

Specification for Carbon and Low- Alloy Steel Rods for Oxyfuel Gas Welding



American Welding Society



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An American National Standard

Approved by the
American National Standards Institute
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Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding

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

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification prescribes the requirements for classification of carbon and low-alloy steel rods for oxyfuel gas welding. The classification requirements include the mechanical properties of the weld metal. Additional requirements are included for chemical composition of the rod and for manufacture, sizes, lengths, and packaging. A guide is appended to the specification as a source of information concerning the classification system employed and the intended use of the rods.

This specification makes use of both U.S. Customary Units and the International System of Units (SI). Since these are not equivalent, each system must be used independently of the other.



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Foreword

This foreword is not part of AWS A5.2/A5.2M:2007, *Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding*, but is included for informational purposes only.

This document is the first of the A5.2 specifications that makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are not exact equivalents; therefore, each system must be used independently of the other, without combining values in any way. In selecting rational metric units, AWS A1.1, *Metric Practice Guide for the Welding Industry*, and International Standard ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances, and markings*, are used where suitable. Tables and figures make use of both U.S. Customary and SI units, which, with the application of the specified tolerances, provides for interchangeability of products in both U.S. Customary and SI units.

The current document is the seventh revision of the initial joint ASTM/AWS document issued in 1942. As such, it is the second oldest document produced by the AWS A5 Committee on Filler Metals and Allied Materials. The first two revisions of the 1942 document were developed by the joint committee of the American Welding Society and the American Society for Testing and Materials. The 1969 revision was the first edition developed by the AWS A5 Committee on Filler Metals and Allied Materials. It was subsequently approved by the American National Standards Institute in 1973. *This revision adds the requirement for identification of individual rods as shown in italic font in Clause 15, Filler Metal Identification. In addition, this revision deleted the minimum tensile strength designators for 70, 80, and 90 ksi for the R(X)XX classification.* The evolution took place as follows:

ASTM A251-42T	<i>Tentative Specifications for Iron and Steel Gas Welding Rods</i>
AWS A5.2-42T	
ASTM A251-46T	<i>Tentative Specifications for Iron and Steel Gas Welding Rods</i>
AWS A5.2-46T	
ASTM A251-66T	<i>Tentative Specification for Iron and Steel Gas Welding Rods</i>
AWS A5.2-66T	
AWS A5.2-69	<i>Specification for Iron and Steel Gas Welding Rods</i>
ANSI W.3.2-1973	
ANSI/AWS A5.2-80	<i>Specification for Iron and Steel Oxyfuel Gas Welding Rods</i>
ANSI/AWS A5.2-88	<i>Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding</i>
ANSI/AWS A5.2-92	<i>Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding</i>

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

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Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding

1. Scope

1.1 This specification prescribes requirements for the classification of carbon and low-alloy steel rods for oxyfuel gas welding.

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

1.3 This specification makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are not exact equivalents; therefore, each system must be used independently of the other without combining in any way when referring to material properties. The specification designated A5.2 uses U.S. Customary Units. The specification designated A5.2M uses SI Units. The latter 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 A5.2 and A5.2M specifications.

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 agreements based on this AWS standard are encouraged to investigate the possibility of applying the most recent edition of the documents shown below. For undated references, the latest edition of the standard referred to applies.

2.2 The following AWS standards¹ are referenced in the normative clauses of this document:

(1) AWS A5.01, *Filler Metal Procurement Guidelines*

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

2.3 The following ANSI standard² is referenced in the normative clauses of this document:

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

2.4 The following ASTM standards³ are referenced in the normative clauses of this document:

(1) ASTM A 36/A 36M, *Standard Specification for Carbon Structural Steel*

(2) ASTM A 285/A 285M, *Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength*

(3) ASTM A 514/A 514M, *Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding*

(4) ASTM E 29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*

(5) ASTM E 350, *Standard Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron*

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

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

3. ASTM standards are published by the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

2.5 The following ISO standard⁴ is referenced in the normative clauses of this document:

(1) ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances, and markings*

3. Classification

3.1 The welding rods covered by this A5.2 specification utilize a classification system based on U.S. Customary Units and are classified according to the mechanical properties of the weld metal in the “as-welded” condition, as shown in Table 1.

3.1M The welding rods covered by this A5.2M specification utilize a classification system based on the International System of Units (SI) and are classified according to the mechanical properties of the weld metal in the “as-welded” condition, as shown in Table 1.

