo		V	W
ERNiCrCoMo-2	N07208	0.04 to 0.08	0.30	1.5	0.015	0.015	0.15	0.1	Rem	9.0 to 11.0	1.38 to 1.65	1.90 to 2.30	18.5 to 20.5	0.3 <sup>k</sup>	8.0 to 9.0	—	0.05	0.50 <sup>l</sup>
ERNiCrFe-5 <sup>f</sup>	N06062	0.08	1.0	6.0 to 10.0	0.03	0.015	0.35	0.50	70.0 min.	(h)	—	—	14.0 to 17.0	1.5 to 3.0 <sup>i</sup>	—	—	—	0.50
ERNiCrFe-6 <sup>f</sup>	N07092	0.08	2.0 to 2.7	8.0	0.03	0.015	0.35	0.50	67.0 min.	—	—	2.5 to 3.5	14.0 to 17.0	—	—	—	—	0.50
ERNiCrFe-7 <sup>m</sup>	N06052	0.04	1.0	7.0 to 11.0	0.02	0.015	0.50	0.30	Rem	—	1.10	1.0	28.0 to 31.5	0.10	0.50	—	—	0.50
ERNiCrFe-7A <sup>m,n</sup>	N06054	0.04	1.0	7.0 to 11.0	0.02	0.015	0.50	0.30	Rem	0.12	1.10	1.0	28.0 to 31.5	0.5 to 1.0	0.50	—	—	0.50
ERNiCrFe-8 <sup>f</sup>	N07069	0.08	1.0	5.0 to 9.0	0.03	0.015	0.50	0.50	70.0 min.	—	0.4 to 1.0	2.00 to 2.75	14.0 to 17.0	0.70 to 1.20	—	—	—	0.50
ERNiCrFe-11	N06601	0.10	1.0	Rem	0.03	0.015	0.50	1.0	58.0 to 63.0	—	1.0 to 1.7	—	21.0 to 25.0	—	—	—	—	0.50
ERNiCrFe-12	N06025	0.15 to 0.25	0.50	8.0 to 11.0	0.020	0.010	0.5	0.1	Rem	1.0	1.8 to 2.4	0.10 to 0.20	24.0 to 26.0	—	—	—	—	0.50
ERNiCrFe-13 <sup>j</sup>	N06055	0.03	1.0	Rem	0.02	0.015	0.50	0.30	52.0 to 62.0	0.10	0.50	0.50	28.5 to 31.0	2.1 to 4.0	3.0 to 5.0	—	—	0.50

(Continued)

**Table 1 (Continued)**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Weight Percent <sup>a,b</sup>														Other Elements Total		
		C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta	Mo		V	W
ERNiCrFe-14	N06043	0.04	3.0	7.0 to 12.0	0.020	0.015	0.50	0.30	Rem	—	0.50	0.50	28.0 to 31.5	1.0 to 2.5 <sup>o</sup>	0.50	—	—	0.50
ERNiCrFe-15	N06056	0.020 to 0.055	2.5 to 3.5	1.0 to 3.0	0.02	0.015	0.50	0.3	Rem	0.10	0.60	0.10 to 0.40	26.0 to 28.0	2.0 to 2.8	—	—	—	0.50
ERNiCrFeSi-1	N06045	0.05 to 0.12	1.0	21.0 to 25.0	0.020	0.010	2.5 to 3.0	0.3	Rem	1.0	0.30	—	26.0 to 29.0	—	—	—	—	0.50
ERNiCrFeAl-1	N06693	0.15	1.0	2.5 to 6.0	0.03	0.01	0.5	0.5	Rem	—	2.5 to 4.0	1.0	27.0 to 31.0	0.5 to 2.5	—	—	—	0.50
ERNiFeCr-1 <sup>f</sup>	N08065	0.05	1.0	22.0 min.	0.03	0.03	0.50	1.5 to 3.0	38.0 to 46.0	—	0.20	0.6 to 1.2	19.5 to 23.5	—	2.5 to 3.5	—	—	0.50
ERNiFeCr-2 <sup>p</sup>	N07718	0.08	0.35	Rem	0.015	0.015	0.35	0.30	50.0 to 55.0	—	0.20 to 0.80	0.65 to 1.15	17.0 to 21.0	4.75 to 5.50	2.80 to 3.30	—	—	0.50
ERNiFeCr-3 <sup>x</sup>	N09946	0.005 to 0.040	1.0	Rem	0.03	0.015	0.5	1.5 to 3.0	45.0 to 55.0	—	0.01 to 0.70	0.5 to 2.5	19.5 to 23.0	2.5 to 4.5	3.0 to 4.0	—	—	0.50
ERNiMo-1	N10001	0.08	1.0	4.0 to 7.0	0.025	0.03	1.0	0.50	Rem	2.5	—	—	1.0	—	26.0 to 30.0	0.20 to 0.40	1.0	0.50
ERNiMo-2	N10003	0.04 to 0.08	1.0	5.0	0.015	0.02	1.0	0.50	Rem	0.20	—	—	6.0 to 8.0	—	15.0 to 18.0	0.50	0.50	0.50

(Continued)



**Table 1 (Continued)**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Weight Percent <sup>a,b</sup>														Other Elements Total		
		C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta	Mo		V	W
ERNiMo-3	N10004	0.12	1.0	4.0 to 7.0	0.04	0.03	1.0	0.50	Rem	2.5	—	—	4.0 to 6.0	—	23.0 to 26.0	0.60	1.0	0.50
ERNiMo-7	N10665	0.02	1.0	2.0	0.04	0.03	0.10	0.50	Rem	1.0	—	—	1.0	—	26.0 to 30.0	—	1.0	0.50
ERNiMo-8	N10008	0.10	1.0	10.0	0.015	0.015	0.50	0.50	60.0 min.	—	—	—	0.5 to 3.5	—	18.0 to 21.0	—	2.0 to 4.0	0.50
ERNiMo-9	N10009	0.10	1.0	5.0	0.015	0.015	0.50	0.3 to 1.3	65.0 min.	—	1.0	—	—	—	19.0 to 22.0	—	2.0 to 4.0	0.50
ERNiMo-10 <sup>f</sup>	N10675	0.01	3.0	1.0 to 3.0	0.03	0.01	0.10	0.20	65.0 min.	3.0	0.50	0.20	1.0 to 3.0	0.20	27.0 to 32.0	0.20	3.0	0.50
ERNiMo-11	N10629	0.010	1.0	2.0 to 5.0	0.020	0.010	0.10	0.5	Rem	1.0	0.1 to 0.5	0.30	0.5 to 1.5	0.50	26.0 to 30.0	—	—	0.50
ERNiMo-12 <sup>g</sup>	N10242	0.03	0.80	2.0	0.030	0.015	0.80	0.50	Rem	1.0	0.50	—	7.0 to 9.0	—	24.0 to 26.0	—	—	0.50
ERNiMoCr-1	N10362	0.010	0.60	1.25	0.025	0.010	0.08	—	Rem	—	0.50	—	13.8 to 15.6	—	21.5 to 23.0	—	—	0.50
ERNiCrMo-1	N06007	0.05	1.0 to 2.0	18.0 to 21.0	0.04	0.03	1.0	1.5 to 2.5	Rem	2.5	—	—	21.0 to 23.5	1.75 to 2.50	5.5 to 7.5	—	1.0	0.50

