AWS C1.5:2019
An American National Standard

Specification for the Qualification of Resistance Welding Technicians

American Welding Society®

AWS C1.5:2019
An American National Standard

Approved by
American National Standards Institute
June 14, 2019

Specification for the Qualification of Resistance Welding Technicians

4th Edition

Prepared by the
AWS C1 Committee on Resistance Welding

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This specification establishes the requirements for qualification of Resistance Welding Technicians (RWT) employed in the welding industry. The minimum education, experience, examination, qualification/requalification requirements and duties are defined herein. This specification is a method for technicians to establish a record of their qualification and abilities in welding industry work such as development of machine trouble shooting, process controls, quality standards, problem solving, etc.

American Welding Society®

ISBN Print: 978-1-64322-062-8
ISBN PDF: 978-1-64322-063-5

Statement on the Use of American Welding Society Standards

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

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

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

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

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

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

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

Official interpretations of any of the technical requirements of this standard may only be obtained by sending a request, in writing, to the appropriate technical committee. Such requests should be addressed to the American Welding Society, Attention: Managing Director, Technical Services Division, 8669 NW 36 St, # 130, Miami, FL 33166 (see Annex B). With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. These opinions are offered solely as a convenience to users of this standard, and they do not constitute professional advice. Such opinions represent only the personal opinions of the particular individuals giving them. These individuals do not speak on behalf of AWS, nor do these oral opinions constitute official or unofficial opinions or interpretations of AWS. In addition, oral opinions are informal and should not be used as a substitute for an official interpretation.

This standard is subject to revision at any time by the AWS C1 Committee on Resistance Welding. It must be reviewed every five years, and if not revised, it must be either reaffirmed or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are requested and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS C1 Committee on Resistance Welding and the author of the comments will be informed of the Committee's response to the comments. Guests are invited to attend all meetings of the AWS C1 Committee on Resistance Welding to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

This page is intentionally blank.

Personnel

C1 Committee on Resistance Welding

B. Kelly, Chair	*Kelly Welding Solutions PC*
W.F. Qualls, Vice Chair	*Consultant*
M. Diaz, Secretary	*American Welding Society*
T.W. Alexander	*Centerline (Windsor) Ltd.*
W. H. Brafford	*Consultant*
R. K. Cohen	*Weld Computer Corporation*
M. Cubert	*Space Exploration Technologies*
M. Gugel	*U.S. Steel*
R. Michelena	*T. J. Snow Company, Inc.*
D. Wellman	*Obara Corporation*

Advisors to the AWS C1 Committee on Resistance Welding

B. J. Bastian	*Benmar Associates*
K. Hofman	*Roman Engineering Services*
M. Kimchi	*Edison Welding Institute*
D. F. Maatz	*R&E Engineering Services*
N.S. Scotchmer	*Huys Industries Limited*
D. C. Sorenson	*Entron Controls, LLC*
M. Tumuluru	*U.S. Steel*

This page is intentionally blank.

Foreword

This foreword is not part of AWS C1.5:2019, *Specification for the Qualification of Resistance Welding Technicians,* but is included for informational purposes only.

This specification for the qualification of resistance welding technicians was developed to provide a qualification basis, which defines minimum requirements for a resistance welding technician to demonstrate competence through a combination of education, experience, and examination.

The resistance welding technician (RWT) is a person who is responsible for maintaining resistance welding equipment, troubleshooting resistance welding problems, and providing advice on the application of the resistance welding process. The RWT shall be familiar with various resistance welding processes, specifications, basic electrical and mechanical principles, resistance welding equipment, inspection methods, acceptance criteria, tests, welding qualification requirements, and other aspects of fabrication and assembly.

For the welding technicians to be effective, the activities they perform must be consistent with specified requirements, technical, and ethical principles. The RWT may also produce reports aimed at optimizing cost, quality, and productivity. The RWT should be able to work with management representatives, inspection personnel, welders, and support crafts, and should be able to understand the role of each in the development of quality welds.

All revisions to the 2019 edition are identified by a vertical line in the margin adjacent to the text.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS C1 Committee on Resistance Welding, American Welding Society, 8669 NW 36th St, #130, Miami, FL 33166.

