



Pembroke/ Hopkins Park Community Outreach Program

2598 S. 14000 E. Rd., Pembroke Township, IL 60958

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**Welding
Performance Tasks**

Level One

MODULE 29101-03 – WELDING SAFETY

Task Number	Item	Date(s)	Recorded By
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This is a knowledge-based module; there is no performance testing.

MODULE 29102-03 – OXYFUEL CUTTING

Task Number	Item	Date(s)	Recorded By
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- 29102-03 -1** Set up oxyfuel equipment.
- 29102-03 -2** Light and adjust an oxyfuel torch.
- 29102-03 -3** Shut down oxyfuel cutting equipment.
- 29102-03 -4** Disassemble oxyfuel equipment.
- 29102-03 -5** Change empty cylinders.
- 29102-03 -6** Perform straight line and square shape cutting.
- 29102-03 -7** Perform piercing and slot cutting.
- 29102-03 -8** Perform bevel cutting
- 29102-03 -9** Perform washing.
- 29102-03 -10** Perform gouging.

Task Number	Item	Date(s)	Recorded By
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- 29102-03 -11** Bevel and prepare the welding coupons for a single open v-groove weld.

MODULE 29104-03 – WELD QUALITY

Task Number	Item	Date(s)	Recorded By
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This is a knowledge-based module; there is no performance testing.



MODULE 29105-03 – SMAW – EQUIPMENT AND SETUP

Task Number	Item	Date(s)	Recorded By
29105-03 -01	Set up a machine for welding.		

MODULE 29106-03 – SMAW – ELECTRODES AND SELECTION

Task Number	Item	Date(s)	Recorded By
This is a knowledge-based module; there is no performance testing.			

MODULE 29107-03 – SMAW – BEADS AND FILLET WELDS

Task Number	Item	Date(s)	Recorded By
29107-03 -01	Set up AC welding equipment.		
29107-03 -02	Strike an arc.		
29107-03 -03	Make stringer, weave, and overlapping beads using E6010 and E7018 electrodes.		
29107-03 -04	Make fillet welds in the 2F, 3F, and 4F positions using E6010 and E7018 electrodes.		

MODULE 29108-03 – SMAW – GROOVE WELDS WITH BACKING

Task Number	Item	Date(s)	Recorded By
29108-03 -01	Set up the arc welding equipment for making groove welds.		
29108-03 -02	Make flat welds on V-groove joints using E7018 electrodes.		
29108-03 -03	Make horizontal welds on V-groove joints using E7018 electrodes.		
29108-03 -04	Make vertical welds on V-groove joints using E7018 electrodes.		
29108-03 -05	Make overhead welds on V-groove joints using E7018 electrodes.		

MODULE 29109-03 – JOINT FIT-UP AND ALIGNMENT

Task Number	Item	Date(s)	Recorded By
29109-03 -01	Fit up joints using plate and pipe fit-up tools.		
29109-03 -02	Check the joint for proper fit-up and alignment using gauges and measuring devices.		



MODULE 29110-03 – SMAW – OPEN V-GROOVE WELDS

Task Number	Item	Date(s)	Recorded By
29110-03 -01	Prepare arc welding equipment for open V-groove welds.		
29110-03 -02	Make flat welds on pads and V-groove joints in the 1G position.		
29110-03 -03	Make horizontal welds on pads and V-groove joints in the 2G position.		
29110-03 -04	Make vertical welds on pads and V-groove joints in the 3G position.		
29110-03 -05	Make overhead welds on pads and V-groove joints in the 4G position.		

MODULE 29111-03 – SMAW – OPEN-ROOT PIPE WELDS

Task Number	Item	Date(s)	Recorded By
29111-03 -01	Prepare arc welding equipment for open-root pipe welds.		
29111-03 -02	Make pipe welds in the 1G position.		
29111-03 -03	Make pipe welds in the 2G position.		
29111-03 -04	Make pipe welds in the 5G position.		
29111-03 -05	Make pipe welds in the 6G position.		

Level Two

MODULE 29201-03 – WELDING SYMBOLS

Task Number	Item	Date(s)	Recorded By
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This is a knowledge-based module; there is no performance testing.

MODULE 29202-03 – READING WELDING DETAIL DRAWINGS

Task Number	Item	Date(s)	Recorded By
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29202-03 -01 Interpret and develop welding detail drawings.

MODULE 29203-03 – SMAW – STAINLESS STEEL GROOVE WELDS AND PIPE

Task Number	Item	Date(s)	Recorded By
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29203-03 -01 Prepare arc welding equipment for stainless steel welds.

29203-03 -02 Perform SMAW on stainless steel open-root V-groove joints in the 1G position.



29203-03 -03 Perform SMAW on stainless steel open-root V-groove joints in the 2G position.

29203-03 -04 Perform SMAW on stainless steel open-root V-groove joints in the 3G position.

29203-03 -05 Perform SMAW on stainless steel open-root V-groove joints in the 4G position.

29203-03 -06 Perform SMAW on stainless steel open-root V-groove pipe welds in the 1G-ROTATED position.

29203-03 -07 Perform SMAW on stainless steel open-root V-groove pipe welds in the 2G position.

29203-03 -08 Perform SMAW on stainless steel open-root V-groove pipe welds in the 5G position.

29203-03 -09 Perform SMAW on stainless steel open-root V-groove pipe welds in the 6G position.

MODULE 29204-03 – AIR CARBON ARC CUTTING AND GOUGING

Task Number	Item	Date(s)	Recorded By
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29204-03 -01 Select and install CAC-A electrodes.

