AWS B4.0:2016-AMD1
An American National Standard

Standard Methods for Mechanical Testing of Welds

American Welding Society®

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Approved by
American National Standards Institute

Standard Methods for Mechanical Testing of Welds

8th Edition

Supersedes AWS B4.0:2007

Prepared by the
AWS Committee on 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.

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Foreword

This foreword is not part of this standard 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 references 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 AWS C3.2M/C3.2, *Standard Methods for Evaluating the Strength of Brazed Joints*. Additional information on the mechanical testing of welded joints may be obtained from the AWS Welding Handbook, Ninth Edition, Volume 1, which describes selected weldability test methods.

AWS B4.0:2016, *Standard Methods for the Mechanical Testing of Welds*, is the eighth 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. The seventh edition included three new weldability tests (WIC, trough, and GBOP) and resistance weld tests. The current edition includes two new annexes (C and D) which address tensile testing of narrow groove welds. Several figures were updated and changes in text are indicated by a vertical margin line. 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*

AWS B4.0:2007, *Standard Methods for Mechanical Testing of Welds*

Comments and suggestions for the improvement of this standard are welcome. The should be sent to the Secretary, Committee on Standard Methods for Mechanical Testing of Welds, American Welding Society, 8669 NW 36 St, Miami, FL 33166.

Amendments

The following Amendments have been identified and incorporated in this reprint.

AWS Standard: B4.0:2016
Amendment Number: 1
Subject: Clause 7.2, replace reference ASTM A370 with ASTM E23:

ASTM Documents:

ASTM E23, *Standard Test Methods for Notched Bar Impact Testing of Metallic Materials*

ASTM E208, *Standard Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels*

ASTM E399, *Standard Test Method for Linear-Elastic Plane-Strain Fracture Toughness KIc of Metallic Materials*

ASTM E604, *Standard Test Method for Dynamic Tear Testing of Metallic Materials*

ASTM E1820, *Standard Test Method for Measurement of Fracture Toughness*

ASTM E1823, *Standard Terminology Relating to Fatigue and Fracture Testing*

ASTM E1921, *Standard Method for Determination of Reference Temperature, To, for Ferritic Steels in the Transition Range.*

AWS Standard: B4.0:2016
Amendment Number: 1
Subject: Clause 7.5.1, replace "ASTM A370" with "ASTM E23":

7.5.1 The apparatus for conducting the various fracture toughness tests shall be in accordance with the latest edition of the following ISO and ASTM Standard Test Methods:

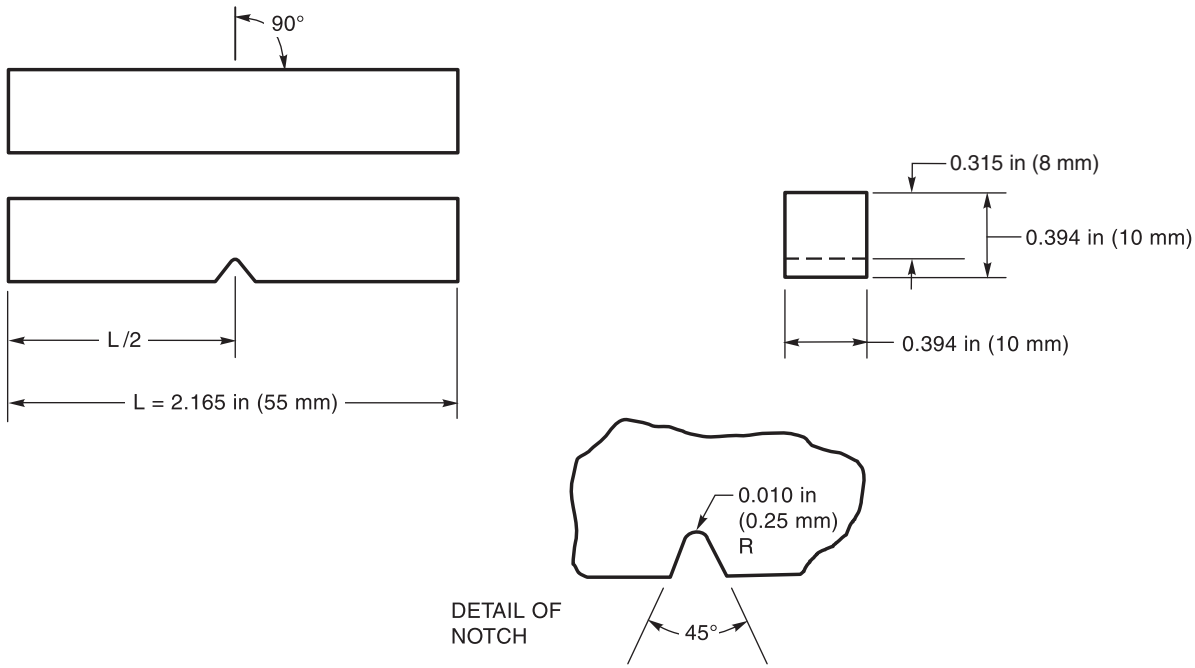
(1) Charpy V-notch, ASTM E23;

AWS Standard: B4.0:2016
Amendment Number: 1
Subject: Clause 7.7.1, replace "ASTM A370" with "ASTM E23":

7.7.1 Test specimen preparation and test procedure for measuring the fracture toughness of a weldment shall be in accordance with the following ISO and ASTM standard test methods:

(1) Charpy V-notch, ASTM E23, except that values up to and including 100% of the testing machine capacity shall be accepted and reported as fracture energy if the specimen breaks. The full machine capacity followed by a plus sign (+), shall be reported if the specimen is not broken. All these results may be used to calculate the average energy absorbed provided the minimum average required for acceptance is within the verified range of the machine;

AWS Standard: B4.0:2016
Amendment Number: 1
Subject: Figure 7.1, replace existing figure with new figure:



NOTE—Dimensional Tolerances shall be as follows:

Notch length to edge	90° ± 2°
Adjacent sides shall be at	90° ± 10 minutes
Cross section dimensions	±0.003 in (0.076 mm)
Length of specimen (*L*)	+0, –0.100 in (+0, –2.5 mm)
Centering of notch (*L*/2)	±0.039 in (1 mm)
Angle of notch	±1°
Radius of notch	±0.001 in (0.025 mm)
Finish requirements	63 microinches (1.5 micrometers) R_a on notched surface and opposite face; 125 microinches (3 micrometers) R_a on other two surfaces
Ligament length	±0.001 in (0.025 mm)

Figure 7.1—Charpy V-Notch Impact Specimen

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All-Weld-Metal Tensile Testing of Narrow Groove Pipeline Girth Welds

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 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

Work performed in accordance with this standard may involve the use of materials that have been deemed hazardous, and may involve operations or equipment that may cause injury or death. This standard does not purport to address all safety and health risks that may be encountered. The user of this standard should establish an appropriate safety program to address such risks as well as to meet applicable regulatory requirements. ANSI Z49.1 should be considered when developing the safety program.

2. Normative References

The 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:

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.*