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WELDER

CBT Curriculum

National Vocational Certificate Level 2

Version 1 - August 2019

NAVTTC

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INTRODUCTION

a. Definition / Description of Welder

A welder is a skilled tradesman who specializes in joining materials together or fills and repairs holes on metal constructions. Welders work on all types of industrial, manufacturing, and construction applications; some even work underwater to repair oil rig foundations, ship hulls and other types of sub-aquatic structures. Skilled welders know the welding specifications of many types of materials. Through either apprenticeship or education, they learn advanced welding techniques and may weld manually or use machines to weld metal components.

Welders typically work from drawings or specifications, then use their knowledge of base metals and joining techniques to select the appropriate material for the job. They cut, position, and tack weld the material/s in preparation for one of the many welding processes. The difficulty of the job depends on the types of materials and welding positions. Regardless of the type of welding process, welders are exposed to intense and blinding heat and radiations and must take special care to ensure their own safety and the safety of those around them. Welders wear special gloves and aprons to prevent sparks and flame from burning their clothes and skin. In addition to taking safety precautions, welders also maintain their equipment and work with various power tools to prepare materials for welding. The specific job duties of a welder vary depending on the skill of the welder and the industry in which he works. Due to almost universal need for their skills, welders are in high demand not only nationally but also internationally.

In order to meet the domestic and worldwide demand for welders, National Vocational and Technical Training Commission (NAVTTC) in collaboration with TVET Sector Support Programme (TVET-SSP) have developed national vocational qualifications comprising of generic, functional and technical competency standards for welder occupation. To facilitate the process of developing national qualifications for welder, a Qualification Development Committee (QDC) was established under NVQF Operational Manual-1.

Competency standards, which are benchmarks for the performance, cover the commercial aspects of a welder's job. While setting the standards for the performances, required skills, underpinning knowledge and attitudes expected of a welder have been incorporated in these competency standards.

b. Purpose of the Training Programme

The purpose of these qualifications is to set high professional standards for welder's job. These national qualifications will support training providers in enhancing the quality of training and assessment in Pakistan. The specific purpose of developing these qualifications is to:

- Improve the overall quality of training delivery and setting national benchmarks for training of welders in the country.
- Provide flexible pathways and progressions to learners enabling them to receive relevant, up-to-date and recent skills.
- Provide basis for competency based assessment which is recognized and accepted by employers.
- Establish a standardized and sustainable system of training for welders in the country.

c. Objectives of the Training Programme

This curriculum is developed by considering the demands of skilled and qualified welders for both domestic and international markets. The primary objectives of this training programme are to:

- Develop and enhance skill level of the incumbent in the industry.
- Impart training and provide the industry a workforce with recognized and certified job knowledge, skills and attitude.
- Reduce unemployment and poverty in the society.
- Provide opportunity to those who want to equip themselves with such knowledge and skills which shall be helpful for their employment after completing this training.
- Enable the trainees to start their own business with professional approach.
- Establish coordination among employers, workers and government agencies relating to human resource development programs.
- Provide basis of technical and vocational training reflecting the requirements of the industry.
- Capacity building of the workforce and trainers in modern competency based trainings, methodologies and processes as envisaged under NVQF.

d. Competencies to be gained after completion of course

The trainee, after successful completion of the training programme, shall be able to describe the following competencies.

- Maintain Safe Work Environment
- Prepare Materials for Welding
- Carry Out Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
- Carry Out Gas Metal Arc Welding (GMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
- Carry Out Flux Cored Arc Welding (FCAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
- Carry Out Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
- Carry Out Submerged Arc Welding (SAW)

e. Possible Job opportunities available immediately and later in the future

Following job opportunities are envisaged for the successful trainees.

