New Publications

The Professional’s Advisor on Procedure Qualification Variables

Cross-Reference Tables for AWS D1.1, AWS D1.5, AWS B2.1, ASME IX, and API 1104.

This highly useful document aids the welding professional in preparing welding procedure specifications (WPSs) and procedure qualification records (PQRs). It covers welding processes of ferrous metals: SAW, SMAW, GMAW, FCAW, and GTAW. The data in the cross-reference tables are typical in a WPS: joint design, base metal, filler metal, position, preheat and interpass, heat treatment, shielding gas, electrical, and other variables such as process type (i.e., manual, mechanized, automatic), single or multi-pass, peening, stronger or weave bead, etc. This new Professional’s Advisor is a convenient adjunct to — but not a substitute for — codes and other standards.

Chapters include safety, explanation of the WPS and PQR, and illustrative forms. Chapters 4 through 8 illustrate process and procedural variables, noting when the variable requires requalification in general (Q), when toughness testing is used (T), and/or when automatic welding is used (A).

Chapter 9 provides terms and definitions (with drawings) from AWS 3.0, Standard Welding Terms and Definitions; applicable to procedure qualification or from the five codes covered in the Advisor. Writer/compiler Kenneth W. Coryell is an AWS technical volunteer, instructor, and successful Ohio-based consultant. Final reviewers were AWS committee chairs and/or AWS technical committee representatives to ASME or API. 132 pages, spiral bound, tabbed, 5-1/2” x 8-1/2”, (2005).

Order Code: AWS PAPQV, Nonmembers: $84, AWS Members: $63

The Industrial Hobarts

Peter C. Hobart, former vice president for international business at Hobart Brothers, and historian Michael W. Williams tell this clear and engaging story of three generations of the Hobart family. The Hobarts used imagination and ingenuity to compete within the electrical-power, food-processing, office-furniture, transportation, construction, defense, and aerospace industries. Stimulated by a corporate culture that encouraged teamwork and creativity, company engineers earned scores of patents. In the growth of their family’s business, the Hobarts found purpose and success in the golden age of American industry.

Enriched by a wealth of photographs, dozens of interviews, and a variety of other primary sources, The Industrial Hobarts is a microcosm of the history of the Industrial Midwest. It spans the era from the infancy of electrical lighting to robotic laser welding, cutting, and coating systems. This fascinating story will captivate anyone interested in technology, business, history, or people. 256 pages, hardbound or softbound. (2004).


The Resistance Welder Manufacturers’ Association (RWMA) has set the standard for resistance welding worldwide. RWMA’s most authoritative text about the resistance welding industry is an absolute must for anyone who wants to increase production capabilities, upgrade product quality, and maximize the use of manufacturing resources. The Resistance Welding Manual, Revised Fourth Edition describes the entire resistance welding process, including theory, methods, materials, equipment, and accessories. The revised edition includes many new features, such as updated weld schedules with the latest calculations for resistance welding processes, new graphic format for easier reading of weld schedules, and information on newer metal alloys, such as hot dip galvanized and electro-plated steel. 468 pages, 25 chapters, 2 appendices (including an index), 308 figures, 85 tables, other features, hardbound. 8-3/4” x 11-1/4”, (2003), 4th edition.

Order Code: AWS RWIM, $125

B5.4:2005, Specification for the Qualification of Welder Test Facilities

This specification defines the requirements to qualify welder test facilities. It details qualification methods and test facility and assessment requirements. A mandatory annex covers qualification of assessors. ANSI Approved. 22 pages, 6 chapters, 4 annexes. (2005).

Order Code: AWS B5.4, Nonmembers: $28, AWS Members: $21

C1.5:2005, Specification for the Qualification of Resistance Welding Technician

This specification establishes the requirements for qualification of resistance welding technicians employed in the welding industry. It defines the minimum experience, examination, application, qualification, and requalification requirements and methods. 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 troubleshooting, processes controls, quality standards, and problem solving. ANSI Approved. 16 pages, 2 annexes, (2005).

Order Code: AWS C1.5, Nonmembers: $28, AWS Members: $21


This document describes methods and techniques for shaping and straightening metal parts (including steel plate, pipes, angles, channel, T bar, and compound structures) by careful application of heat. It presents the theory and mathematical formulas for developing heat shaping patterns. Other topics include oxyfuel gas equipment (torches, tips, regulators, fuel gases, gas cylinders, and bulk supply); torch procedures for spot, line and V heating patterns; and safety procedures. Figures show the locations for placement of heating patterns to obtain desired results for straightening, forming, or bending operations. 53 pages, 39 figures, 4 tables, (2004).

Order Code: AWS C4.4/C4.4M, Nonmembers: $60, AWS Members: $45


An indispensable self-study guide for the new AWS Certified Welding Supervisor certification examinations, this new manual also will appeal to everyone concerned with enhancing productivity in the welding workplace. Written and edited by the Barckhoff and Associates instructors who teach the AWS preparatory course, this book reviews management systems for welding supervisors, requirements of welds, detailed descriptions of four welding processes (SMAW, GMAW, FCAW, and SAW), welding metallurgy, welding symbols, welding instructions, welding economics, the application of welding standards, welding inspection, health and safety, and work reports and records. The welding economics chapter will help the welding supervisor estimate and control costs for welding jobs. Each chapter includes practice questions and additional references. Available soon: approx. 400 pages, 14 chapters, (2005).

Order Code: AWS CMWS, Nonmembers: $176, AWS Members, $132


Does your robotic welding system comply with industry safety standards? Find out from this new standard if you use arc welding robots. Does your robotic welding system comply with industry safety standards? Find out from this new standard if you use arc welding robots. 26 pages, 1 figure, (2004).


To order or for more information: 800-295-5482 or global.ihs.com
The Practical Reference Guide to Arc Welding Steel

How can low-carbon, low-alloy steels be treated to exhibit desirable traits such as very high yield strength, good ductility, and notch toughness? What are the advantages/limitations of shielded metal arc, gas metal arc, flux cored arc, and submerged arc welding? This newest entry in the Practical Reference Guide series has the answers. Roughly half of its pages discuss behavior of steels in a weld's thermal and mechanical environment. This common-sense guide makes hard-to-weld items weldable. With its well-structured descriptions, explanations, and illustrations, The Practical Reference Guide to Arc Welding Carbon Steel fits neatly between Everyday Pocket Handbooks and AWS Recommended Practices in scope and depth. Compiler Eugene Hornberger, SCWI, has 20 years of instructional experience with CWI exam candidates and private training for some of America's largest manufacturers. Includes a deposition-rate appendix. 50 pages, 39 figures, 12 tables, glossary, (2005).

Order Code: AWS PRGAWS, Nonmembers: $48, AWS Members: $36

Total Welding Management

A systematic approach to welding excellence and cost reduction through the marriage of technology and sound management principles. Drawing on more than 50 years of welding experience, author Jack R. Barckhoff, P.E., gives you a solid step-by-step plan to manage your welding operation for maximum productivity and cost efficiency. Implementing the principles and concepts in this book could save you $10,000 to $35,000 annually per welder. Specific recommendations and real-life production examples illustrate how your welding team can realize productivity gains of 20 percent to 50 percent. Total Welding Management explains the management principles, structure, and details you need to transform your welding operation from a cost center into a profit center. A must-read for supervisors, managers, and executives who seek to make their welding operation efficient and productive. 200 pages, 35 figures, 20 tables, hardbound. 6 x 9", (2004).

Order Code: AWS TWM, $49.50

Guide to Weldability: Carbon and Low-Alloy Steels

First in a new series, this Weldability Primer answers a multitude of questions on fabrication and repair projects to help you select the method, materials, and procedures for superior results. Chapters include “The Questions,” “Key Background Information,” “What Happens When You Weld,” “Selection of Proper Electrodes and Rods,” “Weld Defects and Causes,” and “Post Weld Treatments.”

This Primer should sit on the desks of QA/QC personnel, engineers, shop owners and managers, and senior technicians. It provides specifics on:

- The effects of common alloying elements such as carbon, silicon, chromium, and molybdenum on carbon steels
- How to establish carbon equivalency
- Why welding has been called “a mini steelmaking process”
- How to determine cracking susceptibility
- What happens when a weld cools
- The effect of hydrogen migration on weld integrity
- Metallurgically related or induced defects
- When to preheat, and when not to
- When to select an electrode that produces weld metal with tensile strength higher – or lower – than the base metal
- What mechanical tests can tell you
- What defects the naked eye can find easily in a weld cross-section

Author Fritz Saenger, Jr., PE, IWE, has assembled this highly useful tool, drawing heavily from the AWS Welding Handbook; George E. Larner’s Welding Metallurgy; ASM Handbook; Vol. 6; and AWS’s Jefferson’s Welding Encyclopedia. 51 pages, 9 chapters, 2 appendices, 20 figures, 14 tables, (2005).

Order Code: AWS GTW, Nonmembers: $48, AWS Members: $36

NEW 2005 EDITIONS OF FILLER METAL SPECIFICATIONS


A5.20/A5.20M:2005, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding


A2.28/A5.28M:2005, Specification for Low-Alloy Electrodes and Rods for Gas Shielded Arc Welding

A2.29/A5.29M:2005, Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding

For a complete list of Filler Metal Specifications, see page 27.

NEW EDITIONS

ANSI Z49.1:2005, Safety in Welding, Cutting, and Allied Processes

For details, see page 15.


For details, see page 12.

B5.17:2004, Specification for the Qualification of Welding Fabricators

For details, see page 12.

C3.8M/C3.8:2005, Specification for the Ultrasonic Examination of Brazed Joints

For details, see page 24.


For details, see page 20.


For details, see page 20.


For details, see page 21.

D3.7:2004, Guide for Aluminum Hull Welding

For details, see page 29.

D8.6:2005, Standard for Automotive Resistance Spot Welding Electrodes

For details, see page 29.


For details, see page 29.


For details, see page 28.


For details, see page 28.


For details, see page 28.


For details, see page 28.


For details, see page 12.

The Everyday Pocket Handbook on Welded Joint Details for Structural Applications

For details, see page 30.

The Everyday Pocket Handbook for Visual Inspection of AWS D1.1 Structural Welding Code’s Fabrication and Welding Requirements

For details, see page 30.

QC10:2004, Specification for Qualification and Registration of Level I – Entry Welders

For details, see page 13.
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Quality Certification by the American Institute of Steel Construction, Inc., confirms that an individual company has the capability of performing the desired level of work in the discipline(s) for which it is certified. As noted in the table below, several of these certifications require you to have a specific bundle of AWS documents in your library.

### AWS Structural Bundle Pricing Chart

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See descriptions of AWS Structural Standards on pages 6 and 7.
Why You Need the Latest Edition

Save time and money, and maximize reliability and safety, with the 2004 edition of AWS D1.1, Structural Welding Code—Steel.

New for 2004:

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• Details newest allowable stress range formulae.
• Adjusts prequalification figure details.
• Adjusts welder qualification essential variables.
• Presents latest revision of prequalified base metal list.
• Details newest allowable stress range formulae.
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• Updates certain ASTM steel specifications and adds new prequalified steels, reflecting advances in technology.
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• Details newest allowable stress range formulae.
• Adjusts prequalification figure details.
• Adjusts welder qualification essential variables.
• Presents latest revision of prequalified base metal list.


D1.1/D1.1M:2004 CD, Structural Welding Code—Steel

All the information of the Code – the entire AWS D1.1/D1.1M:2004 text, plus all graphics and tables — is now on a powerful CD-ROM! Find specific provisions fast! Five convenient search methods — full text, keyword, document/paragraph number, subject, and table of contents — make referencing practically effortless.