3.2 Welding rods classified under one classification shall not be classified under any other classification in this specification. A welding rod may be classified under both A5.2 and A5.2M providing it meets the requirements of both specifications.

3.3 The welding rods classified under this specification are intended for oxyfuel gas welding, but that is not to prohibit their use for any other process for which they are found suitable.

4. ISO standards are published by the International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland.

4. Acceptance

Acceptance⁵ of the welding rods shall be in accordance with the provisions of AWS A5.01.

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.⁶

6. Rounding-Off Procedure

For the purpose of determining conformance with this specification, an observed or calculated value shall be rounded to the nearest 1000 psi for tensile strength for A5.2, or to the nearest 10 MPa for tensile strength for A5.2M, and to the nearest unit in the last right-hand place of figures used in expressing the limiting values for other quantities in accordance with the rounding-off method given in ASTM E 29.

7. Summary of Tests

The tests required for each classification are specified in Table 2. The purpose of these tests is to determine the

5. See Annex Clause A3 for further information concerning acceptance, testing of the material shipped, and AWS A5.01.

6. See Annex Clause A4 for further information concerning certification and the testing called for to meet this requirement.

Table 1
Tension Test Requirements

AWS Classifications		Minimum Tensile Strength ^a		Elongation in 1 in [25 mm] Percent, Min.
A5.2	A5.2M	ksi	MPa	
R45	RM30	Not Specified	Not Specified	Not Specified
R60	RM40	60	400	20
R65	RM45	65	450	16
R100	RM69	100	690	14
R(X)XX-G ^b	RMXX-G ^c	(X)XX ^b	XX ^c	Not Specified

^a Specimens shall be tested in the as-welded condition.

^b For specification A5.2, classifications R(X)XX-G should be based on minimum tensile strength of all-weld-metal tension test of the test assembly, expressed in multiples of 1000 psi. These designators shall be limited to 45, 60, 65, and 100.

^c For specification A5.2M, classification RMXX-G shall be based on minimum tensile strength of all-weld-metal tension test of the test assembly, expressed in multiples of 10 MPa. These designators shall be limited to 30, 40, 45, and 69.

Table 2
Required Tests

AWS Classification		Chemical Analysis	Tension Test
A5.2	A5.2M		
R45	RM30	Required	Not required
R60	RM40	Required	Required
R65	RM45	Required	Required
R100	RM69	Required	Required
R(X)XX-G	RMXX-G	Not required	Required

chemical composition of the welding rod and the mechanical properties of the weld metal. The base metal for the preparation of test samples, the testing procedures to be employed, and the results required are given in Clauses 9 through 11.

8. Retest

If the results of any test fail to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens or samples for retest may be taken from the original test assembly or sample, or from a new test assembly or sample. For chemical analysis, the 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 specified or proper procedures were not followed in preparing the weld test assembly, or in conducting the test, the test shall be considered invalid, without regard to whether the test was actually completed, or whether the test results met, or failed to meet, the requirement. That test shall be repeated, following proper specified procedures. In this case, the requirement for doubling the number of test specimens does not apply.

9. Weld Test Assembly

9.1 Except for the R45 [RM30] classification, one weld test assembly is required. It is the groove weld for mechanical properties in Figure 1.

