

Qualification Pack



Metal Inert Gas/ Metal Active Gas/ Gas Metal Arc Welder (MIG/MAG/GMAW)

QP Code: CSC/Q0209

Version: 1.0

NSQF Level: 4

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CSC/Q0209: Metal Inert Gas/ Metal Active Gas/ Gas Metal Arc Welder (MIG/MAG/GMAW)

Brief Job Description

Perform manual (semi-automatic) MIG/MAG (GMAW) welding for a range of standard welding job requirements and weld different materials (carbon steel, aluminum and stainless steel) in various positions. The welder can prepare various joints including corner, butt, fillet and tee. Set-up and prepare for operations interpreting the right information from the WPS .

Personal Attributes

Basic communication, numerical and computational abilities. Openness to learning, ability to plan and organize own work and identify and solve problems in the course of working. Understanding the need to take initiative and manage self and work to improve efficiency and effectiveness.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. [CSC/N0203: Manually cut metal and metal alloys using oxy-fuel gases](#)
2. [CSC/N0204: Manually weld carbon and low alloy steels in 1G/1F, 2G/2F, 3G/3F welding positions using Metal Arc Welding/ Shielded Metal Arc Welding](#)
3. [CSC/N0207: Manually cut metal materials using plasma arc](#)
4. [CSC/N0209: Manually \(semi-automatic\) welding joints using the MIG/MAG \(GMAW\) process](#)
5. [CSC/N1335: Use basic health and safety practices at the workplace](#)
6. [CSC/N1336: Work effectively with others](#)

Qualification Pack (QP) Parameters

Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
Occupation	Welding and Cutting



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Country	India
NSQF Level	4
Aligned to NCO/ISCO/ISIC Code	NCO-2004/7212.2
Minimum Educational Qualification & Experience	10th Class with 0-6 Months of experience As a Manual/Shielded Metal Arc Welding
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	24/11/2017
Next Review Date	31/03/2022
NSQC Approval Date	26/03/2015
Version	1.0
Reference code on NQR	2015/CCM/GCSC/00005
NQR Version	1.0

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CSC/N0203: Manually cut metal and metal alloys using oxy-fuel gases

Description

This unit is about competencies required for manual cutting operations to cut different materials in various positions by using oxy-fuel gas such as oxy-acetylene. The person would be able to independently carry out oxy-fuel cutting operations for as per welding procedure specification (WPS).

Scope

This unit/task covers the following:

- Work safely
- Prepare for cutting operations
- Carry out cutting operations
- Test for quality
- Deal with contingencies

Elements and Performance Criteria

Work safely

To be competent, the user/individual on the job must be able to:

- PC1.** work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines Safety precautions: general workshop safety, fire prevention, general hazards, manual lifting, overhead lifting, surface conditions, the stability of surrounding structures, furniture, etc.
- PC2.** take necessary safety precautions for gas cutting operations including equipment, processes and checks

Prepare for cutting operations

To be competent, the user/individual on the job must be able to:

- PC3.** interpret cutting procedure data sheets specifications
- PC4.** check regulators, hoses and check that valves are securely connected and free from leaks and damage
- PC5.** check equipment is calibrated and approved for use
- PC6.** check/fit the correct size gas nozzle to the torch
- PC7.** ensure preheat and oxygen holes on the tips are clean
- PC8.** check that a flashback arrestor is fitted
- PC9.** set appropriate gas pressures
- PC10.** use the correct procedure for lighting, adjusting and extinguishing the flame (Lighting and cutting procedures: lighting the cutting torch; adjusting gas controls to produce a neutral flame; methods of starting the cut and controlling the cutting speed; direction and angle of cut; procedure for extinguishing the flame)
- PC11.** adjust torch valve for the type of flame such as neutral, carburizing and oxidizing
- PC12.** follow a sequence of operations such as pre-heating material and initiating the cut
- PC13.** mark out the locations for cutting accurately and as per requirement

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- PC14.** use appropriate and safe procedures for handling and storing of gas cylinders
- PC15.** prepare the work area for the cutting activities
- PC16.** obtain the appropriate tools and equipment for the oxy-fuel gas cutting operations, and check that they are in a safe and usable condition
Equipment: hand-held oxy-fuel gas cutting equipment, simple, portable, track-driven cutting equipment (electrical or mechanical), fixed bench gas cutting equipment
- PC17.** check that the oxy-fuel gas cutting equipment is set up for the operations to be performed
- PC18.** adjust cylinder valves and adjust the regulator for operating pressure to achieve specifications for required operations
- PC19.** where appropriate, mark out the components for the required operations, using appropriate tools and techniques
- PC20.** perform skill trial cut to check for cut defects

Carry out cutting operations

To be competent, the user/individual on the job must be able to:

- PC21.** operate the oxy-fuel gas cutting equipment to produce items/cut shapes to the dimensions and profiles specified
- PC22.** use various types of oxy-fuel gas cutting methods
- PC23.** perform various cutting operations correctly (Cutting operations: down-hand straight cuts (freehand), making straight cuts (track-guided), cutting regular shapes, cutting irregular shapes, making angled cuts, cutting chamfers, making radial cuts, gouging/flushing, beveled edge weld preparations, cutting out holes)
- PC24.** produce thermal cuts in various forms of material (metal of 3mm and above)
- PC25.** produce cut profiles for various type of materials and forms
Materials: mild carbon steel, high tensile and special steels, other materials
Forms: plate, rolled section, pipe/tube, solid bars
- PC26.** produce thermally-cut components which meet specified quality criteria
Quality criteria: dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 2mm; angled/radial cuts are within specification requirements; cuts are clean and smooth and free from flutes; no drags
- PC27.** recognize and correct burnback and flashback
- PC28.** detect and correct defects in cut
- PC29.** ensure the work area is left in a safe and tidy condition on completion of the cutting activities

Test for accuracy

To be competent, the user/individual on the job must be able to:

- PC30.** check that the finished components meet the standard required
- PC31.** use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the cut material are to the specification
- PC32.** identify various cutting defects and follow organization recommended procedures to address the defects: distortion; grooved, fluted or ragged cuts; poor draglines; rounded edges; tightly adhering slag

Deal with contingencies

To be competent, the user/individual on the job must be able to:

- PC33.** report any difficulties or problems that may arise with the cutting activities, and carry out any agreed actions
- PC34.** detect equipment malfunctions and deal with them appropriately

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- PC35.** deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
- PC36.** shut down and make safe the cutting equipment on completion of the cutting activities
- PC37.** follow standard emergency procedures in case of emergencies (Emergencies (safety procedures): sustained backfire in a blowpipe; close the oxygen valve of the blowpipe; followed by the fuel valve and then close both cylinder valves; investigate the cause and rectify the fault; re-light the blowpipe only after it is completely cooled down; flashback into the hose and equipment, or a house fire or explosion, or a fire at the gas regulator connections; isolate the fuel gas and oxygen supplies by closing the cylinder valves only when this can be done safely; may attempt to control the fire by fire-fighting equipment only when there is no undue risk of personal injury; activate the fire alarm and call for the Fire Services Department as per organizational procedures; fires involving acetylene cylinders; always best dealt with by firemen from the Fire Services Department. However, the following the initial response may be appropriate: cool the cylinder by spraying with water only if it is safe to do so; close the cylinder valve to control the fire only if it is safe to do so; evacuate the building by activating the fire alarm or by any other means; to avoid explosion never move an acetylene cylinder involved in a fire or which has been affected by heat from a nearby fire even if it seems cooled down)

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** job-relevant legislation, standards, policies, and procedures followed in the company
- KU2.** the key purpose of the organization
- KU3.** department structure and hierarchy protocols
- KU4.** workflow and own role in the workflow
- KU5.** dependencies and interdependencies in the workflow
- KU6.** support functions and types of support available for incumbents in this role
- KU7.** types of fire extinguishers and their suitable uses in case of gas cutting related fires
- KU8.** specific safety precautions to be taken when working with oxy-fuel gas cutting equipment in a fabrication environment
Safety precautions: safety from trailing hoses; safety from naked flames; appropriate fume and gases extraction/control measures; safety from explosive gas mixtures and oxygen enrichment; safety from spatter and hot metal (distance, PPE, proper handling and placement); protection from live and other electrical components, including insulation, proper earthing, proper loading, etc.; adequate lighting; appropriate personal protective equipment; protection of self and others from the effects of the flame; safety measures for elevated and trench working; gas cylinder safety: right color code; correctly labelled; no leakage; away from heat or ignition source; never use hose other than that designed for the specified gas; use ferrules or clamps designed for the hose (not ordinary wire or other substitute) to connect hoses to fittings; upright position (fuel gas); physical care to avoid damage and falls, throws and bumps; move on trolleys, cap closed and without regulators; valves closed on empty cylinders
- KU9.** personal protective clothing and equipment (PPE) to be worn when working with gas cutting equipment
Personal protective equipment: suitable aprons, gloves, safety boots, correctly fitting overalls, suitable eye shields/goggles, respirators
- KU10.** hazards associated with carrying out gas cutting activities and how they can be minimized

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- KU11.** safe working practices and procedures for using thermal equipment
- KU12.** principles of oxy-fuel gas cutting (Principles: oxygen cutting for materials which readily get oxidized; oxides have lower melting points than the metals; widely used for ferrous materials; oxygen cutting is not used for materials like aluminum, bronze, mild steels which resist oxidation; cutting of high carbon steels and cast irons require special attention due to the formation of heat affected zone (HAZ) where structural transformation occurs; substitute hydrocarbon gases (propane, butane and natural gas) not suitable for cutting ferrous materials due to their oxidizing characteristics)
- KU13.** procedure for obtaining the required drawings, job instructions, and other related specifications
- KU14.** how to use and extract information from engineering drawings and related specifications, workpiece reference points and system of tolerances
- KU15.** various types of gas cutting equipment available (Equipment: hand-held oxy-fuel gas cutting equipment, simple, portable, track-driven cutting equipment (electrical or mechanical), fixed bench gas cutting equipment))
- KU16.** various components of the gas cutting equipment (Components: color-coded cylinder oxygen; color coded cylinder acetylene; cylinder valve; flashback arrestor; set of nozzles; gas lighter nozzle; cutting tips; pressure regulator; pressure gauge; non-return valves; color-coded flexible hose; trolleys; torches (rose-bud heating, cutting, others))
- KU17.** construction of the heating and cutting torch
- KU18.** types of oxy-fuel gases such as acetylene, natural gas, and propane
- KU19.** accessories that can be used with handheld gas cutting equipment to aid cutting operations (such as cutting guides, trammels, templates)
- KU20.** importance of correct marking procedure before a cut (eg. allowances for post-cut operations, punch marks, etc.)
- KU21.** types of regulators such as low- and high-pressure, and single- and two-stage
- KU22.** how to identify the gases used in the cutting process and the color coding of gas cylinders
- KU23.** type and thickness of base metals related to nozzle type
- KU24.** preparations prior to cutting (including checking connections for leaks, setting gas pressures, setting up the material/workpiece, and checking the cleanliness of materials used)
- KU25.** holding methods that are used to aid thermal cutting, and the equipment that can be used
- KU26.** the correct procedure for lighting, cutting and extinguishing the flame-lighting and cutting procedures: lighting the cutting torch; adjusting gas controls to produce a neutral flame; methods of starting the cut and controlling the cutting speed; direction and angle of cut; procedure for extinguishing the flame
- KU27.** types of flames and their implication for cutting
- KU28.** importance of following the correct procedure for lighting, cutting and extinguishing a flame
- KU29.** problems that can occur with thermal cutting, and how they can be avoided (including causes of distortion during thermal cutting and methods of controlling distortion)
- KU30.** effects of oil, grease, scale or dirt on the cutting process
- KU31.** gas mixture ratio required to get various flames
- KU32.** quality parameters for gas cut materials (Quality parameters: shape and length of the draglines; the smoothness of the sides; sharpness of the top edges; the amount of slag adhering to the metal)
- KU33.** special grade materials used in industry and their behavior with oxy-fuel gas

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- KU34.** causes of cutting defects, how to recognize them, and methods of correction and prevention
Defects: distortion; grooved, fluted or ragged cuts; poor draglines; rounded edges; tightly adhering slag
- KU35.** importance of leaving the work area in a safe and clean condition on completion of activities
- KU36.** correct handling and storage of gas cylinders
- KU37.** emergency procedures for backfires, flashback and other fires (Emergencies (safety procedures): sustained backfire in a blowpipe; close the oxygen valve of the blowpipe; followed by the fuel valve and then close both cylinder valves; investigate the cause and rectify the fault; re-light the blowpipe only after it is completely cooled down; flashback into the hose and equipment, or a house fire or explosion, or a fire at the gas regulator connections; isolate the fuel gas and oxygen supplies by closing the cylinder valves only when this can be done safely; may attempt to control the fire by fire-fighting equipment only when there is no undue risk of personal injury; activate the fire alarm and call for the Fire Services Department as per organizational procedures; fires involving acetylene cylinders; always best dealt with by firemen from the Fire Services Department. However, the following the initial response may be appropriate: cool the cylinder by spraying with water only if it is safe to do so; close the cylinder valve to control the fire only if it is safe to do so; evacuate the building by activating the fire alarm or by any other means; to avoid explosion never move an acetylene cylinder involved in a fire or which has been affected by heat from a nearby fire even if it seems cooled down)
- KU38.** how to close down the cutting equipment safely and correctly
- KU39.** purging tools and their function

Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** read and interpret information correctly from various job specification documents, health, and safety instructions, memos, etc. applicable to the job in English and/or local language
- GS2.** fill up appropriate technical forms, process charts, activity logs as per the organizational format in English and/or local language
- GS3.** undertake numerical operations, geometry and calculations/ formulae
Numerical computations: addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages
- GS4.** use appropriate measuring techniques
- GS5.** use and convert imperial and metric systems of measurements
- GS6.** apply the appropriate degree of accuracy to express numbers
Units and number systems representing a degree of accuracy: decimals places, significant figures, fractions as a decimal quantity
- GS7.** calculate the value of angles in a triangle
Angles in a triangle: right-angled, isosceles, equilateral
- GS8.** convey and share technical information clearly using appropriate language
- GS9.** check and clarify task-related information
- GS10.** liaise with appropriate authorities using the correct protocol
- GS11.** communicate with people in a respectful form and manner in line with organizational protocol



