National Occupational Skill Standard (NOSS)

Occupational Title : **Welder**

Level : **2**

Sector : **Mechanical Engineering**

Sub - Sector : **Welding**

NOSS ID/NSCO ID :

ISCO NO :

Council for Technical Education and Vocational Training

NATIONAL SKILL TESTING BOARD

Madhyapur Thimi-17, Sanothimi, Bhaktapur, Nepal

Revised: 04-01-2021 (20-09-2077)

2045

Verification Panel

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2.	Mr. Hari Nath Pradhan	Member	Peace Technical Training Center, Gwarko, Lalitpur
3.	Mr. Ratna Bahadur Khati	Member	Dynamic Metal Pvt Ltd., Hattiban, Lalitpur
4.	Mr. Dhan Bahadur Thapa	Member	Appropriate Technical Service, Tinkune, Kathmandu
5.	Mr. Binod Pudasaini	Member	Grande International Hospital, Dhapasi, Kathmandu
6.	Mr. Janak Upreti	Member	Panchakanya Group Pvt. Ltd., Thankot, Kathmandu
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DACUM Facilitator/Co-facilitator:

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2. Mr. Suresh Maharjan, Skill Testing Officer, NSTB,Sanothimi, Bhaktapur

Customized DACUM Workshop on 20 December 2016

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Recommended by Mechanical Technical Sub Committee: 22 January 2018 (08 Magh 2074)

The National Occupational Skill Standard Revised by:

No	Name	Designation	Organization
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7.	Mr. Tulsi KC	Member-Secretary	Mechanical Technical Sub Committee National Skill Testing Board, Sanothimi, Bhaktapur
8.	Mr. Suresh Maharjan	Member	Skill Testing Officer, National Skill Testing Board, Sanothimi, Bhaktapur

1	**Occupational Title: Welder** **Level: 2**
2	**Job Description:** Welder, L-2 uses arc and gas welding to weld metal plates and pipes in flat, vertical and horizontal positions.
3	**UNITS OF COMPETENCY:** 1. Perform Shielded Metal Arc Welding (SMAW). 2. Perform Oxy-Acetylene Welding (OAW). 3. Perform Gas Metal Arc Welding (GMAW). 4. Perform Gas Tungsten Arc Welding (GTAW). 5. Perform communication. 6. Develop professionalism. ***Note: Unit 5 and 6 are not for testing purpose.***
4	**Qualifying Notes/Prerequisites:** • Physical Requirements: Sound health • Entry Requirements: As per NSTB rules. **Additional Information:** • Assessment Types: Performance Test only. • Assessment Duration: 4 to 6 Hours (Single Competency) 8 to 10 hours (All Competency) • Recommended Group Size: 6 to 8 candidates

5	**Unit No: 1** **Unit Title: Perform Shielded Metal Arc Welding (SMAW)**	**Unit code:**
	Elements of competency	**Performance standards**
	1.1 Set up welding machine, equipment and accessories	1.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupation Health and Safety (OHS) procedures and policies. 1.1.2 Tools and equipment prepared as per ***task requirements***. 1.1.3 ***Power source*** set up in accordance with manufacturer's operation manual of welding machine. 1.1.4 Welding ***accessories*** assembled as per specifications. 1.1.5 Welding machine arranged in accordance with task requirements. 1.1.6 Operation of welding machine verified in accordance with manufacturer's operation manual. 1.1.7 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.
	1.2 Prepare materials for welding	1.2.1 Materials collected as per given drawings and specifications. 1.2.2 ***Foreign materials*** removed from ***parent metal***. 1.2.3 Parent metal measured and marked as per dimensions and shape. 1.2.4 Parent metal cut as per dimensions and shape. 1.2.5 ***Edge*** of the parent metal prepared as per dimensions and shape.
	1.3 Perform tack welding	1.3.1 Tack welded in equal interval. 1.3.2 Welded joints evenly penetrated at rear part of welded parent metal. 1.3.3 Straight and uniform ripples maintained in weld bead. 1.3.4 Slag and spatter removed from welded parent metal.
	1.4 Perform fillet welding	1.4.1 ***Fillet welded joints*** identified from the given drawings. 1.4.2 Parent metal positioned as per fillet welded joints. 1.4.3 Tack welded in equal interval. 1.4.4 Parent metal welded applying ***distortion prevention measures*** in specified ***positions*** as per task requirements. 1.4.5 Welded joints evenly penetrated. 1.4.6 Straight and uniform ripples maintained in weld bead. 1.4.7 Slag and spatter removed from welded parent metal.

	1.5 Perform groove welding	1.5.1 ***Groove welded joints*** identified from the given drawings. 1.5.2 Parent metal positioned as per groove welded joints. 1.5.3 Tack welded in equal interval. 1.5.4 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 1.5.5 Welded joints evenly penetrated at rear part of welded parent metal. 1.5.6 Straight and uniform ripples maintained in weld bead. 1.5.7 Slag and spatter removed from welded parent metal.
	1.6 Perform finishing	1.6.1 Sharp edge and burrs removed from cut and welded surface. 1.6.2 Rust, corrosion and slag removed. 1.6.3 Outer face smoothened in accordance with the surface of parent metal. 1.6.4 Distortion corrected.
	1.7 Test welded piece	1.7.1 ***Minor weld defects*** identified and marked applying ***testing techniques***. 1.7.2 Minor weld defects corrected to gain full strength.
	1.8 Perform workplace housekeeping	1.8.1 Work area cleaned. 1.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 1.8.3 Tools, equipment and materials cleaned, maintained and stored.
6	**Task Performance Requirements (Tools, Equipment and Materials):** • Welding table, bench vice, arc welding machine, welding electrode, cutting machine, grinding machine, beveling machine, welding cable connectors and lugs, tongs, earth clamp, heating equipment, tool box, Vernier caliper, welding gauge, center punch, marking scriber, file, steel ruler, measuring tape, tri square, protector, marker, cross peen hammer, chipping hammer, wrench, welding clamp, wire brush, nylon brush, file, cutters, hacksaw, optical lens, parent metal, kerosene, thinner, emery paper/cloth, jute, chalk, cutting oil, broom, dust bin, dust pan, first aid kit, fire extinguisher and PPE.	
7	**Safety and Hygiene (Occupational Health and Safety):** • Use Personal Protective Equipment (PPE). • Handle tools, equipment and materials safely. • Prevent from electrical hazards. • Prevent from heated material and electrode stub.	