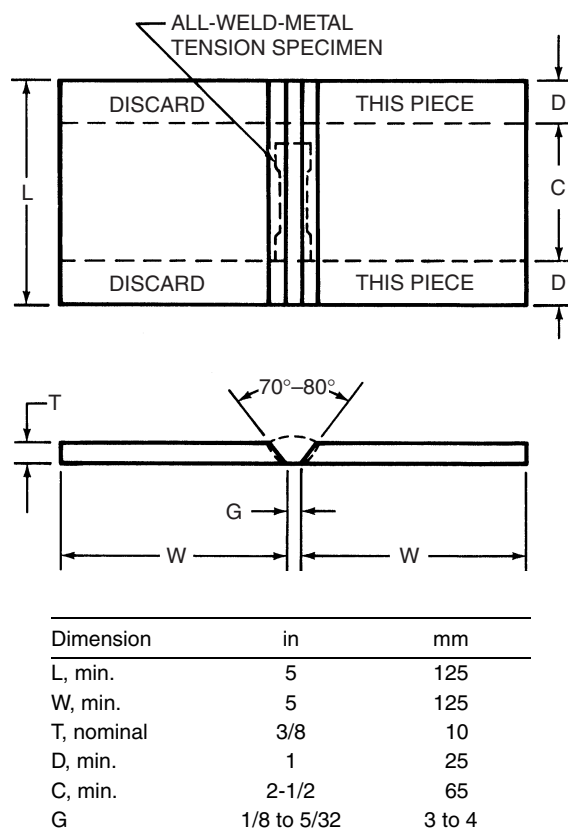


Figure 1—Groove Weld Test Assembly for Mechanical Properties

9.2 Preparation of the weld test assembly shall be as specified in Figure 1. The base metal for the assembly shall be as required in Table 3 and shall meet the requirements of the appropriate ASTM specification shown there or an equivalent specification. Testing of the assembly shall be as prescribed in Clause 11.

Table 3
Base Metal Required for Test Assemblies

AWS Classification		Base Metal		
A5.2	A5.2M	Type	ASTM Specification	UNS Number ^a
R60	RM40	Carbon Steel	A 36, A 285, grade C, or equivalent	K02600
R65	RM45	Carbon Steel	A 36, A 285, grade C, or equivalent	K02600
R100	RM69	Low-Alloy Steel	Any grade of A 514 or equivalent	K11630
R(X)XX-G	RMXX-G	Material shall have tensile strength and chemical composition similar to that of the rod being classified.		

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

9.3 A test assembly shall be prepared as specified in 9.2. It shall be preheated to between 60°F [15°C] and 200°F [95°C], and the assembly shall be welded using a 3/32 in or 1/8 in [2.5 mm or 3.2 mm] diameter welding rod, and using a maximum of five layers. No layer shall exceed 1/8 in [3 mm] in thickness. The filler metal shall be deposited using backhand welding with a neutral or slightly reducing flame. After welding each layer, the assembly shall be allowed to cool in still air until the interpass temperature drops below 350°F [180°C] before proceeding with the next layer. The joint shall be completely welded without treatment of the reverse side (root surface). Maximum weld reinforcement shall be 1/8 in [3 mm]. After the last pass has been completed, the assembly shall be allowed to cool in still air to ambient temperature. The assembly shall be tested in the as-welded condition.

10. Chemical Analysis

10.1 A sample of the welding rod or the rod stock from which it is made shall be prepared for chemical analysis. Welding rod, when analyzed for elements that are present in the coating (copper flashing, for example), shall be analyzed without removing the coating. When the welding rod is analyzed for elements other than those in the coating, the coating must be removed if its presence affects the results of the analysis for the other elements. Rod stock analyzed for elements not in the coating may be analyzed prior to applying the coating.

10.2 The sample shall be analyzed by accepted analytical methods. The referee method shall be ASTM E 350.

10.3 The results of the analysis shall meet the requirements of Table 4 for the classification of the rod under test.

11. Tension Test

11.1 One all-weld-metal tension test specimen, as specified in the Tension Test Clause of AWS B4.0 or B4.0M, shall be machined from the groove weld described in Clause 9 and shown in Figure 1. The all-weld-metal tension test specimen shall have a nominal diameter of 0.250 in [6.5 mm] and a nominal gage length-to-diameter ratio of 4:1.

11.2 The specimen shall be tested in the manner described in the Tension Test Clause of AWS B4.0 or B4.0M.

11.3 The results of the tension test shall meet the requirements specified in Table 1.

12. Method of Manufacture

The welding rods classified according to this specification may be manufactured by any method that will produce welding rods that meet the requirements of this specification.

13. Standard Sizes and Lengths

Standard sizes and lengths for welding rods shall be as shown in Table 5.

Table 4
Chemical Composition Requirements for Welding Rods and Rod Stock

AWS Classification		UNS Number ^a	Amount, Percent by Weight ^b									
A5.2	A5.2M		C	Mn	Si	P	S	Cu	Cr	Ni	Mo	Al
R45	RM30	K00045	0.08	0.50	0.10	0.035	0.040	0.30	0.20	0.30	0.20	0.02
R60	RM40	K00060	0.15	0.90 to 1.40	0.10 to 0.35	0.035	0.035	0.30	0.20	0.30	0.20	0.02
R65	RM45	K00065	0.15	0.90 to 1.60	0.10 to 0.70	0.035	0.035	0.30	0.40	0.30	0.20	0.02
R100	RM69	K12147	0.18 to 0.23	0.70 to 0.90	0.20 to 0.35	0.025	0.025	0.15	0.40 to 0.60	0.40 to 0.70	0.15 to 0.25	0.02
R(X)XX-G ^c	RMXX-G ^d		Not Specified									

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

^b Single values are maxima.