- Steel manufacturing industry
- Construction industry
- Fertilizer industry
- Chemical industry
- Sugar industry
- Cement industry
- Thermal power plants
- Nuclear power plants
- Industrial projects
- PN Shipyards
- Pak Railways
- Pakistan Ordnance Factory, Wah Cantt.
- Heavy Mechanical Complex-1, Taxila
- Heavy Forge and Foundry, Taxila

- Heavy Mechanical Complex-3, Taxila
- National Scientific and Engineering commission, Pakistan
- Pakistan Atomic Energy Commission
- Pakistan International Airlines (PIA)
- Tri-forces of Pakistan
- Water and Power Development Authority (WAPDA)
- Tractor and Agricultural Equipment Industry
- Automobile industry
- Local industry
- Local metal fabrication shops
- TEVTAs
- Training Institutes
- Self-employment etc.

f. Trainee Entry Level

The trainee selected should be minimum Middle (8^{th} grade).

g. Minimum Qualification of Trainer

- D.A.E / B. Tech. / B.E. / B.Ed. Tech. with 2 years experience in the field of welding.
- CSWIP / TTC Certificate course with 5 years experience as welding trainer.

h. Recommended Trainer : Trainee Ratio

Trainer	:	Trainee
01	:	25

i. Medium of instruction

English/Urdu

j. Sequence of the Modules

1. Maintain Safe Work Environment
2. Prepare Materials for Welding
3. Carry Out Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
4. Carry Out Gas Metal Arc Welding (GMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
5. Carry Out Flux Cored Arc Welding (FCAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
6. Carry Out Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions
7. Carry Out Submerged Arc Welding (SAW)

SUMMARY TEMPLATE-OVERVIEW OF THE CURRICULUM

Module Title and Aim	Learning Units	Theory days/Hours	Workplace Days/Hours	Timeframe of Module
Module 1 Maintain Safe Work Environment	**LU1:** Identify Hazards at Workplace **LU2:** Observe Occupational Safety and Health (OSH)	6	24	01 Week
Module 2 Prepare Materials for Welding	**LU1:** Select and mark the material/s as per drawing/job requirement **LU2:** Cut and prepare edge/s of base materials **LU3:** Prepare welding consumables **LU4:** Fit-up base materials	12	48	02 week
Module 3 Carry Out Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions	**LU1:** Prepare welding machine and accessories for SMAW **LU2:** Make fillet welds on mild steel plate **LU3:** Make groove welds on mild steel plate **LU4:** Perform post welding operations	34	136	05 Week
Module 4 Carry Out Gas Metal Arc Welding (GMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions	**LU1:** Prepare welding machine and accessories for GMAW **LU2:** Make fillet welds on mild steel plate **LU3:** Make groove welds on mild steel plate **LU4:** Perform post welding operations	24	96	04 Week
Module 5 Carry Out Flux Cored Arc Welding (FCAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions	**LU1:** Prepare welding machine and accessories for FCAW **LU2:** Make fillet welds on mild steel plate **LU3:** Make groove welds on mild steel plate **LU4:** Perform post welding operations	24	96	04 Week
Module 6 Carry Out Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions	**LU1:** Prepare welding machine and accessories for GTAW **LU2:** Make fillet welds on mild steel plate **LU3:** Make groove welds on mild steel plate **LU4:** Perform post welding operations	36	144	06 Week

Module 7 Carry Out Submerged Arc Welding (SAW)	**LU1:** Prepare welding machine and accessories for SAW **LU2:** Make fillet welds on mild steel plate **LU3:** Make groove welds on mild steel plate **LU4:** Perform post welding operations	24	96	04 week

MODULES

Module Title: **Maintain Safe Work Environment**

Objective of the Module: This Competency Standard identifies the competencies required to apply occupational safety and health (OSH) at workplace in accordance with the organization's approved guidelines and procedures. You will be expected to identify and use Personnel Protective Equipment (PPE) according to the job requirement and potential hazards at workplace. The underpinning knowledge regarding OSH will be sufficient to provide the basis for your work.

Duration: Total Hours: 30 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Identify Hazards at Workplace	• Read and interpret work processes and procedures correctly to identify risk of hazards at workplace. • Recognize engineering processes, tools, equipment and consumable materials that have the potential to cause harm. • Identify any potential hazards and take appropriate action to minimize the risk.	• Types of hazards that are most likely to cause harm to health and safety. • Health and safety precautions. • Health and safety signs and symbols. • Techniques and methods to identify the risks of hazards at workplace. • Dealing with hazards to avoid any accident or injury.	10	• Relevant documentation such as WPS and working drawing • fire-fighting equipment • Personal Protective Equipment (PPE)	Class Room / Workshop
LU2. Observe Occupational Safety and Health (OSH)	• Work safely at all times, complying with health and safety precautions, regulations and other relevant guidelines. • Identify health and safety hazards in the workplace, so that the potential for personal injury, damage to equipment or the workplace is prevented, and corrective action is	• Safety reporting procedures and documentation. • Use of Personal Protective Equipment. • First aid treatment methods including methods of resuscitation • Fire-fighting methods • Safe methods of handling heavy	20	• Personal Protective Equipment (PPE) • Leather apron • Safety goggles • Welding gloves • Ear plugs • Lights/Emergency lights • Leather Apron	Class Room / Workshop