(Continued)

**Table 1 (Continued)**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

		Weight Percent <sup>a,b</sup>														Other Elements Total		
AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta	Mo	V	W	
ERNiCrMo-2	N06002	0.05 to 0.15	1.0	17.0 to 20.0	0.04	0.03	1.0	0.50	Rem	0.5 to 2.5	—	—	20.5 to 23.0	—	8.0 to 10.0	—	0.2 to 1.0	0.50
ERNiCrMo-3 <sup>f</sup>	N06625	0.10	0.50	5.0	0.02	0.015	0.50	0.50	58.0 min.	—	0.40	0.40	20.0 to 23.0	3.15 to 4.15	8.0 to 10.0	—	—	0.50
ERNiCrMo-4	N10276	0.02	1.0	4.0 to 7.0	0.04	0.03	0.08	0.50	Rem	2.5	—	—	14.5 to 16.5	—	15.0 to 17.0	0.35	3.0 to 4.5	0.50
ERNiCrMo-7	N06455	0.015	1.0	3.0	0.04	0.03	0.08	0.50	Rem	2.0	—	0.70	14.0 to 18.0	—	14.0 to 18.0	—	0.50	0.50
ERNiCrMo-8	N06975	0.03	1.0	Rem	0.03	0.03	1.0	0.7 to 1.2	47.0 to 52.0	—	—	0.70 to 1.50	23.0 to 26.0	—	5.0 to 7.0	—	—	0.50
ERNiCrMo-9	N06985	0.015	1.0	18.0 to 21.0	0.04	0.03	1.0	1.5 to 2.5	Rem	5.0	—	—	21.0 to 23.5	0.50	6.0 to 8.0	—	1.5	0.50
ERNiCrMo-10	N06022	0.015	0.50	2.0 to 6.0	0.02	0.010	0.08	0.50	Rem	2.5	—	—	20.0 to 22.5	—	12.5 to 14.5	0.35	2.5 to 3.5	0.50
ERNiCrMo-11	N06030	0.03	1.5	13.0 to 17.0	0.04	0.02	0.80	1.0 to 2.4	Rem	5.0	—	—	28.0 to 31.5	0.30 to 1.50	4.0 to 6.0	—	1.5 to 4.0	0.50
ERNiCrMo-13	N06059	0.010	0.5	1.5	0.015	0.010	0.10	0.50	Rem	0.3	0.1 to 0.4	—	22.0 to 24.0	—	15.0 to 16.5	—	—	0.50

(Continued)

**Table 1 (Continued)**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Weight Percent <sup>a,b</sup>														Other Elements Total	
		C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta	Mo		V
ERNiCrMo-14	N06686	0.01	1.0	5.0	0.02	0.02	0.08	0.5	Rem	—	0.25	19.0 to 23.0	—	15.0 to 17.0	—	3.0 to 4.4	0.50
ERNiCrMo-15	N07725	0.03	0.35	Rem	0.015	0.01	0.20	—	55.0 to 59.0	—	0.35	1.0 to 1.7	2.75 to 4.00	7.0 to 9.5	—	—	0.50
ERNiCrMo-16	N06057	0.02	1.0	2.0	0.04	0.03	1.0	—	Rem	—	—	29.0 to 31.0	—	10.0 to 12.0	0.4	—	0.50
ERNiCrMo-17	N06200	0.010	0.5	3.0	0.025	0.010	0.08	0.50	Rem	2.0	—	22.0 to 24.0	—	15.0 to 17.0	—	—	0.50
ERNiCrMo-18 <sup>f</sup>	N06650	0.03	0.5	12.0 to 16.0	0.020	0.010	0.50	0.05 to 0.50	Rem	1.0	—	19.0 to 21.0	0.05 to 0.50	9.5 to 12.5	0.30	0.5 to 2.5	0.50
ERNiCrMo-19 <sup>g,t</sup>	N06058	0.01	0.5	1.5	0.015	0.010	0.10	0.4	Rem	0.3	—	20.0 to 23.0	—	18.5 to 21.0	—	0.3	0.50
ERNiCrMo-20	N06660	0.03	0.5	2.0	0.015	0.015	0.5	0.4	Rem	0.2	0.4	21.0 to 23.0	0.2	9.0 to 11.0	—	2.0 to 4.0	0.50
ERNiCrMo-21	N06205	0.03	0.5	1.0	0.015	0.015	0.5	0.4	Rem	0.2	0.4	24.0 to 26.0	—	14.0 to 16.0	—	0.3	0.50
ERNiCrMo-22	N06035	0.050	0.50	2.00	0.030	0.015	0.60	0.40	Rem	1.00	0.2	32.25 to 34.25	0.5	7.60 to 9.00	0.20	0.60	0.50

(Continued)

**Table 1 (Continued)**  
**Chemical Composition Requirements for Nickel and Nickel-Alloy Electrodes and Rods**

AWS Classification <sup>c</sup>	UNS Number <sup>d</sup>	Weight Percent <sup>e,h,b</sup>													Other Elements Total			
		C	Mn	Fe	P	S	Si	Cu	Ni <sup>e</sup>	Co	Al	Ti	Cr	Nb Plus Ta		Mo	V	W
<i>ERNiCrMoWNB-1</i>	N06680	0.03	—	0.50	0.02	0.015	0.1	—	56.0 to 65.0	1.0	0.5	1.2 to 3.0	17.0 to 23.0	3.0 to 5.0	5.0 to 8.0	—	4.0 to 8.0	0.50
ERNiCoCrSi-1	N12160	0.02 to 0.10	1.0	3.5	0.030	0.015	2.4 to 3.0	0.50	Rem	27.0 to 32.0	0.40	0.20 to 0.60	26.0 to 29.0	0.30	0.7	—	0.5	0.50
ERNiCrWMo-1 <sup>u</sup>	N06231	0.05 to 0.15	0.3 to 1.0	3.0	0.03	0.015	0.25 to 0.75	0.50	Rem	5.0	0.2 to 0.5	—	20.0 to 24.0	—	1.0 to 3.0	—	13.0 to 15.0	0.50

<sup>a</sup> 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 the work, the amount of those elements shall be determined to ensure that their total does not exceed the limit specified for "Other Elements, Total" in the last column of the table.

<sup>b</sup> Single values are maximum except where otherwise specified. Rem = remainder.

<sup>c</sup> For strip, the classification designator "R" shall be replaced with "Q."

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

<sup>e</sup> Includes incidental cobalt.

<sup>f</sup> MIL-E-21562 grade; Pb < 0.010. "Other Elements Total" shall include Pb, Sn, Zn.

<sup>g</sup> MIL-E-21562 grades EN82H or RN82H; Carbon is 0.03 to 0.10.

<sup>h</sup> Co is 0.12 maximum when specified by the purchaser.

<sup>i</sup> MIL-E-21562 grade, Ta is 0.30 maximum.

