AWS B4.0:2007
An American National Standard

Standard Methods for Mechanical Testing of Welds

American Welding Society

Approved American National Standard
ANSI

AWS B4.0:2007
An American National Standard

Approved by the
American National Standards Institute
May 2, 2007

Standard Methods for Mechanical Testing of Welds

7th Edition

Supersedes ANSI/AWS B4.0-98

Prepared by the
American Welding Society (AWS) B4 Committee on Mechanical Testing of Welds

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

Mechanical test methods that are applicable to welds and welded joints are described. For each testing method, information is provided concerning applicable American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and American Petroleum Institute (API) documents; the required testing apparatus, specimen preparation, procedure to be followed, and report requirements are also described.

American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

International Standard Book Number: 978-0-87171-071-0
American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126

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 guaranty 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.

This standard may be superseded by the issuance of new editions. Users should ensure that they have the latest edition.

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.

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

On occasion, text, tables, or figures are printed incorrectly, constituting errata. Such errata, when discovered, are posted on the AWS web page (www.aws.org).

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, 550 N.W. LeJeune Road, Miami, FL 33126 (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 B4 Committee on Mechanical Testing of Welds. 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 required and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS B4 Committee on Mechanical Testing of Welds 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 B4 Committee on Mechanical Testing of Welds 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, 550 N.W. LeJeune Road, Miami, FL 33126.

This page is intentionally blank.

Dedication

Henry Hahn

The AWS B4 Committee on Mechanical Testing of Welds dedicates this edition of AWS B4.0, *Standard Methods for the Mechanical Testing of Welds*, to the memory of Henry H. Hahn. Henry was an active and productive member and past Chair of the AWS B4 Committee on Mechanical Testing of Welds, a past Chair of ISO/TC44/SC5, past Chair of ISAC-05, and a former member of the AWS Technical Activities Committee and AWS International Standards Activities Committee.

This page is intentionally blank.

Personnel

AWS B4 Committee on Mechanical Testing of Welds

R. J. Wong, Chair	*Naval Surface Warfare Center*
R. F. Waite, 1st Vice Chair	*Consultant*
T. McGaughy, 2nd Vice Chair	*Edison Welding Institute*
B. C. McGrath, Secretary	*American Welding Society*
J. R. Crisci	*Consultant*
D. A. Fink	*The Lincoln Electric Company*
*H. Hahn	*Consultant*
J. M. Morse	*The Lincoln Electric Company*
J. H. Smith	*Consultant*
L. Van Leaven	*Electric Boat*
K. Zerkle	*Hobart Institute*

Advisors to the AWS B4 Committee on Mechanical Testing of Welds

J. J. DeLoach, Jr.	*Naval Surface Warfare Center*
D. B. Holliday	*Northrop Grumman Corporation*
E. L. Lavy	*Consultant*
L. Li	*Utah State University*
H. W. Mishler	*Consultant*
G. R. Pearson	*Anderson Laboratories*
A. G. Portz	*Consultant*
W. W. St. Cyr, II	*NASA*

*Deceased

This page is intentionally blank.

Foreword

This foreword is not part of AWS B4.0:2007, *Standard Methods for Mechanical Testing of Welds*, but is included for informational purposes only.

This standard covers the common tests for the mechanical testing of welds. They are defined and illustrated in sections related to tension tests, shear tests, bend tests, fracture toughness tests, hardness tests, break tests (nick and fillet welds), selected weldability tests and process specific tests (stud weld tests and resistance weld tests).

This document extensively uses American Society for Testing and Materials (ASTM) Standard Methods and specifies how to use these methods when testing weldments. It takes into consideration the variations in properties that can occur between different regions (base metal, heat-affected zone, and weld metal) of a weldment.

Methods of hardness testing and mechanical property tests for base metals are covered by ASTM standards or the individual material specification. The joint tests for brazements are covered in ANSI/AWS C3.2, *Standard Methods for Evaluating the Strength of Brazed Joints in Shear*. Additional information on the mechanical testing of welded joints may be obtained from the AWS Welding Handbook, Volume 1, which describes selected weldability test methods.

AWS B4.0:2007, *Standard Methods for the Mechanical Testing of Welds*, is the seventh edition of the document initially published in 1942. The second edition (1974) incorporated metric conversions and the third edition (1977) incorporated minor changes. The fourth edition (1985) added the plane-strain fracture toughness test and the fifth edition (1992) added hardness testing and stud weld tests, and organized the tests by weld type. The sixth edition (1998) added six new weldability tests, and the current edition includes three new weldability tests (WIC, trough, and GBOP) and resistance weld tests. Previous editions of the document are as follows:

AWS A4.0-42, *Standard Methods for Mechanical Testing of Welds*

AWS B4.0-74, *Standard Methods for Mechanical Testing of Welds*

AWS B4.0-77, *Standard Methods for Mechanical Testing of Welds*

AWS B4.0-85, *Standard Methods for Mechanical Testing of Welds*

AWS B4.0-92, *Standard Methods for Mechanical Testing of Welds*

AWS B4.0-98, *Standard Methods for Mechanical Testing of Welds*

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS B4 Committee on Mechanical Testing of Welds, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

This page is intentionally blank.

Table of Contents

Page No.

Page No.

List of Figures

Figure **Page No.**

Figure **Page No.**

Figure **Page No.**

This page is intentionally blank.

Standard Methods for Mechanical Testing of Welds

1. Scope

This specification establishes standard methods for mechanical testing of welds. The significance of each test, test apparatus, preparation of the test specimens, and the test procedure are described. Example test results sheets are provided.

It is beyond the scope of this document to define the required mechanical properties or acceptance criteria for the weld metal.

This standard makes sole use of U.S. Customary Units. Approximate mathematical equivalents in the International System of Units (SI) are provided for comparison in parentheses or in appropriate columns in tables and figures.

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 other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, and applicable federal, state, and local regulations.

2. Normative References

The following standards contain provisions which, through reference in this text, constitute mandatory provisions of this AWS standard. 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 documents:[1]

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

AWS A2.4, *Standard Symbols for Welding, Brazing and Nondestructive Examination*; and

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

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

3. Terms and Definitions

The welding terms used in this standard are in accordance with AWS A3.0, *Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*.

4. Tension Tests

4.1 Scope. This clause covers the tension testing of welded joints. It does not specify required properties or acceptance criteria. When this standard is used as a portion of specification for a welded structure or assembly or for qualification, the following information shall be furnished:

(1) The specific type(s) and number of specimens required,

(2) Base metal specification/identification,

(3) Filler material specification/identification,

(4) The anticipated property values and whether they are maximum or minimum requirements,

(5) Location and orientation of the specimens,

(6) Report form when required, and

(7) Postweld thermal or mechanical processing treatments, as applicable.

This standard is applicable to the following, when specified:

(1) Qualification of materials and welding procedures where specified mechanical properties are required,