	taken. • Deal with problems which are within your control, and report those that cannot be resolved to safety officer. • Wear, adjust, and maintain personal protective equipment to ensure correct fit and optimum protection in compliance with company procedures. • Keep work area clean and clear of obstructions, and storing tools or equipment, so that the potential for accident or injury is prevented.	loads		• Safety harness	

Module Title: **Prepare Materials for Welding**

Objective of the Module: This competency standard is designed to gain basic knowledge and skills required to prepare materials for a specific job. The standard covers specific knowledge of marking the material as per drawing/job requirement, setting up cutting equipment, cutting and preparing edges of base materials, cleaning surfaces and edges, preparing welding consumables and fitting up base materials.

Duration: Total Hours: 60 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Select and mark the material/s as per drawing/job requirement	• Select and obtain required material/s as per job requirements. • Select appropriate marking tools as per job requirements. • Mark the area to be cut as per drawing/job requirements.	• Interpretation of drawings and sketches • Types of marking tools • Selection of appropriate marking tools • Method/s of marking the material	15	• Relevant documentation such as WPS and working drawing • Measuring tools • Supplies and materials • Personal Protective Equipment (PPE)	Class Room / Workshop

LU2. Cut and prepare edge/s of base materials	• Select appropriate cutting equipment as per job requirements. • Set-up cutting equipment as per manufacturer's instructions/job requirements. • Cut the base material as per job specifications and dimensions provided in the given drawing. • Prepare edges of the base materials as per drawing/WPS. • Check dimensions of the prepared edges as per drawing/WPS. • Select proper tools and chemicals for cleaning. • Clean the edges of the base materials as per job requirements.	• Selection of appropriate method/s of edge preparation • Selection of appropriate cutting equipment, accessories and supplies • Operation of cutting equipment such as mechanical, gas and plasma • Selection of appropriate measuring tools • Selection of appropriate cleaning methods and chemicals • Safety procedures for cutting and grinding	20	• Cutting equipment and accessories • Cutting gases (Oxygen, Acetylene) • Grinding/Cutting equipment and accessories • Stand-by fire-fighting equipment • Gouging electrodes • Grinding/cutting disks	Class Room / Workshop
LU3. Prepare welding consumables	• Select relevant welding consumables as per job requirements/ welding procedure specifications (WPS). • Prepare consumables in accordance with required specifications.	• Types of welding consumables (electrodes, gases, filler wires etc.) • Appropriate ways and means for the preparation of welding consumables	10	• SMAW/GTAW/GMAW /FCAW/SAW power source with all accessories • Run on/run off, backing plates/rings • Mild steel plates • SMAW electrodes • Electrode backing oven • Fume extractors • Exhaust fans • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Fire Extinguishers • Cotton gloves	Class Room / Workshop
LU4. Fit-up base materials	• Select proper tools and equipment to fit-up base materials. • Tack-weld joint/s as per drawing. • Check root gap as per drawing/welding procedure specifications (WPS). • Check alignment as per given drawing.	• Selection of proper tools and equipment for fitting-up the job • Methods of tack welding of joint/s • Methods of checking root gap and alignment	15		Class Room / Workshop

				• Leather apron • Welding gloves • Welding helmet • Safety goggles • Safety helmet • Safety shoes • Set of nose pliers • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set • Lights/Emergency lights	

Module Title: **Carry Out Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions**