	• Prevent from hazards involved in lifting. • Prevent from welding fumes, gases and radiation. • Maintain good ventilation during welding. • Keep away the inflammable material. • Keep the workplace dry and clean.

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools and equipment
	  ○ Use and application
	  ○ Handling technique
	  ○ Safety measures
	• Occupational Health and Safety rules and regulation
	• Uses and importance of first aid kit
	• Shielded Metal Arc Welding
	  ○ Introduction
	  ○ Terminology
	  ○ Use and application
	  ○ Types of weld
	  ○ Types of welded joints
	  ○ Groove design
	  ○ Advantages/disadvantages
	  ○ Set up machine, equipment and accessories
	  ○ Welding positions
	  ○ Welding bead
	  ○ Voltage, current and resistance
	  ○ Welding fixtures and their uses
	  ○ Types of welding electrode
	  ○ Welding procedure
	  ○ Types of edge preparation
	• Introduction to materials
	  ○ Ferrous and non-ferrous metal
	  ○ Cast iron and alloy steel
	  ○ Non metals
		• Calculate area, volume and mass.
		• Convert from one-unit system to another
			• Read and interpret welding drawings.
			• Read and interpret manufacturer's operation manual.

	○ Profile and properties of materials • Drawing ○ Introduction and importance of drawing ○ Drawing instruments ○ Drawing lines ○ Isometric, oblique and orthographic drawing ○ Welding symbols ○ Drawing scales • Measurement system - (SI, Metric (MKS) and Imperial (FPS)) • Use and importance of: ○ Marking ○ Layout ○ Filing ○ Cutting ○ Forming ○ Punching ○ Grinding ○ Chiseling ○ Cleaning • Importance of tack welding • Introduction of beveling • Importance of penetration • Welding defects and remedies • Importance of testing • Testing techniques ○ Visual/optical test		

	○ Gauge test ○ Bending test ○ Cutting test • 3R's principles (Reduce, Reuse, and Recycle)		

9	**Assessment of Competency**					
	Unit: 1 **Unit Title: Perform Shielded Metal Arc Welding (SMAW)**					
	Candidate Details		**Assessors Detail**			
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:		Assessors' Name 1. 2. 3.		ID/License No:	
Element of competency	**Performance Standards**		**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
1.1 Set up welding machine, equipment and accessories	1.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization Occupation Health and Safety (OHS) procedures and policies. 1.1.2 Tools and equipment prepared as per ***task requirements***. 1.1.3 ***Power source*** set up in accordance with manufacturer's operation manual of welding machine. 1.1.4 Welding ***accessories*** assembled as per specifications. 1.1.5 Welding machine arranged in accordance with task requirements. 1.1.6 Operation of welding machine verified in accordance with manufacturer's operation manual. 1.1.7 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.					

1.2 Prepare materials for welding	1.2.1 Materials collected as per given drawings and specifications. 1.2.2 ***Foreign materials*** removed from ***parent metal***. 1.2.3 Parent metal measured and marked as per dimensions and shape. 1.2.4 Parent metal cut as per dimensions and shape. 1.2.5 ***Edge*** of the parent metal prepared as per dimensions and shape.				
1.3 Perform tack welding	1.3.1 Tack welded in equal interval. 1.3.2 Welded joints evenly penetrated at rear part of welded parent metal. 1.3.3 Straight and uniform ripples maintained in weld bead. 1.3.4 Slag and spatter removed from welded parent metal.				
1.4 Perform fillet welding	1.4.1 ***Fillet welded joints*** identified from the given drawings. 1.4.2 Parent metal positioned as per fillet welded joints. 1.4.3 Tack welded in equal interval. 1.4.4 Parent metal welded applying ***distortion prevention measures*** in specified ***positions*** as per task requirements. 1.4.5 Welded joints evenly penetrated. 1.4.6 Straight and uniform ripples maintained in weld bead. 1.4.7 Slag and spatter removed from welded parent metal.				
1.5 Perform groove welding	1.5.1 ***Groove welded joints*** identified from the given drawings. 1.5.2 Parent metal positioned as per groove welded joints. 1.5.3 Tack welded in equal interval. 1.5.4 Parent metal welded applying distortion prevention measures in specified positions as per task requirements.				

	1.5.5 Joints evenly penetrated at rear part of welded parent metal. 1.5.6 Straight and uniform ripples maintained in weld bead. 1.5.7 Slag and spatter removed from welded parent metal.				
1.6 Perform finishing	1.6.1 Sharp edge and burrs removed from cut and welded surface. 1.6.2 Rust, corrosion and slag removed. 1.6.3 Outer face smoothened in accordance with the surface of parent metal. 1.6.4 Distortion corrected.				
1.7 Test welded piece	1.7.1 ***Minor weld defects*** identified and marked applying ***testing techniques***. 1.7.2 Minor weld defects corrected to gain full strength.				
1.8 Perform workplace housekeeping	1.8.1 Work area cleaned. 1.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 1.8.3 Tools, equipment and materials cleaned, maintained and stored.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal Protective Equipment (PPE)	*May include but not limited to:* • Helmet • Goggles • Mask • Face shield • Non-flammable apron • Non-flammable gloves • Ear muff • Leather shoes • Leather sleeves
Task requirements	*May include but not limited to:* • Cleaning • Layout • Cutting • Edge preparation • Welding • Finishing • Testing
Power source	*May include but not limited to:* • Alternative Current (AC) • Direct Current (DC)