29204-03 -02 Prepare the work area and CAC-A equipment for safe operation.

29204-03 -03 Use CAC-A equipment for washing.

29204-03 -04 Use CAC-A equipment for gouging.

29204-03 -05 Perform storage and housekeeping activities for CAC-A equipment.

MODULE 29205-03 – PLASMA ARC CUTTING (PAC)

Task Number	Item	Date(s)	Recorded By
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29205-03 -01 Set up plasma arc cutting equipment.

29205-03 -02 Set the amperage and gas pressures or flow rates for the type and thickness of metal to be cut.

29205-03 -03 Square-cut metal using plasma arc cutting equipment.

29205-03 -04 Bevel-cut metal using plasma arc equipment.

29205-03 -05 Pierce and cut slots in metal using plasma arc cutting equipment.

29205-03 -06 Dismantle and store the equipment.

MODULE 29206-03 - GMAW AND FCAW - EQUIPMENT AND FILLER METALS

Task Number	Item	Date(s)	Recorded By
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29206-03 -01 Set up GMAW and FCAW equipment with appropriate shielding gases and filler metals.



MODULE 29207-03 - GMAW AND FCAW - PLATE

Task Number	Item	Date(s)	Recorded By
29207-03 -01	Make fillet welds on carbon steel plate in the 1F (flat) position, using GMAW with short-circuiting transfer.		
29207-03 -02	Make fillet welds on carbon steel plate in the 2F (horizontal) position, using GMAW with short-circuiting transfer.		
29207-03 -03	Make fillet welds on carbon steel plate in the 3F (vertical) position, using GMAW with short-circuiting transfer.		
29207-03 -04	Make fillet welds on carbon steel plate in the 4F (overhead) position, using GMAW with short-circuiting transfer.		
29207-03 -05	Make fillet welds on carbon steel plate in the 1F (flat) position, using FCAW and flux cored wire.		
29207-03 -06	Make fillet welds on carbon steel plate in the 2F (horizontal) position, using FCAW and flux cored wire.		
29207-03 -07	Make fillet welds on carbon steel plate in the 3F (vertical) position, using FCAW and flux cored wire.		
29207-03 -08	Make fillet welds on carbon steel plate in the 4F (overhead) position, using FCAW and flux cored wire.		
29207-03 -09	Make multiple-pass open-root V-groove welds on carbon steel plate in the 1G (flat) position, using FCAW and flux cored wire.		
29207-03 -10	Make multiple-pass open-root V-groove welds on carbon steel plate in the 2G (horizontal) position, using FCAW and flux cored wire.		
29207-03 -11	Make multiple-pass open-root V-groove welds on carbon steel plate in the 3G (vertical) position, using FCAW and flux cored wire.		
29207-03 -12	Make multiple-pass open-root V-groove welds on carbon steel plate in the 4G (overhead) position, using FCAW and flux cored wire.		
29207-03 -13	Make multiple-pass open-root V-groove welds on carbon steel plate in the 1G (flat) positions, using GMAW with short-circuiting transfer.		
29207-03 -14	Make multiple-pass open-root V-groove welds on carbon steel plate in the 2G (horizontal) position, using GMAW with short-circuiting transfer.		
29207-03 -15	Make multiple-pass open-root V-groove welds on carbon steel plate in the 3G (vertical) position, using GMAW with short-circuiting transfer.		
29207-03 -16	Make multiple-pass open-root V-groove welds on carbon steel plate in the 4G (overhead) position, using GMAW with short-circuiting transfer.		

MODULE 29207-03 - GMAW AND FCAW - PLATE (Continued)

Task Number	Item	Date(s)	Recorded By
29207-03 -17	Make 1F and 2F fillet welds on carbon steel plate, using GMAW with spray transfer.		



29207-03 -18 Make 1G open-root V-groove welds on carbon steel plate, using GMAW with spray transfer.

MODULE 29208-03 - GAS TUNGSTEN ARC WELDING - EQUIPMENT AND FILLER METALS

Task Number	Item	Date(s)	Recorded By
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Given a WPS:

29208-03 -01 Select shielding gas.

29208-03 -02 Select filler metal.

29208-03 -03 Connect the shielding gas and set the flow rate.

29208-03 -04 Select and prepare the electrode.

29208-03 -05 Break down and reassemble a GTAW torch

MODULE 29209-03 - GAS TUNGSTEN ARC WELDING - PLATE

Task Number	Item	Date(s)	Recorded By
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29209-03 -01 Make selected GTAW welds on carbon steel plate coupons.

29209-03 -02 Make multiple-pass open-root V-groove welds on carbon steel plate in the 1G (flat) position using GTAW and carbon steel filler metal.

29209-03 -03 Make multiple-pass open-root V-groove welds on carbon steel plate in the 2G (horizontal) position using GTAW and carbon steel filler metal.

29209-03 -04 Make multiple-pass open-root V-groove welds on carbon steel plate in the 3G (vertical) position using GTAW and carbon steel filler metal.

29209-03 -05 Make multiple-pass open-root V-groove welds on carbon steel plate in the 4G (overhead) position using GTAW and carbon steel filler metal.

MODULE 29210-03 - GAS TUNGSTEN ARC WELDING (GTAW) – ALUMINUM PLATE

Task Number	Item	Date(s)	Recorded By
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29210-03 -01 Set up GTAW equipment to make fillet welds on aluminum plate.

29210-03 -02 Make selected GTAW welds on aluminum plate coupons:

- Weave beads
- Weld restarts
- Weld terminations
- Overlapping beads

29210-03 -03 Make fillet welds on aluminum plate in the 1F (flat) and 2F (horizontal) positions, using GTAW.