Objective of the Module: This Competency Standard is designed to gain basic knowledge and skills required to perform Shielded Metal Arc Welding (SMAW) operations in Flat (1F, 1G) and Horizontal (2F, 2G) positions at workplace. The standard covers specific knowledge of performing Shielded Metal Arc Welding (SMAW) by selecting and setting up welding equipment, installing consumables, adjusting welding parameters and making fillet and groove welds in Flat (1F, 1G) and Horizontal (2F, 2G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 170 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Prepare welding machine and accessories for SMAW	• Identify welding requirements from the job, welding procedure specifications and/or technical drawings. • Prepare SMAW machine in accordance with welding procedure specifications/ manufacturer's instructions. • Set-up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions. • Set polarity indicated in the welding procedure specifications.	• Job requirements/WPS/technical drawings • • Principles and equipment of SMAW process • Principles of operation of welding rectifier, transformer and generator • Correct use of polarity in welding • Use & control of welding current according to different types of welds • Welding with either AC or DC to suit the application • Setting up and maintaining welding equipment used in the SMAW process • Types of SMAW electrodes	30	• SMAW power source with all accessories • Mild steel plates • SMAW electrodes • Electrode backing oven • Angle cutting Machine/ Cut off Machine • Grinder • Cutting discs • Grinding discs • Bevelling machine • Chipping hammer • MS wire brush • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Lights/Emergency lights	Class Room / Workshop

LU2. Make fillet welds on mild steel plate	• Adjust welding parameters (current, polarity, etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1F) and Horizontal (2F) positions following standard procedures. • Check all passes/complete weld for any visual discontinuities as per acceptance standards. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	• Types of welds and joints • Use & control of welding current according to different types of welds • Striking the arc and maintaining the arc gap • Types of welding positions in fillet welding • Standard procedure used to fillet weld on mild steel in 1F and 2F positions • Types of visual welding defects • Acceptance criteria for visual welding defects **Practical** Make a fillet weld (T-joint) in 1F and 2F positions with SMAW process.	50	• Mild steel plates • SMAW electrodes • Electrode backing oven • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Chipping hammer • MS wire brush • File set • Tongs • Combination Plier • Grip Plier/Burner Plier • Ear plugs • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Fire Extinguishers • Cotton gloves • Leather apron • Welding gloves • Welding helmet • Safety goggles • Safety helmet • Safety shoes • Set of nose pliers • Set of screw drivers	Class Room / Workshop
LU3. Make groove welds on mild steel plate	• Adjust welding parameters (current, polarity etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1G) and Horizontal (2G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding procedure specifications/job requirements.	• Types of welds and joints • Use & control of welding current according to different types of welds • Methods of striking the arc and maintaining the arc gap • Types of welding positions in groove welding • Standard procedure used to groove weld on mild steel in 1G and 2G positions • Types of welding defects, causes and remedies • Methods of inspection of welds • Acceptance criteria for welding	80		Class Room / Workshop

	• Deposit filling passes as per welding procedure specifications/job requirements. • Deposit capping pass/es as per welding procedure specifications/job requirements. • Check root, filling and capping passes for any visual discontinuities as per acceptance standards. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	defects **Practical** Make a groove weld (Butt-joint) in 1G and 2G positions with SMAW process.		• Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set Emergency lights	
LU4. Perform post welding operations	• Carry out finishing work of welds following standard procedures. • Inspect weld visually and mark any visual defects, as required. • Carry out repair work in accordance with approved procedures, as required. • Clean work area in accordance with workplace safety practices. • Maintain and store tools/equipment/consumable materials in accordance with organization's guidelines.	• Weld finishing methods (Brushing, Chipping, Filing Grinding, Polishing etc.) • Types of welding defects, causes and remedies • Methods of inspection of welds • Process and selection of defect removal methods • Repair welding methods and procedures • workplace safety practices • Organization's/workshop guidelines for storing tools, equipment and consumable materials	10	• MS wire/power brush • Safety goggles • Leather apron • Welding gloves • Chipping hammer • Ear plugs • Grinder • Grinding discs • Acetone • Cotton gloves • Lights/Emergency lights	Class Room / Workshop

Module Title: **Carry Out Gas Metal Arc Welding (GMAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions**

