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WELDER

CBT Curriculum

National Vocational
Certificate Level 3

Version 1 - August 2019



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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 (NAVTTTC) 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.

- Perform Basic Calculations and Estimation for Welding Work
- Prepare Welding Procedure Specifications (WPS)
- Carry Out Shielded Metal Arc Welding (SMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions
- Carry Out Gas Metal Arc Welding (GMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions
- Carry Out Flux Cored Arc Welding (FCAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions
- Carry Out Gas Tungsten Arc Welding (GTAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions

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 (8th 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. Perform Basic Calculations and Estimation for Welding Work
2. Prepare Welding Procedure Specifications (WPS)
3. Carry Out Shielded Metal Arc Welding (SMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions
4. Carry Out Gas Metal Arc Welding (GMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions
5. Carry Out Flux Cored Arc Welding (FCAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions
6. Carry Out Gas Tungsten Arc Welding (GTAW) in Vertical (3F, 3G) and Overhead (4F, 4G) Positions

SUMMARY TEMPLATE-OVERVIEW OF THE CURRICULUM

Module Title and Aim	Learning Units	Theory days/Hours	Workplace Days/Hours	Timeframe of Module
Module 1 Perform Basic Calculations and Estimation for Welding Work	LU1: Perform four fundamental mathematical operations LU2: Perform conversion of units LU3: Calculate volume of welds LU4: Estimate welding materials	12	48	02 Weeks
Module 2 Prepare Welding Procedure Specifications (WPS)	LU1: Recognize a Welding Procedure Specifications (WPS) LU2: Interpret and explain a Welding Procedure Specifications (WPS) LU3: Prepare a Welding Procedure Specifications (WPS)	12	48	02 Weeks
Module 3 Carry Out Shielded Metal Arc Welding (SMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) 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	42	168	07 Weeks
Module 4 Carry Out Gas Metal Arc Welding (GMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) 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 Weeks
Module 5 Carry Out Flux Cored Arc Welding (FCAW) in Vertical (3F, 3G) and Overhead (4F, 4G) 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 Weeks
Module 6 Carry Out Gas Tungsten Arc Welding (GTAW) in Vertical (3F, 3G) and Overhead (4F, 4G) 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	46	184	07 Weeks

MODULES

Module Title: Perform Basic Calculations and Estimation for Welding Work

Objective of the Module: This competency standard identifies the competencies required to prepare estimates in accordance with client's guidelines. You will be expected to estimate materials, ensuring cost effectiveness, conforming to standards and regulations. The underpinning knowledge regarding calculations and estimation will be sufficient to provide the basis for your work.

Duration:

Total Hours:

60

Theory:

Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Perform four fundamental mathematical operations	<ul style="list-style-type: none"> Interpret the requirement for mathematical operations as per given job. Perform simple calculations involving whole numbers, mixed numbers, fractions and decimals using four mathematical fundamental operations. 	<ul style="list-style-type: none"> Basic engineering terminologies used in welding work. Four fundamental mathematical operations e.g. addition, subtraction, multiplication, division. 	20	<ul style="list-style-type: none"> Relevant literature/books and formulae sheet Measuring tools Components Tools and facilities appropriate to processes or activity Calculator Pen and paper Materials relevant to the proposed activity Working drawing or plans or sketches or Welding Procedure Specifications (WPS) 	Class Room / Workshop
LU2. Perform conversion of units	<ul style="list-style-type: none"> Convert units to the required figures using the given formulae. Convert English measurements to metric measurements according to procedure. 	<ul style="list-style-type: none"> Methods of conversion from one unit to the other. English and metric system of measurements 	10	<ul style="list-style-type: none"> Relevant literature/books and formulae sheet Measuring tools 	

LU3. Calculate volume of welds	<ul style="list-style-type: none"> Identify the requirements for calculation such as volume, mass and, or density of the materials. Calculate correct volume of welds as per standard procedures. 	<ul style="list-style-type: none"> Method of transposing formulae. Methods of formulation of equation 	10	<ul style="list-style-type: none"> Components Tools and facilities appropriate to processes or activity Calculator Pen and paper 	Class Room / Workshop
LU4. Estimate welding materials	<ul style="list-style-type: none"> Recognize the requirements of welding materials as per job requirements. Estimate required welding materials as per job requirements. 	<ul style="list-style-type: none"> Interpretation of drawings, sketches and symbols used in mechanical work. Types of welding materials. Methods of estimation of materials for welding. 	20	<ul style="list-style-type: none"> Materials relevant to the proposed activity Working drawing or plans or sketches or Welding Procedure Specifications (WPS) 	Class Room / Workshop

Module Title: Prepare Welding Procedure Specifications (WPS)

Objective of the Module: This competency standard is designed to gain basic knowledge and skills required to prepare Welding Procedure Specifications (WPS). The standard covers specific knowledge related to recognizing, interpreting and explaining and preparing a Welding Procedure Specifications (WPS).

