

AWS C3.15M/C3.15:2026  
An American National Standard

# Standard Methods for Evaluating the Strength of Soldered Joints



**AWS C3.15M/C3.15:2026**  
**An American National Standard**

**Approved by**  
**American National Standards Institute**  
**December 2, 2025**

# **Standard Methods for Evaluating the Strength of Soldered Joints**

**First Edition**

Prepared by the  
American Welding Society (AWS) C3 Committee on Brazing and Soldering

Under the Direction of the  
AWS Technical Activities Committee

Approved by the  
AWS Board of Directors

## **Abstract**

This standard describes the test methods used to obtain the strength of soldered joints. Monotonic (unidirectional) and cyclic (fatigue) testing are considered in this standard. Sample geometries are described that allow for the application of stresses in tension, shear, bending moment, and peel configurations. Details are provided, which describe specimen preparation methods, soldering procedures, testing parameters, and methods for data analysis.



ISBN PRINT: 978-1-64322-414-5  
ISBN PDF: 978-1-64322-415-2

© 2026 American Welding Society  
All rights reserved.

Printed in the United States of America

**Photocopy Rights.** No portion of this standard may be reproduced, stored in a retrieval system, or transmitted in any form, including mechanical, photocopying, recording, or otherwise, without the prior written permission of the copyright owner.

Authorization to photocopy items for internal, personal, or educational classroom use only or the internal, personal, or educational classroom use only of specific clients is granted by the American Welding Society provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, tel: (978) 750-8400; Internet: [www.copyright.com](http://www.copyright.com).

## 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 revised, 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](http://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, Standards Development, 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 C3 Committee on Brazing and Soldering. 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 C3 Committee on Brazing and Soldering 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 C3 Committee on Brazing and Soldering 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

## AWS C3 Committee on Brazing and Soldering

R. A. Gourley, Chair	<i>Curtiss-Wright</i>
C. F. Darling, 1st Vice Chair	<i>The Prince &amp; Izant Companies</i>
H. Zhao, 2nd Vice Chair	<i>Creative Thermal Solutions</i>
K. R. Bulger, Secretary	<i>American Welding Society</i>
G. L. Alexy	<i>Alexy Metals</i>
J. Arbogast	<i>The Gasflux Company</i>
J. A. Bush	<i>The Prince &amp; Izant Companies</i>
D. Chalasani	<i>Morgan Advanced Materials</i>
E. Chen	<i>SpaceX</i>
K. E. Corona	<i>C/A Design</i>
W. M. Coughlan	<i>Metglas, Incorporated</i>
G. DeVries	<i>Radyne Corporation</i>
M. J. Disabb-Miller	<i>Northrup Grumman – Mission Systems</i>
P. J. Ditzel	<i>The Prince &amp; Izant Companies</i>
T. C. Easley	<i>SEA Limited</i>
P. J. Fassman	<i>L3Harris Technologies</i>
S. L. Feldbauer	<i>Abbott Furnace Company</i>
M. T. Graham	<i>The Prince &amp; Izant Companies</i>
T. D. Grohoske	<i>Expansia</i>
T. Grøstad	<i>Höganäs AB</i>
J. H. Gutierrez	<i>Wall Colmonoy Corporation</i>
T. P. Hirthe	<i>Consultant</i>
D. A. Javernick	<i>Los Alamos National Laboratory</i>
J. A. Kapur	<i>Aimtek, Incorporated</i>
G. F. Kayser	<i>Aerojet Rocketdyne</i>
J. Krywicki	<i>Northrup Grumman – Mission Systems</i>
N. D. Kult	<i>Riverside Machine &amp; Engineering</i>
K. P. Landgraf	<i>Lucas Milhaupt, Incorporated</i>
J. A. Liguori	<i>Ursa Major Technologies</i>
S. Lindsey	<i>Honeywell</i>
J. Longabucco	<i>Lucas-Milhaupt, Incorporated</i>
J. Machala	<i>Honeywell International, Inc.</i>
N. R. Marino	<i>RTX – Collins</i>
S. McAllister	<i>GH Induction Atmospheres LLC</i>
W. Miglietti	<i>Miglietti and Associates, LLC</i>
S. D. Nelson	<i>Rolls-Royce Corporation</i>
T. Oyama	<i>Morgan Advanced Ceramic – WESGO Metals Division</i>
M. E. Paponetti	<i>Solar Atmospheres</i>
J. Parnell	<i>Boyd Corporation</i>
A. M. Perfetti	<i>Thermal-Vac Technology, Inc.</i>
D. L. Pruchenski	<i>Consultant</i>
S. S. Rajan	<i>Raytheon</i>
M. E. Sapp	<i>NAVAIR-MRO Cherry Point</i>
B. T. Schneiderman	<i>Colorado School of Mines</i>
A. E. Shapiro	<i>Titanium Brazing, Incorporated</i>