Objective of the Module: This Competency Standard is designed to gain basic knowledge and skills required to perform Gas Metal Arc Welding (GMAW) operations in Flat (1F, 1G) and Horizontal (2F, 2G) positions at workplace. The standard covers specific knowledge of performing Gas Metal Arc Welding (GMAW) by selecting and setting up welding equipment, installing consumables, adjusting welding parameters and making fillet and groove welds in Flat (1F, 1G) and Horizontal (2F, 2G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 120 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Prepare welding machine and accessories for GMAW	• Identify welding requirements from the job, welding procedure specifications and/or technical drawings. • Prepare GMAW welding machine in accordance with welding procedure specifications/ manufacturer's instructions. • Set-up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions. • Connect welding machine to an independent power supply. • Set polarity indicated in the welding procedure specifications.	• Job requirements/WPS/technical drawings • Principles and equipment of GMAW process • Principles of operation of welding power sources for GMAW • Correct use of polarity in welding • Use & control of welding parameters according to different types of welds • Welding with either AC or DC to suit the application • Setting up and maintaining welding equipment used in the GMAW process • Types of GMAW electrodes and welding consumables	10	• GMAW power source with all accessories • Mild steel plates • Wire spools (Mild steel) • CO2 gas cylinders with regulators • Angle cutting Machine/ Cut off Machine • Grinder • Cutting discs • Grinding discs • Bevelling machine • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Pre-heating equipment • Gouging equipment with all accessories • Air compressor • Welding tables	Class Room / Workshop

LU2. Make fillet welds on mild steel plate	• Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1F) and Horizontal (2F) positions following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Striking the arc and maintaining the arc gap • Types of welding positions in fillet welding • Standard procedure used to fillet weld on mild steel in 1F and 2F positions • Types of visual welding defects • Acceptance criteria for visual welding defects **Practical** Make a fillet weld (T-joint) in 1F and 2F positions with GMAW process.	40	• GMAW power source with all accessories • Mild steel plates • Wire spools (Mild steel) • CO2 gas cylinders with regulators • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Chipping hammer • MS wire brush • File set • Tongs • Combination Plier • Grip Plier/Burner Plier • Ear plugs • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Fire Extinguishers • Cotton gloves • Leather apron • Welding gloves • Welding helmet • Safety goggles • Safety helmet	Class Room / Workshop
LU3. Make groove welds on mild steel plate	• Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1G) and Horizontal (2G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding procedure specifications/job requirements.	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Methods of striking the arc and maintaining the arc gap • Types of welding positions in groove welding • Standard procedure used to groove weld on mild steel in 1G and 2G positions • Types of welding defects, causes and remedies • Methods of inspection of welds • Acceptance criteria for welding	60		Class Room / Workshop

	• Deposit filling passes as per welding procedure specifications/job requirements. • Deposit capping pass/es as per welding procedure specifications/job requirements. • Check root, filling and capping passes for any visual discontinuities as per acceptance standards. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	defects **Practical** Make a groove weld (Butt-joint) in 1G and 2G positions with GMAW process.		• Safety shoes • Set of nose pliers • Set of screw drivers • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set Emergency lights	
LU4. Perform post welding operations	• Carry out finishing work of welds following standard procedures. • Inspect weld visually and mark any visual defects, as required. • Carry out repair work in accordance with approved procedures, as required. • Clean work area in accordance with workplace safety practices. • Maintain and store tools/equipment/consumable materials in accordance with organization's guidelines.	• Weld finishing methods (Brushing, Chipping, Filing Grinding, Polishing etc.) • Types of welding defects, causes and remedies • Methods of inspection of welds • Process and selection of defect removal methods • Repair welding methods and procedures • workplace safety practices • Organization's/workshop guidelines for storing tools, equipment and consumable materials	10	• MS wire/power brush • Safety goggles • Leather apron • Welding gloves • Chipping hammer • Ear plugs • Grinder • Grinding discs • Acetone • Cotton gloves • Lights/Emergency lights	Class Room / Workshop

Module Title: **Carry Out Flux Cored Arc Welding (FCAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions**