Duration: Total Hours: 60 Theory: Practical:

Learning Unit	Learning Outcomes	Learning Elements	Duration (Hours)	Materials (Tool and Equipment) Required	Learning Place
LU1. Recognize a Welding Procedure Specifications (WPS)	<ul style="list-style-type: none"> Know the purpose of a Welding Procedure Specifications (WPS). Describe and understand contents of a Welding Procedure Specifications (WPS). Recognize common acronyms used in a Welding Procedure Specifications (WPS). 	<ul style="list-style-type: none"> Basics of international welding codes and standards Written communication skills (reading and comprehension) Purpose of Welding Procedure Specifications 	10	<ul style="list-style-type: none"> Welding Procedure Specifications (WPS) Applicable manufacturing codes/standards Relevant literature/books Pen and paper Computer/Laptop 	Class Room / Workshop
LU2. Interpret and explain a Welding Procedure Specifications (WPS)	<ul style="list-style-type: none"> Recognize materials specifications (base metals and fillers) according to Welding Procedure Specifications (WPS). Recognize weld type and joint design according to Welding Procedure Specifications (WPS). Recognize welding positions and parameters according to Welding Procedure Specifications (WPS). 	<ul style="list-style-type: none"> Groupings of materials Thickness range Types of welds Joint design Welding processes Welding positions Welding consumables Electrical characteristics (volts, current, polarity etc.) Shielding gases Purge gas Gas flow rate Nozzle diameter Pre-heat/Post-heat Welding speed 	30	<ul style="list-style-type: none"> Welding Procedure Specifications (WPS) Applicable manufacturing codes/standards Relevant literature/books Pen and paper Computer/Laptop 	Class Room / Workshop

<p>LU3. Prepare a Welding Procedure Specifications (WPS)</p>	<ul style="list-style-type: none"> • Prepare a sample Welding Procedure Specifications (WPS) following a simple welding procedure. • Follow a written Welding Procedure Specifications (WPS) to produce a production/sample weld. 	<ul style="list-style-type: none"> • Common contents of WPS 	<p>20</p>	<ul style="list-style-type: none"> • Welding Procedure Specifications (WPS) • Applicable manufacturing codes/standards • Relevant literature/books • Pen and paper • Computer/Laptop 	<p>Class Room / Workshop</p>
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Module Title: Carry Out Shielded Metal Arc Welding (SMAW) in Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 210 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	<ul style="list-style-type: none"> Identify welding requirements from the job, welding procedure specifications and/or technical drawings. Prepare SMAW 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. 	<ul style="list-style-type: none"> 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 	20	<ul style="list-style-type: none"> 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

<p>LU2. Make fillet welds on mild steel plate</p>	<ul style="list-style-type: none"> • 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 Vertical (3F) and Overhead (4F) positions following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects. 	<ul style="list-style-type: none"> • 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 3F and 4F positions • Types of visual welding defects • Acceptance criteria for visual welding defects <p>Practical Make a fillet weld (T-joint) in 3F and 4F positions with SMAW process.</p>	<p>70</p>	<ul style="list-style-type: none"> • Mild steel plates • SMAW electrodes • Electrode backing oven • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Beveling 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 	<p>Class Room / Workshop</p>
<p>LU3. Make groove welds on mild steel plate</p>	<ul style="list-style-type: none"> • 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 Vertical (3G) and Overhead (4G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding procedure specifications/job requirements. 	<ul style="list-style-type: none"> • 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 3G and 4G positions • Types of welding defects, causes and remedies • Methods of inspection of welds • Acceptance criteria for welding 	<p>100</p>	<ul style="list-style-type: none"> • Mild steel plates • SMAW electrodes • Electrode backing oven • Grinder • Angle cutting Machine/ Cut off Machine • Cutting discs • Grinding discs • Beveling 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 	<p>Class Room / Workshop</p>

