

Welding, Brazing, and Soldering

1. Fundamentals of Welding

Energy Sources Used for Fusion Welding
Heat Flow in Fusion Welding
Fluid Flow Phenomena During Welding
Transfer of Heat and Mass to the Base Metal in Gas-Metal Arc Welding
Arc Physics of Gas-Tungsten Arc Welding
Power Sources for Welding
Fundamentals of Weld Solidification
Nature and Behavior of Fluxes Used for Welding
Shielding Gases for Welding
Solid-State Transformations in Weldments
Cracking Phenomena Associated With Welding
Characterization of Welds

2. Fundamentals of Brazing and Soldering

Introduction to Brazing and Soldering
Fundamentals of Brazing
Fundamentals of Soldering

3. Fundamentals of Solid-State Welding

Introduction to Solid-State Welding
Fundamentals of Metal and Metal-to-Ceramic Adhesion
Fundamentals of Friction Welding
Fundamentals of Diffusion Bonding
Fundamentals of Explosion Welding
Mechanical Properties of Soft-Interlayer Solid-State Welds

4. Fusion Welding Processes

Shielded Metal Arc Welding
Gas-Metal Arc Welding
Flux-Cored Arc Welding
Gas-Tungsten Arc Welding
Plasma Arc Welding
Carbon Arc Welding

Submerged Arc Welding
Stud Arc Welding
Capacitor Discharge Stud Welding
Plasma-MIG Welding
Resistance Spot Welding
Projection Welding
Resistance Seam Welding
Flash Welding
Upset Welding
High-Frequency Welding
Electron-Beam Welding
Laser-Beam Welding
Electro slag and Electro gas Welding
Oxyfuel Gas Welding
Termite Welding

5. Solid-State Welding, Brazing, and Soldering Processes

High-Temperature Solid-State Welding
Low-Temperature Solid-State Welding
Explosion Welding
Forge Welding
Cold Welding
Coextrusion Welding
Roll Welding
Friction Welding
Radial Friction Welding
Friction Surfacing
Ultrasonic Welding
Torch Brazing
Furnace Brazing
Induction Brazing
Dip Brazing
Resistance Brazing
Diffusion Brazing
Exothermic Brazing
Brazing With Clad Brazing Materials
Iron Soldering
Torch Soldering
Furnace and Infrared Soldering
Dip Soldering
Resistance Soldering

Laser Soldering
Hot Gas Soldering
Induction Soldering
Wave Soldering
Vapor-Phase Soldering

6. Material Requirements for Service Conditions

Material Requirements for Service Conditions

7. Selection of Carbon and Low-Alloy Steels

Introduction to the Selection of Carbon and Low-Alloy Steels

Influence of Welding on Steel Weldment Soundness

Influence of Welding on Steel Weldment Properties

8. Selection of Stainless Steels

Introduction to the Selection of Stainless Steels

Selection of Wrought Martensitic Stainless Steels

Selection of Wrought Ferritic Stainless Steels

Selection of Wrought Austenitic Stainless Steels

Selection of Wrought Duplex Stainless Steels

Selection of Wrought Precipitation-Hardening Stainless Steels

Selection of Cast Stainless Steels

Dissimilar Welds With Stainless Steels

9. Selection of Nonferrous Low-Temperature Materials

Selection and Weldability of Conventional Titanium Alloys

Selection and Weldability of Advanced Titanium-Base Alloys

Selection and Weldability of Heat-Treatable Aluminum

Selection and Weldability of Non-Heat-Treatable Aluminum Alloys

Selection and Weldability of Dispersion-Strengthened Aluminum Alloys

Selection and Weldability of Aluminum-Lithium Alloys

Selection and Weldability of Aluminum Metal-Matrix Composites

10. Selection of Nonferrous High-Temperature Materials

General Welding Characteristics of High-Temperature Materials

Welding Metallurgy of Nonferrous High-Temperature Materials

Postweld Heat Treatment of Nonferrous High-Temperature Materials

Special Metallurgical Welding Considerations for Nickel and Cobalt Alloys and Superalloys

Special Metallurgical Welding Considerations for Refractory Metals

11. Selection of Nonferrous Corrosion-Resistant Materials

Introduction to the Selection of Nonferrous Corrosion-Resistant Materials

Selection of Nickel, Nickel-Copper, Nickel-Chromium, and Nickel-Chromium-Iron Alloys

Selection of Nickel-Base Corrosion-Resistant Alloys Containing Molybdenum

Selection of Cobalt-, Titanium-, Zirconium-, and Tantalum-Base Corrosion-Resistant Alloys

12. Weld ability Testing

Weldability Testing

13. Brazeability and Solderability of Engineering Materials

Brazeability and Solderability of Engineering Materials

14. Practice Considerations for Arc Welding

Arc Welding of Carbon Steels

Welding of Low-Alloy Steels

Welding of Stainless Steels

Welding of Cast Irons

Welding of Aluminum Alloys

Welding of Nickel Alloys

Welding of Copper Alloys

Welding of Magnesium Alloys
Welding of Titanium Alloys
Welding of Zirconium Alloys
Hardfacing, Weld Cladding, and Dissimilar Metal Joining

15. Practice Considerations for Resistance Welding & High-Energy-Beam Welding

Procedure Development and Practice Considerations for Resistance Welding

Procedure Development and Practice Considerations for Electron-Beam Welding

Procedure Development and Practice Considerations for Laser-Beam Welding

16. Procedure Development and Practice Considerations for Solid-State Welding

Procedure Development and Practice Considerations for Diffusion Welding

Procedure Development and Practice Considerations for Inertia and Direct-Drive Friction Welding

Procedure Development and Practice Considerations for Ultrasonic Welding

Procedure Development and Practice Considerations for Explosion Welding

17. Practice Considerations for Brazing and Soldering

Selection Criteria for Brazing and Soldering

Consumables

Brazing of Cast Irons and Carbon Steels

Brazing of Stainless Steels

Brazing of Heat-Resistant Alloys, Low-Alloy Steels, and Tool Steels

Brazing of Copper, Copper Alloys, and Precious Metals

Brazing of Aluminum Alloys

Brazing of Refractory and Reactive Metals

Brazing of Ceramic and Ceramic-to-Metal Joints

Application of Clad Brazing Materials

General Soldering

Soldering in Electronic Applications

18. Special Welding and Joining Topics

- Introduction to Special Welding and Joining Topics
- Thermal Spray Coatings
- Underwater Welding
- Welding for Cryogenic Service
- Welding in Space and Low-Gravity Environments
- Joining of Organic-Matrix Composites
- Joining of Oxide-Dispersion-Strengthened Materials
- Composite-to-Metal Joining
- Welding of Plastics
- Intelligent Automation for Joining Technology
- Corrosion of Weldments

19. Joint Evaluation and Quality Control

- Overview of Weld Discontinuities
- Inspection of Welded Joints
- Weld Procedure Qualification
- Residual Stresses and Distortion
- Repair Welding
- Fitness-for-Service Assessment of Welded Structures
- Evaluation and Quality Control of Brazed Joints
- Evaluation and Quality Control of Soldered Joints

20. Modeling of Joining Processes

- Numerical Aspects of Modeling Welds
- Characterization and Modeling of the Heat Source
- Validation Strategies for Heat-Affected Zone and Fluid

21. Cutting Processes

- Oxyfuel Gas Cutting
- Plasma Arc Cutting
- Air-Carbon Arc Cutting
- Mechanical Cutting for Weld Preparation