## Contents

1. Scope .......................................................... 1

   **PART A: GENERAL INFORMATION**

2. Provisions ..................................................... 1
   2.1 Acceptance ............................................. 1
   2.2 Certification ......................................... 1
   2.3 Ventilation During Welding ......................... 1
   2.4 Burn Protection ....................................... 1
   2.5 Electrical Hazards .................................... 2
   2.6 Fumes and Gases ...................................... 2
   2.7 Radiation ............................................... 3

   **PART B: CARBON AND LOW-ALLOY STEELS**

3. Guide to Classification of Carbon and Low ... 4
   Alloy Steel Rods for Oxyfuel Gas Welding
   3.1 Provisions ............................................. 4
   3.2 Introduction .......................................... 4
   3.3 Classification System ................................. 4
   3.4 Welding Considerations ............................... 4
   3.5 Description and Intended Use of Carbon ......... 4
     and Low-Alloy Steel Rods

4. Guide to Classification of Carbon Steel ....... 5
   Electrodes for Shielded Metal Arc Welding
   4.1 Provisions ............................................. 5
   4.2 Introduction .......................................... 5
   4.3 Classification System ................................. 5
   4.4 Welding Considerations ............................... 5
   4.5 Electrode Covering Moisture Content and ....... 6
     Conditioning
   4.6 Coverings ............................................. 6
   4.7 Description and Intended Use of Electrodes .... 7

5. Guide to Classification of Low-Alloy Steel ... 11
   Covered Arc Welding Electrodes
   5.1 Provisions ............................................. 11
   5.2 Introduction .......................................... 11
   5.3 Method of Classification ............................ 11
   5.4 Welding Procedure ................................... 11
   5.5 Classification Tests ................................ 12
   5.6 Electrode Coating Moisture Content and ....... 12
     Conditioning
   5.7 Coverings ............................................. 13
   5.8 Description and Intended Use of Electrodes .... 13

   Filler Metals for Gas Shielded Arc Welding
   6.1 Provisions ............................................. 13
   6.2 Introduction .......................................... 13
   6.3 Classification System ................................. 13
   6.4 Description and Intended Use ...................... 13
   6.5 Welding Considerations ............................... 14

7. Guide to Classification of Low-Alloy Steel ... 15
   Filler Metals for Gas Shielded Arc Welding
   7.1 Provisions ............................................. 15
   7.2 Introduction .......................................... 15
   7.3 Classification System ................................. 15
   7.4 Description and Intended Use ...................... 15
   7.5 Welding Considerations ............................... 16

8. Guide to Classification of Carbon Steel ....... 17
   Electrodes for Flux Cored Arc Welding
   8.1 Provisions ............................................. 17
   8.2 Introduction .......................................... 17
   8.3 Method of Classification ............................ 17
   8.4 Welding Procedure ................................... 18
   8.5 Description and Intended Use ...................... 18

9. Guide to AWS Classification of Low-Alloy ... 19
   Steel Electrodes for Flux Cored Arc Welding
   9.1 Provisions ............................................. 19
   9.2 Method of Classification ............................ 19
   9.3 Welding Procedures .................................. 20
   9.4 Description and Intended Use ...................... 20

10. Guide to Carbon Steel Electrodes and ....... 21
    Fluxes for Submerged Arc Welding
   10.1 Provisions .......................................... 21
   10.2 Introduction .......................................... 21
   10.3 Classification System ............................... 21
   10.4 Welding Considerations ............................. 22

    Steel Electrodes and Fluxes for Submerged Arc Welding
   11.1 Provisions .......................................... 24
   11.2 Introduction .......................................... 24
   11.3 Classification System ............................... 24
   11.4 Welding Considerations ............................. 25

12. Guide to Classification of Carbon and Low ... 28
    Alloy Steel Electrodes and Fluxes for Electroslag Welding
   12.1 Provisions .......................................... 28
   12.2 Introduction .......................................... 28
   12.3 Classification System ............................... 28
   12.4 Definition and General Description ............. 29

13. Guide to Classification of Carbon and Low ... 30
    Alloy Steel Electrodes for Electrogas Welding
   13.1 Provisions .......................................... 30
   13.2 Introduction .......................................... 30
   13.3 Classification System ............................... 30
   13.4 Description and Intended Use ...................... 31
# PART C: STAINLESS STEEL

14. Guide to Classification of Stainless Steel for Shielded Metal Arc Welding
   14.1 Provisions .................................................. 31
   14.2 Introduction ................................................ 31
   14.3 Classification System ..................................... 31
   14.4 Ferrite in Weld Deposits ................................ 32
   14.5 Description and Intended Use of Filler Metals .... 32
   14.6 Classification as to Usability ............................. 37
   14.7 Special Tests ................................................. 38

15. Guide to Classification of Bare Stainless Steel Welding Electrodes and Rods
   15.1 Provisions .................................................. 38
   15.2 Introduction ................................................ 38
   15.3 Classification System ..................................... 38
   15.4 Preparation of Samples for Chemical Analysis .... 38
   15.5 Ferrite in Weld Deposits ................................ 39
   15.6 Description and Intended Use of Filler Metals .... 40
   15.7 Usability ..................................................... 46

   16.1 Provisions .................................................. 46
   16.2 Introduction ................................................ 46
   16.3 Method of Classification ................................ 47
   16.4 Ferrite in Weld Deposits ................................ 47
   16.5 Consideration of Chemical Requirements .......... 48
   16.6 Classification According to Composition ............ 49

