

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY  
SAULT STE, MARIE, ONTARIO

COURSE OUTLINE

Course Title: Advanced Welding Processes and Fabrication (Theory & Practical)

Code No: MET127-03 (Theory)

Program: Welding and Fabrication

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Revision: XX

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**MODULE: MFH - WELDING CODES AND STANDARDS**

<b>UNIT</b>	<b>LEARNING TASK</b>
1)	1) To study Canadian Codes and Standards. 2) To study American Codes and Standards. 3) To study Welder Qualification Test Class "S" under CSA 47.1-73. 4) To study Welder Classification Test Class "T" under CSA 47.1-73. 5) To study Welder Qualification Test under ASME Boiler + Pressure Vessel Code, Section IX - Welding + Brazing. 6) To study Welding Procedures Under CSA Standard Z184 - M1983 (Gas Pipeline Systems). 7) To study good work and welding practices based on Code Requirements.

**MODULE: MFE - ADVANCED ARC WELDING**

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|----|--|
| 1) | 1) Concepts of Basic Electricity.<br>2) Concepts of Transformers, Alternating Current and Rectifiers.<br>3) General Requirements for Arc Welding, Duty Cycle and Open Circuit Voltage. |
| 2) | 1) Shielded Metal Arc Basics.<br>2) Manufacture of Electrodes.<br>3) Functions of Electrode Coatings.<br>4) Unit Pre-Test.<br>5) Theory Test #1.                                       |

**UNIT****LEARNING TASK**

- 3)
  - 1) Overhead Fillets  
4-F Position; Stringer Beads  
E6010
  - 2) Overhead Fillets  
4-F Position; Stringer Beads  
E6011
  - 3) Overhead Fillets  
4-F Position? Stringer Beads  
E7018
  - 4) Simulated Overhead Groove Welds  
4G Position  
Stringer Beads  
E6010
  - 5) Simulated Overhead Groove Welds  
4G Position  
Stringer + Weave Beads  
E6010/E7018
  
- 4)
  - 1) Horizontal Fillets on Pipe  
2F Position  
E6010
  - 2) Horizontal Fillets on Pipe  
2F Position  
E6011
  - 3) Horizontal Fillets on Pipe  
2F Position  
E7018
  - 4) Horizontal Fillets on Structural Shapes  
2F Position
  - 5) Horizontal Fillets on Round Bar  
2F Position  
E7018
  
- 5)
  - i) Groove/Fillet Welds  
Pipe-to-Pipe  
Pipe Axis - Horizontal  
E6010
  - 2) Groove/Fillet Welds  
Pipe-to-Pipe  
Pipe Axis - Horizontal  
E6010/E7018

**UNIT****LEARNING TASK**

- 6)
    - 1) Fabricate a Line-up Jib.
    - 2) Outside Corner Joints  
1G Position - E6010
    - 3) Outside Corner Joints  
2G Position - E6010/E7018
    - 4) Outside Corner Joints  
3G Position - E6010
    - 5) Outside Corner Joints  
4G Position - E6010/E7018
  
  - 7)
    - 1) 1G Open Root  
Plate Test  
E6010/E7018
    - 2) 2G Open Root  
Plate Test  
E6010/E7018
    - 3) 3G Open Root  
Plate Test  
E6010/E7018
    - 4) 4G Open Root  
Plate Test  
E6010/E7018
  
  - 8)
    - 1) IGF Plate Test with Backing.
    - 2) 2GF Plate Test with Backing.
    - 3) 3GF Plate Test with Backing.
    - 4) 4GF Plate Test with Backing.
  
  - 9)
    - 1) Specific Materials in Electrode Coatings
    - 2) Electrode Classification.
    - 3) Characteristics of Covered Electrodes.
    - 4) Electrode Selection.
    - 5) Electrode Storage,
    - 6) Low Alloy Electrodes.
    - 7) Unit Pre-Test.
- n\ Thonrv Test # 2.