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- GS12.** plan, prioritize and sequence work operations as per job requirements
- GS13.** organize and analyze information relevant to work
- GS14.** basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimization of time
- GS15.** exercise restraint while expressing dissent and during conflict situations
- GS16.** avoid and manage distractions to be disciplined at work
- GS17.** manage own time for achieving better results
- GS18.** work in a team in order to achieve better results
- GS19.** identify and clarify work roles within a team
- GS20.** communicate and cooperate with others in the team for better results
- GS21.** seek assistance from fellow team members
- GS22.** identify problems with work planning, procedures, output and behavior, and their implications
- GS23.** prioritize and plan for problem-solving
- GS24.** communicate problems appropriately to others
- GS25.** identify sources of information and support for problem-solving
- GS26.** seek assistance and support from other sources to solve problems
- GS27.** identify effective resolution techniques
- GS28.** select and apply resolution techniques
- GS29.** seek evidence for problem resolution
- GS30.** undertake and express new ideas and initiatives to others
- GS31.** modify the work plan to overcome unforeseen difficulties or developments that occur as work progresses
- GS32.** participate in improvement procedures including process, quality and internal/external customer/supplier relationships
- GS33.** enhance one's competencies in new and different situations and contexts to achieve more
- GS34.** participate in on-the-job and other learning, training and development interventions and assessments
- GS35.** clarify task-related information with appropriate personnel or technical adviser
- GS36.** seek to improve and modify own work practices
- GS37.** maintain current knowledge of application standards, legislation, codes of practice and product/process developments

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Work safely</i>	2	4	-	-
PC1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines Safety precautions: general workshop safety, fire prevention, general hazards, manual lifting, overhead lifting, surface conditions, the stability of surrounding structures, furniture, etc.	1	2	-	-
PC2. take necessary safety precautions for gas cutting operations including equipment, processes and checks	1	2	-	-
<i>Prepare for cutting operations</i>	7	36	-	-
PC3. interpret cutting procedure data sheets specifications	1	2	-	-
PC4. check regulators, hoses and check that valves are securely connected and free from leaks and damage	-	2	-	-
PC5. check equipment is calibrated and approved for use	-	2	-	-
PC6. check/fit the correct size gas nozzle to the torch	-	2	-	-
PC7. ensure preheat and oxygen holes on the tips are clean	-	2	-	-
PC8. check that a flashback arrestor is fitted	-	2	-	-
PC9. set appropriate gas pressures	-	2	-	-
PC10. use the correct procedure for lighting, adjusting and extinguishing the flame (Lighting and cutting procedures: lighting the cutting torch; adjusting gas controls to produce a neutral flame; methods of starting the cut and controlling the cutting speed; direction and angle of cut; procedure for extinguishing the flame)	1	2	-	-
PC11. adjust torch valve for the type of flame such as neutral, carburizing and oxidizing	1	2	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC12. follow a sequence of operations such as pre-heating material and initiating the cut	1	2	-	-
PC13. mark out the locations for cutting accurately and as per requirement	1	2	-	-
PC14. use appropriate and safe procedures for handling and storing of gas cylinders	1	2	-	-
PC15. prepare the work area for the cutting activities	-	2	-	-
PC16. obtain the appropriate tools and equipment for the oxy-fuel gas cutting operations, and check that they are in a safe and usable condition Equipment: hand-held oxy-fuel gas cutting equipment, simple, portable, track-driven cutting equipment (electrical or mechanical), fixed bench gas cutting equipment	-	2	-	-
PC17. check that the oxy-fuel gas cutting equipment is set up for the operations to be performed	-	2	-	-
PC18. adjust cylinder valves and adjust the regulator for operating pressure to achieve specifications for required operations	1	2	-	-
PC19. where appropriate, mark out the components for the required operations, using appropriate tools and techniques	-	2	-	-
PC20. perform trial cut to check for cut defects	-	2	-	-
<i>Carry out cutting operations</i>	8	23	-	-
PC21. operate the oxy-fuel gas cutting equipment to produce items/cut shapes to the dimensions and profiles specified	1	4	-	-
PC22. use various types of oxy-fuel gas cutting methods	1	3	-	-
PC23. perform various cutting operations correctly (Cutting operations: down-hand straight cuts (freehand), making straight cuts (track-guided), cutting regular shapes, cutting irregular shapes, making angled cuts, cutting chamfers, making radial cuts, gouging/flushing, beveled edge weld preparations, cutting out holes)	1	3	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC24. produce thermal cuts in various forms of material (metal of 3mm and above)	1	1	-	-
PC25. produce cut profiles for various type of materials and forms Materials: mild carbon steel, high tensile and special steels, other materials Forms: plate, rolled section, pipe/tube, solid bars	1	3	-	-
PC26. produce thermally-cut components which meet specified quality criteria Quality criteria: dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 2mm; angled/radial cuts are within specification requirements; cuts are clean and smooth and free from flutes; no drags	1	3	-	-
PC27. recognize and correct burnback and flashback	1	2	-	-
PC28. detect and correct defects in cut	1	2	-	-
PC29. ensure the work area is left in a safe and tidy condition on completion of the cutting activities	-	2	-	-
<i>Test for accuracy</i>	2	5	-	-
PC30. check that the finished components meet the standard required	1	2	-	-
PC31. use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the cut material are to the specification	-	1	-	-
PC32. identify various cutting defects and follow organization recommended procedures to address the defects: distortion; grooved, fluted or ragged cuts; poor draglines; rounded edges; tightly adhering slag	1	2	-	-
<i>Deal with contingencies</i>	3	10	-	-
PC33. report any difficulties or problems that may arise with the cutting activities, and carry out any agreed actions	1	2	-	-
PC34. detect equipment malfunctions and deal with them appropriately	1	2	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC35. deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve	-	2	-	-
PC36. shut down and make safe the cutting equipment on completion of the cutting activities	1	2	-	-
PC37. follow standard emergency procedures in case of emergencies (Emergencies (safety procedures): sustained backfire in a blowpipe; close the oxygen valve of the blowpipe; followed by the fuel valve and then close both cylinder valves; investigate the cause and rectify the fault; re-light the blowpipe only after it is completely cooled down; flashback into the hose and equipment, or a house fire or explosion, or a fire at the gas regulator connections; isolate the fuel gas and oxygen supplies by closing the cylinder valves only when this can be done safely; may attempt to control the fire by fire-fighting equipment only when there is no undue risk of personal injury; activate the fire alarm and call for the Fire Services Department as per organizational procedures; fires involving acetylene cylinders; always best dealt with by firemen from the Fire Services Department. However, the following the initial response may be appropriate: cool the cylinder by spraying with water only if it is safe to do so; close the cylinder valve to control the fire only if it is safe to do so; evacuate the building by activating the fire alarm or by any other means; to avoid explosion never move an acetylene cylinder involved in a fire or which has been affected by heat from a nearby fire even if it seems cooled down)	-	2	-	-
NOS Total	22	78	-	-

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National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0203
NOS Name	Manually cut metal and metal alloys using oxy-fuel gases
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Welding and Cutting
NSQF Level	3
Credits	TBD
Version	1.0
Last Reviewed Date	24/11/2017
Next Review Date	31/03/2022
NSQC Clearance Date	20/07/2015

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CSC/N0204: Manually weld carbon and low alloy steels in 1G/1F, 2G/2F, 3G/3F welding positions using Metal Arc Welding/ Shielded Metal Arc Welding

Description

This OS unit is about performing manual metal arc welding (MMAW) welding also known as Shielded Metal Arc Welding (SMAW) for producing various types of joints on carbon and low alloy steels in 1G/1F, 2G/2F and 3G/3F welding positions as per specific instructions given.

Scope

This unit/task covers the following:

- Work safely
- Prepare for welding operations
- Carry out welding operations
- Test for quality

Elements and Performance Criteria

Work safely

To be competent, the user/individual on the job must be able to:

- PC1.** work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
- PC2.** adhere to procedures or systems in place for health and safety, personal protective equipment (PPE) and other relevant safety regulations for MIG/MAG welding operations (Safety precautions: e.g. general workshop safety; fire prevention; general hazards; manual lifting; overhead lifting; shop floor housekeeping including surface conditions; waste disposal; stability of surrounding structures, furniture, etc.)
- PC3.** check the condition of welding leads, gas connection arrangements, earthing arrangements and electrode holder
- PC4.** report any faults or potential hazards to appropriate authority
- PC5.** follow fume extraction safety procedures

Prepare for welding operations

To be competent, the user/individual on the job must be able to:

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- PC6.** read and interpret routine information on written job instructions and drawings, welding procedure specifications and standard operating procedures (Interpreting the WPS: e.g. welding process (ISO codes); parent metal; consumables; pre welding joint preparation (edge preparation, assembly, preheat); welding parameters; welding positions (ISO 6947 PA, PB, PC, PD, PE, PF, PG; ASME IXI-6 G/1-6 F); number & arrangement of runs to fully fill /weld joints; electrode sizes for joint thicknesses; electrode & covering; electrical conditions required (type of current, alternating [A.C.] direct [D.C.], electrode polarity (positive or negative), welding current ranges); welding techniques (string/weave);welding sequence; heat input control; bead length/travel speed preheat/ post heat; interpass run cleaning/back gouging methods; post welding activities (wire brushing and grinding, removal of excess weld metal where required); post-weld heat treatment (normalising, stress relief); etc.)
- PC7.** identify welding machines e.g.. transformers, rectifiers, inverters and generators, according to the task
- PC8.** prepare the work area for the welding activities
- PC9.** perform measurements for joint preparation and routine MMAW
- PC10.** prepare the materials and joint in readiness for welding (Materials: carbon, low alloy steel; Form: plate(1.5 - 24mm)/ sheet (1.5mm); Joint preparation: made rust free; cleaned free from scaling, paint, oil/grease; made dry and free from moisture; edges to be welded prepared as per job requirement - such as flat, square or bevelled; use various machines and techniques for the above (e.g.. chamfering machine, grinding and stripping, gas or plasma cutting, etc.); correctly positioned (positioning: devices and techniques; jigs and fixtures; setting up joint in correct position & alignment))
- PC11.** use manual metal-arc welding and related equipment to include an alternating current (AC) equipment b. direct current (DC) equipment (MMAW equipment: transformers; rectifiers; generators; invertors; consumables electrodes, dyes; welding accessories - holders, cables and accessories; ancillary equipment - (power saw, angle, pedestal and straight grinders, tong tester, etc.))
- PC12.** connect equipment to power source
- PC13.** connect cables, electrode holders, return leads and ground clamps to appropriate terminal
- PC14.** re-dry electrodes as per electrode classification requirement
- PC15.** set, read and adjust amperage controls
- PC16.** verify set up by running test weld specimen (scrap plate)
- PC17.** tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding
- PC18.** report any faults or problem to appropriate authority

Carry out welding operations

To be competent, the user/individual on the job must be able to:

- PC19.** strike and maintain a stable arc
- PC20.** stop and properly re-start arc to avoid welding defects (scratch start, tapping techniques)
- PC21.** maintain constant puddle by using appropriate travel speed
- PC22.** maintain proper bead sequence with respect to groove/fillet configurations and positions
- PC23.** remove slag in an appropriate manner (e.g.. wire brush, hammer, etc.)

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- PC24.** produce welded joints to the specified quality, dimensions and profile applicable to carbon and low alloy steel sheets and plates from 1.5 to 24 mm (Quality standards: required parameters for dimensional accuracy; weld finishes are built up to the full section of the weld; joints at stop/start positions merge smoothly; weld surface is (free from cracks; substantially free from porosity; free from any pronounced hump or crater; substantially free from shrinkage cavities; substantially free from trapped slag; substantially free from arcing or chipping marks); fillet welds are (equal in leg length, slightly convex in profile (where applicable), size of the fillet equivalent to the thickness of the material welded); weld contour is (of linear and of uniform profile; smooth and free from excessive undulations; regular and has an even ripple formations); welds are adequately fused, there is minimal undercut, overlap and surface inclusions; tack welds are blended in to form part of the finished weld, without excessive hump; corner joints have minimal burn through to the underside of the joint or, where appropriate joints: fillet lap joints, tee fillet joints, corner joints, butt joints (square, single, vee, double vee))
- PC25.** produce fillet and groove joints in 1F/1G, 2F/2G and 3F/ 3G welding positions as per the WPS specified using single or multi-run welds Positions: flat (PA) 1G/1F, horizontal vertical (PB) 2F, horizontal (PC) 2G, vertical upwards (PF) 3F / 3G, vertical downwards (PG) 3F / 3G, Plate to Pipe (Fixed) 5F
- PC26.** deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
- PC27.** produce joints on carbon and low alloy steel materials using various methods (Methods: drag, weave, whip)
- PC28.** shut down and make safe the welding equipment on completion of the welding activities (MMAW equipment: e.g. transformers; rectifiers; generators; invertors; consumables electrodes, dyes; welding accessories - holders, cables and accessories; ancillary equipment - power saw, angle, pedestal and straight grinders, tong tester; etc.)