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Welded Joint Details for Structural Applications

A two-color, oversized desk chart that diagrams 20 different structural joints with prequalified details from AWS D1.1-96, but applicable to subsequent editions of the AWS D1.1 Code. Includes legends for groove details and AWS joint designations. Can’t and shouldn’t replace the original, but it is particularly handy for the busy professional.

Order Code: AWS SWJ-WC, Nonmembers: $24, AWS Members: $18

To order or for more information: 800-295-5482 or global.ihs.com
D1.5M/D1.5:2002, BRIDGE WELDING CODE

Get the most recent facts and code requirements for bridge building with carbon and low-alloy construction steels.

The American Welding Society's most recent version of the D1.5 Bridge Welding Code outlines requirements of the American Association of State Highway and Transportation Officials (AASHTO) for building highway bridges made from carbon and low-alloy construction steels. Chapters cover inspection, qualification, structural details, stud welding, welded joint details, workmanship, and more. This edition features the latest AASHTO revisions and NDE requirements, as well as a section providing a "Fracture Control Plan for Nonredundant Bridge Members." Welding and construction professionals and designers will find this book essential for all forms of bridge work. ANSI Approved. 364 pages, annexes, 77 figures, 35 tables, (2002).

Other Highlights of This Edition:
- Inclusion of U.S. Customary Units
- Provisions for undermatching electrode usage
- Added commentary section
- New requirements for the modified WPS qualification tests

Order Code: AASHTO/AWS D1.5M/D1.5
Nonmembers: $188, AWS Members: $141

D1.1/D1.1M:2004, Structural Welding Code—Steel

For details, see page 6.

D1.2/D1.2M:2003, Structural Welding Code—Aluminum

Fourth edition reflects vital updates to code requirements and welding inspector qualifications in previous editions. This code is the single most important reference available on welding requirements for any type of aluminum alloy structure (except aluminum pressure vessels and fluid-carrying pipelines). Includes a commentary offering guidance for interpreting and applying the code. ANSI Approved. 216 pages, 59 figures, 27 tables, (2003).

Order Code: AWS D1.2/D1.2M
Nonmembers: $132
AWS Members: $99

D1.3-98, Structural Welding Code—Sheet Steel

If you’re responsible for the welding of steel decks, panels, storage racks, and stud and joist framing members, to name a few applications, this code helps you to effect consistently sound welding of joints. “One of the primary objectives of this code is to define the allowable capacities used in sheet steel applications in which the transfer of calculated load occurs.” Includes allowable load capacities, details of welded connections, prequalification of WPSs, qualification, inspection, stud welding, and a helpful interpretive commentary. ANSI Approved. 76 pages, 5 annexes, 44 figures, 7 tables, (1998).

Order Code: AWS D1.3
Nonmembers: $100
AWS Members: $75

Suggested Preheat Temperatures for Welding Structural Steel Materials

For details, see page 18.

D1.4-98, Structural Welding Code—Reinforcing Steel

Fifth edition covers welding reinforcing steel in most reinforced concrete applications. Includes allowable stresses, inspection, qualification, structural details, joint details, and workmanship requirements. Figures clearly illustrate important welding considerations: unacceptable weld profiles, effective weld sizes, details of joints of anchorages, base plates, and inserts. ANSI Approved. 54 pages, 7 chapters, 5 annexes, 9 tables, (1998).

Order Code: AWS D1.4
Nonmembers: $84
AWS Members: $63

D1.6:1999, Structural Welding Code—Stainless Steel

This code establishes the requirements for welding stainless steel using the gas metal, shielded metal, flux cored, and submerged arc welding processes, including stud welding. The code covers design, fabrication, qualification and prequalification of procedures, welding personnel qualification, and inspection. ANSI Approved. 224 pages, 12 annexes, 79 figures, 26 tables, (1999).

Order Code: AWS D1.6
Nonmembers: $132
AWS Members: $99

Suggested Filler Materials for Welding Structural Steels

For details, see page 26.


Thanks to the AWS D9 Committee on Welding, Brazing and Soldering of Sheet Metal, this popular code is improving workmanship to a 21st-century level. Covers the arc and braze welding requirements for nonstructural sheet metal fabrications. Includes process procedure qualification, welder/operator performance qualification, workmanship, and inspection. Annexes include recommended filler materials; gauge numbers, U.S. Customary, and SI Unit equivalents; WPS and PQR forms; arc and braze welding joint designs; and recommended arc and braze welding practices. ANSI Approved. 54 pages, 11 annexes, 8 figures, 10 tables, (2000).

Order Code: AWS D9.1M/D9.1
Nonmembers: $76
AWS Members: $57

Available in electronic format  NASA Preferred  NASA Pending  Department of Defense Adopted
Add clarity to your technical writing by using the correct terms related to welding, brazing, and nondestructive examination information on drawings, and the most error-free means for welding personnel to adhere to original plans. This publication is essential for interpreting mandatory codes such as the AWS D1.1/D1.1M-2004, Structural Welding Code—Steel. Secure your copy of the only official statement of a welding symbol system approved by ANSI and in use by the U.S. Departments of Transportation and Defense. 120 pages. (1998).

Order Code: AWS A2.1-WC, Nonmembers: $24, AWS Members: $18

Desk Chart
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Order Code: AWS A2.4/A2.1 SET
Nonmembers: $152, AWS Members: $114

A3.0:2001, Standard Welding Terms and Definitions
Add clarity to your technical writing by using the correct terms related to welding, brazing, and allied processes in a precise and accurate manner. Each term should have only one clearly applicable definition, accurately reflecting the term’s use in the welding world. This compilation of over 1,200 terms and definitions includes standard and nonstandard terms and definitions, the Master Chart of Welding and Allied Processes, and the Joining Method Chart. ANSI Approved. 152 pages, 53 drawings. (2001).

Order Code: AWS A3.0, Nonmembers: $128, AWS Members: $96

FMC:2000, Filler Metal Comparison Charts
Thousands of filler metal products exist, each with a distinctive trade name. Most conform to AWS filler metal classifications, making the 2000 edition of Filler Metal Comparison Charts the ultimate guide to the marketplace. It contains:

- 83 national and international suppliers, with their mailing address, telephone, fax, and Web site address. (Over half weren’t in the 1993 edition.)
- Handy indexes arranged by classification numbers (1,500) and brand names (11,000) for finding information quickly.

Order Code: AWS FMC Nonmembers: $164
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Order Code (Book): AWS JWE
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This Advisor’s pages are packed with illustrations, tables, definitions, explanations, tips, and advice. Chapters include voltage, amperage, metering, transformers, controls, selection criteria, efficiency, and cost. Covers the SMAW, GTAW, GMAW, FCAW, and CAC-A processes. Related equipment includes wire feeders, guns, and system controls. Meant to be portable like its sister Advisors, this book should help resolve on-the-shop-floor problems. (When you’ve got problems — and who doesn’t? — go directly to Chapter 10, “Common Problems, Misunderstandings, and Trouble-Shooting. ”) When you’re in the market to buy, become an educated consumer through “Selection Criteria, Efficiency, and Cost Considerations.” 76 pages, 11 chapters, 78 figures, 14 tables, tabbed and spiral-bound. 5-1/2” x 8-1/2”, (1999).

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Order Code: AWS WM1.4 Nonmembers: $148
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Reference Sources
For details, see page 6.

A2.4-98, Standard Symbols for Welding, Brazing, and Nondestructive Examination
As a “language,” these symbols are the precise means for designers and detailers to place welding, brazing, and nondestructive examination information on drawings, and the most error-free means for welding personnel to adhere to original plans. This publication is essential for nonmembers: $152, AWS Members: $114

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Add clarity to your technical writing by using the correct terms related to welding, brazing, and allied processes in a precise and accurate manner. Each term should have only one clearly applicable definition, accurately reflecting the term’s use in the welding world. This compilation of over 1,200 terms and definitions includes standard and nonstandard terms and definitions, the Master Chart of Welding and Allied Processes, and the Joining Method Chart. ANSI Approved. 152 pages, 53 drawings. (2001).

Order Code: AWS A3.0, Nonmembers: $128, AWS Members: $96

Jefferson’s Welding Encyclopedia, 18th Edition
No matter what your involvement in the industry, Jefferson’s Welding Encyclopedia puts the world of welding right at your fingertips. A useful tool for any level in the industry, from student to experienced veteran. It’s a handy reference for anyone who needs quick access to thorough welding information. Topics are explained, illustrated, and made comprehensible. It also includes a historical look at the welding industry, a handy Buyer’s Guide, and an exhaustive listing of key industry suppliers. Color illustrations, revised and edited by Robert L. O’Brien. 768 pages. CD-ROM or 8” x 10”, (1997), 18th edition.

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The Professional’s Advisor on Arc Welding Power Sources and Related Equipment
This Advisor’s pages are packed with illustrations, tables, definitions, explanations, tips, and advice. Chapters include voltage, amperage, metering, transformers, controls, selection criteria, efficiency, and cost. Covers the SMAW, GTAW, GMAW, FCAW, and CAC-A processes. Related equipment includes wire feeders, guns, and system controls. Meant to be portable like its sister Advisors, this book should help resolve on-the-shop-floor problems. (When you’ve got problems — and who doesn’t? — go directly to Chapter 10, “Common Problems, Misunderstandings, and Trouble-Shooting. ”) When you’re in the market to buy, become an educated consumer through “Selection Criteria, Efficiency, and Cost Considerations.” 76 pages, 11 chapters, 78 figures, 14 tables, tabbed and spiral-bound. 5-1/2” x 8-1/2”, (1999).

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The premier publication on welding metallurgy of steels. Comprehensive and encyclopedic in scope, Welding Metallurgy was written by the late George E. Linnert, one of America’s most respected and informed metallurgical authorities. Builders, manufacturers, welding shops, colleges, and universities will benefit from this indispensable reference book. Place a lifetime of welding research and experience at your fingertips with this practical insight into the science and technology of metals. 964 pages, 10 appendices, 248 figures, 62 tables, 7” x 10”, (1994).

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AWS Welding Handbooks

The renowned AWS Welding Handbook series is a must-have reference set for engineers, structural designers, technologists, inspectors, welders, welding educators, and others who need to understand this evolving industry. The books chronicle the industry's continual advancement and diversification; detail its technologies and processes; and put safety, quality, and qualification issues in perspective. An index of major subjects covered in current volumes places all the facts at your fingertips.

**WHB-1.9, Welding Handbook, Ninth Edition, Volume 1, Welding Science and Technology**

Volume 1 presents the latest developments in the basic science and technology of welding. Presents general descriptions of processes, then continues with chapters on the physics of welding and cutting; heat flow; welding metallurgy; design; test methods; residual stress; welding symbols; tooling and positioning; monitoring and control; mechanized, automated, and robotic techniques; economics; weld quality; inspection; qualification and certification; welding codes and standards; and safe practices. 932 pages, 17 chapters, 2 appendices, 530 illustrations, 168 tables; hardbound. 8" x 10", (2001).

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This newest Welding Handbook volume presents comprehensive information on welding and related processes. It contains detailed information on arc welding power sources; shielded metal arc welding; gas tungsten arc; gas metal arc; flux cored, submerged arc; and plasma arc welding processes; and chapters on electroslag welding, stud welding, oxy-fuel gas welding, brazing, soldering, oxygen cutting, and arc cutting and gouging. Revised and reviewed by more than 100 welding experts. 736 pages, 15 chapters, 260 line drawings, 100 photographs, 148 tables, hardbound. (2004).