<sup>j</sup> B is 0.003 maximum and Zr is 0.02 maximum.

<sup>k</sup> Nb(Cb) is 0.2 maximum and Ta is 0.1 maximum.

<sup>l</sup> B is 0.003 to 0.010 and Zr is 0.02 maximum.

<sup>m</sup> Al + Ti is 1.5 maximum.

<sup>n</sup> B is 0.005 maximum and Zr is 0.02 maximum.

<sup>o</sup> Ta is 0.10 maximum.

<sup>p</sup> Boron is 0.006 maximum.

<sup>q</sup> Ni + Mo is 94.0 to 98.0; Ta is 0.02 maximum; Zr is 0.10 maximum.

<sup>r</sup> Nitrogen is 0.05 to 0.20.

<sup>s</sup> Nitrogen is 0.02 to 0.15.

<sup>t</sup> VDM Metals, the requester of the chemical composition change for the ERNiCrMo-19 classification stated that this alloy is not patented in USA, but patent has been granted to "VDM Metals" in Germany (patent DE 59801333), France (patent FR 991788), and the UK (patent GB 991788). All of these were generated out of European patent EP991788 which will expire on May 27, 2018.

<sup>u</sup> Boron is 0.003 maximum and La is 0.050 maximum.

<sup>v</sup> Patent application number US 2009/0257908, Brian A. Baker was filed on October 15, 2009.

<sup>w</sup> Patent application number US 2015/0306710 A1, Kiser is pending.

<sup>x</sup> Patent application number US2013/0327447, Saewan K. Mannan was filed on June 11, 2012.

## 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.<sup>2</sup>

## 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 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 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.*

## 7. Summary of Tests

Chemical analysis of the filler metal, or the stock from which it was made, is the only test required for classification of a product under this specification.

## 8. Retest

If the results of any test fail to meet the requirement of that test, that test shall be repeated twice. The results of both retests shall meet the requirement. Material for retest may be taken from the original test sample or from a new sample. 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 test specimen(s) or in conducting the test, the test shall be considered invalid, without regard to whether the test was actually completed, or whether test results met, or failed to meet, the requirement. That test shall be repeated, following proper prescribed procedures. In this case, the requirement for doubling of the number of test specimens does not apply.

## 9. Chemical Analysis

**9.1** A sample of the filler metal, or the stock from which it was made, shall be prepared for chemical analysis.

**9.2** The sample shall be analyzed by accepted analytical methods. The referee method shall be ASTM E1473, supplemented by ASTM E1019 and ASTM E354 for nickel-base alloys, and ASTM E76 for nickel-copper alloys, as appropriate.

**9.3** The results of the analysis shall meet the requirements set forth in Table 1, for the classification of filler metal under test.

## 10. Method of Manufacture

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

<sup>2</sup> See Annex Clause A4 for further information concerning certification and the testing called for to meet this requirement.

## 11. Standard Sizes

**11.1** Standard sizes for filler metal in the different package forms (straight lengths, coils with support, coils without support, and spools) (see Clause 13) are shown in Table 2 of AWS A5.02/A5.02M:2007.

**11.2** Standard sizes for strip electrodes in coils (see Clause 13) are shown in Table 3 of AWS A5.02/A5.02M:2007.

## 12. Finish and Uniformity

Finish and uniformity shall be as given in 4.2 of AWS A5.02/A5.02M:2007.

## 13. Standard Package Forms

Standard package forms are straight lengths, coils with support, coils without support, and spools. Packaging shall be as given in 4.3 of AWS A5.02/A5.02M:2007.

## 14. Winding Requirements

**14.1** Filler metal on spools and in coils shall be wound per 4.4.1 of AWS A5.02/A5.02M:2007.

**14.2** The cast and helix of filler metal in coils and spools shall be per 4.4.2 of AWS A5.02/A5.02M:2007.

## 15. Filler Metal Identification

Filler metal identification shall be in accordance with 4.5 of AWS A5.02/A5.02M:2007.

## 16. Packaging

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

## 17. Marking of Packages

**17.1** 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 designation (year of issue may be excluded). Additionally, the numerical classification number from ISO 18274 may be applied as a reference designation, provided all the requirements of ISO 18274 are satisfied (see A2.4 in Annex A and Table A.1).

(2) Supplier's name and trade designation

(3) Size and net weight

(4) Lot, control, or heat number

**17.2** The appropriate precautionary information<sup>3</sup> given in ANSI Z49.1, latest edition (as a minimum), shall be prominently displayed in legible print on all packages, including individual unit packages within a larger package.

<sup>3</sup> Typical examples of "warning labels" and precautionary information are shown in figures in ANSI Z49.1 for some common or specific consumables used with certain processes.

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## Annex A (Informative)

# Guide to AWS Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods

This annex is not part of this standard but is included for informational purposes only.

### A1. Introduction

The purpose of this guide is to correlate the nickel and nickel-alloy bare welding electrodes and rods classifications with their intended applications so they 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 a complete listing of the materials for which each filler metal is suitable.

### A2. Classification System

**A2.1** The system for classifying the filler metals in this specification follows the standard pattern used in other AWS filler metal specifications. The letters “ER” at the beginning of each classification designation stand for electrode and rod, indicating that the filler metal may be used either way. The substitution of the letters “EQ” for “ER” at the beginning of a classification indicates that the product is being supplied as strip electrode (see Table 1, Note c).

**A2.2** Since the filler metals are classified according to their chemical composition, the chemical symbol “Ni” appears immediately after the “ER” (or “EQ”) as a means of identifying the filler metal as a nickel-base alloy. The other symbols (Al, Cr, Co, Cu, Fe, Mo, Nb, Si, and W) in the designations are intended to group the filler metals according to their principal alloying elements. The individual designations are made up of these symbols plus a number at the end of the designation (ERNiMo-1 or ERNiMo-2, for example). These numbers separate one composition from another within a group and are not repeated within that group.

#### A2.3 Request for Filler Metal Classification

(1) When a filler metal cannot be classified, a manufacturer may request that a new classification be established. The manufacturer shall do this using the following procedure:

(2) A request to establish a new (filler metal) classification must be submitted in writing. The request needs to provide sufficient detail to permit the AWS A5 Committee on Filler Metals and Allied Materials and the relevant subcommittee to determine whether a new classification or the modification of an existing classification is more appropriate, or if neither is necessary. In particular, the request needs to include:

- (a) A declaration that the new classification will be offered for sale commercially.
- (b) All classification requirements as given for existing classifications, such as, chemical composition ranges, mechanical property requirements, and usability test requirements.
- (c) Any conditions for conducting the tests used to demonstrate that the filler metal meets the classification requirements. (It would be sufficient, for example, to state that welding conditions are the same as for other classifications.)
- (d) Information on Descriptions and Intended Use, which parallels that for existing classifications (for that clause of the annex).
- (e) Actual test data for all tests required for classification according to the requirements of the specification for a minimum of two production heats/lots must be provided. In addition, if the specification is silent regarding mechanical



properties, test data submitted shall include appropriate weld metal mechanical properties from a minimum of two production heats/lots.