^c Designators "(X)XX" correspond to minimum tensile strength of weld metal in ksi (see Note b of Table 1).

^d Designators "XX" correspond to minimum tensile strength of weld metal in multiples of 10 MPa (see Note c of Table 1).

Table 5
Standard Filler Metal Sizes^a

Standard Package Form	Diameter			Tolerance	
	A5.2 (in)	A5.2M (mm)		in	mm
Straight lengths ^b	1/16	(0.062)	1.6	±0.002	±0.05
	3/32	(0.094)	2.4		
	—	(0.098)	2.5		
	1/8	(0.125)	3.2		
	5/32	(0.156)	4.0		
	3/16	(0.188)	4.8 ^c		
	—	(0.197)	5.0		
	—	(0.236)	6.0		
	1/4	(0.250)	6.4 ^c		

^a Other sizes may be supplied as agreed upon between the purchaser and supplier.

^b The standard length of the welding rod shall be 36 in +0, -1/2 in [900 mm +15 mm, -0 mm]. Other lengths may be supplied as agreed upon between the purchaser and supplier.

^c All sizes in mm are standard in ISO 544 except 4.8 mm and 6.4 mm.

14. Finish and Uniformity

14.1 All welding rods shall have a smooth finish that is free from slivers, depressions, scratches, scale, seams, laps, and foreign matter that would adversely affect the welding characteristics or the properties of the weld metal.

14.2 A suitable protective coating may be applied to any welding rod in this specification.

14.3 The welding rods may be coated with the minimum amount of oil necessary to prevent rusting, but not sufficient to adversely affect weld properties, except that oil

is not permitted when copper or other suitable coatings are used to prevent rusting.

15. Filler Metal Identification

Each bare straight length filler rod shall be durably marked with identification traceable to the unique product type of the manufacturer or supplier. Suitable methods of identification could include stamping, coining, embossing, imprinting, flag-tagging, or color coding. (If color coding is used, the choice of color shall be as

agreed upon between the purchaser and supplier, and the color shall be identified on the packaging.) When the AWS classification is used for identification, it shall be used in its entirety; for example, “R65” or “RM45” would be used for an R65 [RM45] welding rod. Additional identification shall be as agreed upon between the purchaser and supplier.

16. Packaging

Welding rods 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 designations (year of issue may be excluded)
- (2) Supplier’s name and trade designation
- (3) Size and net weight
- (4) Lot, control, or heat number

17.2 The appropriate precautionary information⁷ as given in ANSI Z49.1, latest edition (as a minimum), or its equivalent, shall be prominently displayed in legible print on all packages of welding rods, including individual unit packages enclosed within a larger package.

7. Typical examples of “warning labels” are shown in figures in ANSI Z49.1 for some common or specific consumables used with certain processes.

Annex A (Informative)

Guide to AWS Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding

This annex is not part of AWS A5.2/A5.2M:2007, *Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding*, but is included for informational purposes only.

A1. Introduction

The purpose of this guide is to correlate the rod classifications with their intended applications so the specification can be used effectively. Appropriate base metal specifications are referred to whenever that can be done and when it would be helpful. Such correlations are intended only as examples rather than complete listings of the materials for which each filler metal is suitable.

A2. Classification System

A2.1 The system for identifying the rod classifications in this specification follows the standard pattern used in other AWS filler metal specifications.

A2.2 The prefix “R [RM]” designates a rod. For A5.2, the numbers (45, 60, 65, and 100) indicate the required minimum tensile strength, as a multiple of 1000 psi, of the weld metal in a test weld made in accordance with specification A5.2. Similarly, for A5.2M, the numbers (30, 40, 45, and 69) indicate the required minimum tensile strength, as a multiple of 10 MPa, of the weld metal in a test weld made in accordance with specification A5.2M.