29210-03 -04 Make multiple-pass V-groove welds with backing on aluminum plate in the 1G (flat) positions, using GTAW.

Level Three

MODULE 29301-03 - PREHEATING AND POSTWELD HEAT TREATMENT OF METALS

Task Number	Item	Date(s)	Recorded By
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There are no performance tasks for this module.

MODULE 29302-03 - PHYSICAL CHARACTERISTICS AND MECHANICAL PROPERTIES OF METALS

Task Number	Item	Date(s)	Recorded By
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There are no performance tasks for this module.

MODULE 29303-03 – GAS METAL ARC WELDING (GMAW) – PIPE

Task Number	Item	Date(s)	Recorded By
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29303-03 -01 Set up GMAW equipment.

29303-03 -02 Make GMAW open-root V-groove welds in the 1G-ROTATED position, using applicable filler metal and shielding gas.

29303-03 -03 Make GMAW open-root V-groove welds in the 2G position, using applicable filler metal and shielding gas.

29303-03 -04 Make GMAW open-root V-groove welds in the 5G position, using applicable filler metal and shielding gas.

29303-03 -05 Make GMAW open-root V-groove welds in the 6G (or 6GR) position, using applicable filler metal and shielding gas.

MODULE 29304-03 – FLUX CORED ARC WELDING (FCAW) – PIPE

Task Number	Item	Date(s)	Recorded By
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29304-03 -01 Set up FCAW equipment for open-root V-groove pipe welds.

29304-03 -02 Make FCAW open-root V-groove pipe welds in the 1G-ROTATED position.

29304-03 -03 Make FCAW open-root V-groove pipe welds in the 2G position.

29304-03 -04 Make FCAW open-root V-groove pipe welds in the 5G position.



29304-03 -05 Make FCAW open-root V-groove pipe welds in the 6G position.

MODULE 29305-03 – GAS TUNGSTEN ARC WELDING (GTAW) – CARBON STEEL PIPE

Task Number	Item	Date(s)	Recorded By
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29305-03 -01 Set up GTAW equipment.

29305-03 -02 Make GTAW open-root V-groove welds on carbon pipe in the 2G position, using carbon steel filler metal and argon gas.

29305-03 -03 Make GTAW open-root V-groove welds on carbon pipe in the 5G position, using carbon steel filler metal and argon gas.

29305-03 -04 Make GTAW open-root V-groove welds on carbon pipe in the 6G position, using carbon steel filler metal and argon gas.

MODULE 29306-03 – GAS TUNGSTEN ARC WELDING (GTAW) – LOW-ALLOY AND STAINLESS STEEL PIPE

Task Number	Item	Date(s)	Recorded By
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29306-03 -01 Prepare the area for GTAW.

29306-03 -02 Set up GTAW equipment.

29306-03 -03 Make GTAW open-root V-groove welds on appropriate metal pipe in the 2G position, using low-alloy and stainless steel filler metal.

29306-03 -04 Make GTAW open-root V-groove welds on appropriate metal pipe in the 5G position, using low-alloy and stainless steel filler metal.

29306-03 -05 Make GTAW open-root V-groove welds on appropriate metal pipe in the 6G position, using low-alloy and stainless steel filler metal.

MODULE 29307-03 – GAS TUNGSTEN ARC WELDING (GTAW) – ALUMINUM PIPE

Task Number	Item	Date(s)	Recorded By
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29307-03 -01 Set up GTAW equipment to weld aluminum pipe.

29307-03 -02 Make GTAW V-groove or modified U-groove welds on aluminum pipe in the following positions:

- 2G
- 5G
- 6G

MODULE 29308-03 – GAS METAL ARC WELDING (GMAW) – ALUMINUM PLATE AND PIPE



Task Number	Item	Date(s)	Recorded By
29308-03 -01	Make selected GMAW welds on aluminum plate coupons: <ul style="list-style-type: none">• Stringer beads• Weave beads• Weld restarts• Weld terminations• Overlapping beads		
29308-03 -02	Make selected fillet welds on aluminum plate: <ul style="list-style-type: none">• 1F position• 2F position• 3F position• 4F position		
29308-03 -03	Make selected groove welds on aluminum plate: <ul style="list-style-type: none">• 1G position• 2G position• 3G position• 4G position		
29308-03 -04	Make selected groove welds on aluminum pipe: <ul style="list-style-type: none">• 1G-ROTATED position• 2G position• 5G position• 6G position		



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**Welding
Materials and Equipment**

Level One

MODULE 29101-03 - WELDING SAFETY

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations
Performance Profile Sheets
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Various welding gloves
Auto-darkening helmet
Full-face supplied-air respirator (SAR)
Samples of protective welding footwear
Earmuffs and ear plugs

MODULE 29102-03 - OXYFUEL CUTTING

Overhead projector and screen
Transparencies
Blank acetate sheets
Whiteboard/chalkboard
Transparency pens
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Oxygen cylinder (with cap)
Fuel gas cylinder (with cap)
Regulators (oxygen and fuel gas)
Hose set



Combination cutting torch
One-piece cutting torch
Assorted torch nozzles (cutting, washing, gouging)
Cylinder cart
Motorized oxyfuel track cutter
Framing squares
Combination squares with protractor head
Tape measure
Soapstone
Penknife
Pliers
Chipping hammer
Friction lighter
Vendor cutting tip chart
Tip cleaners and file
Wrenches (torch, hose, and regulator)
Steel plate
• Thin (16 to 10 gauge)
• Thick (1/4 inch to 1 inch)
Module Examinations
Performance Profile Sheets