L. A. Shapiro	<i>Titanium Brazing, Incorporated</i>
R. W. Smith	<i>S-Bond Technologies</i>
M. Strojczek	<i>Höganäs AB</i>
E. Theisen	<i>EERC</i>
P. T. Vianco	<i>Consultant</i>
C. M. Volpe	<i>Senior Aerospace – Metal Bellows Division</i>
C. Walker	<i>Consultant</i>
M. Weinstein	<i>Wall Colmonoy Corporation</i>
M. J. Wilson	<i>Harris Products Group – A Lincoln Electric Company</i>
T. Wingens	<i>Wingens LLC</i>
Z. Yu	<i>Colorado School of Mines</i>

**Advisors to the AWS C3 Committee on Brazing and Soldering**

A. N. Jain	<i>Grainger Canada</i>
D. Kay	<i>Kay &amp; Associates</i>
R. P. McKinney	<i>Consultant</i>
M. J. Pohlman	<i>Consultant</i>
E. T. Przybylowicz	<i>Honeywell Aerospace</i>
R. R. Xu	<i>Consultant</i>

**AWS C3B Subcommittee on Soldering**

P. T. Vianco, Chair	<i>Consultant</i>
D. L. Pruchenski, Vice Chair	<i>Consultant</i>
K. R. Bulger, Secretary	<i>American Welding Society</i>
G. L. Alexy	<i>Alexy Metals</i>
J. A. Bush	<i>The Prince &amp; Izant Companies</i>
W. M. Coughlan	<i>Metglas, Incorporated</i>
C. F. Darling	<i>The Prince &amp; Izant Companies</i>
S. L. Feldbauer	<i>Abbott Furnace Company</i>
R. A. Gourley	<i>Curtiss-Wright</i>
M. T. Graham	<i>Prince &amp; Izant Company</i>
J. H. Gutierrez	<i>Wall Colmonoy Corporation</i>
K. P. Landgraf	<i>Lucas Milhaupt, Incorporated</i>
S. Lindsey	<i>Honeywell</i>
J. Longabucco	<i>Lucas-Milhaupt, Incorporated</i>
M. E. Paponetti	<i>Solar Atmospheres</i>
A. Rabinkin	<i>Brazing and Joining Consultant LLC</i>
S. S. Rajan	<i>Raytheon</i>
A. E. Shapiro	<i>Titanium Brazing, Incorporated</i>
L. A. Shapiro	<i>Titanium Brazing, Incorporated</i>
R. W. Smith	<i>S-Bond Technologies</i>
E. Theisen	<i>EERC</i>
C. M. Volpe	<i>Senior Aerospace – Metal Bellows Division</i>
C. Walker	<i>Consultant</i>
H. Zhao	<i>Creative Thermal Solutions</i>

**Advisors to the AWS C3B Subcommittee on Soldering**

R. A. Henson	<i>Consultant</i>
T. P. Hirthe	<i>Consultant</i>
R. P. McKinney	<i>Consultant</i>
R. R. Xu	<i>Consultant</i>

## Foreword

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

The American Welding Society (AWS) C3 Committee on Brazing and Soldering developed and maintains the specification on the mechanical testing of braze joints entitled: “AWS C3.2M/C3.2, *Standard Method for Evaluating the Strength of Brazed Joints*.” This document provides guidance towards the standardization of test specimens and methods to allow for an accurate comparison of data obtained at different test facilities.