A2.3 “G” Classification

A2.3.1 This specification includes filler metals classified as R(X)XX-G [RMXX-G]. The “G” indicates that the filler metal is of a *general* classification. It is general because not all of the particular requirements specified for each of the other classifications are specified for this classification. The intent in establishing this classification is to provide a means by which filler metals that differ in one respect or another (chemical composition,

for example) from all other classifications (meaning that the composition of the filler metal, in the case of the example, does not meet the composition specified for any of the classifications in the specification) can still be classified according to the specification. The purpose is to allow a useful filler metal—one that otherwise would have to await a revision of the specification—to be classified immediately under the existing specification. This means, then, that two filler metals, each bearing the same “G” classification, may be quite different in some certain respect (chemical composition, again, for example).

A2.3.2 The point of difference (although not necessarily the amount of that difference) referred to above will be readily apparent from the use of the words *not required* and *not specified* in the specification. The use of these words is as follows:

Not Specified is used in those areas of the specification that refer to the results of some particular test. It indicates that the requirements for that test are not specified for that particular classification.

Not Required is used in those areas of the specification that refer to the test that must be conducted in order to classify a filler metal. It indicates that the test is not required because the requirements (results) for the test have not been specified for that particular classification.

Restating the case, when a requirement is not specified, it is not necessary to conduct the corresponding test in order to classify a filler metal to that classification. When a purchaser wants the information provided by that test in order to consider a particular product of that classification for a certain application, the purchaser will have to arrange for that information with the supplier of that product. The purchaser will also have to establish with

that supplier just what the testing procedure and the acceptance requirements are to be, for that test. They may want to incorporate that information (via AWS A5.01, *Filler Metal Procurement Guidelines*) in the purchase order.

A2.4 Request for Filler Metal Classification

(1) When a filler metal cannot be classified according to some classification other than a “G” classification, the manufacturer may request that a classification be established for that filler metal. The manufacturer may do this by following the procedure given here. When the manufacturer elects to use the “G” classification, the Committee on Filler Metals and Allied Materials recommends that the manufacturer still request that a classification be established for that filler metal, as long as the filler metal is of commercial significance.

(2) A request to establish a new filler metal classification must be a written request, and it needs to provide sufficient detail to permit the Committee on Filler Metals and Allied Materials or the Subcommittee to determine whether the new classification or the modification of an existing classification is more appropriate, and whether either is necessary to satisfy the need. In particular, the request needs to include:

(a) All classification requirements as given for existing classifications, such as, chemical composition ranges, mechanical property requirements, and usability test requirements.

(b) Any conditions for conducting the tests used to demonstrate that the product meets the classification requirements. (It would be sufficient, for example, to state that welding conditions are the same as for other classifications.)

(c) Information on Descriptions and Intended Use, which parallels that for existing classifications, for that clause of the Annex.

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) 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 shall:

(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 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.

(4) All necessary action on each request will be completed as soon as possible. If more than 12 months lapse, the Secretary shall inform the requester of the status of the request, with copies to the Chairs of the Committee and of the Subcommittee. Requests still outstanding after 18 months shall be considered not to have been answered in a “timely manner” and the Secretary shall report these to the Chair of the Committee on Filler Metals and Allied Materials, for action.

(5) 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 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.

A3. Acceptance

Acceptance of all welding materials classified under this specification is in accordance with 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 this specification, needs to be clearly stated in the purchase order according to the provisions of AWS A5.01. In the absence of any such statement in the purchase order, the supplier may ship the material with whatever testing the supplier normally conducts on material of that classification, as specified in Schedule F, Table 1, of AWS A5.01. 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 material met the requirements of the specification. Representative material, in this case, is material from 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 test of “*representative material*” cited above, and the “Manufacturer’s Quality Assurance Program” in AWS A5.01, *Filler Metal Procurement Guidelines*.

A5. Ventilation During Welding

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

- (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 that space
- (3) Rate of evolution of fumes, gases, or dust, according to the materials and processes used
- (4) The proximity of welders or welding operators to the fumes as these fumes issue from the welding zone, and to the gases and dusts in the space in which they are working
- (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 on Ventilation in that document.

A6. Welding Considerations

A6.1 The test assembly required in this specification is welded according to established techniques of the oxy-fuel gas welding process.

A6.2 The oxyfuel gas supplied to the torch should be adjusted to give a neutral or slightly reducing flame. This assures the absence of the oxidizing flame that could

adversely influence weld quality. The extent of the excess fuel gas is measured by the length of the streamer (the so-called “feather”) of unburned fuel gas visible at the extremity of the inner cone. This streamer should measure about 1/8 to 1/4 the length of the inner cone of the flame. Excessively long streamers should be avoided, since they may add carbon to the weld metal.