MODULE 29103-03 - BASE METAL PREPARATION

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Weld examples
Chipping hammer
Pliers
Tape measure
Soapstone
File
Framing square
Combination square with protractor head
Hand scrapers and wire brushes
Power grinder with grinding and wire brush attachments
Mechanical plate beveling equipment
Mechanical pipe beveling equipment
Oxyfuel cutting equipment



Motorized oxyfuel track cutter
Mild steel plate
Mild steel pipe
Module Examinations
Performance Profile Sheet

MODULE 29104-03 - WELD QUALITY

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations
Performance Profile Sheets
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment

Welding samples showing:

- Porosity
- Inclusions
- Cracks
- Weld metal cracks
- Base metal cracks
- Incomplete joint penetration
- Incomplete fusion
- Undercut
- Arc strikes
- Spatter
- Unacceptable weld profiles

Undercut gauge
Butt weld reinforcement gauge
Fillet weld blade gauge set
Welding code examples
Examples of Welding Procedure Specifications and Procedure Qualification Records
Radiograph examples
Tested specimens of good and failed welds

MODULE 29105-03 - EQUIPMENT AND SETUP

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens



Pencils and scratch paper
Module Examinations
Performance Profile Sheets
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Welding cables
Lugs and quick disconnects
Workpiece clamps
Electrode holders
Chipping hammers
Wire brushes
Files
Pneumatic weld flux chipper
Pneumatic needle scaler
Transformer welding machine
Transformer-rectifier welding machine
Motor generator welding machine
Engine-driven generator welding machine and alternator

MODULE 29106-03 - ELECTRODES AND SELECTION

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations
Performance Profile Sheets
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Electrodes of various types
Sample MSDS for an electrode

MODULE 29107-03 - BEADS AND FILLET WELDS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper



Appropriate personal protective equipment
Sample electrodes
Carbon steel for practice coupons, 1/4" thick minimum
DC (or AC) welding machine
Welding bench with arm for position work
Oxyfuel cutting equipment
Welding shield or helmet
Grinders
Framing square
Soapstone
Tape measure
Pliers
Wire brush
Workpiece clamps
Chipping hammer
Electrode holder
Electrodes, E6010 and E7018 (or E6011 and E6013 for AC)
Friction lighter
Module Examinations
Performance Profile Sheets

MODULE 29108-03 - SMAW - GROOVE WELDS WITH BACKING

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Sample electrodes
Carbon steel for practice coupons, 1/4" thick minimum
DC (or AC) welding machine
Welding bench with arm for position work
Oxyfuel cutting equipment
Welding shield
Grinders
Framing square
Soapstone
Tape measure
Pliers
Friction lighter



Wire brush
Chipping hammer
Workpiece clamps
Electrode holder
Electrodes, 5/32 and 3/16 inch E7018 (or E6013 for AC)
Module Examinations
Performance Profile Sheets

MODULE 29109-03 - JOINT FIT-UP AND ALIGNMENT

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Module Examinations
Performance Profile Sheets
Overhead projector and screen
Whiteboard/chalkboard
Appropriate personal protective equipment
Straightedges
Squares
Levels
Hi-Lo gauges
Hydraulic jacks, chain hoists, come-alongs
Strong-backs, clips, yokes, wedges
Plate alignment tools
Pipe jacks and rollers
Chain clamps, cage clamps, rim clamps
Small-diameter pipe clamping devices
Pipe pullers
Flange alignment tools
Carbon steel plate and pipe of various sizes

MODULE 29110-03 - OPEN V-GROOVE WELDS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper



Appropriate personal protective equipment
Sample electrodes
Carbon steel for practice coupons, 1/4" thick minimum
DC (or AC) welding machine
Welding bench with arm for position work
Oxyfuel cutting equipment
Welding shield or helmet
Grinders
Framing square
Soapstone
Tape measure
Pliers
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Electrode holder
Electrodes, E6010 and E7018 (or E6011 and E6013 for AC)
Module Examinations
Performance Profile Sheets

MODULE 29111-03 - OPEN-ROOT PIPE WELDS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Sample electrodes
Carbon steel pipe for practice coupons, 3" to 12" diameter Schedule 40 or Schedule 80
DC (or AC) welding machine
Welding bench with arm for position work
Pipe rollers
Oxyfuel cutting equipment
Welding shield or helmet
Grinders
Framing square
Soapstone
Tape measure
Friction lighter



Wire brush
Chipping hammer
Workpiece clamps
Electrode holder
Pliers
Electrodes, E6010 and E7018 (or E6011 and E6013 for AC)
Module Examinations
Performance Profile Sheets

Level Two

MODULE 29201-03 - WELDING SYMBOLS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
AWS Standard A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination
Sample site quality standard
Sample fillet welds
Sample V-groove welds
Module Examinations

MODULE 29202-03 - READING WELDING DETAIL DRAWINGS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Welding drawings
Module Examinations
Performance Profile Sheets



MODULE 29203-03 - SMAW– STAINLESS STEEL GROOVE AND PIPE WELDS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Examples of stainless steel with carbide precipitation
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Cutting goggles
Welding bench with arm for position work
Oxyfuel cutting equipment
DC welding machine
Stainless steel, 3/8" thick minimum, or carbon steel plate, 1/4" to 3/4" thick, for practice coupons
Portable angle-head grinders
Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Electrode holder
Stainless steel electrodes, 3/32" and 1/8", compatible with the base metal being welded
Pipe for weld coupons: 3" to 12" Schedule 40 or Schedule 80 stainless or carbon steel pipe
Pipe alignment clamps
Pipe beveling equipment (optional)
Module Examinations
Performance Profile Sheets