**UNIT            LEARNING TASK**

- 10)            1    Welding Cast Irons.  
                 2    Welding with Stainless Steel.  
                 3    Hardsurfacing Techniques.  
                 4    Unit Pre-Test.  
                 5    Theory Test #3.

**MODULE: MFJ - GAS TUNGSTEN ARC WELDING**

- 1)            1    Describe the Gas Tungsten Arc Welding Process.  
                 2    Describe the Advantages and Disadvantages of GTAW.  
                 3    Identify various terms by which GTAW is known.  
                 4    Identify some of the industries that use this  
                 welding process extensively.

Identify all the protective clothing best suited to the TIG Process.  
Determine the proper welding lense selection for TIG.  
List electrical safety checks to be made before welding  
Identify ventilating problems associated with TIG.

Cyber-Wave 300S TIG Unit - Setup assembly, operating functions, shut-down procedures.

Constant Current Welding Machines, Transformer/Rectified Units.

Polarity Relationships to GTAW - Polarity Heat Distributions.

Line Power Characteristics(Utility Power Supply to the Shop).

High Frequency use with GTAW.

Pulse Arc Mode.

Balanced Wave Function in GTAW.

H. F. Radiation (Radio Communication Interference).

Study of the Consol Panels of the CW300S.

## **LEARNING TASK**

Set-up a GTAW Station for Welding Mild Steel and Stainless Steel,

Shut-Down GTAW Station.

Gas Cooled {Air Cooled} and Water Cooled GTAW Torches.

Torch Components and Cup Choices.

Torch Hose Assembly - Light Duty.

Torch Hose Assembly - Water Cooled (Heavy Duty)

Torch Assembly for Welding.

Light gauge M.S. Strip/Filler Wire Beads (Lap and T Joints).

Purpose of the Shielding Gas in GTAW.

Argon Gas Characteristics.

Helium Gas Characteristics.

Gas Mixes (with reactive gases).

Recommended Gas Choices.

Gas Influence on Weld Beads.

Regulator Construction and Function.

Flowmeter Construction and Function.

Effective Gas Volume Coverages.

Assembly of Regulator/Flowmeter Units.

GTAW Light Gauge Lap Joint Welds(Mild Steel).

Contactor Controls.

Remote Amperage Controls.

Connecting of contactor and Amperage Remote Controls.

Prepare M.S. Plate for Butt Welds - Bevel Machine Cuts

**UNIT,            LEARNING TASK**

- 9)            1) Tungsten and Tungsten Alloyed Electrodes and the Colour Code.
- 2) Electrode Care and End Preparation Methods.
- 3) Electrode selection; Size - Alloy Type.
- 4) GTAW of Mild Steel Butt Welds 1G.
- 5) Practice Exercises in GTAW Mild Steel Butt Welds 1G.
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- 10)           1) Study the Filler Wires used in TIG Welding Mild Steel
- 2) Proper Handling and Storage of Mild Steel Filler Wire
- 3) A Demonstration of TIG welding on Mild Steel.
- 4) A Study of Joint Design and Joint Preparation Types.
- 5) A Study of Mild Steel Weld Defects.
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- 11)           1) A study of the correct Filler Rod Selection for some of the common Stainless Alloys and an Examination of the Stainless Alloy Coding System.
- 2) Solar Flux, its purpose and use in TIG Welding Stainless Steels, and Gas Backing Techniques.
- 3) Welding Procedures for Stainless Steel Alloys.
- 4) Examining the Totally Enclosed Environment methods for Welding Stainless and other High Quality Metals.
- 5) Stainless Steel Butt Weld Exercises.  
              M.S. plate / S. ₤. filler?.
- 6) Post Cleaning Stainless Stools.

**MODULE: MFI - AIR CARBON ARC GOUGING & CUTTING**

- 1)            1) Describe the basic principles of how the Air Carbon Arc (AAC) process works and compare it to the oxy-fuel process.
- 2) Identify the advantages provided by the Air Carbon Arc metal removal process.
- 3) Identify some of the disadvantages of AAC cutting and gouging.

