COURSE OUTLINE: MET822 - WELDING

Prepared: Dave Holley
Approved: Corey Meunier, Chair, Technology and Skilled Trades

Course Code: Title	MET822: WELDING
Program Number: Name	6232: STEAMFITTING ADV
Department:	PIPING TRADES
Semesters/Terms:	20F
Course Description:	This course provides apprentices with a combination of knowledge and practical skills in the operation and safe use of shielded metal arc welding equipment. Trade specific skills are developed through the preparation and welding of lap, tee and groove weld joints on steel plate and pipe in the flat and horizontal position and vertical position. Safe work practices and weld quality are stressed throughout the course and are reinforced by means of an independent reading assignment complete with a final theory test.
Total Credits:	3
Hours/Week:	3
Total Hours:	24
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Essential Employability Skills (EES) addressed in this course:	EES 4 Apply a systematic approach to solve problems. EES 5 Use a variety of thinking skills to anticipate and solve problems. EES 10 Manage the use of time and other resources to complete projects. EES 11 Take responsibility for ones own actions, decisions, and consequences.
Course Evaluation:	Passing Grade: 50%, D A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.
Other Course Evaluation & Assessment Requirements:	EVALUATION PROCESS/GRADING SYSTEM: The final course grade will be calculated using the following list of weighted factors. Factor Value Shop Assignments & Tests 100 % Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00 C 60 - 69% 2.00 D 50 - 59% 1.00 F (Fail)49% and below 0.00

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.

CR (Credit) Credit for diploma requirements has been awarded.
S Satisfactory achievement in field /clinical placement or non-graded subject area.
U Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR Grade not reported to Registrar`s office.
W Student has withdrawn from the course without academic penalty.

Books and Required Resources:

ILM Modules by Alberta ILM

Course Outcomes and Learning Objectives:

Course Outcome 1	**Learning Objectives for Course Outcome 1**
Welding Codes and Standards:	1.1 Identify the applicable section of the Ontario Boilers and Pressure Vessels Act which contains requirements for steamfitting-related welding operations 1.2 Identify applicable sections of the ASME and CWB codes from a given welding procedure qualification form 1.3 Describe the requirements of welding codes and standards for: • pressure welding applications to the ASME Boiler and Pressure Vessel Code • base and filler metal requirements to Section II • product design and manufacture requirements to Section III or VIII • welding procedure and performance qualification requirements to Section IX • structural welding applications to the CSA Structural Welding Standards • filler metal requirements to CSA W48 • company and personnel requirements to CSA W47.1 • product design and manufacture requirements to CSA W59 • material test reports • other codes and standards
Course Outcome 2	**Learning Objectives for Course Outcome 2**
Welding Metallurgy and Quality Control	2.1 Identify the fundamentals of metallurgy required for the production of quality welds

		including: • mechanical properties • tensile strength • impact strength • hardness • ductility • chemical properties • corrosion resistance 2.2 Describe the following procedures: • preheating • post heating • stress relief 2.3 Define the fundamentals of distortion control • selection of preventative method • distortion allowances • preheating • back step • weld progression • vertical up vs. vertical down • continuous vs. intermittent welding • pre-setting joints • jigs and fixtures • effects of travel speed • effects of weld size • effects of bead size • effects of over welding • multiple pass vs. single pass 2.4 Describe the recommended quality controls measures for welds 2.5 Explain inspection and testing methods for the following:

	• hardness testing • rockwell method • brinell method • vickers method • metallography • weld joint cross-sections • polishing • etching • analyzing • macro-examination • micro-examination • hydrostatic testing • leak testing • vacuum testing • fracture testing • chemical analysis
Course Outcome 3	**Learning Objectives for Course Outcome 3**
Shielded Metal Arc Welding	3.1 Describe the Shielded Metal Arc Welding procedure variables and their effect on quality and productivity: • pre-selected variables • joint design and fit-up • consumables • primary variables (conducted prior to welding) • current type and polarity • amperage • pre-heat • electrode size • secondary variables (conducted during welding)