MODULE 29204-03 - AIR CARBON ARC CUTTING AND GOUGING

Overhead projector and screen
Transparencies



Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Scrap steel shapes containing bolts, rivets, protruding welds, eyes, clips, or other protrusions to be washed
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Earplugs
Soapstone
Tape measure
Pliers
Wire brush
Chipping hammer
DC welding machine, minimum 200 amps for light duty or 600 amps for medium duty
Air carbon arc torch and cable
Selection of carbon electrodes up to 3/8"
Compressed air source, minimum 16 cfm at 80 psig for light and medium duty or minimum 50 cfm at 100 psig for heavy duty cutting
Module Examinations
Performance Profile Sheets

MODULE 29205-03 - PLASMA ARC CUTTING (PAC)

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Earplugs
Respirator
Soapstone
Tape measure



Pliers

Plasma arc cutting unit with cutting torch and appropriate gas sources

Scrap steel sheet or plate, 12 gauge to 1/2" thick

Scrap stainless steel sheet or plate, 12 gauge to 1/2" thick (if available)

Scrap aluminum plate, 3/16" to 1/2" thick (if available)

Wire brush

Chipping hammer

Module Examinations

Performance Profile Sheets

MODULE 29206-03 - GMAW AND FCAW – EQUIPMENT AND FILLER METALS

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Samples of various types and sizes of electrode wires (labeled)

Examples of welding guns (standard and one- pound spool, if available)

Examples of shielding gas regulator-flow meters (if available)

Examples of wire feeders (if available)

Leather welding gloves

Leather welding jacket or sleeves

Welding shield or helmet

Cutting goggles

FCAW welding equipment

Electrode wire, 0.45" dual shielded flux cored carbon steel

GMAW welding equipment

Carbon steel wire electrode

Shielding gas

Welding bench with arm for position work

Portable angle-head grinders

Framing square

Soapstone

Tape measure

Pliers

Half-round bastard file

Friction lighter

Wire brush

Chipping hammer



Workpiece clamps
Pipe alignment clamps
Pipe beveling equipment (optional)
Module Examinations
Performance Profile Sheets

MODULE 29207-03 - GMAW AND FCAW – PLATE

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Cutting goggles
FCAW welding equipment
Electrode wire, 0.45" dual shield flux cored carbon steel (Class E71T-1)
GMAW welding equipment
Carbon steel wire electrode
Shielding gas
Welding bench with arm for position work
Portable angle-head grinders
Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Module Examinations
Performance Profile Sheets

MODULE 29208-03 - GTAW – EQUIPMENT AND FILLER MATERIALS

Overhead projector and screen
Transparencies



Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Samples of various types and sizes of electrodes (labeled)
Examples of shielding gas regulators/flow meters (if available)
Examples of welding guns
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Cutting goggles
GTAW welding equipment
Tungsten electrodes
Shielding gas
Welding bench with arm for position work
Module Examinations
Performance Profile Sheets

MODULE 29209-03 - GTAW – PLATE

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Cutting goggles
GTAW welding equipment
Tungsten electrodes
Carbon steel filler metal
Carbon steel plate 3/8" thick
Shielding gas
Welding bench with arm for position work
Portable angle-head grinders
Framing square
Soapstone



Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Module Examinations
Performance Profile Sheets

Level Three

MODULE 29301-03 - PREHEATING AND POSTWELD HEAT TREATMENT OF METALS

Overhead projector and screen
Transparencies
Whiteboard/chalkboard
Markers/chalk
Blank acetate sheets
Transparency pens
Pencils and scratch paper
Appropriate personal protective equipment
Sample welds with proper preheating and postweld heat treatment
Sample welds with defects due to improper preheating or postweld heat treatment
Sample preheating tips for oxyfuel torches
Sample gas preheating torch
Sample temperature-indicating crayons
Sample pyrometer, thermocouple devices, or temperature-sensitive indicators
Module Examinations

MODULE 29302-03 - PHYSICAL CHARACTERISTICS AND MECHANICAL PROPERTIES OF METALS

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment



Samples of various types of steels, metals, and filler metals
Magnet
Metal analyzer
Module Examinations

MODULE 29303-03 – GAS METAL ARC WELDING (GMAW) – PIPE

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Cutting goggles
Welding bench with arm for position work
Mechanical, plasma, and/or oxyfuel cutting equipment
Gas-shielded GMAW welding machine and gun
Portable angle-head grinders
Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Appropriately sized wire electrode compatible with the base metal being welded
Pipe for weld coupons: 3" to 12" Schedule 40 or Schedule 80 carbon steel pipe
Pipe alignment clamps
Pipe beveling equipment (optional)
Antispatter compound
Module Examinations
Performance Profile Sheets

MODULE 29304-03 – FLUX CORED ARC WELDING (FCAW) – PIPE

Overhead projector and screen



Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Cutting goggles
Welding bench with arm for position work
Oxyfuel cutting equipment
FCAW welding machine and FCAW-S and/or FCAW-G gun
Portable angle-head grinders
Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Appropriately sized wire electrode compatible with the base metal being welded
Pipe for weld coupons: 3" to 12" Schedule 40 or Schedule 80 carbon steel pipe
Pipe alignment clamps
Pipe beveling equipment (optional)
Hi-Lo gauge
Module Examinations
Performance Profile Sheets