The requirement for a separate specification that addresses soldered joints arises from the latter having several properties that distinguish them from brazed joints. First, with very few exceptions, soldering filler metals have lower bulk strengths than the base materials used in typical soldered joints. Deformation and fracture take place almost exclusively within the joint clearance. Therefore, soldered joint strength is sensitive to its dimensions—joint clearance and footprint (area). Secondly, tin (Sn)- and indium (In)-based soldering filler metals are strain rate sensitive. As a result, the soldered joint strength is prone to be sensitive to test speed. Third, interface reaction layers, which are typically intermetallic compounds (IMCs), provide the bond between the soldering filler metal and the base material so that, together with the soldering filler metal and base material, determine the soldered joint mechanical strength. Fourth, soldering filler metals are used at relatively high homologous temperatures.<sup>1</sup> Their microstructures and thus, their mechanical properties, can evolve over time even when held at only room temperature.

Traditionally, the mechanical testing of soldered joints has been performed with a particular engineering application in mind. The base materials, filler metal, and in particular, the soldered joint geometry are developed to replicate that application to assure relevance of the data to the intended service. The drawback of this methodology is that soldered joint strengths are obtained from a wide range of test configurations and equipment parameters. Therefore, test data cannot be readily compared between different soldering filler metals, base materials, and joint clearances, to either optimize soldered joint design or provide consistent validation data for computational models.

The purpose of this specification is to provide the needed standardization of soldered joint testing. Monotonic (unidirectional) and cyclic (fatigue) testing are considered in this document. Sample geometries are described that allow for the application of stresses in tension, shear, bending moment, and peel configurations. Details are included in the text, which describe specimen preparation methods, soldering procedures, testing parameters, and methods for data analysis.

Comments and suggestions for the improvement of this standard are welcome and should be sent to the Secretary, AWS C3 Committee on Brazing and Soldering, American Welding Society, 8669 NW 36<sup>th</sup> Street, Suite #130, Miami, FL 33166.

---

<sup>1</sup> The homologous temperature,  $T_h$ , is defined as the ratio of the absolute temperature of the use condition over the absolute temperature of the solidus point. For example, 63Sn-37Pb soldering filler metal has a solidus temperature of 183 °C (456K). At 25 °C (298K), the  $T_h$  is 298K/456K, which equals 0.65. By comparison, a  $T_h$  of 0.65 would be equivalent to 814 °C for a nickel-based alloy having a solidus temperature of 1400 °C (1673K), hence, the analogy with the jet engine application.

This page is intentionally blank.

# Table of Contents

	<b>Page No.</b>
<i>Personnel</i> .....	v
<i>Foreword</i> .....	vii
<i>List of Figures</i> .....	x
<b>1. General Requirements</b> .....	<b>1</b>
1.1 Scope .....	1
1.2 Units of Measurement .....	1
1.3 Safety .....	1
<b>2. Normative References</b> .....	<b>2</b>
<b>3. Terms and Definitions</b> .....	<b>3</b>
<b>4. Introduction</b> .....	<b>5</b>
4.1 Mechanical Testing—Bulk Soldering Filler Metals .....	5
4.2 Mechanical Testing—Soldered Joints .....	5
<b>5. General Requirements</b> .....	<b>22</b>
5.1 Temperature Control .....	22
5.2 Base Materials and Configurations .....	22
5.3 Soldered Joint Fabrication .....	24
5.4 Mechanical Test Procedures .....	29
5.5 Data Recording and Analysis .....	31
<b>6. Detailed Requirements</b> .....	<b>36</b>
6.1 Description .....	36
6.2 Butt Joint Tensile Test .....	37
6.3 Lap Joint Shear Test .....	38
6.4 Peel Joint Test .....	45
6.5 Modified Compact Tension (CT) Test .....	47
6.6 Four-Point Bend Test .....	49
Annex A (Informative)—Informative References .....	69
Annex B (Informative)—Requesting an Official Interpretation on an AWS Standard .....	71
List of AWS Documents on Brazing and Soldering .....	73