Accessories	*May include but not limited to:* • Holder • Earth clamp • Welding clamp • Welding cable and lug • Tractor rollers and rails
Foreign materials	*May include but not limited to:* • Rust • Corrosion • Paints • Grease/oil
Parent metal	*May include but not limited to:* • Pipe: Steel, Stainless steel, and Cast iron • Plate: Steel, Stainless steel, and Cast iron
Edge	*May include but not limited to:* • Straight/Square • Bevel • V • U • Flare • Flanged • Single/double

Fillet welded joints	*May include but not limited to:* • Lap • Tee • Corner
Distortion prevention measures	*May include but not limited to:* • Tacking • Bracing • Bolting • Clamping • Pre-setting • Fixing fixtures
Positions	*May include but not limited to:* • Flat (1G1F) • Horizontal (2G2F) • Vertical (3G3F)
Groove welded joints	*May include but not limited to:* • U butt • V butt • Square butt
Minor weld defects	*May include but not limited to:* • Undercut • Under fill • Crack • Overlap

	• Porosity/blow holes • Misalignment • Incomplete fusion/penetration • Spatters • Burn through • Concavity/Convexity
Testing techniques	*May include but not limited to:* • Visual/optical test • Gauge test • Bending test • Cutting test
3R's principles	*May include but not limited to:* • Reduce • Reuse • Recycle

5	**Unit No: 2** **Unit Title: Perform Oxy-Acetylene Welding (OAW)**	**Unit code:**

Elements of competency	Performance standards
2.1 Set up welding equipment and accessories	2.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupational Health and safety (OHS) procedures and policies. 2.1.2 Tools and equipment prepared as per ***task requirements***. 2.1.3 Welding equipment and ***accessories*** assembled and arranged in accordance with task requirements. 2.1.4 Operation of welding equipment and accessories verified in accordance with manufacturer's operation manual. 2.1.5 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.
2.2 Prepare materials for welding	2.2.1 Materials collected as per given drawings and specifications. 2.2.2 ***Foreign materials*** removed from ***parent metal.*** 2.2.3 Parent metal measured and marked as per dimensions and shape. 2.2.4 Cutting method selected as per thickness and types of parent metal. 2.2.5 Parent metal cut as per dimensions and shape. 2.2.6 ***Edge*** of the parent metal prepared as per dimensions and shape.
2.3 Perform tack welding	2.3.1 Tack welded in equal interval. 2.3.2 Welded joints evenly penetrated at rear part of welded parent metal.
2.4 Perform fillet welding	2.4.1 ***Fillet welded joints*** identified from the given drawings. 2.4.2 Parent metal positioned as per fillet welded joints. 2.4.3 Tack welded in equal interval. 2.4.4 Parent metal welded applying ***distortion prevention measures*** in specified ***positions*** as per task requirements. 2.4.5 Welded joints evenly penetrated. 2.4.6 Continuity of weld bead maintained. 2.4.7 Sharp edge and foreign materials removed from welded parent metal.
2.5 Perform groove welding	2.5.1 ***Groove welded joints*** identified from the given drawings. 2.5.2 Parent metal positioned as per groove welded joints. 2.5.3 Tack welded in equal interval.

		2.5.4 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 2.5.5 Joint evenly penetrated at rear part of welded parent metal. 2.5.6 Continuity of weld bead maintained. 2.5.7 Sharp edge and foreign materials removed from welded parent metal.
	2.6 Perform finishing	2.6.1 Sharp edge and burrs removed from cut and welded surface. 2.6.2 Rust and corrosion removed. 2.6.3 Outer face smoothened in accordance with the surface of parent metal. 2.6.4 Distortion corrected.
	2.7 Test welded piece	2.7.1 ***Minor weld defects*** identified and marked applying ***testing techniques***. 2.7.2 Minor weld defects corrected to gain full strength.
	2.8 Perform workplace housekeeping	2.8.1 Work area cleaned. 2.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles*****.** 2.8.3 Tools, equipment and materials cleaned, maintained and stored.
6	**Task Performance Requirements (Tools, Equipment and Materials):** • Welding table, bench vice, oxy fuel gas cutting set, spark lighter, key set, spanners, gas flow meter, gas regulators, flash arrestor, check valve, tool box , gas welding torch, welding tip, soldering hammer, cross peen hammer, chipping hammer, wrench, welding clamp, hacksaw, grinder, mechanical cutter, wire brush, nylon brush, Vernier caliper, welding gauge, center punch, marking scriber, file, steel ruler, measuring tape, tri square, protector, acetylene gas generator, calcium carbide, gas (oxygen and acetylene) cylinders, LPG cylinder, oxygen/acetylene welding hose, nozzle cleaner, emery paper/cloth, jute, kerosene, thinner, optical lens, filler rod, brazing rod, swag/flux, parent metal, broom, dust bin, dust pan, first aid kit, fire extinguisher, and PPE.	
7	**Safety and Hygiene (Occupational Health and Safety):** • Use Personal Protective Equipment (PPE). • Handle tools, equipment and materials safely. • Prevent from electrical hazards • Prevent from hazards involved in lifting.	

	• Prevent from welding fumes, gases and radiation. • Maintain good ventilation during welding. • Keep away the inflammable material. • Keep the workplace dry.

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools and equipment
	  ○ Use and application
	  ○ Handling technique
	  ○ Safety measures
	• Occupational Health and Safety rules and regulation
	• Uses and importance of first aid kit
	• Oxy-acetylene welding
	  ○ Introduction
	  ○ Terminology
	  ○ Use and application
	  ○ Types of weld
	  ○ Types of welded joints
	  ○ Groove design
	  ○ Advantages/disadvantages
	  ○ Set up equipment and accessories
	  ○ Working pressure
	  ○ Types of filler rod
	  ○ Types of flame and their uses
	  ○ Welding fixtures and their uses
	  ○ Welding bead
	  ○ Welding fixtures and their uses
	  ○ Welding positions
	  ○ Welding procedure
	• Use and importance of:
	  ○ Layout
	  ○ Filing
	  ○ Cutting
	  ○ Forming
		• Calculate area, volume and mass.
		• Convert from one-unit system to another.
			• Read and interpret welding drawing.
			• Read and interpret manufacturer's operation manual.