Test for quality

To be competent, the user/individual on the job must be able to:

- PC29.** measure and check that all dimensional and geometrical aspects of the weld are as per instructions
- PC30.** check that the welded joint conforms to the instructions given, by checking various quality parameters by visual inspection (Quality parameters: dimensional accuracy; alignment/squareness; size and profile of weld; visual defects)
- PC31.** identify various weld defects using visual inspection (Weld defects: lack of continuity of the weld; uneven and irregular ripple formation; excessive spatter; incorrect weld size or profile; burn through; undercutting; overlap; inclusions; distortion; porosity; internal cracks; surface cracks; lack of fusion or incomplete fusion; lack of penetration; excessive penetration; gouges; stray arc strikes; sharp edges; excessive convexity; Visual inspections: e.g. use of visual techniques, distance from work piece, angle of observation, adequate lighting, low powered magnification, fillet weld gauges, etc.)
- PC32.** detect and report surface imperfections to appropriate authority
- PC33.** deal with defects in welding as per instructions given

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

Qualification Pack

- KU1.** relevant legislation, standards, policies, and procedures followed in the company
- KU2.** department structure and hierarchy protocols
- KU3.** work flow and own role in the workflow
- KU4.** dependencies and interdependencies in the workflow
- KU5.** support functions and types of support available for incumbents in this role
- KU6.** health and safety hazards associated with MMAW/SMAW welding (Safety precautions (MMAW/SMAW Welding): protection from live and other electrical components, including insulation, proper earthing, etc.; proper handling and placement of hot metal; taking account of spatter and related safe distance; adequate lighting; appropriate personal protective equipment); protection of self and others from the effects of the welding arc; fume extraction/control measures; safety measures for elevated and trench workings (e.g. harness, etc.))
- KU7.** effects of exposure to the electric arc
- KU8.** types of fire extinguishers and their suitable uses
- KU9.** effects of exposure to welding fume
- KU10.** methods of managing welding fume hazards
- KU11.** personal protective equipment (PPE) and clothing to be worn during MMAW/SMAW welding
Personal protective equipment (PPE): (suitable aprons, welding gloves, respirators, safety boots, correctly fitting overalls, suitable eye shields/goggles, hard hat/helmet)
- KU12.** welding specific equipment requirements for MMAW/SMAW welding (MMAW equipment: e.g. transformers; rectifiers; generators; invertors; consumables electrodes, dyes; welding accessories - holders, cables and accessories; ancillary equipment - power saw, angle, pedestal and straight grinders, tong tester; etc.)
- KU13.** main components and controls of welding equipment
- KU14.** how to connect electrical components correctly
- KU15.** type of current used and implication
- KU16.** welding symbols used and their correct interpretation
- KU17.** types of consumables used for MMAW/SMAW welding
- KU18.** various defects associated with the MMAW/SMAW welding process (Weld defects: lack of continuity of the weld; uneven and irregular ripple formation; excessive spatter; incorrect weld size or profile; burn through; undercutting; overlap; inclusions; distortion; porosity; internal cracks; surface cracks; lack of fusion or incomplete fusion; lack of penetration; excessive penetration; gouges; stray arc strikes; sharp edges; excessive convexity)
- KU19.** types of joint configurations for welding (Types: groove and fillet)
- KU20.** factors that determine weld bead shape (Factors: electrode angles and welding technique (push, perpendicular, drag); arc length; thickness of base metal; travel speed (slow, normal, fast))
- KU21.** types of beads, characteristics and uses (stringer, weave, weave patterns) (Bead characteristics: spatter deposits, roughness, evenness, fill, crater, overlap)

Qualification Pack

- KU22.** factors that affect weld quality standards (Quality standards: required parameters for dimensional accuracy; weld finishes are built up to the full section of the weld; joints at stop/start positions merge smoothly; weld surface is (free from cracks; substantially free from porosity; free from any pronounced hump or crater; substantially free from shrinkage cavities; substantially free from trapped slag; substantially free from arcing or chipping marks); fillet welds are (equal in leg length, slightly convex in profile (where applicable), size of the fillet equivalent to the thickness of the material welded); weld contour is (of linear and of uniform profile; smooth and free from excessive undulations; regular and has an even ripple formations); welds are adequately fused, and there is minimal undercut, overlap and surface inclusions; tack welds are blended in to form part of the finished weld, without excessive hump; corner joints have minimal burn through to the underside of the joint or, where appropriate)
- KU23.** weld positions such as flat, horizontal, vertical and overhead (Positions: flat (PA) 1G/1F, horizontal vertical (PB) 2F, horizontal (PC) 2G and 3G/3F vertical downwards and upwards)
- KU24.** types of equipment components such as electrode holders, work leads cables and ground clamps
- KU25.** awareness and importance of cable size and length
- KU26.** types of polarity such as DC electrode negative and DC electrode positive for welding purposes
- KU27.** various types of base metals used in welding and their implications
- KU28.** distortion and how to control distortion (Distortion (causes and control methods): Causes (improper sequence of weld runs; direction of weld runs; heat input errors; lack of inaccuracy of jigs and fixture); Control Methods (sequence of welding as materials; proper direction; tacking and its frequency (where applicable); use clamping and jigs and fixtures (where applicable))
- KU29.** magnetic arc blow or arc deflection, causes and methods to avoid or compensate
- KU30.** significance of diffusible hydrogen for welds
- KU31.** storage requirements for consumable electrodes
- KU32.** welding process specification sheet, process qualification record (PQR) and related essential variables
- KU33.** travel speed and heat inputs
- KU34.** amperage requirements for different classification of electrodes and positions
- KU35.** importance and implications of various diameters of electrodes
- KU36.** gouging and back gouging principles, methods and procedures
- KU37.** purpose and importance of pre-heating requirements for base metals
- KU38.** tools and methods to measure temperature for pre-heat and post-heat requirements such as thermal chalk, thermocouple, etc.
- KU39.** purpose and importance of post-heating in welding
- KU40.** types of visual inspection indicators and methods (Visual inspections: e.g. use of visual techniques, distance from work piece, angle of observation, adequate lighting, low powered magnification, fillet weld gauges, etc.)
- KU41.** awareness of common welder testing codes and their purpose (Welder testing codes: ASME section IX, EN 287, ISO 9606, IS 7310)

Generic Skills (GS)

Qualification Pack

User/individual on the job needs to know how to:

- GS1.** read and interpret information correctly from various job specification documents, health and safety instructions, memos, etc. applicable to the job in English and/or local language
- GS2.** fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/or local language
- GS3.** undertake numerical operations, geometry and calculations/ formulae (including addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages)
- GS4.** use appropriate measuring techniques
- GS5.** apply appropriate degree of accuracy to express numbers
- GS6.** calculate tolerance in terms of limits of size
- GS7.** check measurements, angles, orientation and slopes
- GS8.** types of reference lines such as tangent lines, datum lines, centre lines and work points
- GS9.** select and use tools and equipment such as measuring tapes, levels, squares, protractors and dividers
- GS10.** ability to check dimensions of components
- GS11.** calculate the value of angles in a triangle
- GS12.** convey and share technical information clearly using appropriate language
- GS13.** check and clarify task-related information
- GS14.** liaise with appropriate authorities using correct protocol
- GS15.** communicate with people in respectful form and manner in line with organizational protocol
- GS16.** plan, prioritize and sequence work operations as per job requirements
- GS17.** organize and analyse information relevant to work
- GS18.** basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimization of time
- GS19.** exercise restraint while expressing dissent and during conflict situations
- GS20.** avoid and manage distractions to be disciplined at work
- GS21.** manage own time for achieving better results
- GS22.** work in a team in order to achieve better results
- GS23.** identify and clarify work roles within a team
- GS24.** communicate and cooperate with others in the team for better results
- GS25.** seek assistance from fellow team members
- GS26.** identify problems with work planning, procedures, output and behaviour and their implications
- GS27.** prioritize and plan for problem solving
- GS28.** communicate problems appropriately to others
- GS29.** identify sources of information and support for problem solving
- GS30.** seek assistance and support from other sources to solve problems
- GS31.** identify effective resolution techniques
- GS32.** select and apply resolution techniques
- GS33.** seek evidence for problem resolution



Qualification Pack

- GS34.** undertake and express new ideas and initiatives to others
- GS35.** modify work plan to overcome unforeseen difficulties or developments that occur as work progresses
- GS36.** participate in improvement procedures including process, quality and internal/external customer/supplier relationships
- GS37.** enhance ones competencies in new and different situations and contexts to achieve more
- GS38.** participate in on-the-job and other learning, training and development interventions and assessments
- GS39.** clarify task related information with appropriate personnel or technical adviser
- GS40.** seek to improve and modify own work practices
- GS41.** maintain current knowledge of application standards, legislation, codes of practice and product/process developments

Qualification Pack

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Work safely</i>	4	10	-	-
PC1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines	1	2	-	-
PC2. adhere to procedures or systems in place for health and safety, personal protective equipment (PPE) and other relevant safety regulations for MIG/MAG welding operations (Safety precautions: e.g. general workshop safety; fire prevention; general hazards; manual lifting; overhead lifting; shop floor housekeeping including surface conditions; waste disposal; stability of surrounding structures, furniture, etc.)	1	2	-	-
PC3. check the condition of welding leads, gas connection arrangements, earthing arrangements and electrode holder	-	2	-	-
PC4. report any faults or potential hazards to appropriate authority	1	2	-	-
PC5. follow fume extraction safety procedures	1	2	-	-
<i>Prepare for welding operations</i>	11	28	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC6. read and interpret routine information on written job instructions and drawings, welding procedure specifications and standard operating procedures (Interpreting the WPS: e.g. welding process (ISO codes); parent metal; consumables; pre welding joint preparation (edge preparation, assembly, preheat); welding parameters; welding positions (ISO 6947 PA, PB, PC, PD, PE, PF, PG; ASME IXI-6 G/1-6 F); number & arrangement of runs to fully fill /weld joints; electrode sizes for joint thicknesses; electrode & covering; electrical conditions required (type of current, alternating [A.C.] direct [D.C.], electrode polarity (positive or negative), welding current ranges); welding techniques (string/weave);welding sequence; heat input control; bead length/travel speed preheat/post heat; interpass run cleaning/back gouging methods; post welding activities (wire brushing and grinding, removal of excess weld metal where required); post-weld heat treatment (normalising, stress relief); etc.)	2	3	-	-
PC7. identify welding machines e.g.. transformers, rectifiers, inverters and generators, according to the task	-	2	-	-
PC8. prepare the work area for the welding activities	-	2	-	-
PC9. perform measurements for joint preparation and routine MMAW	1	3	-	-
PC10. prepare the materials and joint in readiness for welding (Materials: carbon, low alloy steel; Form: plate(1.5 - 24mm)/ sheet (1.5mm); Joint preparation: made rust free; cleaned free from scaling, paint, oil/grease; made dry and free from moisture; edges to be welded prepared as per job requirement - such as flat, square or bevelled; use various machines and techniques for the above (e.g.. chamfering machine, grinding and stripping, gas or plasma cutting, etc.); correctly positioned (positioning: devices and techniques; jigs and fixtures; setting up joint in correct position & alignment))	1	3	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. use manual metal-arc welding and related equipment to include an alternating current (AC) equipment b. direct current (DC) equipment (MMAW equipment: transformers; rectifiers; generators; invertors; consumables electrodes, dyes; welding accessories - holders, cables and accessories; ancillary equipment - (power saw, angle, pedestal and straight grinders, tong tester, etc.))	-	2	-	-
PC12. connect equipment to power source	-	2	-	-
PC13. connect cables, electrode holders, return leads and ground clamps to appropriate terminal	1	2	-	-
PC14. re-dry electrodes as per electrode classification requirement	1	2	-	-
PC15. set, read and adjust amperage controls	2	2	-	-
PC16. verify set up by running test weld specimen (scrap plate)	1	1	-	-
PC17. tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding	1	2	-	-
PC18. report any faults or problem to appropriate authority	1	2	-	-
<i>Carry out welding operations</i>	8	24	-	-
PC19. strike and maintain a stable arc	-	2	-	-
PC20. stop and properly re-start arc to avoid welding defects (scratch start, tapping techniques)	-	2	-	-
PC21. maintain constant puddle by using appropriate travel speed	1	2	-	-
PC22. maintain proper bead sequence with respect to groove/fillet configurations and positions	1	2	-	-
PC23. remove slag in an appropriate manner (e.g.. wire brush, hammer, etc.)	1	2	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<p>PC24. produce welded joints to the specified quality, dimensions and profile applicable to carbon and low alloy steel sheets and plates from 1.5 24 mm (Quality standards: required parameters for dimensional accuracy; weld finishes are built up to the full section of the weld; joints at stop/start positions merge smoothly; weld surface is (free from cracks; substantially free from porosity; free from any pronounced hump or crater; substantially free from shrinkage cavities; substantially free from trapped slag; substantially free from arcing or chipping marks); fillet welds are (equal in leg length, slightly convex in profile (where applicable), size of the fillet equivalent to the thickness of the material welded); weld contour is (of linear and of uniform profile; smooth and free from excessive undulations; regular and has an even ripple formations); welds are adequately fused, there is minimal undercut, overlap and surface inclusions; tack welds are blended in to form part of the finished weld, without excessive hump; corner joints have minimal burn through to the underside of the joint or, where appropriate Joints: fillet lap joints, tee fillet joints, corner joints, butt joints (square, single, vee, double vee))</p>	1	3	-	-
<p>PC25. produce fillet and groove joints in 1F/1G, 2F/2G and 3F/ 3G welding positions as per the WPS specified using single or multi-run welds Positions: flat (PA) IG/1F, horizontal vertical (PB) 2F, horizontal (PC) 2G, vertical upwards (PF) 3F / 3G, vertical downwards (PG) 3F / 3G, Plate to Pipe (Fixed) 5F</p>	1	3	-	-
<p>PC26. deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve</p>	1	3	-	-
<p>PC27. produce joints on carbon and low alloy steel materials using various methods (Methods: drag, weave, whip)</p>	1	3	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC28. shut down and make safe the welding equipment on completion of the welding activities (MMAW equipment: e.g. transformers; rectifiers; generators; invertors; consumables electrodes, dyes; welding accessories - holders, cables and accessories; ancillary equipment - power saw, angle, pedestal and straight grinders, tong tester; etc.)	1	2	-	-
<i>Test for quality</i>	5	10	-	-
PC29. measure and check that all dimensional and geometrical aspects of the weld are as per instructions	2	2	-	-
PC30. check that the welded joint conforms to the instructions given, by checking various quality parameters by visual inspection (Quality parameters: dimensional accuracy; alignment/squareness; size and profile of weld; visual defects)	1	2	-	-
PC31. identify various weld defects using visual inspection (Weld defects: lack of continuity of the weld; uneven and irregular ripple formation; excessive spatter; incorrect weld size or profile; burn through; undercutting; overlap; inclusions; distortion; porosity; internal cracks; surface cracks; lack of fusion or incomplete fusion; lack of penetration; excessive penetration; gouges; stray arc strikes; sharp edges; excessive convexity; Visual inspections: e.g. use of visual techniques, distance from work piece, angle of observation, adequate lighting, low powered magnification, fillet weld gauges, etc.)	-	2	-	-
PC32. detect and report surface imperfections to appropriate authority	1	2	-	-
PC33. deal with defects in welding as per instructions given	1	2	-	-
NOS Total	28	72	-	-



Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0204
NOS Name	Manually weld carbon and low alloy steels in 1G/1F, 2G/2F, 3G/3F welding positions using Metal Arc Welding/ Shielded Metal Arc Welding
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery
Occupation	Welding and Cutting
NSQF Level	3
Credits	TBD
Version	1.0
Last Reviewed Date	24/11/2017
Next Review Date	31/03/2022
NSQC Clearance Date	22/04/2015

CSC/N0207: Manually cut metal materials using plasma arc

Description

This unit is about competencies required for manual cutting operations using plasma arc. The candidate will be able to cut different materials (mild carbon steel, stainless steel, aluminum, high tensile and special steels and other materials) in various profiles pertaining to the gas cutting process.