Objective of the Module: This Competency Standard is designed to gain basic knowledge and skills required to perform Flux Cored Arc Welding (FCAW) operations in Flat (1F, 1G) and Horizontal (2F, 2G) positions at workplace. The standard covers specific knowledge of performing Flux Cored Arc Welding (FCAW) by selecting and setting up welding equipment, installing consumables, adjusting welding parameters and making fillet and groove welds in Flat (1F, 1G) and Horizontal (2F, 2G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 120 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Prepare welding machine and accessories for FCAW	• Identify welding requirements from the job, welding procedure specifications and/or technical drawings. • Prepare FCAW welding machine in accordance with welding procedure specifications/ manufacturer's instructions. • Set-up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions. • Connect welding machine to an independent power supply. • Set polarity indicated in the welding procedure specifications.	• Job requirements/WPS/technical drawings • Principles and equipment of FCAW process • Principles of operation of welding power sources for FCAW • Correct use of polarity in welding • Use & control of welding parameters according to different types of welds • Welding with either AC or DC to suit the application • Setting up and maintaining welding equipment used in the FCAW process Types of FCAW electrodes and welding consumables	10	• FCAW power source with all accessories • Mild steel plates • Flux cored wire spools (Mild steel) • CO2 gas cylinders with regulators • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Pre-heating equipment • Gouging equipment with all accessories • Air compressor • Welding tables	Class Room / Workshop

LU2. Make fillet welds on mild steel plate	• Adjust welding parameters (current, voltage, etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1F) and Horizontal (2F) positions following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Striking the arc and maintaining the arc gap • Types of welding positions in fillet welding • Standard procedure used to fillet weld on mild steel in 1F and 2F positions • Types of visual welding defects • Acceptance criteria for visual welding defects **Practical** Make a fillet weld (T-joint) in 1F and 2F positions with FCAW process.	40	• FCAW power source with all accessories • Mild steel plates • Flux cored wire spools (Mild steel) • Mild steel plates • CO2 gas cylinders with regulators • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Chipping hammer • MS wire brush • File set • Tongs • Combination Plier • Grip Plier/Burner Plier • Ear plugs • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Fire Extinguishers • Cotton gloves • Leather apron • Welding gloves • Welding helmet	Class Room / Workshop
LU3. Make groove welds on mild steel plate	• Adjust welding parameters (current, voltage, etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1G) and Horizontal (2G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding procedure specifications/job requirements. • Deposit filling passes as per welding	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Methods of striking the arc and maintaining the arc gap • Types of welding positions in groove welding • Standard procedure used to groove weld on mild steel in 1G and 2G positions • Types of welding defects, causes and remedies • Methods of inspection of welds • Acceptance criteria for welding defects	60		Class Room / Workshop

	procedure specifications/job requirements. • Deposit capping pass/es as per welding procedure specifications/job requirements. • Check root, filling and capping passes for any visual discontinuities as per acceptance standards. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	**Practical** Make a groove weld (Butt-joint) in 1G and 2G positions with FCAW process.		• Safety goggles • Safety helmet • Safety shoes • Set of nose pliers • Set of screw drivers • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set Emergency lights	
LU4. Perform post welding operations	• Carry out finishing work of welds following standard procedures. • Inspect weld visually and mark any visual defects, as required. • Carry out repair work in accordance with approved procedures, as required. • Clean work area in accordance with workplace safety practices. • Maintain and store tools/equipment/consumable materials in accordance with organization's guidelines.	• Weld finishing methods (Brushing, Chipping, Filing Grinding, Polishing etc.) • Types of welding defects, causes and remedies • Methods of inspection of welds • Process and selection of defect removal methods • Repair welding methods and procedures • workplace safety practices • Organization's/workshop guidelines for storing tools, equipment and consumable material	10	• MS wire/power brush • Safety goggles • Leather apron • Welding gloves • Chipping hammer • Ear plugs • Grinder • Grinding discs • Acetone • Cotton gloves • Lights/Emergency lights	Class Room / Workshop

Module Title: **Carry Out Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G) and Horizontal (2F, 2G) Positions**