# PART D: ALUMINUM AND ALUMINUM ALLOY

17. Guide to Classification of Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
   17.1 Provisions .................................................. 51
   17.2 Introduction ................................................ 51
   17.3 Classification System ..................................... 51
   17.4 Welding Considerations ................................ 51
   17.5 Description and Intended Use of Electrodes ........ 52

18. Guide to Classification of Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
   18.1 Provisions .................................................. 52
   18.2 Introduction ................................................ 52
   18.3 Classification System ..................................... 52
   18.4 Welding Considerations ................................ 53
   18.5 Description and Intended Use of Aluminum Electrodes and Rods ........................................... 54

# PART E: COPPER AND COPPER ALLOY

19. Guide to Classification of Copper and Copper Alloy Arc Welding Electrodes
   19.1 Provisions .................................................. 56
   19.2 Introduction ................................................ 56
   19.3 Method of Identification ................................ 56
   19.4 Description and Intended Use of Filler Metal .... 56

20. Guide to Classification of Copper and Copper Alloy Bare Welding Rods and Electrodes
   20.1 Provisions .................................................. 57
   20.2 Introduction ................................................ 57
   20.3 Method of Classification ................................ 57
   20.4 Description and Intended Use of the Welding ... 58

# PART F: NICKEL AND NICKEL ALLOY

   21.1 Provisions .................................................. 58
   21.2 Introduction ................................................ 58
   21.3 Classification System ..................................... 58
   21.4 Welding Considerations ................................ 59
   21.5 Description and Intended Use of Electrodes ...... 59

22. Guide to Classification of Nickel and Nickel Alloy Bare Welding Electrodes and Rods
   22.1 Provisions .................................................. 61
   22.2 Introduction ................................................ 61
   22.3 Classification System ..................................... 61
   22.4 Welding Considerations ................................ 62
   22.5 Description and Intended Use of Electrodes ...... 62

# PART G: CAST IRON

   23.1 Provisions .................................................. 64
   23.2 Introduction ................................................ 64
   23.3 Classification System ..................................... 64
   23.4 Welding Considerations ................................ 64
   23.5 Description and Intended Use of Electrodes ...... 66
   23.6 Postweld Heat Treatment ................................ 68
AWS User’s Guide to Filler Metals

1. Scope

This document contains information on the many different types of filler materials available to industry. Welding considerations and intended applications for the various materials are provided to assist the user. The information has been extracted directly from 30 AWS filler material standards, and it is recommended that the user reference these documents for additional information.

Part A: General Information


Each of the AWS filler material specifications contain sections that establish provisions for material acceptance and certification, as well as safety considerations. Because this information is necessary for the proper application of all filler materials, these sections are included in this guide.

2.1 Acceptance. Acceptance of all welding materials is in accordance with ANSI/AWS A5.01, Filler Metal Procurement Guidelines, as the specification states. Any testing a purchaser requires of the supplier, for material shipped in accordance with the specification, shall be clearly stated in the purchase order according to the provisions of ANSI/AWS A5.01. In the absence of any such statement in the purchase order, the supplier may ship the material with whatever testing is normally conducted on material of the same classification, as specified in Schedule F, Table 1, of ANSI/AWS A5.01. Testing in accordance with any other schedule in that table shall be specifically required by the purchase order. In such cases, acceptance of the material shipped shall be in accordance with those requirements.

2.2 Certification. The act of placing the AWS specification and classification designations on the product packaging, or placing 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 tested material met the requirements of the specification. Representative material, in this case, is any production run of that classification using the same formulation.

“Certification” is not to be construed to mean that tests of any kind were necessarily conducted on samples of the specific material shipped. Tests on such material may or may not have been conducted. The basis for the certification required by the specification is the classification test of “representative material” cited above, and the Manufacturer’s Quality Assurance Program in ANSI/AWS A5.01, Filler Metal Procurement Guidelines.

2.3 Ventilation During Welding. Five major factors govern the quantity of fumes in the atmosphere to which welders and welding operators are exposed during welding; they are:

(1) the dimensions of the space in which welding is performed (with special regard to the height of the ceiling);
(2) the number of welders and welding operators working in that space;
(3) the rate of evolution of fumes, gases, or dust, according to the materials and processes used;
(4) the proximity of the welders or welding operators to the fumes as they issue from the welding zone, and to the gases and dusts in the space in which they are working; and
(5) the ventilation provided to the space in which the welding is performed.

American National Standard Z49.1, Safety in Welding and Cutting (published by the American Welding Society), discusses the ventilation that is required during welding and should be referred to for details. Attention is drawn particularly to the section of that document on health protection and ventilation.

2.4 Burn Protection. Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting, and allied processes. These can cause burns if precautionary measures are not used. Workers should wear protective clothing made of fire-resistant material. Pant cuffs, open pockets, or other places on clothing that can catch and retain molten metal or sparks should not be worn. High-top shoes or leather leggings and fire-resistant gloves should be worn. Pant legs should be worn over the outside of high-top shoes. Helmets or hand shields that provide protection for the face, neck, and ears, and a head covering to protect the head should be used. In addition, appropriate eye protection should be used.

When welding overhead or in confined spaces, ear plugs to prevent weld spatter from entering the ear canal.