A6.3 In forehand welding, the torch flame points ahead in the direction of welding, and the welding rod precedes the torch flame. To distribute the heat and molten weld metal, it is necessary to use opposing oscillating motions for the flame and welding rod. This may cause excessive melting of the base metal and mixing of base metal and weld metal. Weld metal properties may be altered.

A6.4 In backhand welding, the torch flame points back at the molten metal, and the welding rod is interposed between the flame and molten metal. There is significantly less manipulation of the flame, the welding rod, and the molten metal. Therefore, a backhand weld is more likely to approach the chemical composition of undiluted weld metal.

A7. Description and Intended Use of Carbon and Low-Alloy Steel Rods

A7.1 Oxyfuel gas welding rods have no coverings to influence usability of the rod. Thus, the ability to weld in the vertical or overhead position is essentially a matter of welder skill and can be affected to some degree by the chemical composition of the rod.

A7.2 Class R45 [RM30] welding rods are used for the oxyfuel gas welding of steels, where the minimum tensile strength requirement of the steel does not exceed 45 ksi [300 MPa]. Class R45 [RM30] rods have a low carbon steel composition.

A7.3 Class R60 [RM40] welding rods are used for the oxyfuel gas welding of carbon steels, where the minimum tensile strength requirement of the steel does not exceed 60 ksi [400 MPa]. Class R60 [RM40] rods have a carbon steel composition.

A7.4 Class R65 [RM45] welding rods are used for the oxyfuel gas welding of carbon and low-alloy steels, where the minimum tensile strength requirement of the steel does not exceed 65 ksi [450 MPa]. Class R65 [RM45] welding rods may have either a low-alloy or an unalloyed carbon steel composition.

A7.5 Class R100 [RM69] welding rods are used for the oxyfuel gas welding of low-alloy steels, where the minimum tensile strength requirement of the steel does not

exceed 100 ksi [690 MPa] in the as-welded condition. Users are cautioned that response of the weld metal and base metal to postweld heat treatment may be different.

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, mechanical properties at elevated or cryogenic temperatures, wear resistance, and suitability for welding combinations of dissimilar metals may be required. AWS A5.01, *Filler Metal Procurement Guidelines*, contains provisions for ordering such tests, which may be conducted as agreed upon between the purchaser and supplier.

A9. Discontinued Classifications

Some classifications have been discontinued from one revision of this specification to another. Discontinued classifications result from changes in commercial practice or changes in the classification system used in the specification. The classifications that have been discontinued are listed in Table A.1, along with the year in which they were last included in the specification.

A10. General Safety Considerations

A10.1 Safety and health issues and concerns are beyond the scope of this standard and, therefore, are not fully addressed herein. Some safety and health information can be found in Annex Clause A5. Safety and health information is available from other sources, including,

but not limited to, Safety and Health Fact Sheets listed in A10.3; ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*; and applicable federal and state regulations.

A10.2 Safety and Health Fact Sheets. The Safety and Health Fact Sheets listed below are published by the American Welding Society (AWS). They may be downloaded and printed directly from the AWS website at <http://www.aws.org>. The Safety and Health Fact Sheets are revised and additional sheets added periodically.

A10.3 AWS Safety and Health Fact Sheets Index (SHF)⁸

No.	Title
1	<i>Fumes and Gases</i>
2	<i>Radiation</i>
3	<i>Noise</i>
4	<i>Chromium and Nickel in Welding Fume</i>
5	<i>Electrical Hazards</i>
6	<i>Fire and Explosion Prevention</i>
7	<i>Burn Protection</i>
8	<i>Mechanical Hazards</i>
9	<i>Tripping and Falling</i>
10	<i>Falling Objects</i>
11	<i>Confined Spaces</i>
12	<i>Contact Lens Wear</i>
13	<i>Ergonomics in the Welding Environment</i>
14	<i>Graphic Symbols for Precautionary Labels</i>
15	<i>Style Guidelines for Safety and Health Documents</i>
16	<i>Pacemakers and Welding</i>
17	<i>Electric and Magnetic Fields (EMF)</i>
18	<i>Lockout/Tagout</i>
19	<i>Laser Welding and Cutting Safety</i>
20	<i>Thermal Spraying Safety</i>
21	<i>Resistance Spot Welding</i>
22	<i>Cadmium Exposure from Welding & Allied Processes</i>
23	<i>California Proposition 65</i>
24	<i>Fluxes for Arc Welding and Brazing: Safe Handling and Use</i>
25	<i>Metal Fume Fever</i>
26	<i>Arc Viewing Distance</i>
27	<i>Thoriated Tungsten Electrodes</i>
28	<i>Oxyfuel Safety: Check Valves and Flashback Arrestors</i>
29	<i>Grounding of Portable and Vehicle Mounted Welding Generators</i>
30	<i>Cylinders: Safe Storage, Handling, and Use</i>