	○ Punching ○ Grinding ○ Chiseling ○ Cleaning • Introduction to materials ○ Ferrous and non-ferrous metal ○ Cast iron and alloy steel ○ Non metals ○ Profile and properties of materials • Drawing: ○ Introduction and importance ○ Drawing instruments ○ Drawing lines ○ Welding symbols ○ Drawing scales ○ Isometric, oblique and orthographic drawing • Measurement system - (SI, Metric (MKS) and Imperial (FPS)) • Cutting methods and types of gas cutting • Introduction to soldering ○ Types of solder, fluxes and soldering iron • Brazing ○ Introduction ○ Importance ○ Uses ○ Types of filler materials ○ Types of flux ○ Brazing techniques • Importance of tack welding • Introduction of beveling • Importance of penetration		

	• Welding defects and remedies
	• Importance of testing
	• Testing techniques
	  ○ Visual/ optical test
	  ○ Gauge test
	  ○ Bending test
	  ○ Cutting test
	• 3R's principles (Reduce, Reuse, and Recycle)		

9	**Assessment of Competency**					
	Unit: 2 **Unit Title: Perform Oxy-Acetylene Welding**					
	Candidate Details		**Assessors Detail**			
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:		Assessors' Name 1. 2. 3.			ID/License No:

Element of competency	**Performance Standards**	**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
2.1 Set up welding equipment and accessories	2.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupational Health and safety (OHS) procedures and policies. 2.1.2 Tools and equipment prepared as per ***task requirements***. 2.1.3 Welding equipment and ***accessories*** assembled and arranged in accordance with task requirements. 2.1.4 Operation of welding equipment and accessories verified in accordance with manufacturer's operation manual. 2.1.5 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.				
2.2 Prepare materials for welding	2.2.1 Materials collected as per given drawings and specifications. 2.2.2 ***Foreign materials*** removed from ***parent metal.*** 2.2.3 Parent metal measured and marked as per dimensions and shape. 2.2.4 Cutting method selected as per thickness and types of parent metal.				

	2.2.5 Parent metal cut as per dimensions and shape. 2.2.6 Edge of the parent prepared as per dimensions and shape.				
2.3 Perform tack welding	2.3.1 Tack welded in equal interval. 2.3.2 Welded joint evenly penetrated at rear part of welded parent metal.				
2.4 Perform fillet welding	2.4.1 ***Fillet welded joints*** identified from the drawings. 2.4.2 Parent metal positioned as per fillet welded joints. 2.4.3 Tack welded in equal interval. 2.4.4 Parent metal welded applying ***distortion prevention measures*** in specified ***positions*** as per task requirements. 2.4.5 Welded joints evenly penetrated. 2.4.6 Continuity of weld bead maintained. 2.4.7 Sharp edge and foreign materials removed from welded parent metal.				
2.5 Perform groove welding	2.5.1 ***Groove welded joints*** identified from the given drawings. 2.5.2 Parent metal positioned as per groove welded joints. 2.5.3 Tack welded in equal interval. 2.5.4 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 2.5.5 Welded joint evenly penetrated at rear part of welded parent metal. 2.5.6 Continuity of weld bead maintained. 2.5.7 Sharp edge and foreign materials removed from welded parent metal.				
2.6 Perform finishing	2.6.1 Sharp edge and burrs removed from cut and welded surface. 2.6.2 Rust and corrosion removed. 2.6.3 Outer face smoothened in accordance with the surface of parent metal. 2.6.4 Distortion corrected.				

2.7 Test welded piece	2.7.1 ***Minor weld defects*** identified and marked applying testing techniques. 2.7.2 Minor weld defects corrected to gain full strength.				
2.8 Perform workplace housekeeping	2.8.1 Work area cleaned. 2.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 2.8.3 Tools, equipment and materials cleaned, maintained and stored.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal Protective Equipment (PPE)	*May include but not limited to:* • Helmet • Goggles • Mask • Face shield • Non-flammable apron • Non-flammable gloves • Ear muff • Leather shoes • Leather sleeves
Task requirements	*May include but not limited to:* • Cleaning • Layout • Cutting • Gauging • Edge preparation • Welding • Finishing • Testing
Accessories	*May include but not limited to:* • Nozzle • Tractor rollers and rails • Wire cutter

	• Earth clamp, • Welding cable and lugs • Welding clamp • Flux recovery equipment
Foreign materials	*May include but not limited to:* • Rust • Corrosion • Paints • Grease/oil
Parent metal	*May include but not limited to:* • Pipe: Steel, Brass, and Copper • Plate: Steel, Brass, and Copper
Edge	*May include but not limited to:* • Straight/Square • Bevel • V • U • Flare • Flanged • Single/double
Fillet welded joints	*May include but not limited to:* • Lap • Tee • Corner

Distortion prevention measures	*May include but not limited to:* • Tacking • Bracing • Bolting • Clamping • Pre-setting • Fixing fixtures
Positions	*May include but not limited to:* • Flat (1G1F) • Horizontal (2G2F) • Vertical (3G3F)
Groove welded joints	*May include but not limited to:* • U butt • V butt • Square butt
Minor weld defects	*May include but not limited to:* • Undercut • Under fill • Crack • Overlap • Porosity/blow holes • Misalignment • Lack of fusion/penetration • Spatters • Burn through

	• Concavity/Convexity
Testing techniques	*May include but not limited to:* • Visual/optical test • Gauge test • Bending test • Cutting test
3R's principles	*May include but not limited to:* • Reduce • Reuse • Recycle