Order Code: AWS WHB 2.9, Nonmembers: $192, AWS Members: $144


Cover the spectrum of welding and cutting processes with this invaluable resource book. Contains chapters on spot, seam, and projection welding; resistance welding equipment; flash, upset, and percussion welding; high frequency welding; electron beam welding; laser beam welding; friction welding; explosion welding; ultrasonic welding; diffusion welding and diffusion brazing; adhesive bonding of metals; thermal spraying; and laser beam and water jet cutting. Detailed charts, drawings, and appendices make this handbook a practical and indispensable reference. 976 pages, 29 chapters, 8-1/2" x 10-1/2", (1991).

Order Code: AWS WHB-2.8, Nonmembers: $112, AWS Members: $84


This volume covers essential information on nonferrous metals, plastics, composites, and ceramics; and new specialized topics on maintenance and repair welding, and underwater welding and cutting. Also included are discussions on applications of the various processes, weldability, applications of specific metals, and safe practices. Full of easy-to-understand line drawings and tables, and color photos. 538 pages, 10 chapters, 2 indexes, hardbound. 8-1/2" x 10-1/2", (1996).

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Volume 4 is the ultimate reference tool. Packed with more than 500 tables, charts, and photos, this book makes your research easier than ever. Chapters cover carbon and low-alloy steels; high-alloy steels; coated steels; tool and die steels; stainless and heat-resisting steels; clad and dissimilar metals; surfacing; cast irons; titanium and titanium alloys; and reactive, refractory, and precious metals and alloys. 634 pages, 10 chapters, 2 indexes, hardbound. 8-1/2" x 10-1/2", (1998).

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By simplifying some of the welding profession’s technical language, this book delivers practical knowledge of welding to students, less experienced welders, and even hobbyists. Color illustrations and charts explain the common welding processes, filler metals, metallurgy, and safety considerations. Appendices include welding symbols and definitions. By Darrel McGuire. 90 pages. (1998), second printing.

Order Code: AWS WPERF, Nonmembers: $24, AWS Members: $18

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**The Practical Welding Engineer**

This valuable book offers a practical approach to the application of welding theories. Two expert authors with nearly 60 years of hard-gained experience in heavy engineering offer solid advice in real-world application of welding metallurgy, materials behavior, fracture mechanics, and much more. Key topics include contracts and specifications, selection of welding processes, welding procedure qualification, production welding control, estimating and reducing welding costs, common weld defects, and practical problem-solving. By J. Crawford Lochhead and Ken Rodgers. 158 pages. (2000).

Order Code: AWS PWE, Nonmembers: $72, AWS Members: $54

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AWS Resources for Engineers

Mechanized, Automated, and Robotic Welding
A non-commercial look at the efficiencies of mechanized, automated, and robotic welding, this chapter from the Welding Handbook, Ninth Edition, Volume 1, was written by experts from some of the most successful welding-equipment manufacturers and users: Tower Automotive, ABB Flexible Welding Control, KOHOL Systems, Fanuc Robotics-North America, Trek Bicycle Corp., Johnson Controls, Detroit Center Tool, Panasonic Factory Automation, and The Lincoln Electric Co. Covers system components and operating characteristics for arc and resistance welding. Includes section on “Planning for Automated and Robotic Welding” with emphasis on integration and a sample Gantt chart installation schedule. 38 pages, 20 figures, 3 tables, (2001). Order Code: AWS ARE-11, Nonmembers: $52, AWS Members: $39

Welding Metallurgy
Although metallurgy is a standard subject in general engineering, it may not provide the information that welding engineers need. This helpful chapter from the Welding Handbook, Ninth Edition, Volume 1, starts with coverage of physical metallurgy, serving as a solid refresher or a clear introduction. Reviews alloys, phase transformations, phase diagrams, effects of deformation and heat treatment, cold working, austenitization caused by welding, weldability of commercial alloys, and corrosion in welds and brazed or soldered joints. Impressive bibliography and supplementary reading list. 48 pages, 33 figures, 2 tables, (2001). Order Code: AWS ARE-4, Nonmembers: $52, AWS Members: $39

Design for Welding
Designers of weldments must understand basic design principles and concepts. This full chapter from the Welding Handbook, Ninth Edition, Volume 1, consolidates expert information from authorities such as AWS, AA, AISC, API, ASCE, ASTM, and ASME. Topics include mechanical and physical properties, program for welding design, decision factors, design of welded joints, selection of weld type, sizing of steel welds, tubular connections, and aluminum structures. 88 pages, 23 equations, 57 figures, 18 tables, (2001). Order Code: AWS ARE-5, Nonmembers: $64, AWS Members: $48

Test Methods for Evaluating Welded Joints
When selecting a test method, consider the test’s purpose and weigh it against time and cost. This complete chapter from the Welding Handbook, Ninth Edition, Volume 1, examines the methods available to evaluate the performance of welded and brazed joints and thermal spray applications. Engineers must design welded joints to meet the mechanical and physical properties required by the service application and environment. An excellent explanation of when to use what test method, this publication is an essential companion to AWS B4.0, Standard Methods for Mechanical Testing of Welds, which tells you how to conduct the tests. 64 pages, 8 equations, 48 figures, 3 tables, (2001). Order Code: AWS ARE-6, Nonmembers: $64, AWS Members: $48

Residual Stress and Distortion
Complex residual stresses occur in welds and their distribution patterns. This complete chapter from the Welding Handbook, Ninth Edition, Volume 1, presents a highly intelligible explanation of stress in single and multipass welds produced by the arc welding processes. If you need to know the nature, causes, and effects of residual stress and distortion, and/or the factors that increase or decrease the magnitude of stress in welds, you need this publication. It also covers methods of calculating and measuring residual stress and distortion, and reduction and control techniques. 68 pages, 26 equations, 60 figures, 4 tables, (2001). Order Code: AWS ARE-7, Nonmembers: $64, AWS Members: $48

Symbols for Joining and Inspection
The basic welding symbol consists of the reference line, about which the weld symbol and dimensions are located, and an arrow designating the location for the weld. This chapter from the Welding Handbook, Ninth Edition, Volume 1, examines each component of the welding symbol: reference line (required); arrow (required); tail; basic weld symbol; dimensions and other data; finish symbols; specification, process, or other references; and supplementary symbols. It applies the welding symbols to common types of welds: groove, fillet, plug, slot, spot, projection, scar, stud, and edge. Also covers brazed joints, soldering symbols and joints, and the elements of nondestructive examination symbols. Examples are in U.S. Customary units. 42 pages, 45 figures, 4 tables, softcover, (2001). Order Code: AWS ARE-8, Nonmembers: $52, AWS Members: $39

Monitoring and Control of Welding and Joining Processes
Demands for increased productivity and improved quality have been the impetus for real-time process monitoring and control. While a process monitor can be used to compare the output of the sensor to predefined parameter limits, process control goes a step beyond process monitoring by adjusting the welding process automatically. This chapter from the Welding Handbook, Ninth Edition, Volume 1, discusses principles behind process sensing, monitoring, and control; and describes the application of sensors, monitors, and process controls in sections covering the arc, resistance, laser beam, electron beam, friction welding, and brazing processes. 36 pages, 19 figures, 6 tables, (2001). Order Code: AWS ARE-10, Nonmembers: $52, AWS Members: $39

Economics of Welding and Cutting
An unbiased primer based on considerable research, this chapter from the Welding Handbook, Ninth Edition, Volume 1, gives the estimator a good idea of the arc-on versus the nonarc time for any given welding process. Topics include the cost estimate, automated and robotic systems, control of welding costs, and the economics of welding, brazing, soldering, and thermal cutting. 56 pages, 30 equations, 33 figures, 23 tables, (2001). Order Code: AWS ARE-12, Nonmembers: $52, AWS Members: $39

Design Handbook for Calculating Fillet Weld Sizes
Choosing the right fillet weld size is essential for satisfactory weldment performance. This alternative approach to the traditional design philosophy for calculating the correct fillet weld size will help quality-minded welding fabricators in industries using steel, stainless steel, and aluminum alloys. Because this document is not a consensus standard, users also should refer to the standards relevant to their application. 28 pages, 8” x 10”, (1997). Order Code: AWS FW SH, Nonmembers: $48, AWS Members: $36

Design and Planning Manual for Cost-Effective Welding
A practical guide for engineers, planners, and hands-on professionals to improve scheduling and lessen rework regardless of industry. Past AWS board member Eugene Hornberger has edited, updated, and expanded the original text developed under the auspices of the Maritime Administration with support from the U.S. Navy. The Design and Planning Manual for Cost-Effective Welding contains 18 sections, each with its own table of contents; numerous drawings, tables, charts, and checklists; and a bibliography and recommended reading list. Topics include welding cost analysis, modular construction, concepts of welding design, fatigue considerations, joint design, weld distortion and control, information for the welder, NDE, and defects and discontinuities. 142 pages, (1999). Order Code: AWS DPW, Nonmembers: $72, AWS Members: $54

To order or for more information: 800-295-5482 or global.ihs.com
Handbook on the Ultrasonic Examination of Austenitic Welds

You’ll learn from this Handbook how to detect, locate, and evaluate ultrasonic indications of defects in post-fabrication austenitic welds, using manual scanning techniques. With proper data recording procedures, the information also applies to mechanical scanning techniques. The Handbook deals specifically with groove welds to weld metal similar in composition to the base metal, and offers general insights for dissimilar weld metals and non groove weld geometries. Published by the International Institute of Welding. 44 pages, 10 chapters, recommended reading list, 50 figures, (1986).

Order Code: AWS UEAW
Nonmembers: $20
AWS Members: $15

Welding Quality Assurance Guideline for Fabricators

An excellent outline to assist small to medium fabricators in developing new welding quality-assurance systems or to enhance an existing system. Provides three levels of conditions that can be specified to determine radiographic acceptance of welds. 36 pages, charts and diagrams, (1995).

Order Code: AWS WQAG
Nonmembers: $12
AWS Members: $9

WIT-T:2000, Welding Inspection Technology

For at-home study, you can purchase this official reference textbook for the three-day AWS core seminar for CWI exam preparation. You'll find this newest Welding Inspection Technology text more readable, informative, and comprehensive than ever before. 344 pages, 18 chapters, index, 108 figures, 16 tables, 6-1/2” x 9”, (2000), 3rd edition.

Order Code: AWS WIT, Nonmembers: $268, AWS Members: $201

WIT-W-99, Welding Inspection Technology Workbook


This universal qualification document is an excellent tool to ensure economical quality. Covers all welding processes and an exhaustive array of materials used in metal fabrication. Spells out requirements for the qualification of welding procedures, and for the performance qualification of welders and welding operators.

**WELDING PROCESSES INCLUDE:**
- Oxyfuel Gas Welding
- Gas Tungsten Arc Welding
- Laser Beam Welding
- Flux Cored Arc Welding
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- Submerged Arc Welding
- Gas Metal Arc Welding
- Plasma Arc Welding
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**B2.1 GIVES COMPLETE COVERAGE OF:**
- Base Metals
- Qualification Variables
- Filler Metals
- Testing Requirements


Order Code: AWS B2.1, Nonmembers: $124, AWS Members: $93

ALSO SEE STANDARD WELDING PROCEDURE SPECIFICATIONS, PAGES 22 & 23.

**B2.2-91, Standard for Brazing Procedure and Performance Qualification**

Provides the requirements for qualification of brazing procedure specifications, brazers, and brazing operators for manual, mechanized, and automatic brazing. Includes torch, furnace, induction, resistance, dip, and infrared brazing; and base metals, brazing filler metals, brazing fluxes, brazing atmospheres, and brazing joint clearances. ANSI Approved. (1991).