	<ul style="list-style-type: none"> • 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. 	<p>defects</p> <p>Practical Make a groove weld (Butt-joint) in 3G and 4G positions with SMAW process.</p>		<ul style="list-style-type: none"> • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set Emergency lights 	
LU4. Perform post welding operations	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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

<p>LU2. Make fillet welds on mild steel plate</p>	<ul style="list-style-type: none"> • 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 Vertical (3F) and Overhead (4F) positions following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects. 	<ul style="list-style-type: none"> • 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 3F and 4F positions • Types of visual welding defects • Acceptance criteria for visual welding defects <p>Practical Make a fillet weld (T-joint) in 1F and 2F positions with GMAW process.</p>	<p>40</p>	<ul style="list-style-type: none"> • 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 	<p>Class Room / Workshop</p>
<p>LU3. Make groove welds on mild steel plate</p>	<ul style="list-style-type: none"> • 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 Vertical (3G) and Overhead (4G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding procedure specifications/job requirements. 	<ul style="list-style-type: none"> • 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 3G and 4G positions • Types of welding defects, causes and remedies • Methods of inspection of welds • Acceptance criteria for welding 	<p>60</p>	<ul style="list-style-type: none"> • 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 	

	<ul style="list-style-type: none"> • 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. 	<p>defects</p> <p>Practical Make a groove weld (Butt-joint) in 3G and 4G positions with GMAW process.</p>		<ul style="list-style-type: none"> • Safety shoes • Set of nose pliers • Set of screw drivers • Bench vice • Spanner Set • Measuring tools/gauges/templates • Screw driver set • Allen key set <p>Emergency lights</p>	
LU4. Perform post welding operations	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	Class Room / Workshop

				<ul style="list-style-type: none"> Welding tables 	
LU2. Make fillet welds on mild steel plate	<ul style="list-style-type: none"> 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 Vertical (3F) and Overhead (4F) positions following standard procedures. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects. 	<ul style="list-style-type: none"> 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 3F and 4F positions Types of visual welding defects Acceptance criteria for visual welding defects <p>Practical Make a fillet weld (T-joint) in 3F and 4F positions with FCAW process.</p>	40	<ul style="list-style-type: none"> 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 	Class Room / Workshop
LU3. Make groove welds on mild steel plate	<ul style="list-style-type: none"> 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 Vertical (3G) and Overhead (4G) positions following standard procedures. Deposit root pass and ensure root penetration as per welding procedure specifications/job 	<ul style="list-style-type: none"> 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 3G and 4G positions Types of welding defects, causes and remedies Methods of inspection of welds 	60	<ul style="list-style-type: none"> 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 	

	<p>requirements.</p> <ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Acceptance criteria for welding defects <p>Practical Make a groove weld (Butt-joint) in 3G and 4G positions with FCAW process.</p>		<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) 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 Vertical (3F, 3G) and Overhead (4F, 4G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace.

Duration: Total Hours: 230 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	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 	15	<ul style="list-style-type: none"> 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

				<ul style="list-style-type: none"> • Pre-heating equipment • Welding tables 	
LU2. Make fillet welds on mild steel plate	<ul style="list-style-type: none"> • 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 Vertical (3F) and Overhead (4F) positions following standard procedures. • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects. 	<ul style="list-style-type: none"> • 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 3F and 4F positions • Types of visual welding defects • Acceptance criteria for visual welding defects <p>Practical Make a fillet weld (T-joint) in 3F and 4F positions with GTAW process.</p>	75	<ul style="list-style-type: none"> • 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 • Beveling machine • Chipping hammer • MS wire brush • File set 	Class Room / Workshop
LU3. Make groove welds on mild steel plate	<ul style="list-style-type: none"> • 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 Vertical (3G) and Overhead (4G) positions following standard procedures. • Deposit root pass and ensure root penetration as per welding 	<ul style="list-style-type: none"> • 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 3G and 4G positions • Types of welding defects, causes and remedies 	120	<ul style="list-style-type: none"> • 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

	<p>procedure specifications/job requirements.</p> <ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • Methods of inspection of welds • Acceptance criteria for welding defects <p>Practical Make a groove weld (Butt-joint) in 3G and 4G positions with GTAW process.</p>		<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 (NAVTTTC)

 Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan

 +92 51 9044 322

 +92 51 9044 322

 info@navttc.org

 www.navttc.org