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

Table A.1
Discontinued Classifications

AWS Classifications	Last Published Date
GA 50	1946
GA 60	1946
GA 65	1946
GB 45	1946
GB 60	1946
GB 65	1946
RG 45	1969
RG 60	1969
RG 65	1969

Annex B (Informative)

Guidelines for the Preparation of Technical Inquiries

This annex is not part of AWS A5.2/A5.2M:2007, *Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding*, but is included for informational purposes only.

B1. Introduction

The American Welding Society (AWS) Board of Directors has adopted a policy whereby all official interpretations of AWS standards are handled in a formal manner. Under this policy, all interpretations are made by the committee that is responsible for the standard. Official communication concerning an interpretation is directed through the AWS staff member who works with that committee. The policy requires that all requests for an interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the complexity of the work and the procedures that must be followed, some interpretations may require considerable time.

B2. Procedure

All inquiries shall be directed to:

Managing Director
Technical Services Division
American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

All inquiries shall contain the name, address, and affiliation of the inquirer, and they shall provide enough information for the committee to understand the point of concern in the inquiry. When the point is not clearly defined, the inquiry will be returned for clarification. For efficient handling, all inquiries should be typewritten and in the format specified below.

B2.1 Scope. Each inquiry shall address one single provision of the standard unless the point of the inquiry involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the inquiry

along with the edition of the standard that contains the provision(s) the inquirer is addressing.

B2.2 Purpose of the Inquiry. The purpose of the inquiry shall be stated in this portion of the inquiry. The purpose can be to obtain an interpretation of a standard's requirement or to request the revision of a particular provision in the standard.

B2.3 Content of the Inquiry. The inquiry should be concise, yet complete, to enable the committee to understand the point of the inquiry. Sketches should be used whenever appropriate, and all paragraphs, figures, and tables (or annex) that bear on the inquiry shall be cited. If the point of the inquiry is to obtain a revision of the standard, the inquiry shall provide technical justification for that revision.

B2.4 Proposed Reply. The inquirer should, as a proposed reply, state an interpretation of the provision that is the point of the inquiry or provide the wording for a proposed revision, if this is what the inquirer seeks.

B3. Interpretation of Provisions of the Standard

Interpretations of provisions of the standard are made by the relevant AWS technical committee. The secretary of the committee refers all inquiries to the chair of the particular subcommittee that has jurisdiction over the portion of the standard addressed by the inquiry. The subcommittee reviews the inquiry and the proposed reply to determine what the response to the inquiry should be. Following the subcommittee's development of the response, the inquiry and the response are presented to the entire committee for review and approval. Upon approval by the committee, the interpretation is an official

interpretation of the Society, and the secretary transmits the response to the inquirer and to the *Welding Journal* for publication.

B4. Publication of Interpretations

All official interpretations will appear in the *Welding Journal* and will be posted on the AWS web site.

B5. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The *AWS Board Policy Manual* requires that all AWS staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be

obtained only through a written request. Headquarters staff cannot provide consulting services. However, the staff can refer a caller to any of those consultants whose names are on file at AWS Headquarters.

B6. AWS Technical Committees

The activities of AWS technical committees regarding interpretations are limited strictly to the interpretation of provisions of standards prepared by the committees or to consideration of revisions to existing provisions on the basis of new data or technology. Neither AWS staff nor the committees are in a position to offer interpretive or consulting services on (1) specific engineering problems, (2) requirements of standards applied to fabrications outside the scope of the document, or (3) points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.