Order Code: AWS B2.2
Nonmembers: $48
AWS Members: $36

**B5.1:2003, Specification for the Qualification of Welding Inspectors**

This standard defines the qualification requirements for welding inspectors, which include experience, satisfactory completion of an examination, and proof of visual acuity. The examination tests the inspector’s knowledge of welding processes; welding procedures, nondestructive examinations, destructive tests, terms, definitions, symbols, reports, welding metallurgy, related mathematics, safety, quality assurance, and responsibilities. ANSI Approved. 20 pages. (2003).

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Nonmembers: $28
AWS Members: $21

**B5.2:2001, Specification for the Qualification of Welding Inspector Specialists and Welding Inspector Assistants**


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Nonmembers: $28
AWS Members: $21

**B5.5:2000, Specification for the Qualification of Welding Educators**

ANSI Approved. 26 pages, 1 mandatory annex, 1 non-mandatory annex. (2000).

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AWS Members: $21

**B5.9:2000, Specification for the Qualification of Welding Supervisors**

ANSI Approved. 16 pages. (2000).

Order Code: AWS B5.9
Nonmembers: $28
AWS Members: $21

**B5.14:2002, Specification for the Qualification of Welding Sales Representatives**

This specification defines the requirements for qualification of welding sales representatives employed in the welding industry. It describes the position’s typical functions, required education and experience, examination requirements, and requalification, and lists suggested reference material. 12 pages, (2002).

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AWS Members: $21

**B5.15:2003, Specification for the Qualification of Radiographic Interpreters**

This specification defines the requirements for the qualification of radiographic interpreters, including experience, knowledge, and skills unique to the interpretation of radiographic media and the determination of acceptance criteria for weldments and adjacent base metal. Essential to ensuring the competence of individuals engaged in radiographic interpretation are training and work experience in radiographic theory, procedures, weld and adjacent base metal defect recognition, radiographic processing, handling, storage, and code requirements relating to radiographic acceptance criteria. ANSI Approved. 16 pages. (2003).

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**B5.16:2001, Specification for the Qualification of Welding Engineers**


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**NEW EDITION: B5.17:2004, Specification for the Qualification of Welding Fabricators**

This specification establishes the minimum requirements necessary to qualify as a welding fabricator, including an examination based on the fabricator’s quality-control manual. This document also defines the welding fabricator’s functions and lists reference materials that the welding fabricator should possess. ANSI Approved. 16 pages, (2004).

Order Code: AWS B5.17, Nonmembers: $28, AWS Members: $21

**C2.16/C2.16M:2002, Guide for Thermal-Spray Operator Qualification**

See details, page 18.


This specification provides requirements for the qualification of robotic arc welding support personnel at three different levels: CRAW-L1, CRAW-O, and CRAW-T. The revisions in this edition align education and experience requirements more realistically with those in industry. This standard is the basis for the AWS Certification of Robotic Arc Welding Personnel (CRAW) program. (See AWS QC19:2002 on page 14). 22 pages, 2 annexes, 3 figures, 4 tables, (2005).


**EG2.0-95, Guide for the Training and Qualification of Welding Personnel: Entry Level Welders**


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**EG2.0-95 and QC10:2004**

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A competency-based curriculum guideline detailing the minimum acceptable skill requirements for training and qualifying advanced welders. 168 pages. (1996).

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**EG4.0-96, Guide for the Training and Qualification of Welding Personnel: Level III — Expert Welders**

A competency-based curriculum guideline detailing the minimum acceptable skill requirements for training and qualifying expert welders. 158 pages, (1996).

Order Code: AWS EG4.0
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**ELV — Set C (EG4.0-96 and QC12-96)**

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**NEW EDITION: QC10-2004, Specification for Qualification and Registration of Level I — Welding Personnel**

In a new modular format, this standard outlines requirements and program for qualification of entry-level welders. Includes requirements for performance qualification and practical knowledge tests. 34 pages, (2004).

Order Code: AWS QC10
Nonmembers: $24
AWS Members: $18

**QC11-96, Specification for Qualification and Certification for Level II — Advanced Welders**

Requirements and program for AWS to qualify advanced welders. Includes requirements for performance qualification and practical knowledge tests. 38 pages. (1996).

Order Code: AWS QC11
Nonmembers: $24
AWS Members: $18

**QC12-96, Specification for Qualification and Certification for Level III — Expert Welders**

Requirements and program for AWS to qualify expert welders. Includes requirements for performance qualification and practical knowledge tests. 32 pages. (1996).

Order Code: AWS QC12
Nonmembers: $48
AWS Members: $36

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**CM:2000, Certification Manual for Welding Inspectors**

*Self-study to prepare for AWS welding inspector exams*

An excellent reference and introduction for those studying for the CWI examination. An updated version of the best-seller used by thousands of CWI candidates since 1977, now with a sleeker style and improved readability. Veteran editor Eugene Hornberger — an SCWI — has taught the AWS exam preparatory seminar for years. He’s packed this latest edition with a wealth of insights. Chapters cover the welding inspector’s responsibilities; standards; joint geometry and terminology; symbols, weldability; destructive testing; procedure and welder qualification; welding, brazing, and cutting processes; discontinuities; nondestructive examination; and inspector reports. Each chapter concludes with a self-administered test similar in content and style to the actual CWI exam questions. Features a contemporary layout that includes tip boxes. This book has been invaluable to literally thousands of CWI applicants who studied on their own for the AWS CWI exam. 314 pages, 11 chapters, 152 figures, 23 drawings, 8 tables, (2000), 4th edition.

Order Code: AWS CM, Nonmembers: $176, AWS Members: $132

**Code Clinic for Study of AWS D1.1 Structural Welding Code—Steel, Reference Manual**

Official textbook used for CWI preparatory seminar. Helps CWI candidates prepare for the open-book portion of the CWI examination, which tests ability to navigate through a code and find correct answers within a specified time. Includes test questions similar to the exam questions, and the answers. 74 pages; 9 chapters, 28 illustrations, (2003).

Order Code: AWS CC-RM, Nonmembers: $72, AWS Members: $54

**Code Clinic for Study of API Standard 1104 Welding of Pipelines and Related Facilities, Reference Manual**

Official textbook used for CWI preparatory seminar. Helps CWI candidates prepare for the open-book portion of the CWI examination, which tests ability to navigate through a code and find correct answers within a specified time. Includes test questions similar to the exam questions, and the answers. 58 pages; 23 illustrations, (2001), 19th edition.

Order Code: AWS API-M, Nonmembers: $72, AWS Members: $54

**GWF-98, Guide for Setting Up a Welder Training Facility**

This manual defines the physical requirements of a welding instruction facility. It is intended to give step-by-step guidance to institutions that desire to build or convert facilities for welder training. 20 pages, (1998).

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**Visual Inspection Workshop Reference Manual**

Official textbook used for CWI preparatory seminar. This newly revised edition of the Visual Inspection Workshop Reference Manual will help CWI candidates prepare for the hands-on portion of the CWI examination. Includes test questions similar to exam questions, and the answers. 152 pages, 4 chapters, 80 illustrations, (2004).

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**WeldAcademy**

WeldAcademy is a new way to learn about welding technology and the welding industry through e-learning. This Web-based, 10-module course covers a broad range of instruction, including safety, welding processes, welding inspection, and metallurgy. The program features digital videos, animations, and graphics to bring essential welding concepts to life. It is engaging, easy to use, and instructionally sound. WeldAcademy uses a tracking-management system that allows instructors to rate the progress of module users. WeldAcademy covers over 40 hours of instruction. Over 30 pre- and post-assessment questions for each module reinforce key learning objectives. Purchase by module or as a course. Available in English and Spanish. Go to [www.weldacademy.com/](http://www.weldacademy.com/) for a demo, a skill test, and licensing information.
Certification

AWS Certification is the Industry's Most Respected Stamp of Approval.

The Certified Welding Inspector (CWI) program identifies proven professionals who improve product quality through early detection of flaws and defects. Since 1976, over 47,000 professionals have earned CWI certification.

Call 800-443-9353, ext. 273, for a free copy of the standards below, or download them from the AWS Web site, www.aws.org/certification

QC1-96, Standard for AWS Certification of Welding Inspectors

Requirements and programs for AWS to certify welding inspectors. Covers three levels of certification: Senior Certified Welding Inspector (SCWI), Certified Welding Inspector (CWI), and Certified Associate Welding Inspector (CAWI). The CWI examination tests the inspector's knowledge of welding processes, welding procedures, welder qualification, destructive testing, nondestructive examination, terms, definitions, symbols, reports, records, safety, and responsibilities. A supplemental examination is required for upgrade to SCWI. ANSI Approved. 20 pages. (1996).

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QC4-89, Standard for Accreditation of Test Facilities for AWS Certified Welder Program

This standard describes the program directed by the American Welding Society for a third-party accreditation of test facilities used to perform welding qualification, welding, and testing. 12 pages. (1989).

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QC5-91, AWS Standard for Certification of Welding Educators

Establishes the requirements and program for American Welding Society certification of welding educators. Describes the principles of conduct and practice necessary to obtain certification. AWS administers written examinations to verify skill and knowledge of welding fabrication, and requires documentation of teaching skill. The standard is intended to supplement employer requirements or state regulations. 10 pages. (1991).

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QC7-93, Standard for AWS Certified Welders

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QC7-93 Supplement G, AWS Performance Qualification Test


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QC17:2002, Standard for Accreditation of Welding Fabricators for AWS Certified Welding Fabricator Program

Establishes the procedure by which a Welding Fabricator may seek, obtain, and maintain accreditation from AWS to participate in the AWS Certified Welding Fabricator Program. This standard also defines the requirements for a company’s compliance with welding-related functions. 10 pages. (2002).

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Describes the requirements for AWS certification of automated process operators and technicians. It details how personnel are certified, and the principles of conduct and practice necessary to maintain certification. 24 pages. (2002).

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Provides recommendations and guidelines for the safe application of robotic arc welding. Emphasizes conformance of this process with prevailing industry standards for hazard analysis and proper safeguarding, 30 pages, 1 figure, (2001).


Effects of Welding on Health
Reviews of the worldwide medical literature on potential health effects of welding-related physical and chemical hazards. Each volume in the series summarizes recent studies of occupational exposures, information on the human health effects of welding, and the effects of welding on experimental animals and cell cultures. These texts offer industrial hygienists and safety and medical professionals the necessary background and knowledge to deploy effective protective devices and engineering controls, and to respond to unique exposure situations. Highly qualified professionals from organizations including Biomedical Toxicology Associates, The Franklin Institute, and Southwest Research Institute compiled the reports as contractors for the AWS Safety and Health Committee.

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The Independent Shop's Guide to Welding Safety and Health
Provides straightforward information enabling the smaller operation to weld safely — even without the big corporation's advantages, such as safety officers and compliance/training programs. Using text and help boxes, this clear-cut Guide explains the responsibilities of management, and protection from hazards associated with welding in a manufacturing environment. It also contains information sources, Web resources, and a glossary of Material Safety Data Sheets/Hazard Communication Program terms. This book can help even the most economy-minded operation avoid loss of its most valuable component: employees. Written by J. D. Jennings of Expert Services, who retired from Miller Electric Manufacturing Company after many years as manager of technical publications. 42 pages, 3 figures, 1 table, glossary, (2003).