MODULE 29305-03 – GAS TUNGSTEN ARC WELDING (GTAW) – CARBON STEEL PIPE

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment



Examples of pipe with poor weld profiles

Leather welding gloves

Leather welding jacket or sleeves

Welding shield or helmet

Cutting goggles

Welding bench with arm for position work

Oxyfuel cutting equipment

GTAW welding machine and torch

Shielding gas

Backing gas

Portable angle-head grinders

Framing square

Soapstone

Tape measure

Pliers

Half-round bastard file

Friction lighter

Wire brush

Chipping hammer

Workpiece clamps

Appropriately sized carbon steel wire electrodes

Pipe for weld coupons: 3" to 12" Schedule 40 or Schedule 80 carbon steel pipe

Pipe alignment clamps

Pipe beveling equipment (optional)

Module Examinations

Performance Profile Sheets

MODULE 29306-03 – GAS TUNGSTEN ARC WELDING (GTAW) – LOW-ALLOY AND STAINLESS STEEL PIPE

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Examples of pipe with poor weld profiles

Leather welding gloves

Leather welding jacket or sleeves

Welding shield or helmet

Cutting goggles



Welding bench with arm for position work
Mechanical or plasma cutting equipment
GTAW welding machine and torch
Shielding gas
Backing gas
Portable angle-head grinders
Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Pipe for weld coupons: 3" to 12" Schedule 40 or Schedule 80 stainless, low-alloy, or carbon steel pipe
Low-alloy and stainless steel filler metal
Workpiece clamps
Pipe alignment clamps
Pipe beveling equipment (optional)
Module Examinations
Performance Profile Sheets

MODULE 29307-03 – GAS TUNGSTEN ARC WELDING (GTAW) – ALUMINUM PIPE

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Examples of pipe with poor weld profiles
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Welding bench with arm for position work
Mechanical or plasma cutting equipment
GTAW welding machine and torch
Shielding gas
Backing gas
Portable angle-head grinders



Framing square
Soapstone
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Chipping hammer
Workpiece clamps
Aluminum pipe for weld coupons: 3" to 12" Schedule 40
Aluminum filler metal compatible with the base metal being welded
Pipe alignment clamps
Pipe beveling equipment (optional)
Module Examinations
Performance Profile Sheets

MODULE 29308-03 – GAS METAL ARC WELDING (GMAW) – ALUMINUM PLATE AND PIPE

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Examples of pipe with poor weld profiles
Leather welding gloves
Leather welding jacket or sleeves
Welding shield or helmet
Welding bench with arm for position work
Mechanical or plasma cutting equipment
GMAW welding machine and gun
Shielding gas
Backing gas
Portable angle-head grinders
Framing square
Tape measure
Pliers
Half-round bastard file
Friction lighter
Wire brush
Workpiece clamps



Appropriately sized aluminum wire electrode compatible with the base metal being welded

Aluminum plate for weld coupons: 1/4" to 3/4"

Aluminum pipe for weld coupons: 3" to 12" diameter Schedule 40

Pipe alignment clamps

Pipe beveling equipment (optional)

Module Examinations

Performance Profile Sheets



Pembroke Hopkins Park Construction Outreach Program

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**Welding
Competencies/Objectives**

Level One

MODULE 29101-03 – WELDING SAFETY (2.5 Hours)

1. Identify some common hazards in welding.
2. Explain and identify proper personal protection used in welding.
3. Demonstrate how to avoid welding fumes.
4. Explain some of the causes of accidents.
5. Identify and explain uses for material safety data sheets.
6. Demonstrate safety techniques for storing and handling cylinders.
7. Explain how to avoid electric shock when welding.
8. Demonstrate proper material handling methods.

MODULE 29102-03 – OXYFUEL CUTTING (17.5 Hours)

1. Identify and explain the use of oxyfuel cutting equipment.
2. Set up oxyfuel equipment.
3. Light and adjust an oxyfuel torch.
4. Shut down oxyfuel cutting equipment.
5. Disassemble oxyfuel equipment.
6. Change empty cylinders.
7. Perform oxyfuel cutting:
 - Straight line and square shapes
 - Piercing and slot cutting
 - Bevels
 - Washing
 - Gouging
8. Operate a motorized, portable oxyfuel gas cutting machine.

MODULE 29103-03 – BASE METAL PREPARATION (12.5 Hours)

1. Clean base metal for welding or cutting.
2. Identify and explain joint design.
3. Explain joint design considerations.



4. Using a nibbler, cutter, or grinder, mechanically prepare the edge of a mild steel plate 1/4" to 3/4" thick at 22 1/2° (or 30° depending on equipment available).
5. Using a nibbler, cutter, or grinder, mechanically prepare the end of a pipe with a 30° or 37 1/2° bevel (depending on equipment available) and a 3/32" land. Use 6", 8", or 10" Schedule 40 or Schedule 80 mild steel pipe.
6. Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.

MODULE 29104-03 – WELD QUALITY (10 Hours)

1. Identify and explain codes governing welding.
2. Identify and explain weld imperfections and their causes.
3. Identify and explain nondestructive examination practices.
4. Identify and explain welder qualification tests.
5. Explain the importance of quality workmanship.
6. Identify common destructive testing methods.

MODULE 29105-03 – SMAW – EQUIPMENT AND SETUP (5 Hours)

1. Identify and explain shielded metal arc welding (SMAW) safety.
2. Identify and explain welding electrical current.
3. Identify and explain arc welding machines.
4. Explain setting up arc welding equipment.
5. Set up a machine for welding.
6. Identify and explain tools for weld cleaning.

MODULE 29106-03 – SMAW – ELECTRODES AND SELECTION (2.5 Hours)

1. Identify factors that affect electrode selection.
2. Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
3. Identify different types of filler metals.
4. Explain the storage and control of filler metals.
5. Explain filler metal traceability requirements and how to use applicable code requirements.
6. Identify and select the proper electrode for an identified welding task.