Objective of the Module: This Competency Standard is designed to gain basic knowledge and skills required to perform Gas Tungsten Arc Welding (GTAW) operations in Flat (1F, 1G) and Horizontal (2F, 2G) positions at workplace. The standard covers specific knowledge of performing Gas Tungsten Arc Welding (GTAW) by selecting and setting up welding equipment, installing consumables, adjusting welding parameters and making fillet and groove welds in Flat (1F, 1G) and Horizontal (2F, 2G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 180 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Prepare welding machine and accessories for GTAW	• Identify welding requirements from the job, welding procedure specifications and/or technical drawings. • Prepare GTAW welding machine in accordance with welding procedure specifications/ manufacturer's instructions. • Set-up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions. • Connect welding machine to an independent power supply. • Set polarity indicated in the welding procedure specifications.	• Job requirements/WPS/technical drawings • Principles and equipment of GTAW process • Principles of operation of welding power sources for GTAW • Correct use of polarity in welding • Use & control of welding parameters according to different types of welds • Welding with either AC or DC to suit the application • Setting up and maintaining welding equipment used in the GTAW process • Types of GTAW welding consumables Types of Tungsten electrodes	10	• GTAW power source with all accessories • Tungsten electrodes • Tungsten electrode grinder • Mild steel plates • Filler rod/wire (Mild steel) • Argon gas cylinders with regulators • Mild steel plates • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet	Class Room / Workshop

				• Pre-heating equipment • Welding tables	
LU2. Make fillet welds on mild steel plate	• Adjust welding parameters (current, voltage, etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1F) and Horizontal (2F) positions following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Striking the arc and maintaining the arc gap • Types of welding positions in fillet welding • Standard procedure used to fillet weld on mild steel in 1F and 2F positions • Types of visual welding defects • Acceptance criteria for visual welding defects **Practical** Make a fillet weld (T-joint) in 1F and 2F positions with GTAW process.	60	• GTAW power source with all accessories • Tungsten electrodes • Tungsten electrode grinder • Mild steel plates • Filler rod/wire (Mild steel) • Argon gas cylinders with regulators • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Chipping hammer • MS wire brush • File set • Tongs • Combination Plier • Grip Plier/Burner Plier • Ear plugs • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Fire Extinguishers	Class Room / Workshop
LU3. Make groove welds on mild steel plate	• Adjust welding parameters (current, voltage, etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Strike the arc and maintain arc gap between electrode and base metal as per standard practices. • Carry out welding in Flat (1G) and Horizontal (2G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Methods of striking the arc and maintaining the arc gap • Types of welding positions in groove welding • Standard procedure used to groove weld on mild steel in 1G and 2G positions • Types of welding defects, causes and remedies	90		Class Room / Workshop

	procedure specifications/job requirements. • Deposit filling passes as per welding procedure specifications/job requirements. • Deposit capping pass/es as per welding procedure specifications/job requirements. • Check root, filling and capping passes for any visual discontinuities as per acceptance standards. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	• Methods of inspection of welds • Acceptance criteria for welding defects **Practical** Make a groove weld (Butt-joint) in 1G and 2G positions with GTAW process.		• Cotton gloves • Leather apron • Welding gloves • Welding helmet • Safety goggles • Safety helmet • Safety shoes • Set of nose pliers • Set of screw drivers • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set Emergency lights	
LU4. Perform post welding operations	• Carry out finishing work of welds following standard procedures. • Inspect weld visually and mark any visual defects, as required. • Carry out repair work in accordance with approved procedures, as required. • Clean work area in accordance with workplace safety practices. • Maintain and store tools/equipment/consumable materials in accordance with organization's guidelines.	• Weld finishing methods (Brushing, Chipping, Filing Grinding, Polishing etc.) • Types of welding defects, causes and remedies • Methods of inspection of welds • Process and selection of defect removal methods • Repair welding methods and procedures • workplace safety practices • Organization's/workshop guidelines for storing tools, equipment and consumable materials	20	• MS wire/power brush • Safety goggles • Leather apron • Welding gloves • Chipping hammer • Ear plugs • Grinder • Grinding discs • Acetone • Cotton gloves • Lights/Emergency lights	Class Room / Workshop