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Provides advice on contaminants that may be present in the welding environment, and presents a strategy for collecting valid samples from the welder's breathing zone. Includes a table of recommendations for fume analysis for various elements found in AWS filler metal specifications, and a checklist to use in observing the workplace. 24 pages, (1999). Order Code: AWS F1.3, Nonmembers: $48, AWS Members: $36

F1.5M:2003, Methods for Sampling and Analyzing Gases from Welding and Allied Processes

The AWS SH1 Subcommittee on Fumes and Gas has revised this important health publication. Using both OSHA and NIOSH analytical methods, this standard covers contaminants in the welding environment, including such potentially harmful substances as ozone, carbon monoxide, nitric oxide, nitrogen dioxide, and gaseous fluoride. Uses the International System of Units (SI). ANSI Approved. 54 pages, 9 figures, 10 tables, softbound, (2003). Order Code: AWS F1.5M, Nonmembers: $48, AWS Members: $36


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F3.2M/F3.2:2001, Ventilation Guide for Weld Fume

Introduces the reader to various types of ventilation systems, including general supply and exhaust, for control of welding fumes. Find health hazard information on air contaminants from fumes, principles of systems design and selection, and drawings that illustrate ventilation techniques. 42 pages, (2001). Order Code: AWS F3.2M/F3.2, Nonmembers: $48, AWS Members: $36

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PCWC:2001, Preparing Containers for Welding or Cutting: 2001

Informs the reader that all containers are hazardous unless they are verified to be safe. Explosions, fires, and health hazards may result if welding or cutting is performed on containers that contain hazardous substances, such as combustible, reactive, or toxic vapors, dusts, and gases. 12 pages, (2001). Order Code: AWS PCWC, Nonmembers: $24 (25 copies), AWS Members: $18

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Excerpted from the renowned Welding Handbook series, this book covers the basic elements of safety applicable to all welding, cutting, and related processes. It addresses subjects such as fumes and gases, precautionary labeling, handling of compressed gases, electrical safety, and hazards unique to particular welding or cutting processes. Includes a supplementary reading list. 42 pages. Order Code: AWS SP, Nonmembers: $48, AWS Members: $36

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C1.4M/C1.4:1999, Specification for Resistance Welding of Carbon and Low-Alloy Steels

This specification establishes welding equipment and procedure requirements, material preparation, and pre-production requirements for acceptable welds in coated and uncoated, low-carbon, medium-carbon, and low-alloy high-strength steel. The document covers the minimum shear strength and weld button diameter requirements for carbon steel and low-alloy steel sheet resistance and projection welds. Also addresses safety and health issues. ANSI Approved. 28 pages, 9 sections, 5 figures, 6 tables, (1999).

Order Code: AWS C1.4M/C1.4, Nonmembers: $48, AWS Members: $36

C3.7:1999, Specification for Aluminum Brazing

For details, see page 24

D11.2-89, Guide for Welding Iron Castings

An outstanding source of proven technical practices for joining iron castings. Includes: metallurgy and weldability; gas processes; arc welding processes; surfacing and overlaying; welding procedure and performance qualifications; quality control; and safety and health. Case histories with color illustrations demonstrate repair and service life extension. Also includes supplemental safety and health fact sheet collection, details, and instructions for weldability tests. 136 pages, 69 figures, 26 tables. (1989).

Order Code: AWS D11.2, Nonmembers: $96, AWS Members: $72

G2.1M/G2.1:2002, Guide for the Joining of Wrought Nickel-Based Alloys

The definitive guide to welding metals and alloys not covered by other standards. Learn the guidelines for welding different wrought nickel-based alloys, including solid-solution and precipitation-hardening alloys. ANSI Approved. 56 pages, 5 figures, 17 tables, (2003).

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The Practical Reference Guide for Corrosion of Welds—Causes and Cures

Expert witness and AWS lecturer Ted V. Weber draws upon his lengthy experience as a materials troubleshooter for DuPont to present this succinct introduction to basic corrosion mechanisms. It includes pitting, intergranular corrosion, stress corrosion cracking, erosion, crevice and galvanic corrosion, and selective leaching. Full-color digital photos illustrate the costly destruction caused by corrosion in welds. The author offers clear advice on how to avoid and correct corrosion, including allowing for resistance. 28 pages, 44 photographs. (1999).

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The Practical Reference Guide to Welding Aluminium in Commercial Applications

Frank Armao, group leader-nunferrous applications at The Lincoln Electric Company, wrote this Guide. Armao drew rave reviews when he invited members of the AWS D1G Subcommittee on Aluminum Structures, on which he serves, to review the text. With an emphasis on common, effective practices in high-volume situations, it covers mechanical properties of aluminum affected by welding; alloy and temper designations; filler metal selection; pre-welding preparation; GTAW, GMAW, and SMAW: defects and discontinuities; and problems in qualifying welding procedures. 38 pages, 24 figures, 14 tables, (2002).

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The Practical Reference Guide to Welding Metallurgy—Key Concepts for Weldability

If you’re not ready for the depth of George Linnert’s Welding Metallurgy and find data books overloaded, then this guide is for you. It’s written at just the right level as an intelligent introduction for the engineer new to welding and the up-and-coming senior technician. Tables and figures support this topics: metal structures, metal forms, diffusion, solid solubility, residual stress, shielding and purging, phase transformation, hardness and hardenability, grain size, stainless steels, aluminum and its alloys, copper and its alloys, refractory alloys, and repair welding. 34 pages, 32 figures, (1999).

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The Practical Reference Guide to Welding Titanium

Do you hesitate to specify titanium? If so, this succinct guide dispels the myths and negative perceptions about welding this versatile metal. Topics include backing gas shielding, chambers, joint design, equipment, consumables, filler metal transfer, and special welding conditions for gas tungsten arc welding, gas metal arc welding, plasma arc welding, electron and laser beam welding, and resistance welding. To produce this Guide, compiler/editor Eugene Hornberger used sources from AWS, TWI, and NASA, and the International Titanium Association’s advice and review. 16 pages, 5 tables, (1999).

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- AWS D1.1/D1.1M:2004, Structural Welding Code—Steel (see Page 6)
- AWS D18.2:1999, Guide to Weld Discoloration Levels on Inside of Austenitic Stainless Steel Tube (see Page 19)
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- Heat Treatments
- Weld Discontinuities and Defects
- Stainless Steels in Welding Codes and Standards
- Safety and Health Considerations

Also includes eight tables on base metal compositions, 15 tables on filler metal and electrode compositions, 15 tables on welding processes including weld joint designs, transition currents, typical arc voltages, shielding gases, and typical conditions for GMAW, FCAW, and SAW; four tables on heat treatments; and five tables on codes and standards (including A and F-Number groupings, and pre/post heat requirements). Unites important information from numerous AWS standards, including codes, filler metal specifications, and welding process recommended practices; the renowned Welding Handbook; and other sources. Compiler/editor Dr. Richard Campbell brings to this useful guide the clarity and succinctness of his consistently top-rated seminars. 103 pages, 10 tabbed chapters, 13 figures, 47 tables, spiral-bound. 5-1/2" x 8-1/2", (1999).

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For details, see page 9.

Welding Metallurgy, Carbon and Alloy Steels, Volume 1, Fundamentals, Fourth Edition

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C2.20/C2.20M:2002, Specification for Thermal Spraying Zinc Anodes on Steel Reinforced Concrete

Explains metallic zinc cathodic protection systems for corrosion protection of concrete structures with steel reinforcing. A publication useful to departments of transportation, port facilities, power plants, and other operations responsible for repair and maintenance of concrete structures affected by corrosion of steel reinforcement. Includes information on job safety, pass/fail reference standards, feedstock materials, needed equipment, and instructions for surface preparation, thermal spraying, and quality control. ANSI Approved. 40 pages, 13 figures, 5 tables, (2003).

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This specification documents the thermal spray equipment acceptance requirements for plasma, arc-wire, flame-powder, flame-wire, flame-rod, and flame-cord high-velocity oxygen fuel (HVOF) equipment. Also contains inspection report forms. 28 pages, (2004).

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Suggested for use by owners and design, fabrication, and maintenance engineers to detail and contract for the application of thermal spray coatings (TSC) for the preservation and maintenance of steel structures. Also may be used by TSC inspectors and applicators to develop and maintain application procedures, equipment inventory, and an operator-training program. Same as NACE No. 12, SSPC-CS 23,00. 48 pages, 9 figures, 5 tables, (2003).

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This specification classifies solid and composite wires and ceramic rods for thermal spraying, based on their as-manufactured chemical composition. Includes requirements for standard sizes, marking, manufacturing, and packaging. ANSI Approved. 26 pages, 4 figures, 7 tables, (2002).


Thermal Spray Manual

This well-illustrated manual is the result of a National Shipbuilding Research Program conducted by Puget Sound Naval Shipyard. Introduces the practitioner to thermal spraying, including fundamentals, sequencing the job, applications, processes, coating selection, finishing, training, certification, and safety. Excellent training manual. 176 pages, 12 chapters, glossary, (1996).

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Thermal Spraying Practice, Theory, and Application

An excellent primer on thermal spraying and an expert guide for selecting suitable processes. Emphasis on practical shop and field procedures. Case histories of repair and service-life extension, accompanied by job or project costing formulas and information, are sure to improve your existing method of costing, even if you’re a thermal spraying pro. 194 pages, 11 chapters, bibliography, glossary, index, 48 figures, 59 tables (including the Materials Classification Charts), (1985).

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This document outlines welding criteria for use in the manufacture and construction of dairy and food product processing plants. Compiled at the request of the 3-A Sanitary Standards Committee, which develops sanitary design standards for dairy and food processing, packaging, and handling equipment and systems. Covers the requirements for gas tungsten arc welding (GTAW) of austenitic stainless steel tube and pipe at least 1/4 inch (6 mm) in diameter in the fabrication and construction of new sanitary (hygienic) processing systems. The specification lists the required essential and non-essential variables for a written welding procedure qualification (WPS), and acceptance criteria for procedure qualification for visual and mechanical testing of welds. ANSI Approved. 176 pages, (1999).

Order Code: AWS D18.1, Nonmembers: $48, AWS Members: $36

D18.2:1999, Guide to Weld Discoloration Levels on Inside of Austenitic Stainless Steel Tube

Laminated sheet with color illustration showing the degrees of coloration on the inside of an austenitic stainless steel tube with increasing amounts of oxygen in the backing shielding gas. Suitable as a specifying tool and a visual examination guide. Includes two-page instruction sheet. ANSI Approved, (1999).

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G1.2M/G1.2:1999, Specification for Standardized Ultrasonic Welding Test Specimen for Thermoplastics

You need this document to help minimize variations in the geometry, welding, and testing of the ultrasonic welding test sample for thermoplastics. Detailed figures show tolerances on critical dimensions that may affect weldability. Use this specification for studies on the ultrasonic welding of thermoplastics, weldability studies, and optimizations. ANSI Approved. 28 pages, (1999).

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This guide lists and describes defects in welded joints in thermoplastic materials, and classifies each into one of three quality grades, allowing specific defects to be excluded or kept within limits. 44 pages, (2001).

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This document describes methods and techniques for shaping and straightening metal parts (including steel plate, pipes, angles, channel, T bar, and compound structures) by careful application of heat. It presents the theory and mathematical formulas for developing heat shaping patterns. Other topics include oxyfuel gas equipment (torches, tips, regulators, fuel gases, gas cylinders, and bulk supply); torch procedures for spot, line, and V heating patterns; and safety procedures. Figures show the locations for placement of heating patterns to obtain desired results for straightening, forming, or bending operations. 53 pages, 39 figures, 4 tables, (2004).