Scope

This unit/task covers the following:

- Work safely
- Prepare for cutting operations
- Carry out cutting operations
- Test for quality
- Deal with contingencies

Elements and Performance Criteria

Work safely

To be competent, the user/individual on the job must be able to:

- PC1.** work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines (Safety precautions (general): general workshop safety; fire prevention; general hazards; manual lifting; overhead lifting; surface conditions; stability of surrounding structures, furniture, etc.)
- PC2.** take necessary safety precautions for plasma cutting operations including equipment, processes and checks

Prepare for cutting operations

To be competent, the user/individual on the job must be able to:

- PC3.** interpret cutting procedure data sheets specifications
- PC4.** check regulators, hoses and check that valves are securely connected and free from leaks and damage
- PC5.** check equipment is calibrated and approved for use
- PC6.** check/fit the correct nozzle to the torch
- PC7.** match correct tips and cups to the torch as per requirement and manufacturers equipment instructions
- PC8.** set the amperage and gas pressure as per metal thickness, metal type, and type of gas (Materials type: mild steel; high alloy steel; stainless steel; aluminum and its alloys; other appropriate metal; Types of gases: Primary Plasma Gas used to create the plasma arc (Nitrogen, Argon, Hydrogen, Compressed air); Secondary Shielding Gas used to protect the cut metals from oxidation (CO₂, Compressed Air))
- PC9.** use the correct procedure for lighting, adjusting and extinguishing the arc
- PC10.** use appropriate and safe procedures for handling and storing of gas cylinders
- PC11.** prepare the work area for the cutting activities

Qualification Pack

- PC12.** obtain the appropriate tools and equipment for the plasma arc cutting operations, and check that they are in a safe and usable condition
Equipment: plasma power source; pilot arc ignition system; torch; portable straight line cutters; profile cutting machines; air filter with regulator; burner electrode; compressor; nozzle; electrode holder; contact tube; front cap; gas supply system with gauges; cooling system; earthing clamp; connecting leads and cables
- PC13.** check that the plasma arc cutting equipment is correctly set up for the operations to be performed
- PC14.** carry out correct measurements required using appropriate equipment and methods for planning the cut
- PC15.** mark out the components for the required operations using appropriate tools and techniques where appropriate
- PC16.** perform trial cut to check for cut defect

Carry out cutting operations

To be competent, the user/individual on the job must be able to:

- PC17.** operate the plasma cutting equipment to produce items/cut shapes to the dimensions and profiles as specified
- PC18.** use the correct angles to cut and the right speed
- PC19.** use various types of plasma arc cutting methods/techniques (Cutting techniques: stand-off, circle cutting, profile cutting, edge, stenting hole, piercing technique)
- PC20.** perform various cutting operations correctly (Cutting operations: down-hand straight cuts (freehand), making straight cuts (track-guided), cutting regular shapes, cutting irregular shapes, making angled cuts, cutting chamfers, making radial cuts, gouging/flushing, beveled edge weld preparations, cutting out holes)
- PC21.** produce thermal cuts in various forms of material (Forms: plate, rolled section, pipe/tube, solid bars)
- PC22.** produce cut profiles for various type of materials (Materials type: mild steel; high alloy steel; stainless steel; aluminum and its alloys; other appropriate metal)
- PC23.** produce thermally-cut components which meet specified quality criteria
Quality criteria: dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 1mm; angled/radial cuts are within specification requirements; cuts are clean and smooth and free from flutes; no drags
- PC24.** detect and correct defects in cut
- PC25.** leave the work area in a safe and tidy condition on completion of the cutting activities

Test for quality

To be competent, the user/individual on the job must be able to:

- PC26.** check that the finished components meet the required standard
- PC27.** use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the cut material are to the specification
- PC28.** identify various cutting defects
Defects: grooved, fluted or ragged cuts, poor draglines, rounded edges, tightly adhering slag, dross, burr, distortion

Deal with contingencies

To be competent, the user/individual on the job must be able to:

- PC29.** report any difficulties or problems that may arise with the cutting activities, and carry out any agreed actions

Qualification Pack

- PC30.** detect equipment malfunctions and deal with them appropriately
- PC31.** deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
- PC32.** shut down and make safe the cutting equipment on completion of the cutting activities or during an emergency
- PC33.** follow standard emergency procedures in case of emergencies

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** job-relevant legislation, standards, policies, and procedures followed in the company
- KU2.** the key purpose of the organization
- KU3.** department structure and hierarchy protocol
- KU4.** workflow and own role in the workflow
- KU5.** dependencies and interdependencies in the workflow
- KU6.** support functions and types of support available for incumbents in this role
- KU7.** types of fire extinguishers and their suitable uses in case of gas cutting related fires
- KU8.** specific safety precautions to be taken when working with plasma arc cutting equipment in a fabrication environment (Safety precautions: safety from trailing hoses; safety from arc; appropriate fume and gases extraction/control measures; safety from spatter and hot metal (distance, PPE, proper handling and placement); protection from live and other electrical components, including insulation, proper earthing, proper loading, etc.; adequate lighting; appropriate personal protective equipment; protection of self and others from the effects of the arc; cylinder safety; safety measures including nozzles, valves, flowmeter, flashback arrestors, etc.; safety measures for elevated and trench working)
- KU9.** personal protective clothing and equipment (PPE) to be worn when working with plasma cutting equipment
Personal protective equipment: suitable aprons, gloves, safety boots, correctly fitting overalls, suitable eye shields/goggles, ear plugs or covering
- KU10.** hazards associated with carrying out plasma arc cutting activities and how they can be minimized
- KU11.** safe working practices and procedures for using plasma equipment
- KU12.** principles of plasma arc cutting (Principles: plasma an ionized gas that conducts electricity; plasma is created by adding energy to an electrically neutral gas; gas is compressed air, energy is electricity; more electrical energy added, the hotter the plasma; plasma cutting machines constrict the arc and force it through a concentrated area (the nozzle); pilot arc, cutting arc; increasing air pressure and intensifying the arc with higher amperage, the arc becomes hotter and more capable of blasting through thicker metals and blowing away the cuttings and it does not require a pre-heat cycle; using an inert gas for pressure prevents the cut areas from oxidizing; for most ferrous metals, compressed air is used; for nonferrous metals the inert gas is essential to prevent oxidation; different plasma tip diameters are used for different cutting thickness; has smaller heat affected zone (HAZ) preventing the area around the cut from warping and minimizes paint damage; provides gouging and piercing capabilities; minimal cleanup required, small and more precise kerf (width of the cut); cuts any type of electrically conductive metals including aluminum, copper, brass and stainless steel)

Qualification Pack

- KU13.** common terminology used in plasma cutting
- KU14.** procedure for obtaining the required drawings, job instructions, and other related specifications
- KU15.** how to use and extract information from engineering drawings and related specifications, workpiece reference points and system of tolerances
- KU16.** various types of plasma arc cutting equipment (Types: transferred, non- transferred (welding))
- KU17.** various components of the cutting equipment and types of consumables used (Consumables: electrode, gases, tips, cups)
- KU18.** construction of the cutting torch
- KU19.** types of plasma arc gases used (Types of gases: Primary Plasma Gas used to create the plasma arc (Nitrogen, Argon, Hydrogen, Compressed air); Secondary Shielding Gas used to protect the cut metals from oxidation (CO₂, Compressed Air))
- KU20.** accessories that can be used with handheld gas cutting equipment to aid cutting operations (such as cutting guides, templates)
- KU21.** types of regulators such as low- and high-pressure, and single- and two-stage
- KU22.** nozzle type as per type and thickness of base materials
- KU23.** preparations prior to cutting (including checking connections for leaks, setting gas pressures, setting up the material/workpiece, and checking the cleanliness of materials used)
- KU24.** holding methods that are used to aid plasma cutting, and the equipment that can be used
- KU25.** the correct procedure for lighting, cutting and extinguishing the arc
- KU26.** importance of following the correct procedure for lighting, cutting and extinguishing an arc
- KU27.** importance of torch to arc distance in relation to the thickness of materials, types of torches and gases (Torches: air plasma, oxygen injected, dual gas)
- KU28.** factors that impact nozzle life
- KU29.** double arcing and its impact
- KU30.** problems that can occur with plasma cutting, and how they can be avoided (including causes of distortion during plasma cutting and methods of controlling distortion)
- KU31.** effects of oil, grease, scale or dirt on the cutting process
- KU32.** quality parameters for plasma cut materials (Quality parameters: shape and length of the draglines; squareness; angle deviation; the smoothness of the sides; sharpness of the top edges; amount of slag adhering to the metal)
- KU33.** causes of cutting defects, how to recognize them, and methods of correction and prevention
- KU34.** gouging and back gouging principles, methods and procedures
- KU35.** importance of leaving the work area in a safe and clean condition on completion of activities
- KU36.** emergency procedures for electrical and other fires
- KU37.** how to close down the cutting equipment safely and correctly
- KU38.** purging tools and their function

Generic Skills (GS)

User/individual on the job needs to know how to:

Qualification Pack

- GS1.** read and interpret information correctly from various job specification documents, health, and safety instructions, memos, etc. applicable to the job in English and/or local language
- GS2.** fill up appropriate technical forms, process charts, activity logs as per the organizational format in English and/or local language
- GS3.** undertake numerical operations, geometry and calculations/ formulae(including addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages)
- GS4.** use appropriate measuring techniques
- GS5.** use and convert imperial and metric systems of measurements
- GS6.** apply the appropriate degree of accuracy to express numbers
- GS7.** use tolerance in terms of limits of size
- GS8.** check measurements, angles, orientation and slopes
- GS9.** types of reference lines such as tangent lines, datum lines, center lines, and work points
- GS10.** check the square of material using corner-to-corner dimensions and triangulation (3-4-5) method
- GS11.** select and use tools and equipment such as measuring tapes, levels, squares, protractors, and dividers
- GS12.** ability to check dimensions of components
- GS13.** calculate the value of angles in a triangle
- GS14.** convey and share technical information clearly using appropriate language
- GS15.** check and clarify task-related information
- GS16.** liaise with appropriate authorities using the correct protocol
- GS17.** communicate with people in a respectful form and manner in line with organizational protocol
- GS18.** plan, prioritize and sequence work operations as per job requirements
- GS19.** organize and analyze information relevant to work
- GS20.** basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimization of time
- GS21.** exercise restraint while expressing dissent and during conflict situations
- GS22.** avoid and manage distractions to be disciplined at work
- GS23.** manage own time for achieving better results
- GS24.** work in a team in order to achieve better results
- GS25.** identify and clarify work roles within a team
- GS26.** communicate and cooperate with others in the team for better results
- GS27.** seek assistance from fellow team members
- GS28.** identify problems with work planning, procedures, output and behavior, and their implications
- GS29.** prioritize and plan for problem-solving
- GS30.** communicate problems appropriately to others
- GS31.** identify sources of information and support for problem-solving
- GS32.** seek assistance and support from other sources to solve problems
- GS33.** identify effective resolution techniques



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- GS34.** select and apply resolution techniques
- GS35.** seek evidence for problem resolution
- GS36.** undertake and express new ideas and initiatives to others
- GS37.** modify the work plan to overcome unforeseen difficulties or developments that occur as work progresses
- GS38.** participate in improvement procedures including process, quality and internal/external customer/supplier relationships
- GS39.** enhance one's competencies in new and different situations and contexts to achieve more
- GS40.** participate in on-the-job and other learning, training and development interventions and assessments
- GS41.** clarify task-related information with appropriate personnel or technical adviser
- GS42.** seek to improve and modify own work practices
- GS43.** maintain current knowledge of application standards, legislation, codes of practice and product/process developments