## List of Figures

Figure	Page No.
4.1	Schematic Diagram Illustrates the Variety of Soldered Joint Configurations, Including Self-Alignment and Interlocking Structures . . . . .15
4.2	Schematic Diagrams Show the Three Fundamental Loading Modes of a Soldered Joint: Tensile, Shear, and Peel. The Force (F) Direction Is Indicated by the Arrows . . . . .16
4.3	Schematic Diagram Illustrates the Deformation of the Soldering Filler Metal, G to G', Under the Force, F, When the Joint Clearance Is Large When Compared to the Soldered Joint Area, A . . . . .16
4.4	Schematic Diagram Illustrates the Deformation of the Soldering Filler Metal, G to G', Under the Force, F, When the Joint Clearance Is Small When Compared to the Soldered Joint Area, A . . . . .17
4.5	General Force-Displacement Plot Obtained From the T-Peel Test. The Relevant Parameters Are $F_{max}$ , $F_L$ , and $d_L$ . . . . .17
4.6	(A) Schematic Diagram Shows the Modified Compact Tension (CT) Test Specimen. A Magnified Picture Shows the Notch and Soldered Joint Structure of the Joint Clearance. (B) Type I and II Force-Displacement Plots That are Expected From the CT Test of Materials Showing Nominal Ductility. . . . .18
4.7	(A) Schematic Diagram Shows the Four-Point Bending Specimen Having a Loading Span That Was One-Half of the Support Span. The Enlarged Image Shows the Linear Distribution of Fiber Stresses in the Base Materials and Soldered Joints Within the Boundaries of the Loading Span. (B) Fixturing is Illustrated That Would Enable Tension-Compression Testing. . . . .19
4.8	Graph Illustrates the Strain-Time Response of a Material to Isothermal Fatigue . . . . .20
4.9	Graph Illustrates the Strain-Time Response of a Material Subjected to Thermal Mechanical Fatigue (TMF) Under Temperature Cycling Conditions . . . . .20
4.10	(A) Schematic Diagram and (B) Photograph of the Tensile Button Test Specimen. This Photograph Includes an Interlayer. . . . .21
4.11	Schematic Diagram Shows the Ceramic Shear Test Specimen. The Inset Image Shows the Application of the Force, F, on the Coupon Base Material . . . . .21
5.1	Steps (A)-(E) Illustrate the Hot Solder Dipping Process to Replace a Au Protective Layer With a ("Hot Solder Dipped") Coating on the Base Material Faying Surface . . . . .35
5.2	Generic Temperature Versus Time Profile for a Soldering Process. . . . .35
5.3	Generic T-Joint Tensile Strength (A) and Single Lap Shear Strength (B) Test Specimen Configurations That Illustrate the Dimensional Variables of Internal Discontinuities (Porosity and "Voids") as Referenced in the Requirements . . . . .36
6.1	Schematic Diagram and Table of Dimensions for the Round Butt Joint Test Specimen. . . . .51
6.2	Schematic Diagram of the ASTM F19 Tensile Button Base Material Configuration . . . . .52
6.3	Schematic Diagram and Table of Dimensions for the Metal or Alloy, Single Lap Joint Test Specimen . . . . .52
6.4	Schematic Diagram and Table of Dimensions for the Ceramic, Single Lap Joint Test Specimen . . . . .53
6.5	Schematic Diagram and Table of Dimensions for the Metal or Alloy, Conventional Double Lap Joint Test Specimen. (This Configuration May Also Be Used for Ceramic Base Materials.) . . . . .54
6.6	(A) Schematic Diagram and Table of Dimensions of the Finished Ring-and-Plug Test Specimen. This Diagram is also Applicable for Ceramic Base Materials. (B) Post-Soldered Test Specimen, Emphasizing the Plug Geometries, When the Base Materials Are Metals or Alloys (Left-Hand Side) or Ceramic (Right-Hand Side). (C) Schematic Diagram Shows the Preferred Geometry of a Thick Film Coating Applied to the Ceramic Ring and Plug. The Dimensions Are Provided in the Accompanying Table . . . . .56
6.7	Example of the Type of Fixturing That Can Be Used to Assure Base Material Alignment and Joint Clearance. . . . .56