C4.1:1974, Specification for Torch Brazing

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C5.2:2001, Recommended Practices for Plasma Arc Cutting

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C5.3-73, Recommended Practices for Air Carbon Arc Heating Torches

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C5.1-73, Recommended Practices for Plasma Arc Welding

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C4.5:1999, Uniform Designation System for Oxyfuel Nozzles

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This revised and expanded manual for oxyfuel gas cutting is invaluable for operators of hand and machine torches and for managers who oversee oxyfuel cutting. It describes the oxyfuel gas cutting process and presents the latest procedures and safety requirements, using terminology and practices compatible with International Organization for Standardization (ISO) documents. Illustrations show torch and nozzle configurations and examples of production-cut surfaces. ANSI Approved. Available soon: approx. 30 pages, 4 annexes, 20 figures, 4 tables, (2005).

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C4.6M:1999, Specification for Furnace Brazing

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C4.4:1999, Specification for Torch Brazing

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- Fixturing and Tooling
- Quality Control
- Joint Design, Preparation, and Welding Positions
- Equipment and Supplies
- Gas Shielding, Purging, and Backing
- Welding Techniques
- Troubleshooting and Safety
- Welding Characteristics of Selected Alloys


C5.6-89R, Recommended Practices for Gas Metal Arc Welding

Learn from this document about the basic concepts of the gas metal arc welding (GMAW) process, including metal transfer modes, the nature of the process variables, and the necessary equipment and consumables. You’ll obtain a fundamental understanding of GMAW and its variations, such as short circuit, spray, and pulse modes of metal transfer. ANSI Approved. 76 pages. (Reaffirmed 1994).

Order Code: AWS C5.6, Nonmembers: $56, AWS Members: $42

C5.7:2000, Recommended Practices for Electrogas Welding

A particularly useful publication with tables that include procedure specifications and checklists, and chapters that cover fundamentals, equipment, electrodes (in tandem with AWS A5.21/A5.21M Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding), applications, and selection of process variables. Also contains serviceable information on inspection and rework, qualifications, and safety, and a “Troubleshooting Guide.” ANSI Approved. 68 pages, 23 figures, 14 tables, (2000).

Order Code: AWS C5.7, Nonmembers: $60, AWS Members: $45

C5.10/C5.10M:2003, Recommended Practices for Shielding Gases for Welding and Cutting

Covers six industrial gases — argon, carbon dioxide, helium, hydrogen, nitrogen, and oxygen — and various mixtures of these gases. Provides specific recommendations for their use in conjunction with the processes and materials for which they may be recommended. Contains useful tables that provide guidance on the gases or mixtures that are most appropriate for a given process and material. Also incorporates many safety recommendations, including references to OSHA regulations and NFPA standards. ANSI Approved. 64 pages, 26 figures, 17 tables, (2003).

Order Code: AWS C5.10/C5.10M, Nonmembers: $60, AWS Members: $45

C6.1-89R, Recommended Practices for Friction Welding

ANSI Approved. 36 pages, 3 appendices, 9 figures, 2 tables, (Reaffirmed 1998).

Order Code: AWS C6.1, Nonmembers: $56, AWS Members: $42


Provides process definitions and requirements, safe practices, and inspection criteria for electron beam welding. Also covers common applications of electron beam welding. Includes numerous power curves for various alloys. 126 pages, 64 figures, 11 tables, (2004). Order Code: AWS C7.1, Nonmembers: $72, AWS Members: $54


Standard contains information on laser welding metallurgy, and on welding, cutting, and drilling with laser technology. Includes safety considerations, equipment descriptions, process control and monitoring, record keeping, inspection and testing, equipment maintenance, and training. ANSI Approved. 116 pages, (1998).

Order Code: AWS C7.2, Nonmembers: $76, AWS Members: $57


Sister publication to C7.1 Recommended Practices for Electron Beam Welding, this standard discusses applicable specifications, safety, requirements, fabrication, quality examination, equipment calibration and maintenance, approval, and delivery of work. Includes sample WPS and PQR forms, as well as an economic “Nondestructive Evaluation Cost” chart. C7.1 is a best-of-industry-practices standard that uses “should” while this standard uses “shall.” ANSI Approved. 18 pages, (Reaffirmed 2003).

Order Code: AWS C7.3, Nonmembers: $48, AWS Members: $36


Performance recommendations for evaluating components of a typical robotic or automatic welding installation. Emphasizes the role of the welding interface. Chapters include arc welding power sources, torches and accessories, derrting system, shielding gas delivery systems, electrode feeding equipment, welding circuit, communication control wiring, and system grounding. Tables include connector pin assignments. Developed in conjunction with the National Electrical Manufacturers Association (NEMA). ANSI Approved. 24 pages, 4 figures, 2 tables, (2002).

Order Code: AWS D16.2/D16.2M, Nonmembers: $64, AWS Members: $48

International Brazing & Soldering Conference 2003 Proceedings

For details, see page 24.

The Practical Reference Guide for Hardfacing

A good introduction to hardfacing, the surfacing process that helps protect against wear or corrosion exactly where needed. Other benefits of hardfacing include ready application in the field, economical use of expensive alloys, and a hard surface layer supported by a tough substrate to carry the load. An excellent companion to A5.21-2001, Specification for Bare Electrodes and Rods for Surfacing. 20 pages, 4 figures, 12 tables, (2002).

Order Code: AWS PRGHF, Nonmembers: $48, AWS Members: $36

The Professional’s Advisor on Resistance Welding

This fits-in-a-briefcase book accompanies the busiest professionals on resistance welding worksites. Addresses welding definitions, resistance welding electrodes, spot and seam welding parameters, multiple thickness combinations, projection and flash welding, defects and their causes in resistance welding, testing, safety/health precautions for resistance welding, and more. 74 pages, 9 chapters (tabbed for quick access), spiral-bound, 5-1/2” x 8-1/2”, (1998).

Order Code: AWS PARW, Nonmembers: $72, AWS Members: $54

Soldering Handbook

For details, see page 24.
Development and Qualification of Welding Procedures Can Be Time-Consuming and Expensive.

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<tr>
<th>BASE METAL</th>
<th>THICKNESS</th>
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<th>FILLER METAL</th>
<th>CONDITION</th>
<th>ORDER NO.</th>
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<td>PIPE OR PLATE (ALL STANDARDS BELOW ARE ADOPTED BY NATIONAL BOARD INSPECTION CODE)</td>
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<td>Carbon Steel</td>
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<td>GTAW followed by SMAW</td>
<td>E7018 &amp; E7018</td>
<td>As-welded or PWHT</td>
<td>B2.1-1-021:94R</td>
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<td>E71T-8</td>
<td>As-welded</td>
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<td>Carbon Steel</td>
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<td>As-welded</td>
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<td>FCW-G, Ar-CO₂ gas-shielded</td>
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</table>

AWS publishes Standard Welding Procedure Specifications (SWPSs), which are prepared by the Welding Procedures Committee of the Welding Research Council. They are balloted through the AWS standards-development program as American National Standards. Standard Welding Procedure Specifications may be used on work covered by the AWS D1.1, Structural Welding Code—Steel, with the engineer’s approval. The National Board Inspection Code has adopted SWPSs as indicated. SWPSs with red order numbers may be used on ASME Boiler and Pressure Vessel work with additional requirements spelled out in Section IX of ASME Boiler & Pressure Vessel Code. All licenses are good for unlimited intracompany applications.

Web orders: Use AWS and exact order number, or AWS B2.1 for an online list of all AWS SWPSs. The one-time user-license fee for each Standard Welding Procedure Specification is $183 ($244 for nonmembers). Refer to license order number.

To order or for more information: 800-295-5482 or global.ihs.com
Let AWS Standard Welding Procedure Specifications (SWPSs) Do the Work for You.

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<th>PROCESS</th>
<th>FILLER METAL</th>
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<th>ORDER NO.</th>
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Available in electronic format NASA Preferred NASA Pending Department of Defense Adopted
B3.2-91, Standard for Brazing Procedure and Performance Qualification
For details, see page 12.

Brazing and Soldering

Braze Safely
For details, see page 15.

Describes the test method used to obtain reliable data on the strength of brazed joints loaded in tensile, shear, and four-point bending. ANSI Approved. 30 pages, 12 figures, 2 tables, (2002).

Order Code: AWS C3.2M/C3.2, Nonmembers: $64, AWS Members: $48

This standard lists the necessary steps to assure the suitability of brazed components for critical applications. Although such applications vary widely, they have certain common considerations with respect to materials, design, manufacture, and inspection. This document identifies and explains these common considerations and the best techniques for dealing with them, but does not provide specific details. The user must adapt these techniques to fit each application. ANSI Approved. 32 pages, 2 tables, (2002).

Order Code: AWS C3.3, Nonmembers: $64, AWS Members: $48

C3.4:1999, Specification for Torch Brazing
Provides the minimum fabrication, equipment, process procedure requirements, and inspection requirements for the torch brazing of copper, copper alloys, heat- and corrosion-resistant alloys, and other materials that can be adequately torch brazed. ANSI Approved. 18 pages, (1999).

Order Code: AWS C3.4, Nonmembers: $44, AWS Members: $33

C3.5:1999, Specification for Induction Brazing
Presents minimum fabrication and quality requirements for induction brazing materials such as steels, stainless steels, copper, copper alloys, heat- or corrosion-resistant materials, and other materials that can be adequately induction brazed. ANSI Approved. 18 pages, (1999).

Order Code: AWS C3.5, Nonmembers: $44, AWS Members: $33

C3.6:1999, Specification for Furnace Brazing
Presents minimum fabrication and quality requirements for furnace brazing material such as steels, stainless steels, nickel, nickel alloys, copper, copper alloys, heat- or corrosion-resistant materials, and other materials that can be adequately furnace brazed. ANSI Approved. 18 pages, (1999).

Order Code: AWS C3.6, Nonmembers: $44, AWS Members: $33

C3.7:1999, Specification for Aluminum Brazing
Addresses the minimum fabrication, equipment, material, process procedure requirements, and inspection requirements for aluminum brazing using the atmosphere furnace, vacuum furnace, and flux processes. ANSI Approved. 20 pages, (1999).

Order Code: AWS C3.7, Nonmembers: $48, AWS Members: $36

NEW EDITION: C3.8M/C3.8:2005, Specification for the Ultrasonic Examination of Brazed Joints
This standard provides specific criteria and requirements for the application of nondestructive examination to brazed joints. It covers requirements for ultrasonic test instructions and access equipment, procedures, and documentation of such tests. New in this edition is a section on ultrasonic pulse-echo results, including A-scan, B-scan, and C-scan displays. ANSI Approved. Available soon: approx. 20 pages, 1 nonmandatory annex, 2 figures, (2005).

Order Code: AWS C3.8M/C3.8, Nonmembers: $48, AWS Members: $36

This document provides the minimum requirements for brazing of copper tubing for medical-gas and vacuum distribution systems in healthcare facilities. It contains criteria for the preparation and cleanliness of materials and equipment, joint heating and filler metal application techniques, and inspection and testing options. ANSI Approved. 20 pages, 1 figure, 3 tables, (2001).


International Brazing & Soldering Conference 2003 Proceedings
A comprehensive discussion by international experts on brazing and soldering science and technology. Topics range from fundamental metallurgical research to practical engineering solutions. These proceedings highlight advances in ceramic and metal joining, modeling and measurements, interfacial reactions and properties, materials and process development, process characterization, reliability and testing, and applications. 619 pages, 98 papers, on CD-ROM, (2003).

