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WELDING

Competencies / Objectives

Level One

MODULE 29101-09 – WELDING SAFETY

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

MODULE 29102-09 – OXYFUEL CUTTING

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 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 – PLASMA ARC CUTTING

1. Explain the 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 29104-09 – AIR CARBON ARC CUTTING AND GOUGING

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 29105-09 – BASE METAL PREP

1. Clean base metal for welding or cutting.
2. Identify and explain joint design.
3. Explain joint design considerations.
4. Mechanically bevel the edge of a mild steel plate.
5. Thermally bevel the end of a mild steel plate.
6. Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.

MODULE 29106-09 – WELD QUALITY

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.
7. Perform a visual inspection of fillet welds.

MODULE 29107-09 – SMAW – EQUIPMENT AND SETUP

1. Identify and explain shielded metal arc welding (SMAW) safety.
2. Explain welding electrical current.
3. Identify welding power supplies and their characteristics.
4. Explain how to set up welding power supplies.
5. Set up a machine for welding.
6. Identify tools used for weld cleaning.

MODULE 29108-09 – SHIELDED METAL ARC ELECTRODES

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 29109-09 – SMAW – BEADS AND FILLET WELDS

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 29110-09 – JOINT FIT-UP AND ALIGNMENT

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 29111-09 – SMAW – GROOVE WELDS WITH BACKING

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 29112-09 – SMAW – OPEN V-GROOVE WELDS

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

Level Two

MODULE 29201-09 – WELDING SYMBOLS

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.

MODULE 29202-09 – READING WELDING DETAIL DRAWINGS

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. Sketch or draw a basic welding drawing.

MODULE 29203-09 – PHYSICAL CHARACTERISTICS AND MECHANICAL PROPERTIES OF METALS

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 29204-09 – PREHEATING AND POSTWELD HEAT TREATMENT OF METALS

1. Explain and demonstrate how to preheat metals.
2. Describe maintaining interpass temperature.
3. Explain postweld heat treatment of metals.
4. Explain the effects of welding on metal
   - Heat-affected zone (HAZ)
   - Cracking

MODULE 29205-09 – GMAW AND FCAW: EQUIPMENT AND FILLER METALS

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 29206-09 – GMAW AND FCAW: PLATE

1. Perform GMAW-S (short-circuit) multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using solid or composite wire and shielding gas.
2. Perform GMAW-S (short-circuit) multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire.
3. Perform GMAW spray fillet and V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.
4. Perform FCAW multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using flux cored wire and, if required, shielding gas.
5. Perform FCAW multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using flux cored wire and, if required, shielding gas.

MODULE 29207-09 - GTAW: EQUIPMENT AND FILLER METALS

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

MODULE 29208-09 - GTAW – PLATE

1. Weld a pad in the flat position with stringer beads using GTAW and carbon steel filler metal.
2. Make multiple-pass GTAW fillet welds on carbon steel plate coupons in the following positions, using carbon steel filler metal:
   - 1F
   - 2F
   - 3F
   - 4F
3. Make multiple-pass GTAW V-groove welds on carbon steel plate coupons in the following positions, using carbon steel filler metal:
   - 1G
   - 2G
   - 3G
   - 4G
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

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

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

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

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

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

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

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

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)