6.8	Example of a Fixture That Can Fabricate Six (6) Test Specimens on a Single Substrate Base Material and Six (6) Coupons. The Spacers Maintain the Joint Clearance . . . . .	57
6.9	Diagrams Illustrate the Fabrication of the Metal or Alloy Ring-and-Plug Test Specimen. (A) Test Specimen Set Up for the Soldering Process Using Three Spacers to Control the Joint Clearance. (B) Sample Fixture Used to Control the Alignment of the Ring and Plug and Thusly, the Joint Clearance Without the Need for Spacer Wires. The Set-Up Used a Preplaced Soldering Filler Metal Preform. (C) Form of the Metal or Alloy Test Specimen After the Soldering Process. (D) Side View of the Metal or Alloy Test Specimen After the Machining Steps Needed to Ready It for the Mechanical Testing. (E) Planar View of the Post-Machined, Metal or Alloy Test Specimen . . . . .	58
6.10	Schematic Diagrams Show the Profile and Plane View of the Shear Testing of the Single Lap Joint, Ceramic Test Specimen. The Table Lists the Relevant Geometries . . . . .	59
6.11	Schematic Diagram Shows the Ring-and-Plug Mechanical Test Fixture and Configuration for Monotonic Testing. The Table Lists the Ram and Hole Diameters, R and F, Respectively . . . . .	59
6.12	Schematic Diagram Shows the Ring-and-Plug Mechanical Test Fixture and Configuration for Isothermal Fatigue Testing . . . . .	60
6.13	Schematic Diagram Shows the Configuration of the T-Peel Test Specimen. The Dimensions Are Shown in the Accompanying Table . . . . .	60
6.14	(A) Schematic Diagram Shows the Starting Configuration of the T-Peel Test Specimen, That Is, With Unbent Base Material “Legs.” The Spacer Sizes and Location Configuration Are Listed in the Accompanying Table. (B) T-Peel Test Specimen Having the Base Material “Legs” Bent to an Angle of 90° Prior to Filling the Gap with Molten Soldering Filler Metal Using Mandrels and Clamps to Assure the Proper Configuration. (C) The Pre-Bent T-Peel Test Specimen Ready for Soldering. (D) Immersion of the T-Peel Test Sample Into the Soldering Filler Metal Bath. The Block Is Used to Control the Immersion Depth and Allow the Joint to Form by Capillary Flow. (E) The Soldered T-Peel Test Specimen . . . . .	61
6.15	(A) Schematic Diagram Shows the Starting Configuration of the T-Peel Test Specimen, with Unbent Base Material “Legs.” The Spacer Sizes and Location Configuration Details are Listed in Figure 6.14(A) and the Accompanying Table. (B) Immersion of the T-Peel Test Sample into the Soldering Filler Metal Bath. The Block Is Used to Control the Immersion Depth and Allow the Joint to Form by Capillary Flow. (C) The Soldered T-Peel Test Specimen. (D) The Test Specimen is Clamped into the Fixture and the Unsoldered Legs Bent to 90° Around the Properly Aligned Mandrels. (E) The Soldered T-Peel Test Specimen . . . . .	62
6.16	T-Peel Mechanical Test and Table of Dimensions That Position the Grips to the Test Specimen. . . . .	63
6.17	Modified Compact Tension (CT) Test Specimen and Table of Dimensions . . . . .	64
6.18	Schematic Diagram Shows the Placement of Spacer in the Joint Clearance. The Accompanying Table Provides the Dimensions of the Spacers and Their Location. . . . .	65
6.19	Steps Show the Capillary Flow Process Used to Create the Soldered Joint in the Modified CT Test Specimen: (A) Two Base Materials Are Clamped Together; (B) Test Specimen Is Immersed in the Soldering Filler Metal Bath With the Block at the Bottom of the Bath to Control the Immersion Depth; and (C) The Finished Test Specimen With the Soldered Joint. . . . .	65
6.20	(A) Schematic Diagram Shows the Four-Point Bend Soldered Joint Test Specimen. The Table Lists the Dimensions of the Base Materials as well as the Position of the Load Span to Which the Force is Applied (Load), F, Partitioned to F/2 to the Two Rollers, is One-Half the Support Span. The Geometry of the Rollers is for Illustration; See ASTM C1161 for the Detailed Requirements Placed on the Rollers. (B) Configuration of the Spacers Used to Control the Joint Clearance When the Test Specimen is to be Used for Monotonic, Time-Independent Deformation (Stress-Strain) Testing. The Accompanying Table Lists the Dimensions. (C) Configuration of the Spacers Used to Control the Joint Clearance When the Test Specimen is to be Used for Monotonic, Time-Dependent Deformation (Creep) Testing as well as Cyclic Testing—Isothermal Fatigue and TMF. The Accompanying Table Lists the Dimensions. . . . .	67
6.21	Schematic Diagram Shows the Soldered Joint Fabrication of a Four-Point Test Specimen Using a Soldering Filler Metal Fountain (“Mini-Wave”). (A) Spacers and Clamps Are Put Into Place. (B) The Joint Clearance is Placed over the Soldering Filler Metal Fountain to Form the Joint. (C) Diagram Shows the Completed Test Specimen. . . . .	68