Order Code: AWS IBSC, Nonmembers: $84, AWS Members: $63

Soldering Handbook
Contains everything relevant to soldering processes, and to solder joint performance and reliability. Includes fundamentals, technology, materials, substrate materials, fluxes, pastes, assembly processes, inspection, and environment. Good coverage of today's advanced joining applications, the Soldering Handbook also emphasizes:

• New materials, including higher-strength alloys
• Predictive joint performance
• Computer modeling
• Advanced inspection techniques
• New processing concepts, including laser heating and the resurgence in ultrasonic soldering


Order Code: AWS SHB, Nonmembers: $148, AWS Members: $111

This classic work addresses the fundamentals of brazing, brazement design, brazing filler metals and fluxes, brazing processes, applications, safety and health, and many other topics. A must-have for all brazers and brazing engineers! Over 20 groups of materials, including nickel, aluminum, steel, and carbide inserts. Best photocopy available. 512 pages, 33 chapters, 3 appendices, bibliographies/recommended reading lists, index, 200 figures, 55 reference tables, (1991).

Order Code: AWS BRH, Nonmembers: $72, AWS Members: $54

To order or for more information: 800-295-5482 or global.ihs.com
D10.4-86R, Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Pipe and Tubing
ANSI Approved. 42 pages, (Reaffirmed 2000).
Order Code: AWS D10.4
Nonmembers: $36
AWS Members: $27

Incorporates results of research on the effects of atmospheric exposure during welding. Recommended maximum exposure temperature has been lowered and the effects of high-temperature exposure have been revised. Provides coverage on power sources, tungsten electrodes, titanium base metal grades, filler metals, joint design and preparation, pickling and cleaning, fitting and tacking, presweld cleaning, gas shielding, welding procedures and techniques, and preheat and postweld heat treatment. Also includes information on weld quality tests and safety; ANSI Approved. 42 pages, 5 figures, 13 tables, (2000).
Order Code: AWS D10.6/D10.6M
Nonmembers: $48
AWS Members: $36

Expanded from a Recommended Practice to a Guide; this important pipe welding standard reflects the present state of the art. Sections include welding characteristics of aluminum; processes (GTAW, DCEN, GMAW, and automatic); materials; preparation; conditions; backing; technique; heat treatment; and safety and health. U.S. Customary Units and metric; pipe sizes listed as diameter nominal (DN) and nominal pipe size (NPS). ANSI Approved. 38 pages, 2 figures, 13 tables, (2000).
Order Code: AWS D10.7M/D10.7
Nonmembers: $60
AWS Members: $45

D10.8-96, Recommended Practices for Welding of Chromium-Molybdenum Steel Piping and Tubing
ANSI Approved. 18 pages, 1 figure, 4 tables, (1996).
Order Code: AWS D10.8
Nonmembers: $36
AWS Members: $27

The current revision of this popular standard considers both local 360º band and spot heating; thermocouple location, attachment and accuracy; insulation provisions; service environment; and QA system considerations. It also contains a comparative analysis of radiant heating methods (induction, electric resistance, flame, exothermic, gas-flame generated infrared, quartz lamps). The AWS D10 Subcommittee on Local Heat Treating of Pipework states that, “...the objective of this document is to present recommended practices based on an ordered assessment of available research and information, rather than a summary of current practice.” Offers sample “Standard Procedure for Local Heating” form. U.S. Customary and SI (metric) units. ANSI Approved. 176 pages, 8 annexes, 23 figures, 16 tables. (1999).
Order Code: AWS D10.10/D10.10M
Nonmembers: $72
AWS Members: $54

D10.11-87R, Recommended Practices for Root Pass Welding of Pipe Without Backing
Order Code: AWS D10.11
Nonmembers: $48
AWS Members: $36

The “mild steel” in this AWS standard refers to low-carbon (less than 0.25% carbon) steels such as ASTM A 53, A 106, A 135, A 179, A 524, A 587, and API-5L, Grades A25, A and B, and X42. It covers pipe sizes of DN 200 (NPS 8) and under, with wall thicknesses of 13 mm (0.5 in.) and under. You’ll find Guide for Welding Mild Steel Pipe especially useful for piping-system applications such as low-pressure heating, air conditioning, refrigeration, water supplies, and some gas and chemical systems. It explains techniques for procedures such as preheating, joint preparation, alignment and positioning, fittings, and root and hot passes for SMAW, OAW, GTAW, and GMAW. Tables include “Required Filler Metal per Joint for Mild Steel Pipe.” Supersedes D10.12-89, Recommended Practices and Procedures for Low Carbon Steel Pipe. ANSI Approved. 48 pages, 19 line drawings and photographs, 10 tables, (2000).
Nonmembers: $48
AWS Members: $36

For details, see page 24.

D18.2:1999, Guide to Weld Discoloration Levels on Inside of Austenitic Stainless Steel Tube
For details, see page 19.

F4.1:1999, Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping
This standard informs the reader of necessary safe practices for cleaning and preparing to weld and cut containers and piping. It describes various cleaning methods — including water, steam, hot chemical, and mechanical — and proper preparation techniques, such as inerting. 14 pages, (1999).
Order Code: AWS F4.1
Nonmembers: $48
AWS Members: $36

The Practical Reference Guide for Welding Inspection Management—Visual Inspection of Pressure Vessels and Pressure Piping
A planning survey for visual inspectors new to major in-service inspections of pressure vessels or pressure piping. Contains an annex on discontinuities. 32 pages, (1999).
Order Code: AWS PRGVT
Nonmembers: $48
AWS Members: $36

Suggested Filler Materials and Minimum Preheat Temperatures for Welding Steel Pipe with Wall Thicknesses Less than 3/4 in.
Desk chart (DC) and wall chart (WC) set shows base materials including C-steel, C-Mo, 1/2” to 1-1/4” Cr-Mo, 2” to 3” Cr-Mo, 3” to 5” Cr-Mo. Recommends electrodes according to the welding process being used, (1996).
Order Code: AWS PHSP DC & WC
Nonmembers: $20
AWS Members: $15

Available in electronic format  NASA Preferred  NASA Pending  Department of Defense Adopted
If you’re responsible for filler metal procurement or selection, you need AWS Filler Metal Specifications. These crucial specifications give the purchaser and distributor of filler metals a dependable, efficient recognition system. The classifications defined in these standards allow you to identify filler metals uniformly, without consideration of manufacturers’ trade names or brand names.

**THESE SPECIFICATIONS PROVIDE:**
- Required tests and testing procedures
- Standard package forms and weights
- Best use of the filler metal, including operating ranges
- Standard product forms and sizes
- Product identification and marking
- Wealth of weld operations information in annexes
- An economical solution—each A5 Specification is only $36 for AWS Members and $48 for others

**AWS Filler Metal Specifications by Material and Welding Process**

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<tr>
<th>Material Type</th>
<th>OFW</th>
<th>SMAW</th>
<th>GTA/W, GMA/W, PAW</th>
<th>FCAW</th>
<th>SAW</th>
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**A4.2M/A4.2:1997, Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal**


Order Code: AWS A4.2M/A4.2, Nonmembers: $48, AWS Members: $36

**A5.01–93R, Filler Metal Procurement Guidelines**

Essential to today’s purchaser. Learn to state clearly, concisely, and completely the required filler metal specification, including the heat, lot, testing, and certification requirements. ANSI Approved. 18 pages. (Reaffirmed 1999).

Order Code: AWS A5.01, Nonmembers: $48, AWS Members: $36

**Suggested Filler Materials for Welding Structural Steels**

Nothing beats the convenience of a chart when you need to know quickly. (Example: What are appropriate filler materials for ASTM A53. Grade B, if you’re using SMAW?) Laminated two-tone chart comes as desk and wall set, lists four welding processes in the Row or X axis: SMAW, GMAW, FCW, and SAW. In the Column or Y axis are 17 structural steels, from ASTM A36 to ASTM A517. 34 pages, (1999).

Order Code: AWS FMS DC & WC, Nonmembers: $20, AWS Members: $15

**User’s Guide to Filler Metals**

Tips, hints, and general description of filler metals, intended usage, classification methods, welding procedures, and safety considerations such as: “The electrode should be manipulated so that the width of the weld bead is no greater than three times the nominal diameter of the electrode being used.” Also contains Index of Filler Metal Classifications and Specifications. 130 pages, (1995).

Order Code: AWS UGFM, Nonmembers: $60, AWS Members: $45

To order or for more information: 800-295-5482 or global.ihs.com
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A4.3-93R, Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding

Describes a standard 25mm x 12mm x 89mm test specimen and preparation method, with two standard methods of diffusible hydrogen analysis: mercury displacement and gas chromatography. The methods are suitable for FC, GA, GM, and SMAW. ANSI Approved. 26 pages. (Reaffirmed 1997).

Order Code: AWS A4.3
Nonmembers: $48
AWS Members: $36


This document establishes standard procedures for determining the moisture content of welding fluxes and welding electrode coatings. The test involves combustion of a sample in an oxygen carrier gas at elevated temperature, and using Karl Fischer titration or infrared detection to measure any water evolved from the sample or formed by the combustion process. The key differences between these methods and traditional thermo gravimetric techniques are the inclusion of instrument calibration procedures, system verification checks, and use of more accurate analytical techniques for water detection. ANSI Approved. 32 pages, 4 figures, 3 tables.

Order Code: AWS A4.4M
Nonmembers: $48
AWS Members: $36

IFS:2002, International Index to Welding Filler Metal Classifications

The International Institute of Welding (IIW) Commissions II and XII compiled this International Index to establish a generic system for the identification of welding filler metals for use in ISO specifications. IIW representatives from Europe, Japan, China, Australia, Argentina, and the U.S. provided data from their countries. 55 pages, 4 figures, 42 tables. (2002.) CD-ROM only.

Order Code: AWS A4.4M
Nonmembers: $48
AWS Members: $36

To order Filler Metal Comparison Charts, see page 8.
Machinery and Railroad


This extensively illustrated specification applies to the welding of all principal structural weldments and all primary welds used to manufacture cranes for industrial, mill, powerhouse, and nuclear facilities. It also applies to other overhead material-handling machinery and equipment that support and transport loads within the design rating, vertically or horizontally, during normal operations. In addition, when agreed upon between the owner and manufacturer, it applies to loading caused by abnormal operations or environmental events, such as seismic loading.

All provisions of this specification apply equally to the strengthening and repairing of existing overhead cranes and material handling equipment. The specification contains figures and tables with prequalified joint details, allowable stress ranges, stress categories, and NDE techniques. Does not apply to construction or crawler cranes or welding of rails. ANSI approved. Available soon: approx. 150 pages, 60 figures, 21 tables (2005).


This specification establishes common acceptance criteria for carbon and low-alloy steel welded joints in machines and equipment subject to static and dynamic loading. The specification covers weld joint design, workmanship, quality control requirements and procedures, welding operator and welding procedure qualification, weld joint inspection (visual, radiographic, ultrasonic, magnetic particle, liquid penetrant), repair of weld defects, and heat treatment.

It establishes the effect of weld joint geometry, welding practices, and quality control on allowable stress levels, and provides practices for qualification and examination of welded joints in machinery and equipment fabrication. It contains figures and tables with prequalified joint details, NDE techniques, and weld-inspection criteria. ANSI Approved. Available soon: approx. 135 pages, 68 figures, 20 tables (2005).