This page is intentionally blank.

Table of Contents

This page is intentionally blank.

Specification for the Qualification of Resistance Welding Technicians

1. General Requirements

1.1 Scope. This specification establishes qualification requirements for a resistance welding technician (RWT). It describes how qualifications are determined, and the practice by which qualification may be attained and maintained. The user of this specification will evaluate the qualifications of each candidate, and provide examinations to test the candidate's resistance welding skills and knowledge, as well as his or her ability to apply the principles of resistance welding.

This specification is intended to supplement the minimum requirements of employers, codes, other standards, or documents, and shall not be construed as a preemption of the employer's responsibility for the work or for the performance of the work. Resistance welding processes include spot welding, projection welding, seam welding, upset welding, flash welding, and auxiliary resistance welding processes such as resistance microjoining, resistance brazing, resistance soldering and resistance heating. It is understood not all of these disciplines are used in every situation; it shall be the responsibility of employers to determine if their employee, who having qualified as a RWT, is capable of performing the specific duties involved in their career assignments.

Qualification to this specification alone may not legally qualify the technician to provide technical services to the public. Contract documents and building or jurisdiction laws may require technical services to be performed under the direction and responsibility of others such as a registered Professional Engineer (P.E.). The RWT designation **DOES NOT** imply the status of a registered P.E. under the laws of any state or other governmental entity.

1.2 Levels of Certification. There is currently one level of qualification: Resistance Welding Technician (RWT).

1.3 Terminology. As used in this specification, the word ***shall*** denotes a requirement, the word ***should*** denotes a guideline, and the word ***may*** denotes a choice.

1.4 Units of Measurement. This standard does not require units of measurement. Therefore, no equivalents or conversions are contained except when they are cited in examples.

1.5 Safety. Safety and health issues and concerns are beyond the scope of this standard, and therefore are not fully addressed herein.

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 the AWS website

Material or Equipment Manufacturers:

(1) Safety Data Sheets supplied by materials manufacturers

(2) Operating Manuals supplied by equipment manufacturers

Applicable Regulatory Agencies. For example, United States Department of Labor, Occupational Safety and Health Administration (OSHA)

Work performed in accordance with this standard may involve the use of materials having been deemed hazardous, and may involve operations or equipment which 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.

AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians*

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

3. Terms and Definitions

AWS A3.0M/A3.0, *Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*, provides the basis for terms and definitions used herein. However, the following terms and definitions are included below to accommodate usage specific to this document.

candidate. The person attempting to qualify to this standard.

certification. The act of determining, verifying and attesting in writing to the qualification of personnel in accordance with specified requirements.

code. A standard consisting of a set of conditions and requirements relating to a particular subject and indicating appropriate procedures by which it can be determined the requirements have been met. A standard suitable for adoption in whole or part by a governmental authority as a part of a law or regulation or specified by other mandatory documents.

qualification. The training, skill, knowledge, and experience required for personnel to perform the duties of a specific job or function, typically demonstrated by passing a performance test.

qualified. Having capability of meeting specific requirements and performing the specific duties required for the tasks assigned.

specification. A document detailing the essential technical requirements for a material, product, system, or service. It includes the procedures, methods, qualifications, or equipment necessary to verify compliance. This specification is considered mandatory when cited by a mandatory document or when agreed upon by parties, such as for procurement purposes.

standard. A document providing rules or guidelines, produced by consensus, and approved by a recognized body. The term standard encompasses five AWS categories: code, specification, method, recommended practice, and guide.

4. Duties

Each employer shall be responsible for defining the specific duties of a RWT in the place of employment. The detailed duties and capabilities of a RWT include the following:

4.1 Application Principles. The RWT shall be capable of discussing basic resistance welding principles as they apply to resistance welded parts. This includes recognition and understanding applicable codes or specifications.

4.2 Materials and Welding/Joining Metallurgy. The RWT shall possess a basic knowledge of ferrous and nonferrous materials including: carbon steel, various types of alloy steels, stainless steels, nickel and nickel alloys, aluminum and aluminum alloys, copper and copper alloys, titanium and titanium alloys.