MODULE 29107-03 – SMAW – BEADS AND FILLET WELDS (120 Hours)

1. Set up shielded metal arc welding (SMAW) equipment.
2. Describe methods of striking an arc.
3. Properly strike and extinguish an arc.



4. Describe causes of arc blow and wander.
5. Make stringer, weave, and overlapping beads.
6. Make fillet welds in the:
 - Horizontal (2F) position
 - Vertical (3F) position
 - Overhead (4F) position

MODULE 29108-03 – SMAW – GROOVE WELDS WITH BACKING (10 Hours)

1. Identify and explain groove welds.
2. Identify and explain groove welds with backing.
3. Set up shielded metal arc welding (SMAW) equipment for making V-groove welds.
4. Perform SMAW for V-groove welds with backing in the:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position

MODULE 29109-03 – JOINT FIT-UP AND ALIGNMENT (5 Hours)

1. Identify and explain job code specifications.
2. Use fit-up gauges and measuring devices to check joint fit-up.
3. Identify and explain distortion and how it is controlled.
4. Fit up joint using plate and pipe fit-up tools.
5. Check for joint misalignment and poor fit-up before and after welding.

MODULE 29110-03 – SMAW – OPEN V-GROOVE WELDS (120 Hours)

1. Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.
2. Perform open-root V-groove welds in the:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position

MODULE 29111-03 – SMAW – OPEN-ROOT PIPE WELDS (100 Hours)

1. Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove pipe welds.
2. Identify and explain open-root V-groove pipe welds.
3. Perform SMAW for open-root welds in the:
 - Flat (1G-ROTATED) position



- Horizontal (2G) position
- Multiple (5G) position
- Multiple inclined (6G) position

Level Two

MODULE 29201-03 – WELDING SYMBOLS (5 Hours)

1. Identify and explain the various parts of a welding symbol.
2. Identify and explain fillet and groove weld symbols.
3. Read welding symbols on drawings, specifications, and welding procedure specifications.
4. Interpret welding symbols from a print.
5. Draw welding symbols based on the observation of actual welds.

MODULE 29202-03 – READING WELDING DETAIL DRAWINGS (12.5 Hours)

1. Identify and explain a welding detail drawing.
2. Identify and explain lines, material fills, and sections.
3. Identify and explain object views.
4. Identify and explain dimensioning.
5. Identify and explain notes and bill of materials.
6. Interpret basic elements of a welding detail drawing.
7. Develop basic welding drawings.

MODULE 29203-03 – SMAW –STAINLESS STEEL GROOVE AND PIPE WELDS (80 Hours)

1. Identify and explain stainless steel metallurgy.
2. Identify and explain the selection of electrodes for welding stainless steel.
3. Identify and explain welding variations for stainless steel.
4. Prepare arc welding equipment for stainless steel welds.
5. Explain stainless steel open-root V-groove welds.
6. Perform shielded metal arc welding (SMAW) on stainless steel open-root V-groove joints in the following positions:
 - Flat (1G) position
 - Horizontal (2G) position
 - Vertical (3G) position
 - Overhead (4G) position
7. Explain stainless steel open-root V-groove pipe welds.
8. Perform shielded metal arc welding (SMAW) on stainless steel open-root V-groove pipe welds in the following positions:



- Flat (1G-ROTATED) position
- Horizontal (2G) position
- Multiple (5G) position
- Inclined multiple (6G) position

MODULE 29204-03 – AIR CARBON ARC CUTTING AND GOUGING (12.5 Hours)

1. Identify and explain the air carbon arc cutting (CAC-A) process and equipment.
2. Select and install CAC-A electrodes.
3. Prepare the work area and CAC-A equipment for safe operation.
4. Use CAC-A equipment for washing and gouging activities.
5. Perform storage and housekeeping activities for CAC-A equipment.
6. Make minor repairs to CAC-A equipment.

MODULE 29205-03 – PLASMA ARC CUTTING (PAC) (7.5 Hours)

1. Identify and understand plasma arc cutting processes.
2. Identify plasma arc cutting equipment.
3. Prepare and set up plasma arc cutting equipment.
4. Use plasma arc cutting equipment to make various types of cuts.
5. Properly store equipment and clean the work area after use.

MODULE 29206-03 – GMAW AND FCAW – EQUIPMENT AND FILLER METALS (10 Hours)

1. Explain gas metal arc welding (GMAW) and flux cored arc welding (FCAW) safety.
2. Explain the characteristics of welding current and power sources.
3. Identify and explain the use of GMAW and FCAW equipment:
 - Spray transfer
 - Globular
 - Short circuiting
 - Pulse
4. Identify and explain the use of GMAW and FCAW shielding gases and filler metals.
5. Set up GMAW and FCAW equipment and identify tools for weld cleaning.

MODULE 29207-03 - GMAW AND FCAW – PLATE (80 Hours)

1. Perform GMAW multiple-pass fillet welds on plate, using solid or composite wire and shielding gas in multiple positions.
2. Perform GMAW multiple-pass open-root V-groove welds on plate, using solid or composite wire and shielding gas, in multiple positions.
3. Perform GMAW spray fillet and open-root V-groove welds on plate, using solid or composite wire and shielding gas, in flat and horizontal positions.



4. Perform FCAW multiple-pass fillet welds on plate in multiple positions using flux cored wire and, if required, shielding gas.
5. Perform FCAW multiple-pass open-root V-groove welds on plate in multiple positions using flux cored wire and, if required, shielding gas.