5	**Unit No: 3** **Unit Title: Perform Gas Metal Arc Welding (GMAW)**	**Unit code:**
	Elements of competency	**Performance standards**
	3.1 Set up welding machine, equipment and accessories	3.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupational Health and Safety (OHS) procedures and policies. 3.1.2 Tools and equipment prepared as per ***task requirements.*** 3.1.3 ***Power source*** set up in accordance with manufacturer's operation manual of welding machine. 3.1.4 Welding ***accessories*** assembled and arranged in accordance with task requirements. 3.1.5 Welding machine arranged in accordance with task requirements. 3.1.6 Current ampere range, wire feed rate and gas flow rates adjusted as per thickness, types of parent metal and welding size. 3.1.7 Operation of welding machine verified in accordance with manufacturer's operation manual. 3.1.8 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.
	3.2 Prepare materials for welding	3.2.1 Materials collected as per given drawings and specifications. 3.2.2 ***Foreign materials*** removed from ***parent metal***. 3.2.3 Parent metal measured and marked as per dimensions and shape. 3.2.4 Cutting method selected as per thickness and types of parent metal. 3.2.5 Parent metal cut as per dimensions and shape. 3.2.6 ***Edge*** of the parent metal prepared as per dimensions and shape.
	3.3 Perform tack welding	3.3.1 Tack welded in equal interval. 3.3.2 Welded joint evenly penetrated at rear part of welded parent metal. 3.3.3 Spatter removed from welded parent metal.
	3.4 Perform fillet welding	3.4.1 ***Fillet welded joints*** identified from the given drawings. 3.4.2 Parent metal positioned as per fillet welded joints. 3.4.3 Arc length, angle of filler rod and gun maintained. 3.4.4 Tack welded in equal interval.

		3.4.5 Parent metal welded applying ***distortion prevention measures*** in specified positions as per task requirements. 3.4.6 Welded joint evenly penetrated. 3.4.7 Straight and uniform ripples maintained in weld bead. 3.4.8 Spatters removed from welded parent metal.
	3.5 Perform groove welding	3.5.1 ***Groove welded joints*** identified from the given drawings. 3.5.2 Parent metal positioned as per groove welded joints. 3.5.3 Arc length, angle of filler rod and gun maintained. 3.5.4 Tack welded in equal interval. 3.5.5 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 3.5.6 Welded joint evenly penetrated at rear part of welded parent metal. 3.5.7 Straight and uniform ripples maintained in weld bead. 3.5.8 Spatters removed from welded parent metal.
	3.6 Perform finishing	3.6.1 Sharp edge and burrs removed from cut and welded surface. 3.6.2 Rust and corrosion removed. 3.6.3 Outer face smoothened in accordance with the surface of parent metal. 3.6.4 Distortion corrected.
	3.7 Test welded piece	3.7.1 ***Minor weld defects*** identified and marked applying ***testing techniques***. 3.7.2 Minor weld defects corrected to gain full strength.
	3.8 Perform workplace housekeeping	3.8.1 Work area cleaned. 3.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 3.8.3 Tools, equipment and materials cleaned, maintained and stored.
6	**Task Performance Requirements (Tools, Equipment and Materials):** • Welding table, bench vice, GMAW welding machine set, cutting machine, grinding machine, beveling machine, welding cable connectors and lugs, tongs, earth clamp, gas regulator set, contact tube, welding clamp, vice grip, nozzle, tool box, Vernier caliper, welding gauge, center punch, marking scriber, steel ruler, measuring tape, tri square, protector, chipping hammer, cross peen hammer, wrench, wire cutter, levels,	

	chop saw, file, measuring tape, tack welding equipment, pliers, wire brush, nylon brush, CO_2 gas, MIG wire, optical lens, parent metal, anti-spatter spray, cutting oil, broom, dust bin, dust pan, first aid kit, fire extinguisher and PPE.
7	**Safety and Hygiene (Occupational Health and Safety):** • Use Personal Protective Equipment (PPE). • Handle tools, equipment and materials safely. • Prevent from electrical hazards. • Prevent from hazards involved in lifting. • Prevent from welding fumes, gases and radiation. • Maintain good ventilation during welding. • Keep away the inflammable material. • Avoid using MIG gun with blocked nozzle. • Always check the connection of gun and gas setup. • Close the shielding gas valve after use. • Keep the workplace dry and clean.

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools and equipment
	  ○ Use and application
	  ○ Handling technique
	  ○ Safety measures
	• Occupational Health and Safety rules and regulation
	• Uses and importance of first aid kit
	• Gas Metal Arc Welding:
	  ○ Introduction
	  ○ Terminology
	  ○ Use and application
	  ○ Types of weld
	  ○ Types of welded joints
	  ○ Groove design
	  ○ Advantages/disadvantages
	  ○ Set up machine, equipment and accessories
	  ○ Wire and gas selection
	  ○ Gas flow rate
	  ○ Welding angle
	  ○ Welding positions
	  ○ Welding bead
	  ○ Voltage, current and resistance
	  ○ Welding fixtures and their uses
	  ○ Welding Procedures
	• Use and importance of:
	  ○ Layout
	  ○ Filing
	  ○ Cutting
		• Calculate area, volume and mass.
		• Convert from one-unit system to another.
			• Read and interpret welding drawing.
			• Read and interpret manufacturer's operation manual.

