

# WELDING PRINCIPLES AND PROCEDURES

## CLASS FORMAT:

Classroom

Option of lab using the client's equipment

## STANDARD CLASS SIZE:

NTT recommends a class of no more than 35 participants to obtain the best results.

(Hands-on option: NTT recommends a class of no more than 12 participants for the best results)

## NTT PROVIDES:

- 4 day (32 contact hours) of on-site instruction
- Textbooks "Welding Practices & Procedures" and "Welding Pocket Reference Guide"
- Classroom consumables
- Completion certificates
- Shipping and instructor travel logistics

## CLIENT PROVIDES:

- Classroom of 500 square feet or greater
- Projection screen, white board and/or flip chart(s)
- Lab Option: portable welding stations, safety equipment (i.e., helmet w/shield, certified welding gloves, and proper safety helmets for non-welding students) and welding materials will be provided by client in a safe and dry working environment.)

## CERTIFICATION TESTING:

NTT can conduct ASW D1.1 certification tests using client equipment. There is a separate fee for this service.

*Understand the complete range of welding practices and procedures while increasing your proficiency and broadening your capabilities.*

**Learn about applied metallurgy, welding process applications, safety and troubleshooting. The course material is in accordance with the American Welding Society.**

This course is designed for welding operators, technicians and supervisors to gain a better understanding of welding repair procedures encountered in a maintenance environment.

## COURSE AGENDA

### SHIELDED METAL ARC WELDING ("STICK")

- Fundamentals of SMAW process
- Maintenance/repair welding
- Limitations of process
- Welding current types and application
- Electrode numbering system
- Electrode types, comparisons and selection
- Welding variables
- All position welding techniques
- Troubleshooting weld defects: porosity, blowholes, undercut, coldlap, overlap, slag inclusions & arc strikes

### GAS METAL ARC (MIG) AND FLUX CORED ARC WELDING

- Fundamentals of GMAW and FCAW processes
- Maintenance/repair welding
- Limitations of processes
- Wire electrode numbering system
- Wire electrode types, comparisons, and selection
- Shielding gas blends, comparisons and selection
- Machine adjustment variables: amperage, voltage and ipm feed rates
- Preventive maintenance of equipment
- All position welding techniques
- Troubleshooting weld defects

### GAS TUNGSTEN ARC WELDING (TIG)

- Fundamentals of GTAW process
- Application of process in maintenance/repair welding
- Limitations of process
- Welding current types and applications
- Tungsten electrode selection and preparation
- Filler metal selection and applications



# WELDING PRINCIPLES AND PROCEDURES

## COURSE AGENDA, continued

### GAS TUNGSTEN ARC WELDING (TIG), CONTINUED

- Equipment setup
- Machine adjustment variables
- All position welding techniques
- Troubleshooting weld defects

### OXY-ACETYLENE FLAME CUTTING/GOUGING

- Principles of flame cutting
- Equipment setup, light-up and shutdown procedures
- Acetylene and oxygen line-pressure adjustment for cutting
- Cutting tip types, sizes and selection
- Cutting techniques for plate and structural shapes, plus weld joint preparation
- Flame gouging techniques for weld removal
- Troubleshooting poor cuts

### OXY-ACETYLENE WELDING, BRAZE WELDING, BRAZING AND SOLDERING

- Principles of processes
- Fluxes/function, selection and application
- Acetylene and oxygen line-pressure adjustment
- Techniques for fusion welding, braze welding, brazing and soldering

### AIR CARBON ARC GOUGING

- Principles of operation
- Welding current selection
- Carbon electrode selection
- Equipment setup/amperages and air pressures
- Arc gouging techniques for weld removal and weld joint preparation

### PLASMA ARC CUTTING & GOUGING

- Principles of operation
- Equipment setup
- Cutting techniques on carbon steel, stainless steel and aluminum
- Gouging techniques for weld removal on aluminum and stainless steel
- Equipment preventive maintenance

### WELDING AND CUTTING SAFETY ELECTRIC ARC WELDING EQUIPMENT

- Eye and skin protection from arc radiation
- Electric shock prevention
- Fume and particulate concerns

- Dangers of welding and cutting on containers
- Dangers of arc welding near compressed gas cylinders
- Specific safety concerns: SMAW, GMAW, FCAW and GTAW equipment
- Specific safety concerns: PAC and AAC equipment

### OXYGEN-ACETYLENE EQUIPMENT

- Properties of oxygen and acetylene
- Dangers of oxygen-rich and oxygen-starved environments
- Handling and storage of compressed gas cylinders
- Setup, lightup and shutdown procedures
- Acetylene and oxygen line-pressure determination
- Prevention of backfires and backflashes
- Proper use of multi-orifice heating tips (“rosebuds”)
- Safety considerations of oxy-fuel cutting

### WELDING CERTIFICATION REQUIREMENTS

- Why maintenance welders need certification
- Structural certification under AWS code
- Pressure vessel certification under ASME code

### CONTROLLING WELD QUALITY

- Essentials for producing good welds
- Weld profiles, plus weld size requirements and control
- Starting and ending welds/cratering out, plus using run-off tabs
- Radiography evaluation/examples of weld defects

### UNDERSTANDING METALS

- Basic metallurgy/properties of metals
- Metal identification
- Effects of welding on various metals
- Causes and prevention of weld failures
- Causes and control of weldment distortion

### REPAIR WELDING PRINCIPLES

- Welding process selection/limitations
- Filler metal/electrode selection
- Weld joint preparation requirements
- Weld size requirements
- Weld joint reinforcement considerations
- Sequence for tack welding and weld off
- Preheat, inter-pass heat and post heat
- Wear surfacing/hardfacing and buildup
- Knowing when NOT to weld
- Knowing where NOT to weld

# WELDING PRINCIPLES AND PROCEDURES

## COURSE AGENDA, continued

### REPAIR WELDING PROCEDURES

- Metal identification methods
- Repairing a failed weld
- Repairing tubular frame members
- Repairing pipe members
- Repairing broken solid shafts
- Repairing cracks and fractures in high-carbon and alloy steels
- Repairing steel forgings and steel castings
- Repairing cracks and fractures in cast iron
- Buildup and wear surfacing techniques