MODULE 29208-03 - GTAW – EQUIPMENT AND FILLER METALS (10 Hours)

1. Explain gas tungsten arc welding (GTAW) safety.
2. Identify and explain the use of GTAW equipment.
3. Identify and explain the use of GTAW filler metals.
4. Identify and explain the use of GTAW shielding gases.
5. Set up GTAW equipment.

MODULE 29209-03 - GTAW – PLATE (40 Hours)

1. Build a pad in the flat position with stringer beads using GTAW and carbon steel filler metal.
2. Make multiple-pass open-root V-groove welds on carbon steel plate in the 1G (flat) position using GTAW and carbon steel filler metal.
3. Make multiple-pass open-root V-groove welds on carbon steel plate in the 2G (horizontal) position using GTAW and carbon steel filler metal.
4. Make multiple-pass open-root V-groove welds on carbon steel plate in the 3G (vertical) position using GTAW and carbon steel filler metal.
5. Make multiple-pass open-root V-groove welds on carbon steel plate in the 4G (overhead) position using GTAW and carbon steel filler metal.

MODULE 29210-03 - GTAW – ALUMINUM PLATE (50 Hours)

1. Identify and explain aluminum metallurgy.
2. Explain and identify characteristics of aluminum.
3. Explain GTAW and set up equipment to weld aluminum plate.
4. Explain and practice GTAW techniques for plate, including padding in the flat position with stringer beads, using aluminum filler metal.
5. Make fillet welds on aluminum plate in the following positions:
 - 1F (flat)
 - 2F (horizontal)
 - 3F (vertical)
 - 4F (overhead)
6. Make multiple-pass V-groove welds with backing on aluminum plate in the following positions:
 - 1G (flat)
 - 2G (horizontal)
 - 3G (vertical)



- 4G (overhead)

Level Three

MODULE 29301-03 - PREHEATING AND POSTWELD HEAT TREATMENT OF METALS (5 Hours)

1. Explain how to preheat metals.
2. Describe maintaining interpass temperature.
3. Explain postweld heat treatment of metals.
4. Identify and explain the effects of welding on metals:
 - Heat-affected zone (HAZ)
 - Cracking
 - Face changes/grain structure

MODULE 29302-03 - PHYSICAL CHARACTERISTICS AND MECHANICAL PROPERTIES OF METALS (7.5 Hours)

1. Identify and explain the composition and classification of base metals.
2. Explain and demonstrate field identification methods for base metals.
3. Identify and explain the physical characteristics and mechanical properties of metals.
4. Identify and explain forms and shapes of structural metals.
5. Explain metallurgical considerations for welding metals.

MODULE 29303-03 – GAS METAL ARC WELDING (GMAW) – PIPE (60 Hours)

1. Prepare GMAW equipment for open-root V-groove pipe welds.
2. Identify and explain open-root V-groove pipe weld techniques.
3. Perform open-root V-groove pipe welds using GMAW in the following positions:
 - 1G-ROTATED
 - 2G
 - 5G
 - 6G

MODULE 29304-03 – FLUX CORED ARC WELDING (FCAW) – PIPE (60 Hours)

1. Prepare FCAW equipment for open-root V-groove pipe weld techniques.
2. Identify and explain open-root V-groove pipe welds.
3. Perform open-root V-groove pipe welds using FCAW in the following positions:
 - 1G-ROTATED
 - 2G
 - 5G



- 6G

MODULE 29305-03 – GAS TUNGSTEN ARC WELDING (GTAW) – CARBON STEEL PIPE (60 Hours)

1. Set up GTAW equipment.
2. Identify and explain open-root V-groove pipe weld techniques.
3. Perform open-root V-groove pipe welds using GTAW in the following positions:
 - 1G-ROTATED
 - 2G
 - 5G
 - 6G

MODULE 29306-03 – GAS TUNGSTEN ARC WELDING (GTAW) – LOW-ALLOY AND STAINLESS STEEL PIPE (70 Hours)

1. Set up GTAW equipment to perform stainless and/or low-alloy steel pipe welding.
2. Identify and explain open-root V-groove pipe weld techniques.
3. Perform open-root V-groove pipe welds using GTAW in the following positions:
 - 1G-ROTATED
 - 2G
 - 5G
 - 6G

MODULE 29307-03 – GAS TUNGSTEN ARC WELDING (GTAW) – ALUMINUM PIPE (50 Elective Hours)

1. Set up GTAW equipment to perform aluminum pipe welding.
2. Identify and explain V-groove and modified U-groove pipe weld techniques.
3. Perform V-groove or modified U-groove pipe welds using GTAW in the following positions:
 - 2G
 - 5G
 - 6G

MODULE 29308-03 – GAS METAL ARC WELDING (GMAW) – ALUMINUM PLATE AND PIPE (50 Elective Hours)

1. Explain GMAW, and set up equipment to weld aluminum.
2. Build a pad with stringer beads and weave beads, using aluminum wire and shielding gas.
3. Perform multiple-pass fillet welds on aluminum plate in the following positions, using aluminum wire and shielding gas:



- 1F (flat)
 - 2F (horizontal)
 - 3F (vertical)
 - 4F (overhead)
4. Perform V-groove welds on aluminum plate in the following positions, using aluminum wire and shielding gas:
- 1G (flat)
 - 2G (horizontal)
 - 3G (vertical)
 - 4G (overhead)
5. Perform V-groove welds on aluminum pipe in the following positions, using aluminum wire and shielding gas:
- 1G-ROTATED (flat)
 - 2G (horizontal)
 - 5G (multiple)
 - 6G (inclined multiple)