	○ Forming ○ Punching ○ Grinding ○ Chiseling ○ Cleaning • Introduction to materials ○ Ferrous and non-ferrous ○ Cast iron and alloy steel ○ Non metals ○ Profile and properties of materials • Drawing ○ Introduction and importance ○ Drawing instruments ○ Drawing lines ○ Welding symbols ○ Drawing scales ○ Isometric, oblique and orthographic drawing • Measurement system - (SI, Metric (MKS) and Imperial (FPS)) • Importance of Tack welding • Importance of penetration • Welding defects and remedies • Importance of testing • Testing techniques ○ Visual/optical test ○ Gauge test ○ Bending test		

	○ Cutting test • 3R's principles (Reduce, Reuse, and Recycle)		

9	**Assessment of Competency**					
	Unit: 3 **Unit Title: Perform Gas Metal Arc Welding (GMAW)**					
	Candidate Details		**Assessors Detail**			
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:		Assessors' Name 1. 2. 3.			ID/License No:

Element of competency	**Performance Standards**	**Standard Met**	**Standard Not Met**	**Evidence Type**	**Comments**
3.1 Set up welding machine, equipment and accessories	3.7.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupational Health and Safety (OHS) procedures and policies. 3.7.2 Tools and equipment prepared as per ***task requirements.*** 3.7.3 ***Power source*** set up in accordance with manufacturer's operation manual of welding machine. 3.7.4 Welding ***accessories*** assembled and arranged in accordance with task requirements. 3.7.5 Welding machine arranged in accordance with task requirements. 3.7.6 Current ampere range, wire feed rate and gas flow rates adjusted as per thickness, types of parent metal and welding size. 3.7.7 Operation of welding machine verified in accordance with manufacturer's operation manual. 3.1.8 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.				

3.2 Prepare materials for welding	3.2.1 Materials collected as per given drawings and specifications. 3.2.2 ***Foreign materials*** removed from ***parent metal***. 3.2.3 Parent metal measured and marked as per dimensions and shape. 3.2.4 Cutting method selected as per thickness and types of parent metal. 3.2.5 Parent metal cut as per dimensions and shape. 3.2.6 ***Edge*** of the parent metal prepared as per dimensions and shape.				
3.3 Perform tack welding	3.3.1 Tack welded in equal interval. 3.3.2 Welded joint evenly penetrated at rear part of welded parent metal. 3.3.4 Spatter removed from welded parent metal.				
3.4 Perform fillet welding	3.4.1 ***Fillet welded joints*** identified from the drawing. 3.4.2 Parent metal positioned as per fillet welded joints. 3.4.3 Arc length and angle of filler rod and torch maintained. 3.4.4 Tack welded in equal interval. 3.4.5 Parent metal welded applying ***distortion prevention measures*** in specified positions as per task requirements. 3.4.6 Welded joint evenly penetrated. 3.4.7 Straight and uniform ripples maintained in weld bead. 3.4.8 Spatters removed from welded parent metal.				
3.5 Perform groove welding	3.5.1 ***Groove welded joints*** identified from the drawing. 3.5.2 Parent metal positioned as per groove welded joints. 3.5.3 Arc length and angle of filler rod and torch maintained. 3.5.4 Tack welded in equal interval. 3.5.5 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 3.5.6 Welded joint evenly penetrated at rear part of welded parent metal.				

	3.5.7 Straight and uniform ripples maintained in weld bead. 3.5.8 Spatters removed from welded parent metal.				
3.6 Perform finishing	3.6.1 Sharp edge and burrs removed from cut and weld surface. 3.6.2 Rust and corrosion removed. 3.6.3 Outer face smoothened in accordance with the surface of parent metal. 3.6.4 Distortion corrected.				
3.7 Test welded piece	3.7.1 Minor weld defects identified and marked applying ***testing techniques***. 3.7.2 Minor weld ***defects*** corrected to gain full strength.				
3.8 Perform workplace housekeeping	3.8.1 Work area cleaned. 3.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 3.8.3 Tools, equipment and materials cleaned, maintained and stored.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG –**Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal Protective Equipment (PPE)	*May include but not limited to:* • Helmet • Goggles • Mask • Face shield • Non-flammable apron • Non-flammable gloves • Ear muff • Leather shoes
Task requirements	*May include but not limited to:* • Cleaning • Layout • Cutting • Gauging • Edge preparation • Welding • Finishing • Testing
Power source	*May include but not limited to:* • AC • DC

Accessories	*May include but not limited to:* • Welding gun • Gas regulator • Earth clamp • Welding clamp • Hose pipe • Hose pipe connector
Foreign materials	*May include but not limited to:* • Rust • Corrosion • Paints • Grease/oil
Parent metal	*May include but not limited to:* • Pipe: Steel and Stainless steel • Plate: Steel and Stainless steel
Edge	*May include but not limited to:* • Straight/Square • Bevel • V • U • Flare • Flanged • Single/double

Fillet welded joints	*May include but not limited to:* • Lap • Tee • Corner
Distortion prevention measures	*May include but not limited to:* • Tacking • Bracing • Bolting • Clamping • Pre-setting • Fixing fixtures
Positions	*May include but not limited to:* • Flat (1G1F) • Horizontal (2G2F) • Vertical (3G3F)
Groove welded joints	*May include but not limited to:* • U butt • V butt • Square butt
Minor weld defects	*May include but not limited to:* • Undercut • Under fill • Crack • Overlap • Porosity/blow holes

	• Misalignment • Lack of fusion/penetration • Spatters • Burn through • Concavity/Convexity
Testing techniques	*May include but not limited to:* • Visual/optical test • Gauge test • Bending test • Cutting test
3R's principles	*May include but not limited to:* • Reduce • Reuse • Recycle