The RWT shall be able to demonstrate a practical knowledge of how the different resistance welding processes and pre- and post-welding heat treating processes affect the metallurgy of ferrous and nonferrous materials.

4.3 Resistance Welding, Joining, and Heating Processes. The RWT shall demonstrate a working knowledge of one or more of the resistance welding processes, such as spot welding, projection welding, seam welding, upset welding, resistance brazing, resistance soldering, flash welding, and of resistance heating.

4.4 Machinery, Equipment, and Maintenance. The RWT shall demonstrate a working knowledge of the following:

(1) Operation of the welding machinery,

(2) Electrodes and tooling,

(3) Resistance welding controls,

(4) Electrical power systems,

(5) Operation of machine control systems,

(6) Initial machine set-up, and

(7) Welding machinery maintenance.

4.5 Quality Assurance. The RWT shall have a basic knowledge of quality management systems as well as welding procedures and equipment qualifications. The RWT shall be capable of performing visual and mechanical inspection of welds, and of understanding other types of weld inspection.

5. Education and Experience Requirements

Candidates are recommended to have taken courses or completed studies in the following areas:

(1) Fundamentals of mathematics, including basic algebra.

(2) Fundamentals of science, with a recommendation of physics and chemistry.

(3) Engineering drawing or basic blueprint reading.

(4) Metallurgy with a basic understanding of both ferrous and nonferrous materials.

(5) Electricity with a basic understanding of AC and DC secondary circuits.

5.1 Minimum Education and Experience Requirements. A Resistance Welding Technician (RWT):

Shall be a high school graduate or have completed a state or military approved high school equivalency diploma (e.g., GED); and shall have a minimum one (1) year of work experience in resistance welding machine operation or a related function, or

Shall be a post-high school graduate or post-GED graduate; and shall have a minimum six (6) months of work experience in resistance welding machine operation or a related function, or

As an alternative to education requirements, candidates shall have at least three (3) years of related work experience in resistance welding machine operation or a related function.

5.2 Types of Experience Defined. Candidates shall submit verifiable documentation of education and work in a resistance welding field. Each candidate seeking qualification shall have experience consisting of the design, application, or operation of welding lines or cells for the manufacture of welded products such as automobiles, appliances, wire products, sheet metal products or other resistance welded products. Manufactured products may be covered by national, customer, or internal standards or specifications.

6. Examination Requirements

6.1 Examination. Candidates seeking qualification as a RWT shall successfully complete a written examination. The examination questions will be taken from publications referenced in AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians*. The examination should be drawn from and matched to the Knowledge, Skills, and Abilities (KSAs) needed to perform the duties of the RWT developed from a Job Task Analysis (JTA). *Certification: The*

ICE Handbook is an excellent resource book for best practice guidelines for conducting a JTA for a certification examination. The KSAs in AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians* can be used as a guideline.

6.2 Passing Requirements. The passing standard for a certification examination should be determined by a standard setting based on the specific content of the examination. *Certification: The ICE Handbook* is an excellent resource book for best practice guidelines for setting a standard for a certification examination.

7. Examination Structure

The test specifications should be formed following the KSAs from the JTA in Clause 6.1. Weights (i.e., the percent and number of questions on the examination) should be specified at least at the primary domain level in relation to the relevance and importance of the KSAs. The Test Specifications in AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians* should be used as a guideline.

8. Maintenance of Qualification.

The RWT shall maintain the qualification through continued education every (5) years as specified in AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians* . This education shall be related to the functions as defined in Clause 4. If the RWT does not complete the required continuing education, then the RWT may retake the written examination (Clause 6.1) to maintain qualification.

The candidate shall be employed in the resistance welding field during this time and be gaining practical knowledge and manufacturing experience by working with resistance welding equipment as specified in AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians*. The RWT requesting renewal of certification shall attest to having no period of continuous work inactivity greater than one year in activities during the previous five years of certification.

In addition, the RWT is required to retain written proof of his or her qualification for presentation as specified in AWS QC20, *Specification for AWS Certification of Resistance Welding Technicians*.