(f) A request for a new classification without the above information will be considered incomplete. The Secretary will return the request to the requester for further information.

(3) In order to comply with the AWS Policy on Patented Items, Trademarks, and Restraint of Trade, if the proposed new classification is patented, if a patent is pending for it, or if there is any intention to apply for a patent, the requester shall disclose this. The affected classification shall be identified in all drafts and eventually the published standard identifying the patent owner. The requester shall also provide written assurance to AWS that:

(a) No patent rights will be enforced against anyone using the patent to comply with the standard;

or

(b) The owner will make licenses available to anyone wishing to use the patent to comply with the standard, without compensation or for reasonable rates, with reasonable terms and conditions demonstrably free of any unfair competition.

The status for the patent shall be checked before publication of the document and the patent information included in the document will be updated as appropriate.

Neither AWS, the Committee on Filler Metals and Allied Materials, nor the relevant Subcommittee is required to consider the validity of any patent or patent application.

The published standard shall include a note as follows:

*“NOTE: The user’s attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to the validity of any such claim(s) or of any patent rights in connection therewith. If a patent holder has filed a statement of willingness to grant a license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, then details may be obtained from the standards developer.”*

(4) The request should be sent to the Secretary of the Committee on Filler Metals and Allied Materials at AWS Headquarters. Upon receipt of the request, the Secretary will:

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

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

(c) Send a copy of the request to the Chair of the AWS A5 Committee on Filler Metals and Allied Materials and the Chair of the particular subcommittee involved.

(d) File the original request.

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

(5) All necessary action on each request will be completed as soon as possible.

(6) The Secretary shall include a copy of the log of all requests pending and those completed during the preceding year with the agenda for each AWS A5 Committee on Filler Metals and Allied Materials meeting. Any other publication of requests that have been completed will be at the option of the American Welding Society, as deemed appropriate.

**A2.4** From an application point of view, most of the filler metal classifications in this specification have a corresponding classification in AWS A5.11/A5.11M, *Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding*. For those cases in which there is a corresponding application for a bare electrode or rod “ER” and a covered electrode “E,” Table A.1 correlates the “ER” classification in this edition with the corresponding covered electrode “E” classification in AWS A5.11/A5.11M. It also lists the current designation for each classification as it is given in Military Specification MIL-E-21562, when such a designation exists.

**A2.5** An international system for designating welding filler metals, developed by the International Institute of Welding (IIW), has been adopted in many ISO specifications. Table A.1 also shows the ISO 18274 designations for comparison with comparable classifications in this specification.

**Table A.1**  
**Comparison of Classifications<sup>a</sup>**

Present Classification <sup>b</sup>	UNS Number	Military Designation <sup>c</sup>	Corresponding Classification in A5.11/A5.11M	ISO 18274 Designation <sup>d</sup>
ERNi-1	N02061	EN61 & RN61	ENi -1	S Ni 2061
ERNiCu-7	N04060	EN60 & RN60	ENiCu-7	S Ni 4060
ERNiCu-8	N05504	EN64 & RN64	—	S Ni 5504
ERNiCr-3	N06082	EN82 & RN82 EN82H & RN82H	ENiCrFe-3	S Ni 6082
ERNiCr-4	N06072	—	—	S Ni 6072
ERNiCr-6	N06076	EN6N & RN6N	—	S Ni 6076
ERNiCr-7	N06073	—	—	<i>S Ni 6073</i>
<i>ERNiCrCo-1</i>	<i>N07740</i>	—	—	—
ERNiCrCoMo-1	N06617	—	ENiCrCoMo-1	S Ni 6617
<i>ERNiCrCoMo-2</i>	<i>N07208</i>	—	—	—
ERNiCrFe-5	N06062	EN62 & RN62	ENiCrFe-1	S Ni 6062
ERNiCrFe-6	N07092	EN6A & RN6A	ENiCrFe-2	S Ni 7092
ERNiCrFe-7	N06052	—	ENiCrFe-7	S Ni 6052
ERNiCrFe-7A	N06054	—	—	<i>S Ni 6054</i>
ERNiCrFe-8	N07069	RN69	—	S Ni 7069
ERNiCrFe-11	N06601	—	—	S Ni 6601
ERNiCrFe-12	N06025	—	ENiCrFe-12	S Ni 6025
ERNiCrFe-13	N06055	—	—	<i>S Ni 6055</i>
ERNiCrFe-14	N06043	—	—	S Ni 6043
<i>ERNiCrFe-15</i>	<i>N06056</i>	—	—	—
ERNiCrFeSi-1	N06045	—	ENiCrFeSi-1	<i>S Ni 6045</i>
ERNiCrFeAl-1	N06693	—	—	S Ni 6693
ERNiFeCr-1	N08065	RN65	—	S Ni 8065
ERNiFeCr-2	N07718	—	—	S Ni 7718
<i>ERNiFeCr-3</i>	<i>N09946</i>	—	—	—
ERNiMo-1	N10001	—	ENiMo-1	S Ni 1001
ERNiMo-2	N10003	—	—	S Ni 1003
ERNiMo-3	N10004	—	ENiMo-3	S Ni 1004
ERNiMo-7	N10665	—	ENiMo-7	S Ni 1066

(Continued)

**Table A.1 (Continued)**  
**Comparison of Classifications<sup>a</sup>**

Present Classification <sup>b</sup>	UNS Number	Military Designation <sup>c</sup>	Corresponding Classification in A5.11/A5.11M	ISO 18274 Designation <sup>d</sup>
ERNiMo-8	N10008	—	ENiMo-8	S Ni 1008
ERNiMo-9	N10009	—	ENiMo-9	S Ni 1009
ERNiMo-10	N10675	—	ENiMo-10	S Ni 1067
ERNiMo-11	N10629	—	ENiMo-11	S Ni 1069
ERNiMo-12	N10242	—	—	<i>S Ni 1024</i>
<i>ERNiMoCr-1</i>	<i>N10362</i>	—	—	—
ERNiCrMo-1	N06007	—	ENiCrMo-1	—
ERNiCrMo-2	N06002	—	ENiCrMo-2	S Ni 6002
ERNiCrMo-3	N06625	EN625 & RN625	ENiCrMo-3	S Ni 6625
ERNiCrMo-4	N10276	—	ENiCrMo-4	S Ni 6276
ERNiCrMo-7	N06455	—	ENiCrMo-7	S Ni 6455
ERNiCrMo-8	N06975	—	—	S Ni 6975
ERNiCrMo-9	N06985	—	ENiCrMo-9	S Ni 6985
ERNiCrMo-10	N06022	—	ENiCrMo-10	S Ni 6022
ERNiCrMo-11	N06030	—	ENiCrMo-11	S Ni 6030
ERNiCrMo-13	N06059	—	ENiCrMo-13	S Ni 6059
ERNiCrMo-14	N06686	—	ENiCrMo-14	S Ni 6686
ERNiCrMo-15	N07725	—	—	S Ni 7725
ERNiCrMo-16	N06057	—	—	S Ni 6057
ERNiCrMo-17	N06200	—	ENiCrMo-17	S Ni 6200
ERNiCrMo-18	N06650	—	ENiCrMo-18	S Ni 6650
ERNiCrMo-19	N06058	—	ENiCrMo-19	<i>S Ni 6058</i>
ERNiCrMo-20	N06660	—	—	S Ni 6660
ERNiCrMo-21	N06205	—	—	S Ni 6205
ERNiCrMo-22	N06035	—	<i>ENiCrMo-22</i>	<i>S Ni 6035</i>
<i>ERNiCrMoWMNb-1</i>	<i>N06680</i>	—	—	—
ERNiCoCrSi-1	N12160	—	—	S Ni 6160
ERNiCrWMo-1	N06231	—	ENiCrWMo-1	S Ni 6231

<sup>a</sup> The requirements for the equivalent classifications shown are not necessarily identical in every respect.