Module Title: **Carry Out Submerged Arc Welding (SAW)**

Objective of the Module: This Competency Standard is designed to gain basic knowledge and skills required to perform Submerged Arc Welding (SAW) operations at workplace. The standard covers specific knowledge of performing Submerged Arc Welding (SAW)) by selecting and setting up welding equipment, installing consumables, adjusting and welding parameters and making fillet and groove welds in Flat (1F, 1G) position of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 120 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Prepare welding machine and accessories for SAW	• Identify welding requirements from the job, welding procedure specifications and/or technical drawings. • Prepare SAW welding machine in accordance with welding procedure specifications/ manufacturer's instructions. • Set-up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions. • Connect welding machine to an independent power supply. • Set polarity indicated in the welding procedure specifications.	• Job requirements/WPS/technical drawings • Principles and equipment of SAW process • Principles of operation of welding power sources for SAW • Correct use of polarity in welding • Use & control of welding parameters according to different types of welds • Welding with either AC or DC to suit the application • Setting up and maintaining welding equipment used in the SAW process • Types of SAW electrodes and welding consumables	20	• SAW power source and welding head (Tractor/Column and Boom type) with all accessories • Mild steel plates • Wire spools (mild steel) with compatible Granular flux • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Pre-heating equipment • Welding tables	Class Room / Workshop
LU2. Make fillet	• Adjust welding parameters (current,	• Types of welds and joints	40	• SAW power source and	

welds on mild steel plate	voltage, welding speed, polarity etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Adjust electrode/wire extension as per standard practices. • Carry out welding in 1F position following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	• Use & control of welding parameters according to different types of welds • Striking the arc and maintaining the arc gap • Types of welding positions in fillet welding • Standard procedure used to fillet weld on mild steel in 1F position • Types of visual welding defects • Acceptance criteria for visual welding defects **Practical** Make a fillet weld (T-joint) in 1F position with SAW process.		welding head (Tractor/Column and Boom type) with all accessories • Mild steel plates • Wire spools (mild steel) with compatible Granular flux • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Bevelling machine • Chipping hammer • MS wire brush • File set • Tongs • Combination Plier • Grip Plier/Burner Plier • Ear plugs • Fume extractors • Exhaust fans • Pencil Grinder • WPS/ instruction sheet • Welding tables • Jigs and fixtures • Fire Blankets • Fire Extinguishers • Cotton gloves • Leather apron • Welding gloves • Welding helmet • Safety goggles	
LU3. Make groove welds on mild steel plate	• Adjust welding parameters (current, voltage, welding speed, polarity etc.) as per welding procedure specifications/job requirements to produce acceptable weld. • Adjust electrode/wire extension as per standard practices. • Carry out welding in 1G position following standard procedures. • Deposit root pass as per welding procedure specifications/job requirements. • Deposit filling passes as per welding procedure specifications/job requirements. • Deposit capping pass/es as per welding procedure specifications/job requirements.	• Types of welds and joints • Use & control of welding parameters according to different types of welds • Methods of striking the arc and maintaining the arc gap • Types of welding positions in groove welding • Standard procedure used to groove weld on mild steel in 1G position • Types of welding defects, causes and remedies • Methods of inspection of welds • Acceptance criteria for welding defects	50		Class Room / Workshop

	• Check root, filling and capping passes for any visual discontinuities as per acceptance standards. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.	**Practical** Make a groove weld (Butt-joint) in 1G position with SAW process.		• Safety helmet • Safety shoes • Set of nose pliers • Set of screw drivers • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set • Emergency lights	
LU4. Perform post welding operations	• Carry out finishing work of welds following standard procedures. • Inspect weld visually and mark any visual defects, as required. • Carry out repair work in accordance with approved procedures, as required. • Clean work area in accordance with workplace safety practices. • Maintain and store tools/equipment/consumable materials in accordance with organization's guidelines.	• Weld finishing methods (Brushing, Chipping, Filing Grinding, Polishing etc.) • Types of welding defects, causes and remedies • Methods of inspection of welds • Process and selection of defect removal methods • Repair welding methods and procedures • workplace safety practices • Organization's/workshop guidelines for storing tools, equipment and consumable materials	10	• MS wire/power brush • Safety goggles • Leather apron • Welding gloves • Chipping hammer • Ear plugs • Grinder • Grinding discs • Acetone • Cotton gloves • Lights/Emergency lights	Class Room / Workshop

National Vocational and Technical Training Commission (NAVTTC)

Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan
+92 51 9044 322
+92 51 9044 322
info@navttc.org
www.navttc.org