## LEARNING TASK

- 1) Identify ten areas of industry that extensively use the Air Carbon Arc process and indicate some common practical uses employed in various construction and prepare industries•
  - 2) OMIT
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- 1) Study the areas of personal safety that are associated with the Air Carbon Arc cutting and gouging process.
  - 2) Study ventilation needs, fire and electrical shock hazards associated with the Air Carbon Arc system.
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- 1) Express in pounds per square inch (PSI) and cubic feet per minute (CFM) the air requirements to operate:
    - a light duty AAC torch
    - a standard industrial AAC torch capacities
  - 2) OMIT
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- 1) Study the power supplies recommended for AAC use and understand machine capacities in:
    - duty cycle, primary input, and nema classification and relate this information to AAC needs.
  - 2) OMIT
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- 1) Study the parts of an Air Carbon Arc hand torch and the combined air hose/cable lead and know the function of the components.
  - 2) OMIT
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- 1) Study the construction, copper cladding, sizes and shapes of carbon electrodes.
  - .) ULitiiy Uui uoniimjL IHU tiinl HHIHULIUH imi'lnjii HIIUJUWIHH designed for AC and DC application\*
  - 3) Study the socket joint type carbon electrodes and their use with semi and automatic equipment.
  - 4) Study the care in storing and identifying of carbon electrodes.
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- 1) OMIT

## LEARNING TASK

- 3) Study the metallurgical affects of air carbon arc heat cycle and carborizing possibilities when using the AAC process.
  
  - 1) Study the methods of edge and groove preparation of stainless steels and the limitations and advantages of some processes.
  - 2) Identify "chromium carbide precipitation" and how it can affect finished welded products.
  
  - 1) OMIT
  - 2) OMIT
  
  - 1) Study an air carbon arc station set up.
  - 2)a)Have the instructor explain assembly procedure, safety check out<sub>f</sub> electrode air pressure and amperage selections.  
b)Observe instructor's demonstration for electrode stickoutr speed of travel, angle of rod to work piece, depth of groove, etc.  
c)Assemble materials for AAC gouging:
    - 1) 1/2" X 6" X 6" (scrap welded sample with existing welds) including T-Joints, cross-joints, pipe to plate, etc.
    - 2) one air carbon arc torch, heavy duty (class 1) welding machine and compressed air line supply.
    - 3) Arrange booth or shielded work area.
    - 4) Arrange standby fire equipment (extinguisher).d)Practice on flat gouging on items in c - 1. Do not attempt position gouging until you have a qualifying grade in flat work.
- 3)a)Obtain a qualification in setting up and dismantling an AAC station.
  - b)1) Make 3/8" single pass grooves in the 1 G position using 1/4" round electrodes. (a minimum of size 6 inch single passes).

**UNIT**  
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**LEARNING TASK**

2) OMIT

3) OMIT

4) OMIT

12) OMIT

13) 1) Study and follow the preventive maintenance procedure outline.

2) Study and recognize the problems the operator can experience in air carbon arc use and how they can be resolved.

**MODULE: MFF - GAS METAL & FLUX CORE ARC WELDING**

1) 1) Identify all parts of the GMAW and FCAW Welding units

2) Identify the sequence of assembling the equipment and testing and shutting down the equipment.

2) 1) Identify the types of wire used in GMAW and FCAW and the method used to classify them.

3) 1) Identify the various types of shielding gases used in GMAW and FCAW and the method of storage.

4) 1) Identify the type of welding machine used for GMAW and FCAW\*

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5) 1) Weld GMAW stringer beads in the flat position

2) Weld FCAW stringer beads in the flat position

## LEARNING TASK

- 1) Weld GMAW fillet welds in the flat position\*
- 2) Weld FCAW fillet welds in the flat position.

- 1) Weld GMAW fillet welds in the horizontal position.
- 2) Weld FCAW fillet welds in the horizontal position.

- 1) Weld GMAW butt welds in the flat position.
- 2) Weld FCAW butt welds in the flat position.