<sup>b</sup> For strip, the classification designator “R” shall be replaced with “Q.”

<sup>c</sup> MIL E-21562. All designations are prefixed with “MIL.”

<sup>d</sup> For strip, the classification designator “S” shall be replaced with “B.”

### A3. Acceptance

Acceptance of all welding materials classified under this specification is in accordance with AWS A5.01M/A5.01 (ISO 14344 MOD), *Welding Consumables—Procurement of Filler Metals and Fluxes*, 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 AWS A5.01M/A5.01 (ISO 14344 MOD). 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 AWS A5.01M/A5.01 (ISO 14344 MOD). 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 will be in accordance with those requirements.

### A4. Certification

The act of placing the AWS specification and classification designations on the packaging enclosing the product, or the classification on the product itself, constitutes the supplier's (manufacturer's) certification that the product meets all of the requirements of the specification.

The only testing requirement implicit in this certification is that the manufacturer has actually 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 made. The basis for the certification required by the specification is the classification tests of "representative material" cited above, and the "Manufacturer's Quality Assurance System" in AWS A5.01M/A5.01 (ISO 14344 MOD).

### A5. Ventilation During Welding

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

- (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 the space;
- (3) Rate of evolution of fumes, gases, or dust, according to the materials and processes involved;
- (4) The proximity of the welder or welding operator to the fumes as they issue from the welding zone and to the gases and dust in the space in which the welder is working; and
- (5) The ventilation provided to the space in which the welding is done.

**A5.2** American National Standard ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes* (published by the American Welding Society), discusses the ventilation that is required during welding and should be referred to for details. Attention is drawn particularly to the clause of that document dealing with ventilation. See also AWS F3.2M/F3.2, *Ventilation Guide for Weld Fume*, for more detailed description of ventilation options.

### A6. Welding Considerations

**A6.1** The filler metals in this specification can be used with any of a variety of welding processes. Most notable among them are gas tungsten arc welding (GTAW), gas metal arc welding (GMAW), submerged arc welding (SAW), electroslag strip cladding (ESW) and plasma arc welding (PAW). SAW, ESW, and PAW are quite specialized, and the supplier of the filler metals should be consulted for recommendations concerning their use. General suggestions are given below for the other two processes.

**A6.2** Before welding or heating any nickel-base alloy, the base metal must be clean. Oil, grease, paint, lubricants, marking pencils, temperature indicating materials, threading compounds, and other such materials frequently contain sulfur or lead that may cause cracking (embrittlement) of the base metal or the weld metal if present during welding or heating.

**A6.3** For GTAW, direct current–electrode negative (dcen) is used. Either argon or helium (or a combination of the two) are used as a shielding gas.

**A6.4** For GMAW, direct current–electrode positive (dcep) is often employed. Argon shielding gas is often used, but mixtures of argon and helium are also commonly used.

## A7. Description and Intended Use of Electrodes and Rods

### A7.1 ERNi-X Classification

**A7.1.1 ERNi-1.** The nominal composition (wt %) of filler metal of this classification is 96 Ni and 3 Ti. Filler metal of this classification is intended for welding wrought and cast forms of commercially pure nickel alloy (ASTM B160, B161, B162, and B163 having UNS number N02200 or N02201) to itself using the GTAW, GMAW, SAW, and PAW processes. The filler metal contains sufficient titanium to control weld-metal porosity with these welding processes.

### A7.2 ERNiCrCo-X Classification

**A7.2.1 ERNiCrCo-1.** *The nominal composition (wt %) of filler metal of this classification is 45 Ni, 25 Cr, 20 Co, 2 Nb, and 1 Ti. Filler metal of this classification is used for welding nickel-chromium-cobalt alloy (UNS N07740) for power boiler and coal ash applications to itself, to steels, and to weld overlay steels using the GTAW and GMAW processes. The weld metal will age harden on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature. The alloy is resistant to oxidation, sulfidation, chlorination, and coal ash corrosion environments.*

### A7.3 ERNiCu-X Classifications

**A7.3.1 ERNiCu-7.** The nominal composition (wt %) of filler metal of this classification is 65 Ni, 30 Cu, 3 Mn, and 2 Ti. Filler metal of this classification is used for welding nickel-copper alloy (ASTM B127, B163, B164, and B165 having UNS number N04400) to itself using the GTAW, GMAW, SAW, and PAW processes. The filler metal contains sufficient titanium to control porosity with these welding processes.

**A7.3.2 ERNiCu-8.** The nominal composition (wt %) of filler metal of this classification is 66 Ni, 29 Cu, 3 Al, 1 Fe, and 0.5 Ti. Filler metal of this classification is used for welding age-hardening nickel-copper alloy (ASTM F467 and F468 having UNS number N05500) to itself using the GTAW, GMAW, SAW, and PAW processes. The filler metal will age harden on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature.

### A7.4 ERNiCr-X Classifications

**A7.4.1 ERNiCr-3.** The nominal composition (wt %) of filler metal of this classification is 72 Ni, 20 Cr, 3 Mn, and 2.5 Nb plus Ta. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06600) to itself, for the clad side of joints in steel clad with nickel-chromium-iron alloy, for surfacing steel with nickel-chromium-iron weld metal, for dissimilar welding of nickel-base alloys, and for joining steel to stainless steel or nickel-base alloys using the GTAW, GMAW, SAW, and PAW processes.

**A7.4.2 ERNiCr-4.** The nominal composition (wt %) of filler metal of this classification is 55 Ni and 44 Cr. Filler metal of this classification is used for GTAW of 50/50 nickel/chromium alloy, cladding nickel/chromium alloy onto nickel-iron-chromium tubing, and casting repair. The filler metal is resistant to high-temperature corrosion, including fuel-ash corrosion in atmospheres containing sulfur and vanadium.

**A7.4.3 ERNiCr-6.** The nominal composition (wt %) of filler metal of this classification is 78 Ni, 20 Cr, 1 Fe, and 0.4 Ti. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06600) to itself, for the clad side of joints in steel clad with nickel-chromium-iron alloy, for surfacing steel with nickel-chromium-iron weld metal, and for joining steel to nickel-base alloys using the GTAW, GMAW, SAW, and PAW processes.