Annex A (Informative)
References Documents

This annex is not part of AWS C1.5:2019, *Specification for the Qualification of Resistance Welding Technicians*, but is included for informational purposes only.

Number	Title
ANSI Z49.1	*Safety in Welding, Cutting and Allied Processes*
AWS A2.4	*Standard Symbols for Welding, Brazing, and Nondestructive Examination*
AWS C1.1M/C1.1	*Recommended Practices for Resistance Welding*
AWS C1.4M/C1.4	*Specification for Resistance Welding of Carbon and Low-Alloy Steels*
AWS D17.2/D17.2M	*Specification for Resistance Welding for Aerospace Applications*
AWS J1.2M/J1.2	*Guide to Installation and Maintenance of Resistance Welding Machines*
JWE	*Jefferson's Welding Encyclopedia 18th Edition*
RWMA	*Resistance Welding Manual Revised Fourth Edition*
AWS	*Welding Handbook Vols. 1, 2, 3, Ninth Edition*
AWS	*RWPH (RW Pocket Handbook)*
AWS J1.1M/J1.1	*Specification for Resistance Welding Controls*
ASM	*Metals Handbook Vol. 17, NDE*
AWS	*Introductory Welding Metallurgy*
RWMA	*Bulletin #16 Resistance Welding Equipment Standard*
ICE	*Certification: The ICE Handbook*

This page is intentionally blank.

Annex B (Informative)
Requesting an Official Interpretation on an AWS Standard

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

B1. Introduction

The following procedures are here to assist standard users in submitting successful requests for official interpretations to AWS standards. Requests from the general public submitted to AWS staff or committee members that do not follow these rules may be returned to the sender unanswered. AWS reserves the right to decline answering specific requests; if AWS declines a request, AWS will provide the reason to the individual why the request was declined.

B2. Limitations

The activities of AWS technical committees regarding interpretations are limited strictly to the interpretation of provisions of standards prepared by the committees. 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.

B3. General Procedure for all Requests

B3.1 Submission. All requests shall be sent to the Managing Director of AWS Technical Services Division. For efficient handling, it is preferred that all requests should be submitted electronically through technical@aws.org. Alternatively, requests may be mailed to:

Managing Director
Technical Services Division
American Welding Society
8669 NW 36 St, # 130 Miami,
FL 33166

B3.2 Contact Information. All inquiries shall contain the name, address, email, phone number, and employer of the inquirer.

B3.3 Scope. Each inquiry shall address one single provision of the standard unless the issue in question involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the request along with the edition of the standard (e.g., D1.1:2006) that contains the provision(s) the inquirer is addressing.

B3.4 Question(s). All requests shall be stated in the form of a question that can be answered ‘yes’ or ‘no’. The request shall be concise, yet complete enough to enable the committee to understand the point of the issue in question. When the point is not clearly defined, the request will be returned for clarification. Sketches should be used whenever appropriate, and all paragraphs, figures, and tables (or annexes) that bear on the issue in question shall be cited.

B3.5 Proposed Answer(s). The inquirer shall provide proposed answer(s) to their own question(s).

B3.6 Background. Additional information on the topic may be provided but is not necessary. The question(s) and proposed answer(s) above shall stand on their own without the need for additional background information.

B4. AWS Policy on Interpretations

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 official interpretations are approved by the technical committee that is responsible for the standard. Communication concerning an official interpretation is directed through the AWS staff member who works with that technical committee. The policy requires that all requests for an official interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the procedures that must be followed, some requests for an official interpretation may take considerable time to complete.

B5. AWS Response to Requests

Upon approval by the committee, the interpretation is an official interpretation of the Society, and AWS shall transmit the response to the inquirer, publish it in the *Welding Journal*, and post it on the AWS website.

B6. 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.

List of AWS C1 Documents

Designation	Title
AWS C1.1M/C1.1	*Recommended Practices for Resistance Welding*
AWS C1.4M/C1.4	*Specification for Resistance Welding of Carbon and Low-Alloy Steels*
AWS C1.5	*Specification for the Qualification of Resistance Welding Technicians*

This page is intentionally blank.