For self-propelled, on- and off-highway machinery and agricultural equipment

This specification will cover crawlers, tractors, graders, loaders, off-highway trucks, power shovels, backhoes, mobile cranes, draglines, and other heavy earthmoving, construction, and agricultural equipment. For complete or partial joint penetration, it provides exhaustive illustrations — many multi-paged — of prequalified welded joints (butt, corner, T-, or combination) for shielded metal arc, submerged arc, gas metal arc, and flux cored arc welding. Variables for prequalified fillet welds are included. Workmanship and welder qualification are emphasized. Annexes include a forms collection and “Recommended Practices for Treatment of Shielded Metal Arc and Flux Cored Arc Electrodes.” Tables include “Weldability Classification—Typical Steel Products” and “Minimum Preheat and Interpass Temperature for Prequalified Procedures.” In U.S. Customary and SI (metric) units. ANSI Approved. Available soon: approx. 100 pages, 46 figures, 14 tables, (2005).


D14.4-97, Specification for Welding of Presses and Press Components

This specification presents the current minimum standards and guidelines for the welded fabrication and repair of presses and press components. It addresses classification, weld joint design, stresses, tolerances, and welder qualification. ANSI Approved. 156 pages, 78 figures, 21 tables (1997).

Order Code: AWS D14.4, Nonmembers: $72, AWS Members: $54


This revised specification establishes minimum acceptable requirements for weld joint detail and fabrication, by welding, of rotating elements in new equipment and modification or repair of existing equipment. Equipment types the specification covers include crushers, fans, gears, cranes, flywheels, centrifugal impellers, kilns, air-moving devices, and blowers. It contains a useful updated table on ferrous and nonferrous material groupings for procedure qualification. This specification promotes high-quality construction and repairs, and clear, concise fabrication practices. ANSI approved. 222 pages, 42 figures, 18 tables (2005).


Input for this authoritative specification came from all segments of the railroad industry — users and suppliers, the public, and representatives from the Association of American Railroads. Coverage includes welding metal 1/8 in. + in thickness, specific requirements for welding railroad cars, and requirements for manufacturing and reconditioning locomotives and passenger cars. Appendices include base metal groups and filler metal classifications. ANSI Approved. 386 pages, 8 appendices, 91 figures, 64 metric figures, 41 tables, 22 metric tables (2002).

Order Code: AWS D15.1, Nonmembers: $184, AWS Members: $138

D15.2:2003, Recommended Practices for the Welding of Rails and Related Rail Components for Use by Rail Vehicles


Order Code: AWS D15.2, Nonmembers: $56, AWS Members: $42

The Practical Reference Guide for Hardfacing

For details, see page 21.
NEW EDITION: D8.6:2005, Standard for Automotive Resistance Spot Welding Electrodes

Order Code: AWS D8.6, Nonmembers: $48, AWS Members: $36

This document presents recommended practices and criteria for evaluating resistance spot welds typical of automotive sheet steel applications. It contains weld characteristics, metrics, and testing methods useful in evaluating weld quality on coated and uncoated automotive sheet steels of all strength levels and compositions. These test methods are designed to assess static and dynamic properties of automotive sheet steel welds. ANSI Approved. Available soon: approx. 28 pages, 18 figures, 3 tables, (2000).

Order Code: AWS D8.7M, Nonmembers: $48, AWS Members: $36

D8.8-97, Specification for Automotive and Light Truck Components Weld Quality—Arc Welding
The AWS/SAE Joint Committee on Automotive Welding defines the practical tolerances needed to achieve satisfactory weld quality for production volumes associated with automotive structural parts. Covers welding of uncoated carbon steels (including HSLA) that don’t require preheat or postheat. Sets limits for various types of discontinuities, with an illustrative schematic example. ANSI Approved. 22 pages, 17 figures, (1997).

Order Code: AWS D8.8, Nonmembers: $48, AWS Members: $36

Helps to predict the performance of sheet steel that is resistance spot welded for use in auto manufacturing. Also addresses equipment setup, electrode installation and dressing, electrode endurance testing, and current level and range assessment. ANSI Approved. 78 pages, 3 annexes, 30 figures, 12 tables, (2002).

Order Code: AWS/SAE D8.9M, Nonmembers: $68, AWS Members: $51

Small suppliers will find this manufacturing standard for aluminum automotive components especially helpful. It covers the minimum standards for arc welding of aluminum components associated with the body and supporting structural members such as frames, space frames, cradles, and suspensions. Metric and U.S. Customary units. ANSI Approved. 28 pages, 3 annexes, 15 figures, 6 tables, (2000).


D17.1:2001, Specification for Fusion Welding for Aerospace Applications
This revolutionary document represents the most significant change to aviation welding standards in more than 30 years, including coverage in three areas never addressed in MIL-STDs: design, repair, and nonflight hardware. And, for the first time, there are authoritative procedures for weld repair of in-service (existing) aerospace flight hardware. In fact, the standard’s use of weld repair technology enables weld overhaul beyond the areas originally designated for a weld. Bolstering the excellent coverage on inspection is information to avoid both under- and over-inspection, arising from the D17 Committee’s position that, “Choosing acceptance criteria beyond the capability of the welding process may lead to numerous inspection rejections, increasing costs.”

To help, tables on acceptance criteria (one in U.S. Customary units, the other in SI units) provide distinctions for Class A, B, and C welds. Also includes an annex offering “Guidelines for Design, Analysis, and Fabrication of Weld Joints.”

D17.1:2001 emphasizes fusion welding of aluminum-based, nickel-based, iron-based, cobalt-based, magnesium-based, and titanium-based alloys using electric arc and high energy beam processes. SI (metric) equivalents provided. ANSI Approved. 94 pages, 5 annexes, commentary, 47 figures, 14 tables, (2001).

Order Code: AWS D17.1, Nonmembers: $156, AWS Members: $117

D3.5-93R, Guide for Steel Hull Welding
The best practical methods to weld steel hulls for ships, barges, mobile offshore drilling units, and other marine vessels. Includes information on steel plates, shapes, castings, and forgings, their selection, and their weldability. Features:

• Welding processes and proper welding design
• Hull construction preparation: materials, erection, fitting, and control of distortion
• Qualification of procedures and personnel
• Inspection methods
• Stray current protection
• Health and safety of the work force
Contains non-mandatory appendices for informational purposes. ANSI Approved. 118 pages, 72 illustrations, 9 tables, (Reaffirmed 2000).

Order Code: AWS D3.5, Nonmembers: $100, AWS Members: $75

NEW EDITION: D3.7:2004, Guide for Aluminum Hull Welding
Proven processes, techniques, and procedures for welding aluminum hulls and related ship structures. The information presented applies chiefly to the welding of aluminum hulls that are over 30 ft. (9 m) long and made of sheet and plate 3/16 in. (4.8 mm) thick and greater. The distinction is made because thin-gauge less than 3/16 in.) and thick-gauge (1/4 in. and over) aluminum have different welding requirements. ANSI Approved. 86 pages, (2004).


Developed by leaders in underwater welding, this specification covers the requirements for the underwater welding of structures or components in wet and dry environments. The first six sections cover the general requirements for underwater welding, while sections 7 through 10 contain the special requirements applicable to four levels of welding: above-water welding, welding for less critical applications, welding where load bearing is not a primary consideration, and welding to meet the requirements of another code or specification. This is critical information on general underwater welding provisions, the classification and design of welded connections, workmanship, technique, and qualification. Includes sample welding forms, terms and definitions, guidelines on safety, references, and other information. ANSI Approved. 144 pages, 6 annexes, (1999).

Order Code: AWS D3.6M, Nonmembers: $76, AWS Members: $57

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These fit-in-your-pocket problem-solvers are just $9 for AWS Members and only $12 for others.

The Everyday Pocket Handbook for Arc Welding Steel

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Order Code: AWS PHB-1, Nonmembers: $12, AWS Members: $9

The Everyday Pocket Handbook for Visual Inspection and Weld Discontinuities—Causes and Remedies


Order Code: AWS PHB-2, Nonmembers: $12, AWS Members: $9

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Order Code: AWS PHB-3, Nonmembers: $12, AWS Members: $9

The Everyday Pocket Handbook for Gas Metal Arc Welding (GMAW) and Flux Cored Arc Welding (FCAW)

GMAW portion includes shielding gas information for spray arc transfer, short-circuiting arc transfer, globular to spray transition currents, arc voltages, wire-feed speed, melting rates, and typical welding conditions for carbon and low-alloy steels, stainless steels, and aluminum. FCAW portion includes specification and classification system for FCW electrodes, and same topics as GMWA portion for CFERO and self-shielding. Covers troubleshooting advice for mechanical and electrical GMAW and FCAW. 50 pages, spiral-bound, 3-1/2” x 6”, (2000).

Order Code: AWS PHB-4, Nonmembers: $12, AWS Members: $9

The Everyday Pocket Handbook for Visual Inspection of AWS D1.1 Structural Welding Code’s Fabrication and Welding Requirements

Long title covers succinct compilation of excerpts from D1.1/D1.1M:2004, which also apply to subsequent editions. Includes transitions between unequal thickness, access hold requirements, pre-weld joint detail, base material surface and weld profile requirements, and five pages of visual acceptance criteria. Useful when actual D1.1 code is too cumbersome for tight, on-the-job areas. Cites actual D1.1 page, figure, and table numbers, 35 pages, spiral-bound, 3-1/2” x 6”, (Revised 2004).

Order Code: AWS PHB-5, Nonmembers: $12, AWS Members: $9

The Everyday Pocket Handbook for Shielded Metal Arc Welding (SMAW)

Portable guide emphasizes SMAW electrode care, handling, and use. Includes convenient charts on meaning of classification suffix(es), suggested amperage ranges, stub loss, electrode orientation, suggested joint designs, and more. 34 pages, spiral-bound, 3-1/2” x 6”, (1996).

Order Code: AWS PHB-6, Nonmembers: $12, AWS Members: $9

The Everyday Pocket Handbook for Gas Metal Arc Welding (GMAW) of Aluminum

Covers preparation of aluminum for welding, tips and troubleshooting, typical procedures for groove and fillet welds in aluminum alloys with argon shielding, aluminum filler metal properties (as-welded condition), and guide to selection of filler metal for general-purpose welding, 32 pages, spiral-bound, 3-1/2” x 6”, (1998).

Order Code: AWS PHB-8, Nonmembers: $12, AWS Members: $9

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- L  Utilities
- M  Welding distributors & retail trade
- N  Misc. repair services (incl. welding shops)
- O  Educational Services (univ., libraries, schools)
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- Q  Misc. business services (incl. commercial labs)
- R  Government (federal, state, local)
- S  Other

Job Classification (Check ONE only)

- A  President, owner, partner, officer
- B  Manager, director, superintendent (or assistant)
- C  Sales
- D  Purchasing
- E  Engineer — design
- F  Engineer — manufacturing
- G  Engineer — other
- H  Architect/designer
- I  Metallurgist
- J  Research & development
- K  Quality control
- L  Inspector, tester
- M  Supervisor, foreman
- N  Technician
- O  Welder, welding or cutting operator
- P  Consultant
- Q  Educator
- R  Librarian
- S  Student
- T  Customer Service
- U  Other

Technical Interests (Check all that apply)

- A  Ferrous metals
- B  Aluminum
- C  Nonferrous metals except aluminum
- D  Advanced materials/Intermetallics
- E  Ceramics
- F  High energy beam processes
- G  Arc welding
- H  Brazing and soldering
- I  Resistance welding
- J  Thermal spray
- K  Cutting
- L  NDT
- M  Safety and health
- N  Bending and shaping
- O  Roll forming
- P  Stamping and punching
- Q  Aerospace
- R  Automotive
- S  Machinery
- T  Marine
- U  Piping and tubing
- V  Pressure vessels and tanks
- W  Sheet metal
- X  Structures
- Y  Other
- Z  Automation
- a  Robotics
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