**A7.4.4 ERNiCr-7.** The nominal composition (wt %) of filler metal of this classification is 60 Ni, 37.5 Cr, 0.95 Al, and 0.6 Nb plus Ta. Filler metal of this classification is used for the overlay cladding of ferrous materials used in high temperature applications, and the welding of nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06690) to itself, and to steels using the GTAW, GMAW, SAW, ESW, and PAW processes. Welds made with this composition are particularly resistant to high temperature oxidation, carburization, and sulfidation.

## A7.5 ERNiCrCoMo-X Classifications

**A7.5.1 ERNiCrCoMo-1.** The nominal composition (wt %) of filler metal of this classification is 53 Ni, 23 Cr, 12 Co, 9 Mo, and 1 Fe. Filler metal of this classification is used for welding nickel-chromium-cobalt-molybdenum alloy (UNS number N06617) to itself using the GTAW and GMAW processes.

**A7.5.2 ERNiCrCoMo-2.** *The nominal composition (wt %) of filler metal of this classification is 57 Ni, 19.5 Cr, 10 Co, 8.5 Mo, 2.1 Ti, and 1.5 Al. Filler metal of this classification is used for welding nickel-chromium-cobalt-molybdenum alloy to itself (UNS N07208) and for welding other solid-solution strengthened and precipitation-strengthened nickel base alloys using the GTAW and GMAW processes. The weld metal will age harden on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature.*

## A7.6 ERNiCrFe-X Classifications

**A7.6.1 ERNiCrFe-5.** The nominal composition (wt %) of filler metal of this classification is 74 Ni, 16 Cr, 8 Fe, and 2 Nb plus Ta. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06600) to itself using the GTAW, GMAW, SAW, and PAW processes. The higher niobium content of the filler metal is intended to minimize cracking where high welding stresses are encountered, as in thick-section base metal.

**A7.6.2 ERNiCrFe-6.** The nominal composition (wt %) of filler metal of this classification is 71 Ni, 16 Cr, 6 Fe, 3 Ti, and 2.5 Mn. Filler metal of this classification is used for cladding steel with nickel-chromium-iron weld metal and for joining steel to nickel-base alloys using the GTAW, GMAW, SAW, and PAW processes. The filler metal will age harden on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature.

**A7.6.3 ERNiCrFe-7.** The nominal composition (wt %) of filler metal of this classification is 60 Ni, 29 Cr, and 9 Fe. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06690) to itself, to steels, to overlay on steels, and to weld steels clad with the nickel-chromium-iron alloys using the GTAW, GMAW, SAW, and PAW processes.

**A7.6.4 ERNiCrFe-7A.** The nominal composition (wt %) of filler metal of this classification is 60 Ni, 29 Cr, 9 Fe, and 0.75 Nb plus Ta. Filler metal of this composition is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06690) to itself, to steels, and to weld overlay steels using the GTAW, GMAW, SAW, ESW, and PAW processes. Welds made with this composition are particularly resistant to ductility-dip-cracking (DDC), and oxide inclusions.

**A7.6.5 ERNiCrFe-8.** The nominal composition (wt %) of filler metal of this classification is 73 Ni, 15.5 Cr, 7 Fe, 2.4 Ti, 1 Nb, and 0.7 Al. Filler metal of this classification is used for cladding steel with nickel-chromium-iron weld metal and for joining steel to nickel-base alloys using the GTAW, GMAW, SAW, and PAW processes. The weld metal will age harden on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature.

**A7.6.6 ERNiCrFe-11.** The nominal composition (wt %) of filler metal of this classification is 61 Ni, 23 Cr, 14 Fe, and 1.4 Al. Filler metal of this classification is used for welding nickel-chromium-iron-aluminum alloy (ASTM B166, B167, and B168 having UNS number N06601) to itself and to other high-temperature compositions using the GTAW process. It is used for severe applications where the exposure temperature can exceed 2100°F [1150°C].

**A7.6.7 ERNiCrFe-12.** The nominal composition (wt %) of filler metal of this classification is 63 Ni, 25 Cr, 9.5 Fe, and 2.1 Al. Filler metal of this classification is used for welding UNS number N06025, welding nickel-chromium-iron to steel and to other nickel base alloys. The ASTM specifications for UNS number N06025 are B163, B166, B167, B168, B366, B516, B517, B546, and B564.

**A7.6.8 ERNiCrFe-13.** The nominal composition (wt %) of filler metal of this classification is 55 Ni, 30 Cr, 8 Fe, 4 Mo, and 3 Nb plus Ta. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, and B168 having UNS number N06690) to itself, to steels, and to weld overlay steels using the GTAW, GMAW, SAW, ESW, and PAW processes. Welds made with this composition are particularly resistant to ductility-dip-cracking (DDC) and oxide inclusions.

**A7.6.9 ERNiCrFe-14.** The nominal composition (wt %) of filler metal of this classification is 57 Ni, 30 Cr, 9 Fe, and 1.8 Nb plus Ta. Filler metal of this classification is used to produce nickel-chromium-iron weld overlays on steel comparable to UNS number N06690. Weld deposits made with this composition are particularly resistant to ductility-dip-cracking (DDC), especially in the case of wire/flux combination.

**A7.6.10 ERNiCrFe-15.** *The nominal composition (wt %) of filler metal of this classification is 63 Ni, 27 Cr, 3 Mn, 2.4 Nb plus Ta, 2.0 Fe, and 0.25 Ti. Filler metal of this classification is used for welding nickel-chromium-iron alloy 690 (ASTM B163, B166, B167, B168, and B564 having UNS number N06690) to itself, to steels, and to weld overlay steels in nuclear pressure vessel applications. It also shows excellent resistance to primary water stress corrosion cracking (PWSCC) in intended service conditions (similar to the base metal UNS N06690).*

#### **A7.7 ERNiCrFeSi-X Classification**

**A7.7.1 ERNiCrFeSi-1.** The nominal composition (wt %) of filler metal of this classification is 46 Ni, 28 Cr, 23 Fe, and 2.75 Si. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B163, B166, B167, B168, B366, B516, B517, B546 and B564 having UNS number N06045) to itself, to steel, and to other nickel base alloys.

#### **A7.8 ERNiCrFeAl-X Classification**

**A7.8.1 ERNiCrFeAl-1.** The nominal composition (wt %) of filler metal of this classification is 59 Ni, 29 Cr, 4 Fe, and 3 Al. Filler metal of this classification is used for welding nickel-chromium-iron alloy (ASTM B166, B167, and B168 having UNS number N06693) to itself, to steels, and to weld overlay steels using the GTAW and GMAW processes. Welds made with this composition are particularly resistant to metal dusting in chemical and petrochemical applications. The alloy is resistant to carburization, sulfidation, and other high temperature corrosion forms.

#### **A7.9 ERNiFeCr-X Classifications**

**A7.9.1 ERNiFeCr-1.** The nominal composition (wt %) of filler metal of this classification is 42 Ni, 30 Fe, 21 Cr, 3 Mo, and 2 Cu. Filler metal of this classification is used for welding the nickel-iron-chromium-molybdenum-copper alloy (ASTM B423 having UNS number N08825) to itself using the GTAW and GMAW processes.