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Work safely</i>	2	4	-	-
PC1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines (Safety precautions (general): general workshop safety; fire prevention; general hazards; manual lifting; overhead lifting; surface conditions; stability of surrounding structures, furniture, etc.)	1	2	-	-
PC2. take necessary safety precautions for plasma cutting operations including equipment, processes and checks	1	2	-	-
<i>Prepare for cutting operations</i>	10	28	-	-
PC3. interpret cutting procedure data sheets specifications	1	2	-	-
PC4. check regulators, hoses and check that valves are securely connected and free from leaks and damage	1	2	-	-
PC5. check equipment is calibrated and approved for use	-	2	-	-
PC6. check/fit the correct nozzle to the torch	1	2	-	-
PC7. match correct tips and cups to the torch as per requirement and manufacturers equipment instructions	-	2	-	-
PC8. set the amperage and gas pressure as per metal thickness, metal type, and type of gas (Materials type: mild steel; high alloy steel; stainless steel; aluminum and its alloys; other appropriate metal; Types of gases: Primary Plasma Gas used to create the plasma arc (Nitrogen, Argon, Hydrogen, Compressed air); Secondary Shielding Gas used to protect the cut metals from oxidation (CO ₂ , Compressed Air))	-	2	-	-
PC9. use the correct procedure for lighting, adjusting and extinguishing the arc	1	2	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. use appropriate and safe procedures for handling and storing of gas cylinders	1	2	-	-
PC11. prepare the work area for the cutting activities	1	2	-	-
PC12. obtain the appropriate tools and equipment for the plasma arc cutting operations, and check that they are in a safe and usable condition Equipment: plasma power source; pilot arc ignition system; torch; portable straight line cutters; profile cutting machines; air filter with regulator; burner electrode; compressor; nozzle; electrode holder; contact tube; front cap; gas supply system with gauges; cooling system; earthing clamp; connecting leads and cables	1	2	-	-
PC13. check that the plasma arc cutting equipment is correctly set up for the operations to be performed	-	2	-	-
PC14. carry out correct measurements required using appropriate equipment and methods for planning the cut	1	2	-	-
PC15. mark out the components for the required operations using appropriate tools and techniques where appropriate	1	2	-	-
PC16. perform trial cut to check for cut defect	1	2	-	-
<i>Carry out cutting operations</i>	8	25	-	-
PC17. operate the plasma cutting equipment to produce items/cut shapes to the dimensions and profiles as specified	1	3	-	-
PC18. use the correct angles to cut and the right speed	1	3	-	-
PC19. use various types of plasma arc cutting methods/techniques (Cutting techniques: stand-off, circle cutting, profile cutting, edge, stenting hole, piercing technique)	1	3	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC20. perform various cutting operations correctly (Cutting operations: down-hand straight cuts (freehand), making straight cuts (track-guided), cutting regular shapes, cutting irregular shapes, making angled cuts, cutting chamfers, making radial cuts, gouging/flushing, beveled edge weld preparations, cutting out holes)	1	3	-	-
PC21. produce thermal cuts in various forms of material (Forms: plate, rolled section, pipe/tube, solid bars)	1	3	-	-
PC22. produce cut profiles for various type of materials (Materials type: mild steel; high alloy steel; stainless steel; aluminum and its alloys; other appropriate metal)	1	3	-	-
PC23. produce thermally-cut components which meet specified quality criteria Quality criteria: dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 1mm; angled/radial cuts are within specification requirements; cuts are clean and smooth and free from flutes; no drags	1	3	-	-
PC24. detect and correct defects in cut	1	2	-	-
PC25. leave the work area in a safe and tidy condition on completion of the cutting activities	-	2	-	-
<i>Test for quality</i>	4	6	-	-
PC26. check that the finished components meet the required standard	1	2	-	-
PC27. use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the cut material are to the specification	2	2	-	-
PC28. identify various cutting defects Defects: grooved, fluted or ragged cuts, poor draglines, rounded edges, tightly adhering slag, dross, burr, distortion	1	2	-	-
<i>Deal with contingencies</i>	2	11	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC29. report any difficulties or problems that may arise with the cutting activities, and carry out any agreed actions	1	2	-	-
PC30. detect equipment malfunctions and deal with them appropriately	-	2	-	-
PC31. deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve	1	3	-	-
PC32. shut down and make safe the cutting equipment on completion of the cutting activities or during an emergency	-	2	-	-
PC33. follow standard emergency procedures in case of emergencies	-	2	-	-
NOS Total	26	74	-	-

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National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0207
NOS Name	Manually cut metal materials using plasma arc
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
Occupation	Welding and Cutting
NSQF Level	4
Credits	TBD
Version	1.0
Last Reviewed Date	24/11/2017
Next Review Date	31/03/2022
NSQC Clearance Date	20/07/2015

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CSC/N0209: Manually (semi-automatic) welding joints using the MIG/MAG (GMAW) process

Description

This unit is about performing manual (semi-automatic) operations for metal inert gas welding (MIG)/ metal active gas welding (MAG) also known as gas metal arc welding (GMAW) for welding joints in all positions as per welding procedure specification (WPS).

Scope

This unit/task covers the following:

- Work Safely
- Prepare for welding operations
- Carry out welding operations
- Test for quality
- Post welding activities
- Deal with contingencies

Elements and Performance Criteria

Work safely

To be competent, the user/individual on the job must be able to:

- PC1.** work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
- PC2.** adhere to procedures or systems in place for health and safety, personal protective equipment (PPE) and other relevant safety regulations for MIG/MAG welding operations (Safety precautions: e.g. general workshop safety; fire prevention; general hazards; manual lifting; overhead lifting; shop floor housekeeping including surface conditions; waste disposal; stability of surrounding structures, furniture, etc.)
- PC3.** check the condition of welding leads, gas connection arrangements, earthing arrangements and electrode holder
- PC4.** report any faults or potential hazards to appropriate authority

Prepare for welding operations

To be competent, the user/individual on the job must be able to:

- PC5.** interpret weld procedure data sheets specifications, PQR and WPS (Interpreting WPS: e.g. welding process (ISO codes); parent metal; consumables; pre welding joining preparation (cleaning, edge preparation, assembly, pre-heat); welding parameters; welding positions (EN ISO 6947 PA, PB, PC, PD, PE, PF, PG; ASME IX I-6 G/1-6 F); number and arrangement of runs to fully fill/weld joints; electrode sizes for joint thicknesses; electrode/filler wire; electrical conditions required (direct [D.C..], electrode polarity (positive, negative), welding current and voltage ranges; methods of arc ignition (scratch, high frequency, lift start); shielding gas (type, flow rate, pre-weld gas flow, post-weld gas flow); welding techniques; sequence of welding; control of heat input; interpass/run cleaning/back gouging methods; post welding activities (wiring brushing, removal of excess weld metal where required); post-weld heat treatment; etc.

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- PC6.** select welding machines such as inverters, rectifiers and generators, according to the task
- PC7.** select electrodes according to classification and specifications
- PC8.** prepare the materials and joint in readiness for welding (Material and joint preparation: made rust free; cleaned free from scaling, paint, oil/grease; made dry and free from moisture; edges to be welded prepared as per job requirement - such as flat, square or bevelled; use various machines and techniques for the above (e.g.. chamfering machine, gas and plasma cutting, grinding and stripping, etc.); correctly positioned-positioning: devices and techniques- jigs and fixtures; restraining devices such as clamps and weights/blocks; setting up the joint in the correct position and alignment)
- PC9.** check the condition of, and correctly connect, welding leads/cables, hoses, shielding gas supply and wire feed mechanisms (Welding concepts and mechanisms: rated output (duty cycle); measurement of electrical output and continuity; relationship between wire feed speed control and welding current; power source characteristics (volt/ampere graph, flat characteristic, constant voltage output); function of induction (principle, effect, fixed, stepped, variable control, return; earth; wire feed control (variable speed motor, direct control of wire feed rate); indirect control of welding current; relay for electrical power)
- PC10.** prepare the welding equipment for a range of given applications (Welding equipment: rectifier (diode, thyristor/transistor), inverter, generator; wire feed system; measurement equipment for measuring electrical output and continuity (voltmeter/multi-meter, ammeter/shunts/coils, tong tester); welding cables - wire feed to torch (air cooled, harness construction); welding guns/torches (air cooled, construction, types [push, pull, reel-on-gun] swan neck design, pistol design); nozzles (dip, spray); return clamps (types, clamping mechanisms) and cables; solenoid valves (shielding gas); jog-feed control, gas purge control; ancillary equipment (angle grinders, wire brushes, linishers, hammer, power saw, angle, pedestal and straight grinders, chisel); other tools and equipment such as wrenches, wire cutters and MIG pliers)
- PC11.** select the welding shielding gases and equipment for a range of given applications (Shielding gases: applications for shielding gases/gas mixtures (argon, mixture, helium, argon/helium mixtures, helium/argon mixtures, argon/hydrogen mixtures, nitrogen argon/nitrogen mixtures, CO₂ and CO₂ mixtures); flow rates for applications; identify percentage of purity and mixture with respect to WPS (Welding Procedure Specification)/PQR (Process Qualification Record) Shielding gas equipment: cylinders; manifold systems; regulators (fixed, single stage, two-stage); gas flow meters; gas tubes and connectors; use of solenoid valves)
- PC12.** plan the welding activities before they start them effectively and efficiently for achieving specifications as per WPS
- PC13.** clean wire feeder and torch tip
- PC14.** connect torches and components
- PC15.** connect and adjust regulators and flow meters to cylinders
- PC16.** adjust wire feed rate and read and set current as required
- PC17.** set other welding parameters (e.g.. voltage, slope of current versus voltage curve where required) (Parameters: correct set-up of the joint; proper condition of electrical connections; welding return and earthing arrangements; operating parameters)
- PC18.** choose appropriate mode of metal transfer
- PC19.** set pre-purge with shielding gas as required
- PC20.** set and verify gas flow rates
- PC21.** prepare and support the joint, using the appropriate methods

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PC22. tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding

Carry out welding operations

To be competent, the user/individual on the job must be able to:

PC23. use manual welding and related equipment, to carry out MIG/MAG welding processes

PC24. perform MIG/MAG welding operations using various welding techniques to meet welding procedure specification requirements (Welding techniques: e.g. fine adjustment of parameters, correct manipulation of the torch, blending in stops/starts, tack welds, angle of the torch, setting of individual parameters like wire feed speed, voltage, gas flow rate, stick-out, etc.)

PC25. adjust wire stick-out as per requirement

PC26. use welding consumables appropriate to the material and application to DC current types (Welding consumables: wire electrodes, wires and rods for arc welding; shielding gases; welding spools and drum packs; anti-spatter compound)

PC27. produce joints of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level C of ISO 5817 (Weld quality standards: required parameters for dimensional accuracy; weld finishes are built up to the full section of the weld; joints at stop/start positions merge smoothly; weld surface is; free from cracks, substantially free from porosity, free from any pronounced hump or crater, substantially free from shrinkage cavities, substantially free from trapped slag, substantially free from arcing or chipping marks; fillet welds are: equal in leg length, slightly convex in profile (where applicable, size of the fillet equivalent to the thickness of the material welded; weld contour is; of linear and of uniform profile, smooth and free from excessive undulations, regular and has an even ripple formation; welds are adequately fused, and there is minimal undercut, overlap and surface inclusions; tack welds are blended in to form part of the finished weld, without excessive hump; corner joints have minimal burn through to the underside of the joint or, where appropriate)

PC28. produce joints from various materials in different forms
Types of ferrous metals/materials: carbon steel, stainless steel
Types of forms: sheet (less than 1.5 mm), plate, structural section, pipe/tube, other forms

PC29. weld joints in good access situations, in select positions
Welding positions: flat (PA) 1G/1F, horizontal vertical (PB) 2F, horizontal (PC) 2G, vertical upwards (PF) 3F / 3G, vertical downwards (PG) 3F / 3G, plate to pipe (fixed) 5F

PC30. make sure that the work area is maintained and left in a safe and tidy condition

Test for quality

To be competent, the user/individual on the job must be able to:

PC31. identify various weld defects use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification (Weld defects: lack of continuity of the weld; uneven and irregular ripple formation; excessive spatter; incorrect weld size or profile; burn through; undercutting; overlap; inclusions; distortion; porosity; internal cracks; surface cracks; lack of fusion or incomplete fusion; lack of penetration; excessive penetration; gouges; stray arc strikes; sharp edges; excessive convexity)

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- PC32.** check that the welded joint conforms to the specification, by checking various quality parameters by visual inspection (Quality parameters: dimensional accuracy; alignment/squareness; size and profile of weld; visual defects; NDT/DT tested defects; Visual inspections: use of visual techniques, distance of observation, angle of observation, adequate lighting, low powered magnification, fillet weld gauges)
- PC33.** detect surface imperfections and deal with them appropriately
- PC34.** carry out DPT tests to assess fine defect open to the surface not detected by visual inspection (VT)

Post welding activities

To be competent, the user/individual on the job must be able to:

- PC35.** assist in preparation for non-destructive testing of the welds, for a range of tests (Non-destructive tests (NDT): dye penetrant (DPT), fluorescent penetrant (FPT), magnetic particle (MPT))
- PC36.** prepare for destructive tests on weld specimens for fillet, butt and corner (Destructive tests (DT): macro examination, nick break test, bend tests (such as face, root or side, as appropriate), mechanical (peel, tensile and shear, fatigue, impact tests), chemical)
- PC37.** shut down and make safe the welding equipment on completion of the welding activities
- PC38.** follow the established organisational process for dealing with the welded pieces including handover, storage, safety and security, record keeping, etc.