5	**Unit No: 4** **Unit Title: Perform Gas Tungsten Arc Welding (GTAW)**	**Unit code:**
	Elements of competency	**Performance standards**
	4.1 Setup welding machine, equipment and accessories	4.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupational Health and Safety (OHS) procedures and policies. 4.1.2 Tools and equipment prepared as per ***task requirements***. 4.1.3 ***Power source*** set up in accordance with manufacturer's operation manual of welding machine. 4.1.4 Welding ***accessories*** assembled and arranged in accordance with task requirements. 4.1.5 All connections and fittings tightened as per manufacturer's operation manual. 4.1.6 Welding machine arranged in accordance with task requirements. 4.1.7 Current ampere range and shielding gas flow rate adjusted as per thickness, types of parent metal and welding size. 4.1.8 Operation of welding machine verified in accordance with manufacturer's operation manual. 4.1.9 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.
	4.2 Prepare materials for welding	4.2.1 Materials collected as per given drawings and specifications. 4.2.2 ***Foreign materials*** removed from ***parent metal***. 4.2.3 Parent metal measured as per dimensions and shape. 4.2.4 Cutting method selected as per thickness and types of parent metal. 4.2.5 Parent metal cut as per dimensions and shape. 4.2.6 ***Edge*** of the parent metal prepared as per dimensions and shape. 4.2.7 Tip of tungsten electrode grinded as per power source**.**
	4.3 Perform tack welding	4.3.1 Tack welded in equal interval. 4.3.2 Welded joint evenly penetrated at rear part of welded parent metal. 4.3.3 Spatter removed from welded parent metal.
	4.4 Perform fillet welding	4.4.1 ***Fillet welded joints*** identified from the given drawings. 4.4.2 Parent metal positioned as per fillet welded joints. 4.4.3 Arc length, angle of filler rod and torch maintained. 4.4.4 Tack welded in equal interval.

		4.4.5 Full length welding maintained with straight equal bead width. 4.4.6 Parent metal welded applying ***distortion prevention measures*** in specified ***positions*** as per task requirements. 4.4.7 Welded joints evenly penetrated. 4.4.8 Uniform ripples and reinforcement maintained in weld bead. 4.4.9 Spatters removed from welded parent metal.
	4.5 Perform groove welding	4.5.1 ***Groove welded joints*** identified from the given drawings. 4.5.2 Parent metal positioned as per groove welded joints. 4.5.3 Arc length, angle of filler rod and torch maintained. 4.5.4 Tack welded in equal interval. 4.4.5 Full length welding maintained with straight equal bead width. 4.5.6 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 4.5.7 Welded joint evenly penetrated at rear part of welded parent metal. 4.5.8 Uniform ripples and reinforcement maintained in weld bead. 4.5.9 Spatters removed from welded parent metal.
	4.6 Perform finishing	4.6.1 Sharp edge and burrs removed from cut and welded surface. 4.6.2 Rust and corrosion removed. 4.6.3 Outer face smoothened in accordance with the surface of parent metal. 4.6.4 Distortion corrected.
	4.7 Test welded piece	4.7.1 ***Minor weld defects*** identified and marked applying ***testing techniques***. 4.7.2 Minor weld defects corrected to gain full strength.
	4.8 Perform workplace housekeeping	4.8.1 Work area cleaned. 4.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 4.8.3 Tools, equipment, materials cleaned, maintained and stored.
6	**Task Performance Requirements (Tools, Equipment and Materials):** • Welding table, bench vice, vice grip, GTAW welding machine set, shearing machine, cutting machine, pedestal grinding machine, argon gas regulator set, ceramic cup, collets body, earth clamp, welding clamp, hose pipe, hose pipe connector, welding cable and lugs ,angle grinder, tool box, wrench, Vernier caliper, file, welding gauge, center punch, marking scriber, steel ruler, measuring tape, tri square, protector, hack-saw, hammer, wire brush, nylon brush, argon gas, tungsten electrode, filler rod, emery cloth, seal tape, optical lens, parent metal, anti-spatter spray, cutting oil, broom, dust bin, dust pan, first aid kit, fire extinguisher and PPE.	

7	**Safety and Hygiene (Occupational Health and Safety):** • Use Personal Protective Equipment (PPE). • Handle tools, equipment and materials safely. • Prevent from electrical hazards • Prevent from hazards involved in lifting. • Prevent from welding fumes, gases and radiation. • Maintain good ventilation during welding. • Avoid using broken ceramic cup. • Always check the connection of torch and gas setup. • Avoid using blunt tungsten electrodes. • Keep away the inflammable material. • Always place the torch on hanger after welding. • Keep the workplace dry and clean.

8	Required Knowledge		
	Technical Knowledge	**Applied Calculation**	**Graphical Information**

	• Tools and equipment
	  ○ Use and application
	  ○ Handling technique
	  ○ Safety measures
	• Occupational Health and Safety rules and regulation Uses and importance of first aid kit
	• GTAW welding
	  ○ Introduction
	  ○ Terminology
	  ○ Use and application
	  ○ Types of weld
	  ○ Types of welded joints
	  ○ Groove design
	  ○ Advantages/disadvantages
	  ○ Set up machine, equipment and accessories
	  ○ Equipment and metal preparation
	  ○ Welding with or without filler rod
	  ○ Types of tungsten electrodes and their uses
	  ○ Grinding of tungsten electrode
	  ○ Torch setup
	  ○ Gas Flow rate
	  ○ Gas regulator and cylinder set up
	  ○ Types of inert gases
	  ○ Types of filler rod
	  ○ Gas flow rate Welding angle
	  ○ Welding positions
	  ○ Welding bead
	  ○ Voltage, current and resistance
	  ○ Welding fixtures and their uses
		• Calculate area, volume and mass.
		• Convert from one-unit system to another
			• Read and interpret welding drawing.
			• Read and interpret manufacturer's operation manual.