	• travel speed • arc length • work angle • electrode angle • technique • whipping • weaving • stringer • multiple passes • drag 3.2 Perform Shielded Metal Arc Welding procedures to produce butt welds in pipe
Course Outcome 4	**Learning Objectives for Course Outcome 4**
Metal Inert Gas Welding	4.1 Define the fundamentals of the Metal Inert Gas Welding process: • modes of metal transfer • short-circuiting transfer • spray arc transfer • globular • pulsed • gas shielding • purpose • types • Argon / Helium • CO2 • mixed gases • triple mix gas 4.2 Explain safety concerns applicable to the Metal Inert Gas Welding process: • UV radiation • appropriate helmet and filter plate

- spatter and proper safety clothing
- storage and handling of high pressure cylinders
- flow meters
- fumes and gases
- oxygen depletion

4.3 Explain the function of the components of the Metal Inert Gas Welding process:

- fundamentals and characteristics of the constant voltage power source
self-correcting arc gap
- application of constant current power sources
- wire feeders
- spool guns
- push type
- push pull type
- drive rolls
- liners
- metallic
- non-metallic
- gas diffusers
- contact tips / contact tubes
- nozzles
- water cooled guns

4.4 Explain the selection and characteristics of consumables necessary for Metal Inert Gas
Welding for:

- short-circuit transfer
- spray-arc transfer
- optimal wire type and size (diameter)
- filler metal classification system
- low alloy

- steels
- stainless steels
- aluminum
- types and sizes
- purpose of copper plating
- shielding gas
- types
- flow rate

4.5 Describe the procedure variables for Metal Inert Gas Welding and their effect on quality
and productivity:

- pre-selected variables
- joint design and fit-up
- consumables
- wire
- shielding gas
- primary variables
- current type and polarity
- amperage
- wire feed speed
- wire diameter
- voltage
- preheat
- secondary variables (conducted during welding)
- travel speed
- nozzle to work distance
- work angle
- gun angle to work
- technique
- stringer

	• multi-passes • weaving • forehand • backhand 4.6 Explain the use of the term Gas Metal Arc Welding (GMAW) 4.7 View a demonstration of Metal Inert Gas Welding in various positions: • horizontal • vertical • overhead
Course Outcome 5	**Learning Objectives for Course Outcome 5**
Tungsten Inert Gas Welding	5.1 Define the fundamentals of the Tungsten Inert Gas Welding process: • non-consumable tungsten electrode • gas shielding of weld • advantages of the Tungsten Inert Gas Welding process • no spatter • all position capable • precision • weld light gauge materials • high quality welds • concentrated high-temperature arc • wide variety of applications and alloys • limitations of the Tungsten Inert Gas Welding process • deposition rates • pre-cleaning required 5.2 Explain the safety concerns applicable to the Tungsten Inert Gas Welding process: • arc radiation • heat

- air quality
- fumes
- gases
- oxygen depletion
- electrical
- high frequency
- thorium
- high pressure cylinders

STEAMFITTER - LEVEL 3

5.3 Explain the required equipment and components for the Tungsten Inert Gas Welding process including:

- power source
- fundamentals and characteristics of the constant current power source
- equipment controls
- welding currents
- AC
- DC electrode negative
- DC electrode positive
- high frequency (HF) circuit
- contractor and current control methods
- manual control
- remote controls
- foot control
- torch thumbwheel
- shielding gas supply system
- cylinders or bulk systems
- regulator
- flow meter

- hoses
- torches
- air and water cooled
- amperage rating
- coolant circulators
- collet and body
- nozzle
- gas lens

5.4 Explain the characteristics and selection considerations for consumables used for Tungsten
Inert Gas Welding on steel:

- shielding gas
- type
- flow rate (Imperial and metric)
- filler material
- type (alloy) and classification
- size
- tungsten electrode
- type and grade
- size
- conditioning and contamination control

5.5 Explain the set-up and control of the process variables for the Tungsten Inert Gas Welding
process:

- electrical
- current type and polarity
- amperage adjustment
- shielding gas
- flow rate
- backing gas and purging

		• filler rod selection • diameter • arc initiation methods • scratch start • lift start • high frequency start • technique • torch and filler rod angles • arc length • travel speed • filler rod addition method 5.6 Explain the use of the term Gas Tungsten Arc Welding (GTAW) 5.7 View a demonstration of Tungsten Inert Gas Welding to produce butt welds in the following positions: • horizontal • vertical • overhead
Date:	October 27, 2020	
Addendum:	Please refer to the course outline addendum on the Learning Management System for further information.	