Deal with contingencies

To be competent, the user/individual on the job must be able to:

- PC39.** detect equipment malfunctions and deal with them safely and as per organisation procedures
- PC40.** deal promptly and effectively with problems within own control, and seek timely and appropriate help and guidance from relevant personnel where required

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** relevant legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions
- KU2.** key purpose of the organization
- KU3.** department structure and hierarchy protocols
- KU4.** work flow and own role in the workflow
- KU5.** dependencies and interdependencies in the workflow
- KU6.** support functions and types of support available for incumbents in this role
- KU7.** types of fire extinguishers and their suitable uses in case of welding related fires
- KU8.** effects of exposure to welding fume and related safety practices

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- KU9.** range of welding equipment available for GMAW welding (Welding equipment: rectifier (diode, thyristor/transistor), inverter, generator; wire feed system; measurement equipment for measuring electrical output and continuity (voltmeter/multi-meter, ammeter/shunts/coils, tong tester); welding cables - wire feed to torch (air cooled, harness construction); welding guns/torches (air cooled, construction, types [push, pull, reel-on-gun] swan neck design, pistol design); nozzles (dip, spray); return clamps (types, clamping mechanisms) and cables; solenoid valves (shielding gas); jog-feed control, gas purge control; ancillary equipment (angle grinders, wire brushes, linishers, hammer, power saw, angle, pedestal and straight grinders, chisel); other tools and equipment such as wrenches, wire cutters and MIG pliers)
- KU10.** functions of welding equipment
- KU11.** principles and techniques of MIG/MAG welding (Welding technique: e.g. fine adjustment of parameters, correct manipulation of the torch, blending in stops/starts, tack welds, angle of the torch, setting of individual parameters like wire feed speed, voltage, gas flow rate, stick-out, etc.)
- KU12.** relationship between wire feed, speed control and welding current
- KU13.** how to compare welding consumables for suitability for a range of given applications (Welding consumables: wire electrodes, wires and rods for arc welding; shielding gases; welding spools and drum packs; anti-spatter compound)
- KU14.** welding consumables classification as applicable to GMAW
- KU15.** safe working practices and procedures to be followed when preparing and using MIG/MAG welding equipment
- KU16.** hazards associated with MIG/MAG welding and safety precautions to minimize risk (Safety precautions (MIG/MAG Welding): protection from live and other electrical components, including insulation, proper earthing, etc.; proper handling and placement of hot metal; taking account of spatter and related safe distance; adequate lighting; appropriate personal protective equipment: suitable aprons, welding gloves, respirators, safety boots, correctly fitting overalls, suitable eye shields/goggles (higher grade of glasses DIN 13); protection of self and others from the effects of the welding arc; fume extraction/control measures; safety measures for working in enclosed spaces)
- KU17.** personal protective equipment to be worn for the welding activities
- KU18.** correct handling and storage of gas cylinders for welding purposes
- KU19.** manual MIG/MAG welding process
- KU20.** type and thickness of base metals for welding purposes
- KU21.** types (availability, typical sizes), storage (storage, identification, segregation (classification, size) of ferrous metals
- KU22.** current and polarity required for GMAW
- KU23.** types, selection and application of filler wires and welding electrodes
- KU24.** reasons for using shielding gases, and the types and application of the various gases (Shielding gases: applications for shielding gases/gas mixtures (argon, mixture, helium, argon/helium mixtures, helium/argon mixtures, argon/hydrogen mixtures, nitrogen argon/nitrogen mixtures, CO₂ and CO₂ mixtures); flow rates for applications; identify percentage of purity and mixture with respect to WPS/PQR)
- KU25.** use, impact and importance of gas pressures and flow rates (in relationship to the type of material being welded) (Types of ferrous metals/materials: carbon steel, stainless steel)
- KU26.** methods/modes of metal transfer and their uses (Methods: globular, short circuit transfer, spray arc, pulse, surface tension transfer (STT))

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- KU27.** types of welded joints to be produced (Types of joints: fillet lap joints, tee fillet joints, corner joints, butt joints: square, single vee, double vee)
- KU28.** terminology used for the appropriate welding positions (Welding positions: flat (PA) IG/1F, horizontal vertical (PB) 2F, horizontal (PC) 2G, vertical upwards (PF) 3F / 3G, vertical downwards (PG) 3F / 3G, plate to pipe (fixed) 5F)
- KU29.** type, components and features of a manual gas shielded arc welding torch (Components of torch: handle; neck; trigger; hose package; shielding gas nozzle; contact tip and tip fixture; insulator; wire guide tube (liner); shielding gas supply lead; welding current supply lead)
- KU30.** how to prepare the materials in readiness for the welding activity
- KU31.** purpose and correct use of anti-spatter compound
- KU32.** importance and procedure to clean torch tip and liner
- KU33.** how to set up and restrain the joint, and the tools and techniques to be used
- KU34.** appropriate tack welding size and spacing (in relationship to material thickness)
- KU35.** checks to be made prior to welding
- KU36.** factors that determine weld bead shape (Factors: gun angles and weld bead profiles (push, perpendicular, drag); electrode extensions stick out (short, normal, long); fillet weld electrode extension stick out (short, normal, long); gun travel speed (slow, normal, fast); current and voltage)
- KU37.** types of weld beads and uses (stringer, weave, weave patterns)
- KU38.** weld bead quality characteristics (Bead characteristics: spatter deposits, roughness, evenness, fill, crater, overlap, contour convex, concave, mitre)
- KU39.** techniques of operating the welding equipment to produce a range of joints in the various joint positions
- KU40.** effects of the electrical characteristics of the MIG/MAG welding arc
- KU41.** how to control distortion (such as welding sequence; deposition technique) (Distortion (causes and control methods)- Causes: improper sequence of weld runs; direction of weld runs; heat input errors; lack of inaccuracy of jigs and fixture; Control Methods: sequence of welding as materials; proper direction; tacking and its frequency (where applicable); use clamping and jigs and fixtures (where applicable))
- KU42.** problems that can occur with the welding activities and how to address them
- KU43.** how to close down the welding equipment safely and correctly
- KU44.** own responsibility to assist in preparation of the welds and weld pieces for examination
- KU45.** how to check the welded joints for uniformity, alignment, position, weld size and profile
- KU46.** gouging and back gouging, its importance, principles, methods and procedures in welding
- KU47.** purpose and importance of pre-heating requirements for base metals in preparation for welding
- KU48.** purpose and importance of post-heating in welding
- KU49.** methods to achieve pre-heat and post heat requirements for welding purposes
- KU50.** tools and methods to measure temperature for pre-heat and post-heat requirements such as thermal chalk, thermocouple, etc.
- KU51.** significance of diffusible hydrogen for welds and how it is measured
- KU52.** procedure to conduct dye penetrant test to assess weld quality

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- KU53.** various procedures for visual examination of the welds for cracks (Visual inspections: use of visual techniques, distance of observation, angle of observation, adequate lighting, low powered magnification, fillet weld gauges)
- KU54.** types of non-destructive and destructive tests for assessing weld quality (Non-destructive tests (NDT): dye penetrant (DPT), fluorescent penetrant (FPT), magnetic particle (MPT) Destructive tests (DT): macro examination, nick break test, bend tests (such as face, root or side, as appropriate), mechanical (peel, tensile and shear, fatigue, impact tests), chemical)
- KU55.** methods of removing a test piece of weld from a suitable position in the joint
- KU56.** safe working practices, handling and procedures to be adopted when (preparing the welds for examination (Handling specimens for tests: handling hot materials; using chemicals for cleaning and etching; using equipment to fracture welds))
- KU57.** importance of leaving the work area and equipment in a safe condition on completion of the welding activities

Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** read and interpret information correctly from various job specification documents, health and safety instructions, memos, etc. applicable to the job in English and/or local language
- GS2.** fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/or local language
- GS3.** undertake numerical operations, geometry and calculations/ formulae (including addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages)
- GS4.** use appropriate measuring techniques
- GS5.** use and convert imperial and metric systems of measurements
- GS6.** apply appropriate degree of accuracy to express numbers (Units and number systems representing degree of accuracy: decimal places, significant figures, fractions as a decimal quantity)
- GS7.** use and understand tolerance in terms of limits of size
- GS8.** check measurements, angles, orientation and slopes
- GS9.** types of reference lines such as tangent lines, data lines, centre lines and work points
- GS10.** check square of material using corner-to-corner dimensions and triangulation (3-4-5) method
- GS11.** select and use tools and equipment such as measuring tapes, levels, squares, protractors and dividers
- GS12.** ability to check dimensions of components
- GS13.** calculate the value of angles in a triangle
- GS14.** convey and share technical information clearly using appropriate language
- GS15.** check and clarify task-related information
- GS16.** liaise with appropriate authorities using correct protocol
- GS17.** communicate with people in respectful form and manner in line with organizational protocol
- GS18.** plan, prioritize and sequence work operations as per job requirements
- GS19.** organize and analyse information relevant to work

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- GS20.** basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimization of time
- GS21.** exercise restraint while expressing dissent and during conflict situations
- GS22.** avoid and manage distractions to be disciplined at work
- GS23.** manage own time for achieving better results
- GS24.** work in a team in order to achieve better results
- GS25.** identify and clarify work roles within a team
- GS26.** communicate and cooperate with others in the team for better results
- GS27.** seek assistance from fellow team members
- GS28.** identify problems with work planning, procedures, output and behaviour and their implications
- GS29.** prioritize and plan for problem solving
- GS30.** communicate problems appropriately to others
- GS31.** identify sources of information and support for problem solving
- GS32.** seek assistance and support from other sources to solve problems
- GS33.** identify effective resolution techniques
- GS34.** select and apply resolution techniques
- GS35.** seek evidence for problem resolution
- GS36.** undertake and express new ideas and initiatives to others
- GS37.** modify work plan to overcome unforeseen difficulties or developments that occur as work progresses
- GS38.** participate in improvement procedures including process, quality and internal/external customer/supplier relationships
- GS39.** enhance ones competencies in new and different situations and contexts to achieve more
- GS40.** participate in on-the-job and other learning, training and development interventions and assessments
- GS41.** clarify task related information with appropriate personnel or technical adviser
- GS42.** seek to improve and modify own work practices
- GS43.** maintain current knowledge of application standards, legislation, codes of practice and product/process developments

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Work safely</i>	1	8	-	-
PC1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines	1	2	-	-
PC2. adhere to procedures or systems in place for health and safety, personal protective equipment (PPE) and other relevant safety regulations for MIG/MAG welding operations (Safety precautions: e.g. general workshop safety; fire prevention; general hazards; manual lifting; overhead lifting; shop floor housekeeping including surface conditions; waste disposal; stability of surrounding structures, furniture, etc.)	-	2	-	-
PC3. check the condition of welding leads, gas connection arrangements, earthing arrangements and electrode holder	-	2	-	-
PC4. report any faults or potential hazards to appropriate authority	-	2	-	-
<i>Prepare for welding operations</i>	10	34	-	-
PC5. interpret weld procedure data sheets specifications, PQR and WPS (Interpreting WPS: e.g. welding process (ISO codes); parent metal; consumables; pre welding joining preparation (cleaning, edge preparation, assembly, pre-heat); welding parameters; welding positions (EN ISO 6947 PA, PB, PC, PD, PE, PF, PG; ASME IX I-6 G/1-6 F); number and arrangement of runs to fully fill/weld joints; electrode sizes for joint thicknesses; electrode/filler wire; electrical conditions required (direct [D.C.], electrode polarity (positive, negative), welding current and voltage ranges; methods of arc ignition (scratch, high frequency, lift start); shielding gas (type, flow rate, pre-weld gas flow, post-weld gas flow); welding techniques; sequence of welding; control of heat input; interpass/run cleaning/back gouging methods; post welding activities (wiring brushing, removal of excess weld metal where required); post-weld heat treatment; etc.	1	2	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC6. select welding machines such as inverters, rectifiers and generators, according to the task	-	2	-	-
PC7. select electrodes according to classification and specifications	1	2	-	-
PC8. prepare the materials and joint in readiness for welding (Material and joint preparation: made rust free; cleaned free from scaling, paint, oil/grease; made dry and free from moisture; edges to be welded prepared as per job requirement - such as flat, square or bevelled; use various machines and techniques for the above (e.g.. chamfering machine, gas and plasma cutting, grinding and stripping, etc.); correctly positioned-positioning: devices and techniques- jigs and fixtures; restraining devices such as clamps and weights/blocks; setting up the joint in the correct position and alignment)	1	1	-	-
PC9. check the condition of, and correctly connect, welding leads/cables, hoses, shielding gas supply and wire feed mechanisms (Welding concepts and mechanisms: rated output (duty cycle); measurement of electrical output and continuity; relationship between wire feed speed control and welding current; power source characteristics (volt/ampere graph, flat characteristic, constant voltage output); function of induction (principle, effect, fixed, stepped, variable control, return; earth; wire feed control (variable speed motor, direct control of wire feed rate); indirect control of welding current; relay for electrical power)	-	2	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. prepare the welding equipment for a range of given applications (Welding equipment: rectifier (diode, thyristor/transistor), inverter, generator; wire feed system; measurement equipment for measuring electrical output and continuity (voltmeter/multi-meter, ammeter/shunts/coils, tong tester); welding cables - wire feed to torch (air cooled, harness construction); welding guns/torches (air cooled, construction, types [push, pull, reel-on-gun] swan neck design, pistol design); nozzles (dip, spray); return clamps (types, clamping mechanisms) and cables; solenoid valves (shielding gas); jog-feed control, gas purge control; ancillary equipment (angle grinders, wire brushes, linishers, hammer, power saw, angle, pedestal and straight grinders, chisel); other tools and equipment such as wrenches, wire cutters and MIG pliers)	-	2	-	-
PC11. select the welding shielding gases and equipment for a range of given applications (Shielding gases: applications for shielding gases/gas mixtures (argon, mixture, helium, argon/helium mixtures, helium/argon mixtures, argon/hydrogen mixtures, nitrogen argon/nitrogen mixtures, CO2 and CO2 mixtures); flow rates for applications; identify percentage of purity and mixture with respect to WPS (Welding Procedure Specification)/PQR (Process Qualification Record) Shielding gas equipment: cylinders; manifold systems; regulators (fixed, single stage, two-stage); gas flow meters; gas tubes and connectors; use of solenoid valves)	1	1	-	-
PC12. plan the welding activities before they start them effectively and efficiently for achieving specifications as per WPS	-	2	-	-
PC13. clean wire feeder and torch tip	-	2	-	-
PC14. connect torches and components	-	2	-	-
PC15. connect and adjust regulators and flow meters to cylinders	1	2	-	-
PC16. adjust wire feed rate and read and set current as required	1	1	-	-