	○ Welding Procedures • Use and importance: ○ Layout ○ Filing ○ Cutting ○ Forming ○ Punching ○ Grinding ○ Chiseling ○ Cleaning • Introduction to materials ○ Ferrous and non-ferrous ○ Cast iron and alloy steel ○ Non metals ○ Profile and properties of materials • Drawing ○ Introduction and importance ○ Drawing instruments ○ Drawing lines ○ Welding symbols ○ Drawing scales ○ Isometric, oblique and orthographic drawing • Measurement system - (SI, Metric (MKS) and Imperial (FPS)) • Importance of Tack welding • Importance of penetration • Welding defects and remedies		

	• Importance of testing
	• Testing techniques
	  ○ Visual/optical test
	  ○ Gauge test
	  ○ Bending test
	  ○ Cutting test
	• 3R's principles (Reduce, Reuse, and Recycle)		

9	**Assessment of Competency**				
	Unit: 4 **Unit Title: Perform Gas Tungsten Arc Welding (GTAW)**				
	Candidate Details		**Assessors Detail**		
	Candidate's Name: Registration Number: Symbol No: Test Centre: Test Date:		Assessors' Name 1. 2. 3.		ID/License No:

Element of competency	Performance Standards	Standard Met	Standard Not Met	Evidence Type	Comments
4.1 Setup welding machine, equipment and accessories	4.1.1 ***Personal Protective Equipment (PPE)*** used in accordance with organization's Occupational Health and Safety (OHS) procedures and policies. 4.1.2 Tools and equipment prepared as per ***task requirements***. 4.1.3 ***Power source*** set up in accordance with manufacturer's operation manual of welding machine. 4.1.4 Welding ***accessories*** assembled and arranged in accordance with task requirements. 4.1.5 All connections and fittings tightened as per manufacturer's operation manual. 4.1.6 Welding machine arranged in accordance with task requirements. 4.1.7 Current ampere range and shielding gas flow rate adjusted as per thickness, types of parent metal and welding size. 4.1.8 Operation of welding machine checked in accordance with manufacturer's operation manual.				

	4.1.9 Malfunctions of tools and equipment rectified as per manufacturer's operation manual.				
4.2 Prepare materials for welding	4.2.1 Materials collected as per given drawings and specifications. 4.2.2 ***Foreign materials*** removed from ***parent metal***. 4.2.3 Parent metal measured as per dimensions and shape. 4.2.4 Cutting method selected as per thickness and types of parent metal. 4.2.5 Parent metal cut as per dimensions and shape. 4.2.6 ***Edge*** of the parent metal prepared as per dimensions and shape. 4.2.7 Tip of tungsten electrode grinded as per power source***.***				
4.3 Perform tack welding	4.3.1 Tack welded in equal interval. 4.3.2 Welded joint evenly penetrated at rear part of welded parent metal. 4.3.3 Spatter removed from welded parent metal.				
4.4 Perform fillet welding	4.4.1 ***Fillet welded joints*** identified from the given drawings. 4.4.2 Parent metal positioned as per fillet welded joints. 4.4.3 Arc length and angle of filler rod and torch maintained. 4.4.4 Tack welded in equal interval. 4.4.5 Full length welding maintained with straight equal bead width. 4.4.6 Parent metal welded applying ***distortion prevention measures*** in specified ***positions*** as per task requirements. 4.4.7 Welded joints evenly penetrated. 4.4.8 Uniform ripples and reinforcement maintained in weld bead 4.4.9 Spatters removed from welded parent metal.				
4.5 Perform groove welding	4.5.1 ***Groove welded joints*** identified from the given drawings. 4.5.2 Parent metal positioned as per groove welded joints. 4.5.3 Arc length and angle of filler rod and torch maintained.				

	4.5.4 Tack welded in equal interval. 4.5.5 Full length welding maintained with straight and equal bead width. 4.5.6 Parent metal welded applying distortion prevention measures in specified positions as per task requirements. 4.5.7 Welded joint evenly penetrated at rear part of welded parent metal. 4.5.8 Uniform ripples and reinforcement maintained in weld bead. 4.5.9 Spatters removed from welded parent metal.				
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4.7 Test welded piece	4.7.1 ***Minor weld defects*** identified and marked applying ***testing techniques***. 4.7.2 Minor weld defects corrected to gain full strength.				
4.8 Perform workplace housekeeping	4.8.1 Work area cleaned. 4.8.2 Waste and unwanted materials disposed in accordance with ***3R's principles***. 4.8.3 Tools, equipment, materials cleaned, maintained and stored.				

WT- Written Test **OQ**- Oral Question **PT-** Practical Test **DO** – Direct Observation **SR**- Supervisor's report **SN**–Simulation

RP- Role Play **PG** –Photographs **VD**- Video **CT** – Certificates **TS** – Testimonials (Reward) **PP** – Product Produced

CS – Case Study

Range Statement

Variable	Range
Personal Protective Equipment (PPE)	*May include but not limited to:* • Helmet • Goggles • Mask • Face shield • Non-flammable apron • Non-flammable gloves • Ear muff • Leather shoes
Task requirements	*May include but not limited to:* • Cleaning • Layout • Cutting • Gauging • Edge preparation • Welding • Finishing • Testing
Power source	*May include but not limited to:* • AC • DC

Accessories	*May include but not limited to:* • Ceramic cup • Earth clamp • Welding clamp • Collets body • Collets • Hose pipe • Hose pipe connector • Welding cable and lugs
Foreign materials	*May include but not limited to:* • Rust • Corrosion • Paints • Grease/oil
Parent metal	*May include but not limited to:* • Pipe: Steel and Stainless steel • Plate: Steel and Stainless steel
Edge	*May include but not limited to:* • Straight/Square • Bevel • V • U • Flare • Flanged • Single/double

Fillet welded joints	*May include but not limited to:* • Lap • Tee • Corner
Distortion prevention measures	*May include but not limited to:* • Tacking • Bracing • Bolting • Clamping • Pre-setting • Fixing fixtures
Positions	*May include but not limited to:* • Flat (1G1F) • Horizontal (2G2F) • Vertical (3G3F)
Groove welded joints	*May include but not limited to:* • U butt • V butt • Square butt

Minor weld defects	*May include but not limited to:* • Undercut • Under fill • Crack • Overlap • Porosity/blow holes • Misalignment • Lack of fusion/penetration • Spatters • Burn through • Concavity/Convexity
Testing techniques	*May include but not limited to:* • Visual/optical test • Gauge test • Bending test • Cutting test
3 R's principles	*May include but not limited to:* • Reduce • Reuse • Recycle