Open-Head Wire-Feed Orbital GTAW Welding for Industrial Piping Systems

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

Target Audience: Welders, welding engineers, QA/QC personnel, maintenance techs, and project managers in oil & gas, nuclear, and heavy industrial fields.

Day 1: Introduction to Orbital GTAW Systems & Industry Demands

Theme: Foundational understanding of the orbital open-head GTAW process and its real-world industrial applications.

Morning Session (08:00 – 12:00)

- **Orientation & Safety:**
    - Safety briefing, PPE review
    - Orientation to orbital GTAW vs manual and closed-head systems
- **Overview of Open-Head GTAW Wire-Feed Welding:**
    - Process flow: arc initiation, wire feed, arc control, shielding
    - Open-head advantages for thick-wall, variable-diameter pipe
- **Industrial Application Breakdown:**
    - Oil & Gas: API 1104, B31.3, high-pressure systems
    - Nuclear: ASME Section III, RCC-M, documentation rigor
    - Heavy Industrial: Process water, steam lines, skids

Afternoon Session (13:00 – 17:00)

- **Equipment System Walkthrough:**
    - Power sources (AMI, Polysoude, Liburdi Dimetrics, Magnatech)

- **Pipe Diameter & Schedule Mapping:**

    - Pipe range focus: 2 inch - 8 inch, Schedule 20 to 120
    - How wall thickness affects heat input, prep, and arc stability

Day 2: Material Science, Gas Chemistry & Weld Variables

Theme: Deep dive into metallurgy, shielding gas behavior, and core GTAW control variables.

Morning Session (08:00 – 12:00)

- **Material Properties & Weldability:**

    - Hands-on 304/316L SS, carbon steel, Inconel 625/825, P91, chrome-moly
    - Grain growth, carbide precipitation, intergranular corrosion

- **GTAW Shielding Gas Chemistry**

    - 100% Argon: Baseline, stable arc, moderate penetration
    - Ar/He Mix (75/25, 90/10): Deeper penetration on thick wall
    - Ar/Hâ, Mix (98/2): Increased arc energy, risk of porosity in CS
    - Effects on arc shape, penetration profile, and spatter

- **Joint Design Considerations**

    - Square groove vs. V-groove vs. J-prep
    - Root gap control for open-head orbital welds

Afternoon Session (13:00 – 17:00)

- **Core Variables in Open-Head Orbital GTAW:**

    - Current modes (pulsed, slope-in, slope-out)
    - AVC (Arc Voltage Control): maintaining arc gap, auto tracking
    - Oscillation: width, dwell, frequency
    - Wire feed: push angle, speed tuning for fill, reinforcement

- **Practical Lab Demo:**
    - Live setup with varying wire feed and oscillation on 4 inch Sch 80 SS
    - Shielding gas comparison (Argon vs. Ar/He): weld pool behavior observation

Day 3: Weld Programming, Setup, and Real-World Fit-Up

Theme: Trainees apply learned principles in full weld head setup, programming, and joint preparation.

Morning Session (08:00 – 12:00)

- **WPS and Weld Program Development:**
    - How to interpret and build a weld procedure (WPS)
    - Setting up slope, background current, peak current, oscillation, AVC limits

- **Fixture and Head Mounting:**
    - Aligning open heads for multi-pass welds
    - Troubleshooting misalignment or pipe ovality

- **Purge Planning:**
    - Internal dams vs. continuous purge
    - Gas flow rates and volume control
    - Oxygen analyzer usage for critical industries (Nuclear, Biopharma)

Afternoon Session (13:00 – 17:00)

- **Hands-On: Multi-Pass Programming Exercise:**
    - Develop 3-pass program for 6 inch Sch 80 CS pipe
    - Use oscillation and wire feed strategies to control bead shape

- **Pipe Prep Lab & Fit-Up Challenge:**
    - Full prep of 3 material types (CS, SS, Inconel)

- Realistic bevels and tack welds done per industry spec

Day 4: Welding Execution, Defect Prevention, and Code Compliance

Theme: Trainees conduct welds, observe key defects, and evaluate against code standards.

Morning Session (08:00 – 12:00)

- **Welding Defects & Discontinuities:**
  - Porosity, tungsten inclusions, incomplete fusion, undercut, overlap
  - Root causes: gas flow issues, improper AVC, wire feed lag

- **Weld Execution:**
  - 4 inch Sch 40 SS and 6 inch Sch 80 CS live welding
  - Program adjustments on-the-fly for oscillation/wire feed feedback

- **Intermediate Weld Inspection:**
  - Visual inspection and borescope
  - Peer review and instructor scoring based on AWS D1.1/API 1104 criteria

Afternoon Session (13:00 – 17:00)

- **Defect Simulation Station:**
  - Programmed introduction of common flaws (low wire feed, too fast travel, arc length too short)
  - Observe outcomes and fix parameters

- **Code Compliance Overview:**
  - Review industry standards: API 1104 (Oil & Gas) ASME Sec. IX & III (Nuclear) B31.1/B31.3 (Industrial Piping)
  - Traceability and recordkeeping (weld logs, WQTRs)

Day 5: Weld Qualification, Field Readiness & Certification

Theme: Full performance testing and real-world deployment readiness

Morning Session (08:00 – 12:00)

- **Review & Q&A:**
    - Final overview of concepts, field scenarios, troubleshooting

- **Performance Qualification Test:**
    - Full orbital weld (trainee-selected setup: 4 inch 6 inch pipe, any material)
    - Adhere to WPS, fit-up, purge, and execution standards

Afternoon Session (13:00 – 17:00)

- **Weld Evaluation:**
    - Visual + borescope inspection
    - Code-based scoring sheet (pass/fail criteria)

- **Post-Weld Documentation:**
    - Complete WQTR forms
    - Practice writing field reports and weld maps

- **Certification & Wrap-Up:**
    - Issue Certificate of Completion + WQT endorsement
    - Jobsite deployment guidance (EPC firms, nuclear job onboarding)
    - Discussion: career pathways and advanced certs (NADCAP, ASME IX 6G orbital endorsements)

Key Integrated Topics Across All Days:

Topic	Covered In
• Gas Selection and Behavior	• Day 2 (Deep Chemistry & Weld Influence)
• AVC & Oscillation Programming	• Day 2 (Intro) + Day 3 (Application)
• Material Science & Code Standards	• Day 2 + Day 4
• Pipe Sizes & Wall Thickness Management	• Day 1 (Theory) + Day 3 (Hands-on)
• Defect Identification & Remediation	• Day 4 (Simulated and live)
• Welding to Code	• Day 4 + 5

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!