Qualification Pack

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC17. set other welding parameters (e.g.. voltage, slope of current versus voltage curve where required) (Parameters: correct set-up of the joint; proper condition of electrical connections; welding return and earthing arrangements; operating parameters)	1	2	-	-
PC18. choose appropriate mode of metal transfer	1	2	-	-
PC19. set pre-purge with shielding gas as required	-	2	-	-
PC20. set and verify gas flow rates	1	2	-	-
PC21. prepare and support the joint, using the appropriate methods	-	2	-	-
PC22. tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding	1	3	-	-
<i>Carry out welding operations</i>	3	17	-	-
PC23. use manual welding and related equipment, to carry out MIG/MAG welding processes	-	2	-	-
PC24. perform MIG/MAG welding operations using various welding techniques to meet welding procedure specification requirements (Welding techniques: e.g. fine adjustment of parameters, correct manipulation of the torch, blending in stops/starts, tack welds, angle of the torch, setting of individual parameters like wire feed speed, voltage, gas flow rate, stick-out, etc.)	1	2	-	-
PC25. adjust wire stick-out as per requirement	-	2	-	-
PC26. use welding consumables appropriate to the material and application to DC current types (Welding consumables: wire electrodes, wires and rods for arc welding; shielding gases; welding spools and drum packs; anti-spatter compound)	-	3	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC27. produce joints of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level C of ISO 5817 (Weld quality standards: required parameters for dimensional accuracy; weld finishes are built up to the full section of the weld; joins at stop/start positions merge smoothly; weld surface is; free from cracks, substantially free from porosity, free from any pronounced hump or crater, substantially free from shrinkage cavities, substantially free from trapped slag, substantially free from arcing or chipping marks; fillet welds are: equal in leg length, slightly convex in profile (where applicable, size of the fillet equivalent to the thickness of the material welded; weld contour is; of linear and of uniform profile, smooth and free from excessive undulations, regular and has an even ripple formation; welds are adequately fused, and there is minimal undercut, overlap and surface inclusions; tack welds are blended in to form part of the finished weld, without excessive hump; corner joints have minimal burn through to the underside of the joint or, where appropriate)	1	2	-	-
PC28. produce joints from various materials in different formsTypes of ferrous metals/materials: carbon steel, stainless steelTypes of forms: sheet (less than 1.5 mm), plate, structural section, pipe/tube, other forms	-	2	-	-
PC29. weld joints in good access situations, in select positionsWelding positions: flat (PA) 1G/1F, horizontal vertical (PB) 2F, horizontal (PC)2G, vertical upwards (PF) 3F / 3G, vertical downwards (PG) 3F / 3G, plate to pipe (fixed) 5F	-	2	-	-
PC30. make sure that the work area is maintained and left in a safe and tidy condition	1	2	-	-
<i>Test for quality</i>	4	8	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC31. identify various weld defects use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification (Weld defects: lack of continuity of the weld; uneven and irregular ripple formation; excessive spatter; incorrect weld size or profile; burn through; undercutting; overlap; inclusions; distortion; porosity; internal cracks; surface cracks; lack of fusion or incomplete fusion; lack of penetration; excessive penetration; gouges; stray arc strikes; sharp edges; excessive convexity)	1	2	-	-
PC32. check that the welded joint conforms to the specification, by checking various quality parameters by visual inspection (Quality parameters: dimensional accuracy; alignment/squareness; size and profile of weld; visual defects; NDT/DT tested defects; Visual inspections: use of visual techniques, distance of observation, angle of observation, adequate lighting, low powered magnification, fillet weld gauges)	1	2	-	-
PC33. detect surface imperfections and deal with them appropriately	1	2	-	-
PC34. carry out DPT tests to assess fine defect open to the surface not detected by visual inspection (VT)	1	2	-	-
<i>Post welding activities</i>	3	6	-	-
PC35. assist in preparation for non-destructive testing of the welds, for a range of tests (Non-destructive tests (NDT): dye penetrant (DPT), fluorescent penetrant (FPT), magnetic particle (MPT))	-	2	-	-
PC36. prepare for destructive tests on weld specimens for fillet, butt and corner (Destructive tests (DT): macro examination, nick break test, bend tests (such as face, root or side, as appropriate), mechanical (peel, tensile and shear, fatigue, impact tests), chemical)	1	2	-	-
PC37. shut down and make safe the welding equipment on completion of the welding activities	1	1	-	-
PC38. follow the established organisational process for dealing with the welded pieces including handover, storage, safety and security, record keeping, etc.	1	1	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Deal with contingencies</i>	2	4	-	-
PC39. detect equipment malfunctions and deal with them safely and as per organisation procedures	1	2	-	-
PC40. deal promptly and effectively with problems within own control, and seek timely and appropriate help and guidance from relevant personnel where required	1	2	-	-
NOS Total	23	77	-	-



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National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0209
NOS Name	Manually (semi-automatic) welding joints using the MIG/MAG (GMAW) process
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
Occupation	Welding and Cutting
NSQF Level	4
Credits	TBD
Version	1.0
Last Reviewed Date	24/11/2017
Next Review Date	31/03/2022
NSQC Clearance Date	26/03/2015

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CSC/N1335: Use basic health and safety practices at the workplace

Description

This OS unit is about knowledge and practices relating to health, safety and security that candidates need to use in the workplace. It covers responsibilities towards self, others, assets and the environment.

Scope

This unit/task covers the following:

- Health and safety
- Fire safety
- Emergencies, rescue and first-aid procedure

Elements and Performance Criteria

Health and safety

To be competent, the user/individual on the job must be able to:

- PC1.** use protective clothing/equipment for specific tasks and work conditions (Protective clothing: leather or asbestos gloves, flame proof aprons, flame proof overalls buttoned to neck, cuffless (without folds), trousers, reinforced footwear, helmets/hard hats, cap and shoulder covers, ear defenders/plugs, safety boots, knee pads, particle masks, glasses/goggles/visors
Equipment: hand shields, machine guards, residual current devices, shields, dust sheets, respirator)
- PC2.** state the name and location of people responsible for health and safety in the workplace
- PC3.** state the names and location of documents that refer to health and safety in the workplace
- PC4.** identify job-site hazardous work and state possible causes of risk or accident in the workplace (Hazards: sharp edged and heavy tools; heated metals; oxyfuel and gas cylinders; welding radiation; hazardous surfaces(sharp, slippery, uneven, chipped, broken, etc.); hazardous substances(chemicals, gas, oxy-fuel, fumes, dust, etc.); physical hazards(working at heights, large and heavy objects and machines, sharp and piercing objects, tolls and machines, intense light, load noise, obstructions in corridors, by doors, blind turns, noise, over stacked shelves and packages, etc.) electrical hazards (power supply and points, loose and naked cables and wires, electrical machines and appliances, etc.) Possible causes of risk and accident: physical actions; reading; listening to and giving instructions; inattention; sickness and incapacity (such as drunkenness); health hazards (such as untreated injuries and contagious illness))
- PC5.** carry out safe working practices while dealing with hazards to ensure the safety of self and others (Safe working practices: using protective clothing and equipment; putting up and reading safety signs; handle tools in the correct manner and store and maintain them properly; keep work area clear of clutter, spillage and unsafe object lying casually; while working with electricity take all electrical precautions like insulated clothing, adequate equipment insulation, use of control equipment, dry work area, switch off the power supply when not required, etc.; safe lifting and carrying practices; use equipment that is working properly and is well maintained; take due measures for safety while working in confined places, trenches or at heights, etc. including safety harness, fall arrestors, etc.)

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- PC6.** state methods of accident prevention in the work environment of the job role (Methods of accident prevention: training in health and safety procedures; using health and safety procedures; use of equipment and working practices (such as safe carrying procedures); safety notices, advice; instruction from colleagues and supervisors)
- PC7.** state location of general health and safety equipment in the workplace (General health and safety equipment: fire extinguishers; first aid equipment; safety instruments and clothing; safety installations(eg fire exits, exhaust fans))
- PC8.** inspect for faults, set up and safely use steps and ladders in general use (Ladder faults: corrosion of metal components, deterioration, splits and cracks timber components, imbalance, loose rungs, missing/ unfixed nuts or bolts, etc.) (Ladders set up: firm/level base, clip/lash down, leaning at the correct angle, etc.)
- PC9.** work safely in and around trenches, elevated places and confined areas
- PC10.** lift heavy objects safely using correct procedures
- PC11.** apply good housekeeping practices at all times (Good housekeeping practices: clean/tidy work areas, removal/disposal of waste products, protect surfaces)
- PC12.** identify common hazard signs displayed in various areas (Various areas: on chemical containers; equipment; packages; inside buildings; in open areas and public spaces, etc.)
- PC13.** retrieve and/or point out documents that refer to health and safety in the workplace (Documents: fire notices, accident reports, safety instructions for equipment and procedures, company notices and documents, legal documents (eg government notices))

Fire safety

To be competent, the user/individual on the job must be able to:

- PC14.** use the various appropriate fire extinguishers on different types of fires correctly (Types of fires: Class A: eg. ordinary solid combustibles, such as wood, paper, cloth, plastic, charcoal, etc.; Class B: flammable liquids and gases, such as gasoline, propane, diesel fuel, tar, cooking oil, and similar substances; Class C: eg. electrical equipment such as appliances, wiring, breaker panels, etc. (These categories of fires become Class A, B, and D fires when the electrical equipment that initiated the fire is no longer receiving electricity); Class D: combustible metals such as magnesium, titanium, and sodium (These fires burn at extremely high temperatures and require special suppression agents))
- PC15.** demonstrate rescue techniques applied during fire hazard
- PC16.** demonstrate good housekeeping in order to prevent fire hazards
- PC17.** demonstrate the correct use of a fire extinguisher

Emergencies, rescue and first-aid procedures

To be competent, the user/individual on the job must be able to:

- PC18.** demonstrate how to free a person from electrocution
- PC19.** administer appropriate first aid to victims where required eg. in case of bleeding, burns, choking, electric shock, poisoning etc.
- PC20.** demonstrate basic techniques of bandaging
- PC21.** respond promptly and appropriately to an accident situation or medical emergency in real or simulated environments
- PC22.** perform and organize loss minimization or rescue activity during an accident in real or simulated environments
- PC23.** administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock, before the arrival of emergency services in real or simulated cases

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- PC24.** demonstrate the artificial respiration and the CPR Process
- PC25.** participate in emergency procedures (Emergency procedures: raising alarm, safe/efficient, evacuation, correct means of escape, correct assembly point, roll call, correct return to work)
- PC26.** complete a written accident/incident report or dictate a report to another person, and send report to person responsible (Incident Report includes details of: name, date/time of incident, date/time of report, location, environment conditions, persons involved, sequence of events, injuries sustained, damage sustained, actions taken, witnesses, supervisor/manager notified)

Emergencies, rescue and first-aid procedures

To be competent, the user/individual on the job must be able to:

- PC27.** demonstrate correct method to move injured people and others during an emergency

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** names (and job titles if applicable), and where to find, all the people responsible for health and safety in a workplace
- KU2.** names and location of documents that refer to health and safety in the workplace
- KU3.** meaning of hazards and risks
- KU4.** health and safety hazards commonly present in the work environment and related precautions
- KU5.** possible causes of risk, hazard or accident in the workplace and why risk and/or accidents are possible
- KU6.** possible causes of risk and accident (Possible causes of risk and accident: physical actions; reading; listening to and giving instructions; inattention; sickness and incapacity (such as drunkenness); health hazards (such as untreated injuries and contagious illness))
- KU7.** methods of accident prevention (Methods of accident prevention: training in health and safety procedures; using health and safety procedures; use of equipment and working practices (such as safe carrying procedures); safety notices, advice; instruction from colleagues and supervisors)
- KU8.** safe working practices when working with tools and machines
- KU9.** safe working practices while working at various hazardous sites
- KU10.** where to find all the general health and safety equipment in the workplace
- KU11.** various dangers associated with the use of electrical equipment
- KU12.** preventative and remedial actions to be taken in the case of exposure to toxic materials (Exposure: ingested, contact with skin, inhaled); (Preventative action: ventilation, masks, protective clothing/ equipment); (Remedial action: immediate first aid, report to supervisor Toxic materials: solvents, flux, lead)
- KU13.** importance of using protective clothing/equipment while working
- KU14.** precautionary activities to prevent the fire accident
- KU15.** various causes of fire (Causes of fires: heating of metal; spontaneous ignition; sparking; electrical heating; loose fires (smoking, welding, etc.); chemical fires; etc.)
- KU16.** techniques of using the different fire extinguishers
- KU17.** different methods of extinguishing fire

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- KU18.** different materials used for extinguishing fire (Materials: sand, water, foam, CO₂, dry powder)
- KU19.** rescue techniques applied during a fire hazard
- KU20.** various types of safety signs and what they mean
- KU21.** appropriate basic first aid treatment relevant to the condition eg. shock, electrical shock, bleeding, breaks to bones, minor burns, resuscitation, poisoning, eye injuries
- KU22.** content of written accident report
- KU23.** potential injuries and ill health associated with incorrect manual handling
- KU24.** safe lifting and carrying practices
- KU25.** personal safety, health and dignity issues relating to the movement of a person by others
- KU26.** potential impact to a person who is moved incorrectly

Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** read and comprehend basic content to read labels, charts, signages
- GS2.** read and comprehend basic English to read manuals of operations
- GS3.** read an accident/incident report in local language or English
- GS4.** write an accident/incident report in local language or English
- GS5.** question co-workers appropriately in order to clarify instructions and other issues
- GS6.** give clear instructions to coworkers, subordinates others
- GS7.** make appropriate decisions pertaining to the concerned area of work with respect to intended work objective, span of authority, responsibility, laid down procedure and guidelines
- GS8.** plan and organize their own work schedule, work area, tools, equipment and materials to maintain decorum and for improved productivity
- GS9.** remain congenial while discussing and debating issues with co-workers
- GS10.** follow appropriate protocols for communication based on situation, hierarchy, organizational culture and practice
- GS11.** ask for, provide and receive required assistance where possible to ensure achievement of work related objectives
- GS12.** thank co-workers for any assistance received
- GS13.** offer appropriate respect based on mutuality and respect for fellow workmanship and authority
- GS14.** identify immediate or temporary solutions to resolve delays
- GS15.** identify sources of support that can be availed of for problem solving for various kind of problems
- GS16.** seek appropriate assistance from other sources to resolve problems
- GS17.** report problems that you cannot resolve to appropriate authority
- GS18.** identify cause and effect relations in their area of work
- GS19.** use cause and effect relations to anticipate potential problems and their solution