AWS Filler Metal Specifications by Material and Welding Process

	OFW	SMAW	GTAW GMAW PAW	FCAW	SAW	ESW	EGW	Brazing
Carbon Steel	A5.2	A5.1	A5.18	A5.20	A5.17	A5.25	A5.26	A5.8, A5.31
Low-Alloy Steel	A5.2	A5.5	A5.28	A5.29	A5.23	A5.25	A5.26	A5.8, A5.31
Stainless Steel		A5.4	A5.9, A5.22	A5.22	A5.9	A5.9	A5.9	A5.8, A5.31
Cast Iron	A5.15	A5.15	A5.15	A5.15				A5.8, A5.31
Nickel Alloys		A5.11	A5.14		A5.14			A5.8, A5.31
Aluminum Alloys		A5.3	A5.10					A5.8, A5.31
Copper Alloys		A5.6	A5.7					A5.8, A5.31
Titanium Alloys			A5.16					A5.8, A5.31
Zirconium Alloys			A5.24					A5.8, A5.31
Magnesium Alloys			A5.19					A5.8, A5.31
Tungsten Electrodes			A5.12					
Brazing Alloys and Fluxes								A5.8, A5.31
Surfacing Alloys	A5.21	A5.13	A5.21	A5.21	A5.21			
Consumable Inserts			A5.30					
Shielding Gases			A5.32	A5.32			A5.32	

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AWS Filler Metal Specifications and Related Documents

Designation	Title
FMC	<i>Filler Metal Comparison Charts</i>
IFS	<i>International Index of Welding Filler Metal Classifications</i>
UGFM	<i>User's Guide to Filler Metals</i>
A4.2M (ISO 8249: 2000 MOD)	<i>Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal</i>
A4.3	<i>Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding</i>
A4.4M	<i>Standard Procedures for Determination of Moisture Content of Welding Fluxes and Welding Electrode Flux Coverings</i>
A5.01	<i>Filler Metal Procurement Guidelines</i>
A5.02/A5.02M	<i>Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes</i>
A5.1/A5.1M	<i>Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding</i>
A5.2/A5.2M	<i>Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding</i>
A5.3/A5.3M	<i>Specification for Aluminum and Aluminum-Alloy Electrodes for Shielded Metal Arc Welding</i>
A5.4/A5.4M	<i>Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding</i>
A5.5/A5.5M	<i>Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding</i>
A5.6	<i>Specification for Covered Copper and Copper Alloy Arc Welding Electrodes</i>
A5.7	<i>Specification for Copper and Copper Alloy Bare Welding Rods and Electrodes</i>
A5.8/A5.8M	<i>Specification for Filler Metals for Brazing and Braze Welding</i>
A5.9/A5.9M	<i>Specification for Bare Stainless Steel Welding Electrodes and Rods</i>
A5.10/A5.10M	<i>Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods</i>
A5.11/A5.11M	<i>Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding</i>
A5.12/A5.12M	<i>Specification for Tungsten and Tungsten-Alloy Electrodes for Arc Welding and Cutting</i>
A5.13	<i>Specification for Surfacing Electrodes for Shielded Metal Arc Welding</i>
A5.14/A5.14M	<i>Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods</i>
A5.15	<i>Specification for Welding Electrodes and Rods for Cast Iron</i>
A5.16/A5.16M	<i>Specification for Titanium and Titanium-Alloy Welding Electrodes and Rods</i>
A5.17/A5.17M	<i>Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding</i>
A5.18/A5.18M	<i>Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding</i>
A5.19	<i>Specification for Magnesium Alloy Welding Electrodes and Rods</i>
A5.20/A5.20M	<i>Specification for Carbon Steel Electrodes for Flux Cored Arc Welding</i>
A5.21	<i>Specification for Bare Electrodes and Rods for Surfacing</i>
A5.22	<i>Specification for Stainless Steel Electrodes for Flux Cored Arc Welding and Stainless Steel Flux Cored Rods for Gas Tungsten Arc Welding</i>
A5.23/A5.23M	<i>Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding</i>
A5.24/A5.24M	<i>Specification for Zirconium and Zirconium-Alloy Welding Electrodes and Rods</i>
A5.25/A5.25M	<i>Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding</i>
A5.26/A5.26M	<i>Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding</i>
A5.28/A5.28M	<i>Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding</i>
A5.29/A5.29M	<i>Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding</i>
A5.30/A5.30M	<i>Specification for Consumable Inserts</i>
A5.31	<i>Specification for Fluxes for Brazing and Braze Welding</i>
A5.32/A5.32M	<i>Specification for Welding Shielding Gases</i>

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