

Comprehensive 5-day Orbital Welding Class Agenda

Classes are Instructed By an AWS/QC1-CWE/CWI/ASNT Level 2 Visual Certified Personnel

Day 1: Welding Fundamentals & Materials Science

08:00 – 08:30 | Welcome & Industry Overview

- Introduction to orbital welding and its cross-industry applications
- Discussion of industrial standards: ASME, AWS, SEMI, NADCAP, ISO, API, BPE

08:30 – 10:00 | Introduction to GTAW Process

- History and evolution of TIG (GTAW) and orbital welding
- Electrical theory in welding: voltage, current, resistance Key Variables:
 - Arc gap
 - Shielding gas type
 - Current type (AC/DC), polarity
 - Electrode type and geometry
 - Workpiece material
- Maintaining the correct arc gap is fundamental to ensuring:
 - Effective plasma creation and stable arc behavior
 - Proper ionization of the shielding gas
 - Prevention of weld defects and equipment inefficiencies
 - Pulse welding: benefits for weld quality and heat control

10:00 – 10:15 | Break

10:15 – 12:00 | Welding Gases & Consumables

- Shielding and backing gases (argon, helium, blends)
- Effects of gas type, flow rate, and purity in different environments
- Electrode types, geometry, and longevity
- Key Takeaways:
- Correct ID pressure ensures clean fusion and prevents oxidation.



- The tube must be 100% purged before welding starts — no air pockets.
- Convexity and concavity are direct indicators of internal pressure balance and heat input.
- Color on the ID is a real-time indicator of purge effectiveness — use it for QA/QC.
- Always monitor pressure, flow rate, and purge duration, and confirm tubing is fully filled with inert gas before ignition.

12:00 – 13:00 | Lunch

13:00 – 15:00 | Materials & Metallurgy

- Overview of common alloys: stainless steels, duplex, Inconel, titanium
- Mechanical properties: strength, hardness, toughness, ductility
- Metallurgical challenges: sensitization, carbide precipitation, ferrite control

15:00 – 15:15 | Break

15:15 – 17:00 | Weld Schedule Fundamentals

- Variables: amperage, travel speed, rotation, wire feed
- Developing weld schedules for various wall thicknesses and materials
- Introduction to codes and procedures: WPS, PQR, WPQ

Day 2: Equipment Setup & Operational Practice

08:00 – 10:00 | Orbital Welding Systems Overview

- Orientation to leading brands (AMI, Orbitalum, Swagelok, Magnatech, AXXAIR, Liburdi Dimetrics, Polysoude, Orbitec, etc ..)
- Power supply interface: program walkthrough and screen navigation
- Features and settings for automated control

10:00 – 10:15 | Break

10:15 – 12:00 | Head Setup & Alignment

- Unboxing and assembly of closed/open weld heads
- Adjustments: side plates, plenums, collets, arc gap gauges
- Fixture alignment for optimal weld results



12:00 – 13:00 | Lunch

13:00 – 15:00 | Programming Welds

- Use of auto-schedule generation functions
- Customizing weld programs for joint type, diameter, and position
- Hands-on: building and saving a weld schedule

15:00 – 15:15 | Break

15:15 – 17:00 | Hands-On Practice: Basic Welding

- Performing bead-on-plate and butt welds
- Weld inspection: visual, dimensional, and purge traceability
- Coupon evaluation and documentation

Day 3: Sector-Specific Welding Techniques

08:00 – 10:30 | Industry-Specific Applications (Rotating Topics)

- *Semiconductor*: high-purity UHP welds, SEMI F78/F81 compliance
- *Aerospace*: critical tubing, AWS D17.1, tight tolerance welds
- *Oil & Gas*: corrosion-resistant alloys, B31.3/API 1104 compliance
- *Pharma/FB&D*: ASME BPE, sanitary fittings, electropolished tubing

10:30 – 10:45 | Break

10:45 – 12:30 | Material Handling & Preparation

- Tube facing, squaring, and cleaning
- Preventing contamination and oxidation
- Use of oxygen analyzers and purge validation

12:30 – 13:30 | Lunch

13:30 – 15:30 | Advanced Programming & Troubleshooting

- Welding dissimilar materials or wall thicknesses
- Fine-tuning parameters to correct common issues
- Purge failures, arc wander, inconsistent penetration



15:30 – 17:00 | Hands-On Challenge

- Complex joint setup (elbows, tees, transitions)
- Real-world mockups by industry sector
- Weld performance evaluation and critique

Day 4: Qualification, Inspection & Maintenance

08:00 – 12:00 | Weld Qualification & Documentation

- Overview of WPS, PQR, WPQ/WOPQ procedures
- ISO vs ASME standards for qualification
- Preparing test coupons for 3rd-party lab analysis (ASME Section IX)

12:00 – 13:00 | Lunch

13:00 – 14:30 | Inspection Methods

- Visual inspection standards (ASNT SNT-TC-1A Level II practices)
- Introduction to NDT: radiography (RT), dye penetrant (PT), borescope
- Weld acceptance criteria for each sector

14:30 – 15:30 | Weld Head Maintenance & Best Practices

- Preventative maintenance and troubleshooting
- Cleaning protocols for sanitary and cleanroom environments
- Equipment logbooks and operator checklists
- understanding, weld logs and weld mapping



15:30 – 17:00 | Mock Qualification Exam

- Practical assembly using tees, elbows, fittings (multi-sector mockup)
- Weld under supervision with feedback

Day 5: Final Certification & Review

08:00 – 10:00 | Weld Exam & Final Practical

- Students perform welds for final review
- Evaluation by instructor per industry-relevant codes

10:00 – 11:00 | Final Review & Q&A

- Recap of course content and key techniques
- Student-led discussion of lessons learned and future challenges

11:00 – 12:00 | Certification & Wrap-Up

- Distribution of completion certificates
- Overview of additional certification paths (AWS, ASME, SEMI, BPE, NADCAP)
- Industry networking resources and next steps

Optional Add-Ons

- Welding, a thermal couple's regulators differential pressure valves, needle valves etc
- Welding socket, welds, and how to build well schedules and correct fit up and preparation of them
- Understanding differential wall and how to weld it
- Welding coaxial tubing
- Cleanroom Protocols & FOD
- Prevention Module
- Advanced Metallurgy for Engineers



- Portable Field Welding Simulation Lab
- Guest Speakers from Industry (NASA, Intel, Chevron, Pfizer, etc.)

During the course, students will engage in the comprehensive fabrication of tube and pipe assemblies that simulate real-world scenarios they will encounter across various industries—including biopharmaceutical, aerospace, semiconductor, oil & gas, and general manufacturing. These hands-on projects are meticulously designed to replicate industry-specific standards and fabrication challenges, utilizing a wide range of components such as sanitary tubing and fittings, fuel and hydraulic lines, socket welds, VCR and Micro-Fit connectors, flanges, DPR valves, and other high-precision assemblies. Students will interpret and work from technical blueprints, calculate weld shrinkage, and ensure assemblies meet tight dimensional tolerances—often within ± 0.0005 inches. Emphasis will be placed on achieving level, plumb, and true installations while preparing tubing through precise facing, alignment, and cleaning procedures. Throughout the exercises, students will learn to control factors such as discoloration, purge integrity, and joint preparation, while applying orbital welding techniques that ensure repeatable, code-compliant results across various diameters and wall thicknesses.

Thank you for your interest in our training program!

If you have any questions regarding this class agenda or need further information, please don't hesitate to contact us.

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We look forward to supporting your learning journey!