**A7.9.2 ERNiFeCr-2.** The nominal composition (wt %) of filler metal of this classification is 52 Ni, 18 Fe, 19 Cr, 5 Nb plus Ta, 3 Mo, and 1 Ti. Filler metal of this classification is used for welding nickel-chromium-niobium-molybdenum alloy (ASTM B637 and AMS 5589 having UNS number N07718) to itself using the GTAW process. The weld metal will age harden on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature.

**A7.9.3 ERNiFeCr-3.** *The nominal composition (wt %) of filler metal of this classification is 47 Ni, 23 Fe, 20.5 Cr, 2 Cu, 3 Nb, 3.2 Mo, and 1.5 Ti. Filler metal of this classification is used for welding nickel-iron-chromium alloy approved by NACE MR0175/ISO-15156-3 for oil and gas applications (having UNS number N09945 or N09946) to itself, to steels, and to weld overlay steels using the GTAW and GMAW processes. The weld metal will age harden on heat treatment. For specific information concerning age hardening consult the supplier or the supplier's technical literature. The alloy is resistant to sulfide-induced stress corrosion cracking and stress cracking in hydrogen sulfide environments.*

#### **A7.10 ERNiMo-X Classifications**

**A7.10.1 ERNiMo-1.** The nominal composition (wt %) of filler metal of this classification is 66 Ni, 28 Mo, and 5.5 Fe. Filler metal of this classification is used for welding nickel-molybdenum alloy (ASTM B333 having UNS number N10001) to itself using the GTAW and GMAW processes.

**A7.10.2 ERNiMo-2.** The nominal composition (wt %) of filler metal of this classification is 71 Ni, 16 Mo, 7 Cr, and 3 Fe. Filler metal of this classification is used for welding nickel-molybdenum alloy (ASTM B366, B434, and B573 having UNS number N10003) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-molybdenum weld metal using the GTAW and GMAW processes.

**A7.10.3 ERNiMo-3.** The nominal composition (wt %) of filler metal of this classification is 63 Ni, 24 Mo, 6 Fe, and 5 Cr. Filler metal of this classification is used for weld repair of various nickel-, cobalt-, and iron-base alloys and for dissimilar joining applications of nickel, cobalt, and iron base alloys.

**A7.10.4 ERNiMo-7.** The nominal composition (wt %) of filler metal of this classification is 69 Ni and 28 Mo. Filler metal of this classification is used for welding nickel-molybdenum alloy (ASTM B333 and B335 having UNS number N10665) to itself and for cladding steel with nickel-molybdenum weld metal using the GTAW and GMAW processes.

**A7.10.5 ERNiMo-8.** The nominal composition (wt %) of filler metal of this classification is 70 Ni, 19 Mo, 5 Fe, 3 W, and 2 Cr. Filler metal of this classification is used for welding 9% nickel steel (ASTM A333, A334, A353, and A553 having UNS number K81340) to itself using the GTAW and SAW processes.

**A7.10.6 ERNiMo-9.** The nominal composition (wt %) of filler metal of this classification is 70 Ni, 20 Mo, 1 Fe, and 3 W. Filler metal of this classification is used for welding 9% nickel steel (ASTM A333, A334, A353, and A553 having UNS number K81340) to itself using the GTAW and SAW processes.

**A7.10.7 ERNiMo-10.** The nominal composition (wt %) of filler metal of this classification is 68 Ni, 28.5 Mo, 1.5 Cr, 1.5 Fe, and low carbon. Filler metal of this classification is used for welding nickel-molybdenum alloy (ASTM B333, B335, B366, B564, B619, B622, and B626 having UNS number N10675) to itself, for welding the clad side of joints in steel clad with nickel-molybdenum alloy, and for welding nickel-molybdenum alloys to steel and to other nickel-base alloys using the GTAW, GMAW, and PAW processes.

**A7.10.8 ERNiMo-11.** The nominal composition (wt %) of filler metal of this classification is 67 Ni, 28 Mo, 3 Fe, 1.3 Cr, and low carbon. Filler metal of this classification is used for welding nickel-molybdenum alloy (ASTM B333, B335, B366, B564, B619, B622, and B626 having UNS number N10629) to itself, for welding the clad side of joints clad with nickel-molybdenum alloy, and for welding nickel-molybdenum alloys to steel and other nickel-base alloys using the GTAW, GMAW, and PAW processes.

**A7.10.9 ERNiMo-12.** The nominal composition (wt %) of filler metal of this classification is 65 Ni, 25 Mo, and 8 Cr. Filler metal of this classification is used for welding nickel-molybdenum alloy (ASTM B366, B434, B564, B619, B622, and B626 having UNS number N10242) to itself and for cladding steel with nickel-molybdenum weld metal using the GTAW and GMAW processes.

#### **A7.11 ERNiMoCr-X Classification**

**A7.11.1 ERNiMoCr-1.** *The nominal composition (wt %) of filler metal of this classification is 62 Ni, 22 Mo, and 15 Cr. Filler metal of this classification is used for welding nickel-molybdenum-chromium alloy (ASTM B366, B462, B564, B575, B619, B622, and B626 having UNS number N10362) to itself and for cladding steel with nickel-molybdenum-chromium weld metal using the GTAW and GMAW processes.*

#### **A7.12 ERNiCrMo-X Classifications**

**A7.12.1 ERNiCrMo-1.** The nominal composition (wt %) of filler metal of this classification is 44 Ni, 22 Cr, 20 Fe, 6.5 Mo, 2 Nb plus Ta, 2 Cu, and 1.5 Mn. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B581 and B582 having UNS number N06007) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.2 ERNiCrMo-2.** The nominal composition (wt %) of filler metal of this classification is 47 Ni, 22 Cr, 18 Fe, 9 Mo, and 1.5 Co. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B366, B435, and B572 having UNS number N06002) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.3 ERNiCrMo-3.** The nominal composition (wt %) of filler metal of this classification is 61 Ni, 22 Cr, 9 Mo, and 3.5 Nb plus Ta. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B443, B444, and B446 having UNS number N06625) to itself, to steel, to other nickel-base alloys, for cladding steel with nickel-chromium-molybdenum weld metal, and for welding the clad side of joints in steel with nickel-chromium-molybdenum alloy using the GTAW, GMAW, SAW, and PAW processes. This filler metal is recommended for applications where the operating temperature ranges from cryogenic to 1000°F [540°C].

**A7.12.4 ERNiCrMo-4.** The nominal composition (wt %) of filler metal of this classification is 57 Ni, 16 Cr, 15.5 Mo, 5.5 Fe, and 4 W. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B574, B575, B619, B622, and B628 having UNS number N10276) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW and GMAW processes.