This page is intentionally blank.

# Standard Methods for Evaluating the Strength of Soldered Joints

## 1. General Requirements

**1.1 Scope.** The purpose of this document is to standardize the methods used to obtain reproducible strength data on soldered joints. Requirements are made with respect to base materials—metal alloy and ceramic; test specimen geometries; soldered joint clearance; test specimen fabrication processes; mechanical testing procedures; as well as data reporting and failure analysis. The standardization of these requirements will allow for the comparison of soldered joint strength data between different testing sources. The objective of this specification is to describe those standard requirements for design, process, reliability, and test engineers and operators.

The user will note that specific base material metal (alloy) and ceramic compositions are specified for the test specimens. This requirement was introduced, once again, with the objective of standardizing the mechanical test data. However, applications may arise whereby the user would deviate from these base material requirements in order to measure the effects on soldered joint mechanical strength caused by the combined effects of temperature cycling and dissimilar coefficients of thermal expansion (CTEs) between base materials or between the base materials and the soldering filler metal. Test documentation should reflect these deviations.

**1.1.1 Printed Circuit Board Soldered Joints.** This specification does not address the mechanical testing of soldered joints used on printed circuit boards (PCBs). The omission of this topic does not imply that the mechanical properties of PCB soldered interconnections are of lesser importance in soldering technology. Rather, addressing this specific category of soldered joints would require a separate set of requirements to address the sheer breadth of materials and design configurations that are used on PCBs. Such an effort was beyond the scope of this document. Nevertheless, the test procedures and analysis techniques, which are discussed in the following paragraphs, could be applied to the development of mechanical tests for PCB soldered joints.

**1.1.2. Computational Modeling.** Lastly, the level of rigor underlying the requirements in this specification will result in property data with sufficient fidelity to validate computational model predictions.

**1.1.3. Control Documents.** Control documents shall have the following order of authority from highest to lowest: instructions from the Organization Having Quality Responsibility (OHQR), assembly drawings, contract or purchase order contents, and this specification. The OHQR shall have the authority to make any modifications to the requirements in this document or other control document(s) and the responsibility to communicate those modifications to the relevant engineer(s), operator(s), or both. Any and all modifications to control documents shall be fully documented by the OHQR.

**1.2 Units of Measurement.** This standard makes use of both the International System of Units (SI) and U.S. Customary Units. The latter are shown within brackets ([ ]) or in appropriate columns in tables and figures. The measurements may not be exact equivalents; therefore, each system must be used independently.

**1.3 Safety.** Safety and health issues and concerns are beyond the scope of this standard; some safety and health information is provided, but such issues are not fully addressed herein.

Safety and Health information is available from the following sources: