



Republic of the Philippines

Department of Education

DepEd Complex, Meralco Avenue, Pasig City

STRENGTHENED SENIOR HIGH SCHOOL CURRICULUM

MANUAL METAL ARC WELDING

Grade 11/12

Course Description:

This course is designed to equip learners with essential skills and knowledge in Manual Metal Arc Welding (MMAW), aligning with industry standards. It covers welding carbon steel plates and pipes components, following technical drawings, blueprints and welding procedure specification (WPS). This course conforms with the latest edition of ISO 9606-1: Qualification testing of welders, Fusion welding Part 1: Steels, AWS D1.1: Structural Welding Code-Steel and ASME IX: Boiler and Pressure Vessel Code. Upon completion, learners are eligible to take assessments to earn National Certificate level I and/or II in Manual Metal Arc Welding, higher education, and careers in the welding sector industry.

Elective: Technical Professional

Prerequisite: None

Time Allotment: In Grade 11, 320 hours for two semesters, 8 hours per week. In Grade 12, 320 hours for one semester, 16 hours per week

Schedule: First/Second Semester

QUARTER I

CONTENT STANDARD	The learners demonstrate an understanding of the concepts and principles of Manual Metal Arc Welding Process (MMAW).	
PERFORMANCE STANDARD	The learners perform setting-up welding machine, accessories, jigs and fixtures, stringer and weave bead patterns in carbon steel plates. Joint fit-up in workpiece/weld specimen and inspect visually following the safety precautions.	
LEARNING COMPETENCIES		CONTENT
1. Discuss the overview of manual metal arc welding process		Overview of Manual Metal Arc Welding Process (MMAW) <ul style="list-style-type: none"> • Weld Joint Design • Welding Symbols • Stringer and weave bead patterns • Joint Fit-up Procedures • Fillet Welding in Carbon Steel Plates in all positions • Groove Welding in Carbon Steel Plates and Pipes in all positions

	Career and Business Opportunities for Manual Metal Arc Welding Process (MMAW)
2. Discuss the weld joint design	Weld Joint Design (<i>but not limited to the following</i>) <ul style="list-style-type: none"> • Types of Joints • Types of Welds • Parts of Weld Joints • Parts of Groove Weld • Parts of Fillet Weld • Welding Positions
3. Interpret technical drawing, sketches and welding symbols in reading blueprints/plans	technical drawing, sketches and welding symbols <ul style="list-style-type: none"> • blueprints • plans
4. Discuss welding procedure specification (WPS)	Welding Procedure Specification (WPS) (<i>but not limited to the following</i>) <ul style="list-style-type: none"> • Welding positions • Material thickness • Type of material • Welding Electrodes • Welding Parameters • Joint Preparation
5. discuss occupational safety and health (OSH)	Occupational Safety and Health (OSH) <ul style="list-style-type: none"> • Requirements • Regulations • Policies • Procedures
6. Perform setting-up welding machine, accessories, positioners, jigs and fixtures	Procedures in setting up welding machine, accessories, positioner, jigs and fixtures
7. Prepare tools, materials and equipment for stringer and weave beads	Stringer and weave bead <ul style="list-style-type: none"> • Tools • Materials • Equipment

8. Perform stringer and weave bead patterns in carbon steel plates	Stringer and weave bead patterns in carbon steel plates <i>(but not limited to the following)</i> <ul style="list-style-type: none"> • Stringer • Box • Circular • Crescent • Double J • Zigzag
9. Perform visual weld inspection	Visual weld inspection <ul style="list-style-type: none"> • Fully fused to the base metal • Free from defects • Evenly distributed
10. Apply joint fit-up of the workpiece/weld specimen	Joint Fit-up Procedures <ul style="list-style-type: none"> • Root opening • Workpiece Alignment • Tack Welding

QUARTER 2

CONTENT STANDARD	The learners demonstrate an understanding of the concepts and principles of the fillet welding in carbon steel plates in PA (1F), PC (2F), PF (3F) and PE (4F) positions.
PERFORMANCE STANDARD	The learners perform fillet welding procedures in carbon steel plates in PA (1F), PC (2F), PF (3F) and PE (4F) positions, following the safety precautions. Inspect visually and compute the service cost based on job requirements.
LEARNING COMPETENCIES	
	CONTENT
1. Discuss fillet welding in carbon steel plates and the prescribed welding positions; PA (1F), PC (2F), PF (3F) and PE (4F)	Fillet welding in carbon steel plates <ul style="list-style-type: none"> • PA (1F) • PC (2F) • PF (3F) • PE (4F)
2. Prepare tools, materials and equipment for fillet welding	Fillet welding

	<ul style="list-style-type: none"> • Tools • Materials • Equipment
3. Perform fillet welding in carbon steel plates PA (1F) position	<p>Fillet Welding Procedures in Carbon Steel Plates in PA (1F) Position</p> <ul style="list-style-type: none"> • Single pass • Multiple passes
4. Perform fillet welding in carbon steel plates in PC (2F) position	<p>Fillet Welding Procedures in Carbon Steel Plates in PC (2F) Position</p> <ul style="list-style-type: none"> • Single pass • Multiple passes
5. Perform fillet welding in carbon steel plates in PF (3F) position	<p>Fillet Welding Procedures in Carbon Steel Plates in PF (3F) Position</p> <ul style="list-style-type: none"> • Single pass • Multiple passes
6. Perform fillet welding in carbon steel plates in PE (4F) position	<p>Fillet Welding Procedures in Carbon Steel Plates in PE (4F) Position</p> <ul style="list-style-type: none"> • Single pass • Multiple passes
7. Perform visual weld inspection	<p>Visual weld inspection</p> <ul style="list-style-type: none"> • Fully fused to the base metal • Free from defects • Evenly distributed
8. Compute the service cost based on the job requirements	<p>Service Cost</p> <ul style="list-style-type: none"> • material costing • manpower (labor costing)

QUARTER 3

CONTENT STANDARD	The learners demonstrate an understanding of the concepts and principles of the groove welding in carbon steel plates in PA (1G), PC (2G), PF (3G) and PE (4G) positions.	
PERFORMANCE STANDARD	The learners perform groove welding procedures in carbon steel plates in PA (1G), PC (2G), PF (3G) and PE (4G) positions following the safety precautions. Inspect visually and compute the service cost based on job requirements.	
LEARNING COMPETENCIES	CONTENT	
1. Discuss groove welding in carbon steel plates and the prescribed welding positions; PA (1G), PC (2G), PF (3G) and PE (4G)	Groove welding in carbon steel plates <ul style="list-style-type: none"> • Flat (1G) • Horizontal (2G) • Vertical (3G) • Overhead (4G) 	
2. Prepare tools, materials and equipment for groove welding carbon steel plates	Groove welding in carbon steel plates <ul style="list-style-type: none"> • Tools • Materials • Equipment 	
3. Perform groove welding in carbon steel plates in PA (1G) position	Groove Welding Procedures in Carbon Steel Plates in Flat (1G) Position <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass 	
4. Perform groove welding in carbon steel plates in PC (2G) position	Groove Welding Procedures in Carbon Steel Plates in Horizontal (2G) Position <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass 	
5. Perform groove welding in carbon steel plates in a PF (3G) position	Groove Welding Procedures in Carbon Steel Plates in Vertical (3G) Position <ul style="list-style-type: none"> • Root pass • Hot pass 	

	<ul style="list-style-type: none"> • Filler pass/es • Capping/Cover Pass
6. Perform groove welding in carbon steel plates in the PE (4G) position	Groove Welding Procedures in Carbon Steel Plates in Overhead (4G) Position <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass
7. Perform visual weld inspection	Visual weld inspection <ul style="list-style-type: none"> • Fully fused to the base metal • Free from defects • Evenly distributed
8. Compute the service cost based on the job requirements	Service Cost <ul style="list-style-type: none"> • material costing • manpower (labor costing)

QUARTER 4

CONTENT STANDARD	The learners demonstrate an understanding of the concepts and principles of groove welding in carbon steel pipes in PA (1G), PC (2G), PH (5G) and H-LO45 (6G) positions.
PERFORMANCE STANDARD	The learners perform groove welding in carbon steel pipes in PA (1G), PC (2G), PH (5G) and H-LO45 (6G) positions following the safety precautions. Inspect visually and compute the service cost based on job requirements.
LEARNING COMPETENCIES	
	CONTENT
1. Discuss groove welding in carbon steel plates and the prescribed welding positions; PA (1G), PC (2G), PH (5G) and H-LO45 (6G)	Groove welding in carbon steel pipes <ul style="list-style-type: none"> • flat (1G) position • horizontal (2G) position • flat, vertical and overhead (5G) positions • flat, horizontal, vertical and overhead (6G) positions

2. Prepare tools, materials and equipment for groove welding in carbon steel pipes	Groove welding in carbon steel pipes <ul style="list-style-type: none"> • Tools • Materials • Equipment
3. Perform groove welding in carbon steel pipes in PA (1G) position	Groove Welding Procedures in Carbon Steel Pipes in Flat (1G) Position <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass
4. Perform groove welding in carbon steel pipes PC (2G) position	Groove Welding Procedures in Carbon Steel Pipes in Horizontal (2G) Position <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass
5. Perform groove welding in carbon steel pipes PH (5G) position	Groove Welding Procedures in Carbon Steel Pipes in overhead, vertical and flat (5G) positions <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass
6. Perform groove welding in carbon steel pipes H-LO45 (6G) position	Groove Welding Procedures in Carbon Steel Pipes in overhead, vertical, horizontal and flat (6G) positions <ul style="list-style-type: none"> • Root pass • Hot pass • Filler pass/es • Capping/Cover Pass
7. Perform visual weld inspection	Visual weld inspection <ul style="list-style-type: none"> • Fully fused to the base metal • Free from defects • Evenly distributed

8. Compute the service cost based on the job requirements	Service Cost <ul style="list-style-type: none"> • material costing • manpower (labor costing)
---	---

GLOSSARY

Base Metal	The metal that is to be worked, cut or welded
Bead	A weld deposit resulting from a single welding pass
Bend Test	A destructive testing method that calls for a test specimen taken from a test coupon to be bent to a specified bend radius. This test is used to evaluate the soundness and ductility of the welded joint
Break Test	A destructive testing method in which a fillet weld test is loaded so that the weld root is in tension until it breaks. Once broken, soundness of the welded joint is evaluated by examining the fractured surface for incomplete fusion, porosity, and other internal discontinuities. This test is primarily used for welders qualification.
Cover Pass/Capping	The final pass in a multi-pass weld, which covers the previous passes and provides the final appearance and strength to the weld.
Discontinuity	An interruption of the typical structure of a material, such as lack of homogeneity in its mechanical, metallurgical or physical characteristics. A discontinuity is not necessarily a defect.
Destructive testing (DT)	Is undertaken in order to understand a specimen's performance or material behavior. These procedures are carried out to the test specimen's failure. DT methods are commonly used for materials characterization, fabrication validation, failure investigation, and can form a key part of engineering critical assessments.
Electrode	A coated metal wire that is used in welding to conduct current and melt into the weld pool to fuse the weld joint
Filler Pass	Intermediate weld passes that fill the joint after the root pass and before the capping pass.

Fillet Weld	A weld of approximately triangular cross section joining two surfaces approximately at right angles to each other in a lap joint, T-joint, or corner joint.
Groove Weld	Is a type of weld that is used to fill a groove or joint between two pieces of metal that are to be joined together. The groove is typically created by beveling, flanging, or preparing the edges of the materials to form a space where the weld metal can be deposited.
Hot Pass	The second pass in the welding process, applied immediately after root pass to remove any impurities and ensure a strong weld.
Jig	(A.K.A Fixture) A device designed to hold and maintain parts in proper relation to each other. Jig and fixture have essentially the same meaning. They both function to facilitate assembly of parts and to hold a work piece assembly in proper alignment and position during handling and welding.
Joint	The junction of members or the edges of the base metal that are to be joined or have been joined by welding
Liquid Penetrant Testing (PT)	A non-destructive testing method in which a penetrating agent is used to detect weld defects and other possible flaws in non-magnetic and non-porous material.
MMAW	(A.K.A SMAW) An arc welding process with an arc between a covered electrode and the weld pool. The process is used with shielding from the decomposition of the electrode covering, without the application of pressure, and with filler metal from the electrode.
Non-Destructive Testing (NDT)	Is a testing and analysis technique used by the industry to evaluate the properties of a material, component, structure or system for characteristic differences or welding defects and discontinuities without causing damage to the original part.
Occupational Safety and Health (OSH)	Refers to a set of rules issued by DOLE which mandates the adoption and use of appropriate practices, means, methods, reasonable standards operations or processes, and working conditions necessary to ensure safe and healthful employment.

Root Pass	Is the first layer of welding applied to a joint, particularly in a groove weld, which joins the base materials at the root of the joint. This pass is typically the foundational weld layer that forms the initial connection between the two pieces of metal.
Visual Inspection	When an object is inspected by the eye directly.
Weld Defects	A discontinuity or discontinuities accumulated effect that render a welded part or product unable to meet minimum applicable acceptance standard or specification.
Welding	A joining process that causes materials to fuse and merge by heating them to the welding temperature, with or without the application of pressure or by the application of pressure alone, and with or without using filler metal.
Welding Electrode	A component of the welding circuit through which current is run and that ends at the arc, in a molten conductive slag, or in the base metal. The flux covered consumable filler in MMAW/SMAW
Welding Torch	A gas mixing and burning tool for the welding of metals
Weldment	An assembly or structure whose component parts are joined by welding
Welding Procedure Specification (WPS)	A document providing the required welding variables for a specific application to assure repeatability by properly trained welders and welding operators.

PA (1F)	Flat Position (Steel Plate-Fillet Welding)
PC (2F)	Horizontal Position (Steel Plate-Fillet Welding)
PF (3F)	Vertical Position (Steel Plate-Fillet Welding)

PE (4F)	Overhead Position (Steel Palte-Fillet Welding)
PA (1G)	Flat Position (Steel Plate-Groove Welding)
PC (2G)	Horizontal Position (Steel Plate- Groove Welding)
PF (3G)	Vertical Position (Steel Plate- Groove Welding)
PE (4G)	Overhead Position (Steel Palte- Groove Welding)
PA (1G)	Flat Position (Steel Pipe-Groove Welding)
PC (2G)	Horizontal Position (Steel Pipe-Groove Welding)
PH (5G)	Flat, Horizontal and Vertical Positions (Steel Pipe-Groove Welding)
H-LO45 (4G)	Flat, Horizontal, Vertical and Overhead Positions. 45 Degree (Steel Pipe-Groove Welding)

TOOLS, MATEERIALS AND EQUIPMENT

TOOLS	MATERIALS	EQUIPMENT
Chipping Hammer	Electrodes 3.2mm (ISO / E6011)	MMAW/SMAW machine AC/DC 250-300amps and accessories
Steel brush	Electrodes 3.2mm (ISO / E7018)	Welding table with welding positioners
Pliers/tongs	Softstone / Chalk Marker	Electrode oven (Big)
Files-bastard cut	Dark glass #10	Portable disc grinder
Welding Mask	Clear glass	Ventilation System
Welding apron/jacket	Cutting disc 3/32" X 5/8" X 4"	Work bench w/ bench vice on 4 corners
Welding gloves(long)	Grinding disc 1/4" X 5/8" X 4"	Oxy-fuel cutting outfit with trolley
Safety goggles, wide vision, clear	Carbon steel plate 10mm x 150mm x 200mm	Pedestal /bench grinding machine

Oxy-acetylene Goggles	Carbon steel pipe, 150ø mm. x 125mm (sch. 40)	Industrial fan
Tri-square 300 mm. Long		Portable Oven (quiver type)
Steel rule 300mm. long		Fire Extinguishers
Files-half round		Waste Bins
Welding gauges		Scrap Bin
Respirator (as per NIOSH)		Broom and dustpans
Safety Shoes (High-cut)		Liquid Penetrant Test (PT) kit
Adjustable wrench 12 inch		Vernier Caliper
C- Clamps (8inch)		Spirit Level
Clamp Ammeter (Optional)		Plate and pipe beveling cutting equipment (Mechanical or Automatic)

REFERENCES

American Society of Mechanical Engineers. (Year). ASME IX: Boiler and pressure vessel code — Welding, brazing, and fusing qualifications.

American Welding Society. (Year). AWS D1.1 Structural welding code — Steel.

Asian Welding Federation. (Year). Training regulations for shielded metal arc welding (SMAW) NC II. Common Welder Certification Scheme (CWCS), aligned to ISO 9606-1 Standard.

International Organization for Standardization. (Year). ISO 9606-1: Qualification testing of welders — Fusion welding — Part 1: Steels.

Technical Education and Skills Development Authority-Qualification Standards Office. (2013). Training Regulations for Manual Metal Arc Welding NC I.

Technical Education and Skills Development Authority-Qualification Standards Office. (2013). Training Regulations for Manual Metal Arc Welding NC II