**A7.12.5 ERNiCrMo-7.** The nominal composition (wt %) of filler metal of this classification is 65 Ni, 16 Cr, 15.5 Mo, and 2 Fe. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B574, B575, B619, B622, and B 628 having UNS number N06455) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.6 ERNiCrMo-8.** The nominal composition (wt %) of filler metal of this classification is 50 Ni, 25 Cr, 17 Fe, 6 Mo, and 1 Cu. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B581, B582, B619, B622, and B626 having UNS number N06975) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.7 ERNiCrMo-9.** The nominal composition (wt %) of filler metal of this classification is 44 Ni, 22 Cr, 20 Fe, 7 Mo, 2 Co, and 2 Cu. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B581, B582, B619, B622, and B626 having UNS number N06007 or N06985) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.8 ERNiCrMo-10.** The nominal composition (wt %) of filler metal of this classification is 56 Ni, 22 Cr, 13 Mo, 4 Fe, and 3 W. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B574, B575, B619, B622 and B628 having UNS number N06022) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.9 ERNiCrMo-11.** The nominal composition (wt %) of filler metal of this classification is 43 Ni, 30 Cr, 15 Fe, 5 Mo, 2 Co, 3 W, and 2 Cu. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B581, B582, B619, B622, and B626 having UNS number N06030) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.10 ERNiCrMo-13.** The nominal composition (wt %) of filler metal of this classification is 59 Ni, 23 Cr, 16 Mo, 1 Fe, and low carbon. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (B564, B574, B575, B619, B622, and B626 having UNS number N06059) to itself, to steel, to other nickel-base alloys, and for cladding steel using the GTAW, GMAW, SAW, and PAW processes.

**A7.12.11 ERNiCrMo-14.** The nominal composition (wt %) of the filler metal of this classification is 57 Ni, 21 Cr, 16 Mo, and 4 W. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B574, B575, B619, B622, and B628 having UNS number N06686) to itself, to steel, to other nickel-base alloys, and for cladding steel using the GTAW, GMAW, and SAW processes.

**A7.12.12 ERNiCrMo-15.** The nominal composition (wt %) of filler metal of this classification is 57 Ni, 21 Cr, 8 Mo, 7 Fe, 3 Nb plus Ta, and 1.4 Ti. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B805, UNS number N07725) to itself and for cladding steel using the GMAW and GTAW processes. The weld metal age hardens on heat treatment. For specific information concerning age hardening, consult the supplier or the supplier's technical literature.

**A7.12.13 ERNiCrMo-16.** The nominal composition (wt %) of filler metal of this classification is 60 Ni, 30 Cr, and 10 Mo. Filler metal of this classification is used for corrosion-resistant (especially excellent to crevice corrosion) overlaying by the GTAW, GMAW, and PAW processes.

**A7.12.14 ERNiCrMo-17.** The nominal composition (wt %) of filler metal of this classification is 59 Ni, 23 Cr, 16 Mo, and 1.6 Cu. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B574, B575, B619, B622 and B629 having UNS number N06200) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.15 ERNiCrMo-18.** The nominal composition (wt %) of filler metal of this classification is 50 Ni, 20 Cr, 11.5 Mo, 14 Fe, and 1.5 W. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloys having UNS number N06650 to itself, to steel, to super-austenitic stainless steels, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.16 ERNiCrMo-19.** The nominal composition (wt %) of filler metal of this classification is 58 Ni, 21 Cr, 20 Mo, and 1 Fe. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B574, B575, B366, B564, B619, B622, and B626 having UNS N06058) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.17 ERNiCrMo-20.** The nominal composition (wt %) of filler metal of this classification is 64 Ni, 22 Cr, and 9 Mo (niobium free). The properties of this filler metal are suitable to weld super duplex stainless steels for low-temperature applications with high impact toughness. Filler metal of this composition is used for welding of nickel-chromium-molybdenum alloys of similar composition as well as for cladding using GTAW, GMAW, SAW, and PAW processes.

**A7.12.18 ERNiCrMo-21.** The nominal composition (wt %) of filler metal of this classification is 55 Ni, 25 Cr, 15 Mo, and 1 Fe. Filler metal of this classification is used for welding of nickel-chromium-molybdenum alloys (ASTM B574, B575, B366, B564, B619, B622 and B626 having UNS number N06205) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW, GMAW, and PAW processes.

**A7.12.19 ERNiCrMo-22.** The nominal composition (wt %) of filler metal of this classification is 58 Ni, 33 Cr, and 8 Mo. Filler metal of this classification is used for welding nickel-chromium-molybdenum alloy (ASTM B366, B434, B564, B619, B622, and B626 having UNS number N06035) to itself and for cladding steel with nickel-chromium-molybdenum weld metal using the GTAW and GMAW processes.

### **A7.13 ERNiCrMoWNb-X Classification**

**A7.13.1 ERNiCrMoWNb-1** *The nominal composition (wt %) of filler metal of this classification is 60 Ni, 20 Cr, 7 Mo, 6 W, 3.5 Nb, and 1.5 Ti. Filler metal of this classification is used for welding high strength steel materials for oil and gas applications to themselves, to dissimilar metals, and to weld overlay steels using the GTAW and GMAW processes. The alloy is resistant to sulfide-induced stress corrosion cracking and stress cracking in hydrogen sulfide environments.*

### **A7.14 ERNiCoCrSi-X Classification**

**A7.14.1 ERNiCoCrSi-1.** The nominal composition (wt %) of filler metal of this classification is 38 Ni, 30 Co, 28 Cr, 2.8 Si and 1 Fe. Filler metal of this classification is used for welding nickel-cobalt-chromium-silicon alloy (ASTM B435, B572, B619 and B626 having UNS number N12160) to itself using the GTAW, GMAW, and PAW processes. This alloy is sensitive to iron pick-up; therefore its use is not recommended for the welding of the nickel-cobalt-chromium-silicon alloy to iron-base alloys.

### **A7.15 ERNiCrWMo-X Classification**

**A7.15.1 ERNiCrWMo-1.** The nominal composition (wt %) of filler metal of this classification is 57 Ni, 22 Cr, 14 W, 2 Co, 2 Fe, and 2 Mo. Filler metal of this classification is used for welding nickel-chromium-tungsten-molybdenum-lanthanum alloy (ASTM B366, B435, B564, and B572 having UNS number N06230) to itself using the GTAW and GMAW processes.

## **A8. Special Tests**

It is recognized that supplementary tests may be required for certain applications. In such cases, tests to determine specific properties such as corrosion resistance, scaling resistance, or strength at elevated or cryogenic temperatures may be required. AWS A5.01M/A5.01 (ISO 14344 MOD) contains provisions for ordering such tests. This clause is included to give guidance to those who desire to specify such special tests. Those tests shall be conducted as agreed upon between the purchaser and supplier.

**A8.1 Corrosion or Scaling Tests.** Although welds made with electrodes and rods classified in this specification are commonly used in corrosion and heat-resisting applications, tests for those properties are not included in the specification. When required for a particular application, testing can be conducted on specimens taken from either a weld pad or a welded joint.

**A8.1.1** Specimens from a joint are suitable for qualifying the welding procedure (for a specific application involving corrosion or oxidation resistance), but not for qualifying the filler metal. Tests on specimens from a joint have the disadvantage of being a combined test of the properties of the weld metal, the heat-affected zone (HAZ), and the unaffected base metal. With such specimens, it is more difficult to obtain reproducible data (when a difference exists in the properties of the metal in the various parts of the specimen). Specimens taken from a joint do have the advantage of being able to duplicate the joint design and the welding sequence planned for fabrication.