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Health and safety</i>	21	32	-	-
PC1. use protective clothing/equipment for specific tasks and work conditions (Protective clothing: leather or asbestos gloves, flame proof aprons, flame proof overalls buttoned to neck, cuffless (without folds), trousers, reinforced footwear, helmets/hard hats, cap and shoulder covers, ear defenders/plugs, safety boots, knee pads, particle masks, glasses/goggles/visors Equipment: hand shields, machine guards, residual current devices, shields, dust sheets, respirator)	1	3	-	-
PC2. state the name and location of people responsible for health and safety in the workplace	1	2	-	-
PC3. state the names and location of documents that refer to health and safety in the workplace	1	2	-	-
PC4. identify job-site hazardous work and state possible causes of risk or accident in the workplace (Hazards: sharp edged and heavy tools; heated metals; oxyfuel and gas cylinders; welding radiation; hazardous surfaces(sharp, slippery, uneven, chipped, broken, etc.); hazardous substances(chemicals, gas, oxy-fuel, fumes, dust, etc.); physical hazards(working at heights, large and heavy objects and machines, sharp and piercing objects, tools and machines, intense light, load noise, obstructions in corridors, by doors, blind turns, noise, over stacked shelves and packages, etc.) electrical hazards (power supply and points, loose and naked cables and wires, electrical machines and appliances, etc.) Possible causes of risk and accident: physical actions; reading; listening to and giving instructions; inattention; sickness and incapacity (such as drunkenness); health hazards (such as untreated injuries and contagious illness))	2	3	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC5. carry out safe working practices while dealing with hazards to ensure the safety of self and others (Safe working practices: using protective clothing and equipment; putting up and reading safety signs; handle tools in the correct manner and store and maintain them properly; keep work area clear of clutter, spillage and unsafe object lying casually; while working with electricity take all electrical precautions like insulated clothing, adequate equipment insulation, use of control equipment, dry work area, switch off the power supply when not required, etc.; safe lifting and carrying practices; use equipment that is working properly and is well maintained; take due measures for safety while working in confined places, trenches or at heights, etc. including safety harness, fall arrestors, etc.)	2	2	-	-
PC6. state methods of accident prevention in the work environment of the job role (Methods of accident prevention: training in health and safety procedures; using health and safety procedures; use of equipment and working practices (such as safe carrying procedures); safety notices, advice; instruction from colleagues and supervisors)	2	1	-	-
PC7. state location of general health and safety equipment in the workplace (General health and safety equipment: fire extinguishers; first aid equipment; safety instruments and clothing; safety installations(eg fire exits, exhaust fans))	2	3	-	-
PC8. inspect for faults, set up and safely use steps and ladders in general use (Ladder faults: corrosion of metal components, deterioration, splits and cracks timber components, imbalance, loose rungs, missing/unfixed nuts or bolts, etc.) (Ladders set up: firm/level base, clip/lash down, leaning at the correct angle, etc.)	2	3	-	-
PC9. work safely in and around trenches, elevated places and confined areas	2	3	-	-
PC10. lift heavy objects safely using correct procedures	2	2	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. apply good housekeeping practices at all times (Good housekeeping practices: clean/tidy work areas, removal/disposal of waste products, protect surfaces)	2	3	-	-
PC12. identify common hazard signs displayed in various areas (Various areas: on chemical containers; equipment; packages; inside buildings; in open areas and public spaces, etc.)	1	2	-	-
PC13. retrieve and/or point out documents that refer to health and safety in the workplace (Documents: fire notices, accident reports, safety instructions for equipment and procedures, company notices and documents, legal documents (eg government notices))	1	3	-	-
<i>Fire safety</i>	4	10	-	-
PC14. use the various appropriate fire extinguishers on different types of fires correctly (Types of fires: Class A: eg. ordinary solid combustibles, such as wood, paper, cloth, plastic, charcoal, etc.; Class B: flammable liquids and gases, such as gasoline, propane, diesel fuel, tar, cooking oil, and similar substances; Class C: eg. electrical equipment such as appliances, wiring, breaker panels, etc. (These categories of fires become Class A, B, and D fires when the electrical equipment that initiated the fire is no longer receiving electricity); Class D: combustible metals such as magnesium, titanium, and sodium (These fires burn at extremely high temperatures and require special suppression agents))	1	2	-	-
PC15. demonstrate rescue techniques applied during fire hazard	1	2	-	-
PC16. demonstrate good housekeeping in order to prevent fire hazards	1	3	-	-
PC17. demonstrate the correct use of a fire extinguisher	1	3	-	-
<i>Emergencies, rescue and first-aid procedures</i>	9	20	-	-
PC18. demonstrate how to free a person from electrocution	1	3	-	-

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Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC19. administer appropriate first aid to victims where required eg. in case of bleeding, burns, choking, electric shock, poisoning etc.	1	2	-	-
PC20. demonstrate basic techniques of bandaging	1	2	-	-
PC21. respond promptly and appropriately to an accident situation or medical emergency in real or simulated environments	1	2	-	-
PC22. perform and organize loss minimization or rescue activity during an accident in real or simulated environments	1	2	-	-
PC23. administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock, before the arrival of emergency services in real or simulated cases	1	2	-	-
PC24. demonstrate the artificial respiration and the CPR Process	1	2	-	-
PC25. participate in emergency procedures (Emergency procedures: raising alarm, safe/efficient, evacuation, correct means of escape, correct assembly point, roll call, correct return to work)	1	3	-	-
PC26. complete a written accident/incident report or dictate a report to another person, and send report to person responsible (Incident Report includes details of: name, date/time of incident, date/time of report, location, environment conditions, persons involved, sequence of events, injuries sustained, damage sustained, actions taken, witnesses, supervisor/manager notified)	1	2	-	-
<i>Emergencies, rescue and first-aid procedures</i>	2	2	-	-
PC27. demonstrate correct method to move injured people and others during an emergency	2	2	-	-
NOS Total	36	64	-	-

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National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1335
NOS Name	Use basic health and safety practices at the workplace
Sector	Capital Goods
Sub-Sector	Machine Tools, Process Plant Machinery, Dies, Moulds and Press Tools, Electrical and Power Machinery, Plastics Manufacturing Machinery, Light Engineering Goods, Textile Manufacturing Machinery
Occupation	Machining
NSQF Level	3
Credits	TBD
Version	1.0
Last Reviewed Date	24/11/2017
Next Review Date	19/06/2022
NSQC Clearance Date	22/04/2015

CSC/N1336: Work effectively with others

Description

This unit covers basic etiquette and competencies that a candidate is required to possess and demonstrate in their behavior and interactions with others at the workplace. These cover areas such as communication etiquette, discipline, listening etc.

Elements and Performance Criteria

Work effectively with others

To be competent, the user/individual on the job must be able to:

- PC1.** accurately receive information and instructions from the supervisor and fellow workers, getting clarification where required
- PC2.** accurately pass on information to authorized persons who require it and within agreed timescale and confirm its receipt
- PC3.** give information to others clearly, at a pace and in a manner that helps them to understand
- PC4.** display helpful behavior by assisting others in performing tasks in a positive manner, where required and possible
- PC5.** consult with and assist others to maximize effectiveness and efficiency in carrying out tasks
- PC6.** display appropriate communication etiquette while working (Communication etiquette: do not use abusive language; use appropriate titles and terms of respect; do not eat or chew while talking (vice versa) etc.)
- PC7.** display active listening skills while interacting with others at work
- PC8.** use appropriate tone, pitch and language to convey politeness, assertiveness, care and professionalism
- PC9.** demonstrate responsible and disciplined behaviors at the workplace (Disciplined behaviors: e.g. punctuality; completing tasks as per given time and standards; not gossiping and idling time; eliminating waste, honesty, etc.)
- PC10.** escalate grievances and problems to appropriate authority as per procedure to resolve them and avoid conflict

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1.** legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions
- KU2.** reporting structure, inter-dependent functions, lines and procedures in the work area
- KU3.** relevant people and their responsibilities within the work area
- KU4.** escalation matrix and procedures for reporting work and employment related issues
- KU5.** various categories of people that one is required to communicate and coordinate within the organization
- KU6.** importance of effective communication in the workplace

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- KU7.** importance of teamwork in organizational and individual success
- KU8.** various components of effective communication
- KU9.** key elements of active listening
- KU10.** value and importance of active listening and assertive communication
- KU11.** barriers to effective communication
- KU12.** importance of tone and pitch in effective communication
- KU13.** importance of avoiding casual expletives and unpleasant terms while communicating professional circles
- KU14.** how poor communication practices can disturb people, environment and cause problems for the employee, the employer and the customer
- KU15.** importance of ethics for professional success
- KU16.** importance of discipline for professional success
- KU17.** what constitutes disciplined behavior for a working professional
- KU18.** common reasons for interpersonal conflict
- KU19.** importance of developing effective working relationships for professional success
- KU20.** expressing and addressing grievances appropriately and effectively
- KU21.** importance and ways of managing interpersonal conflict effectively

Generic Skills (GS)

User/individual on the job needs to know how to:

- GS1.** read basic terms and terminologies to accurately interpret work-related documents, labels, supervisor instructions in the local language
- GS2.** read and interpret accurate information from various relevant work instructions and records
- GS3.** write clear and legible notes to self, colleagues and seniors to pass messages, keep records, prepare to-do lists, take down instructions
- GS4.** write basic numbers, quantities and work-related terminology for operational requirements in the local language
- GS5.** interact with the supervisor appropriately (correct protocol and manner of speaking) in order to understand the basic requirements of the product, production plans, and other associated requirements
- GS6.** give clear instructions to co-workers about the type of output required and answer queries
- GS7.** display active listening skills while interacting with co-workers and others in the workplace
- GS8.** use appropriate planning to maintain a smooth relationship with fellow team members
- GS9.** take steps within ones limits of authority to initiate modification in plan if the circumstances require it
- GS10.** check that work meets customer requirements
- GS11.** deliver consistent and reliable service to internal and external customers
- GS12.** work with co-workers and supervisor to resolve any issues that threaten disruption, increase risk, cause delays or under-achievement of quality and targets as per the planned schedule

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Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Work effectively with others</i>	30	70	-	-
PC1. accurately receive information and instructions from the supervisor and fellow workers, getting clarification where required	3	7	-	-
PC2. accurately pass on information to authorized persons who require it and within agreed timescale and confirm its receipt	3	7	-	-
PC3. give information to others clearly, at a pace and in a manner that helps them to understand	3	7	-	-
PC4. display helpful behavior by assisting others in performing tasks in a positive manner, where required and possible	3	7	-	-
PC5. consult with and assist others to maximize effectiveness and efficiency in carrying out tasks	3	7	-	-
PC6. display appropriate communication etiquette while working (Communication etiquette: do not use abusive language; use appropriate titles and terms of respect; do not eat or chew while talking (vice versa) etc.)	3	7	-	-
PC7. display active listening skills while interacting with others at work	3	7	-	-
PC8. use appropriate tone, pitch and language to convey politeness, assertiveness, care and professionalism	3	7	-	-
PC9. demonstrate responsible and disciplined behaviors at the workplace (Disciplined behaviors: e.g. punctuality; completing tasks as per given time and standards; not gossiping and idling time; eliminating waste, honesty, etc.)	3	7	-	-
PC10. escalate grievances and problems to appropriate authority as per procedure to resolve them and avoid conflict	3	7	-	-
NOS Total	30	70	-	-

Qualification Pack

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1336
NOS Name	Work effectively with others
Sector	Capital Goods
Sub-Sector	Machine Tools, Dies, Moulds and Press Tools, Plastics Manufacturing Machinery, Textile Manufacturing Machinery, Process Plant Machinery, Electrical and Power Machinery, Light Engineering Goods
Occupation	Machining
NSQF Level	3
Credits	TBD
Version	1.0
Last Reviewed Date	30/09/2021
Next Review Date	30/07/2024
NSQC Clearance Date	30/09/2021

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

1. Criteria for assessment for the Qualification Pack will be created by CGSC.
2. Performance Criteria (PC) have been assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
3. The assessment for the theory part will/may be based on knowledge bank of questions approved CGSC.
4. Assessment will be conducted for all compulsory NOS, and where applicable, on the selected elective/option NOS/set of NOS.
5. Assessment Agencies will create Assessor Guides comprising of Theory and Practical Assessment Set and Guidelines for each examination/training centre (as per assessment criteria below). The same will be approved by CGSC for adequacy.
6. To successfully attain Certification on the Qualification Pack, the trainee must score a minimum of 70% in each Core NOS and minimum of 50% in all non-core NOS. In addition, a candidate needs to attain a minimum overall pass percentage of 70% for certification.

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7. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack.

Minimum Aggregate Passing % at QP Level : 70

(Please note: Every Trainee should score a minimum aggregate passing percentage as specified above, to successfully clear the Qualification Pack assessment.)

Assessment Weightage

Compulsory NOS

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
CSC/N0203.Manually cut metal and metal alloys using oxy-fuel gases	22	78	-	-	100	15
CSC/N0204.Manually weld carbon and low alloy steels in 1G/1F, 2G/2F, 3G/3F welding positions using Metal Arc Welding/ Shielded Metal Arc Welding	28	72	-	-	100	20
CSC/N0207.Manually cut metal materials using plasma arc	26	74	-	-	100	20
CSC/N0209.Manually (semi-automatic) welding joints using the MIG/MAG (GMAW) process	23	77	-	-	100	15
CSC/N1335.Use basic health and safety practices at the workplace	36	64	-	-	100	15
CSC/N1336.Work effectively with others	30	70	-	-	100	15
Total	165	435	-	-	600	100

Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
MIG	Metal Inert Gas
MAG	Metal Active Gas
GMAW	Gas Metal Arc Welding
WPS	Welding Procedure Speciation
NDT	Non-Destructive Testing
DT	Destructive Testing
RT	Radiographic Testing
UT	Ultrasonic Testing
DPT	Dye Penetrant Testing
MPT	Magnetic Particle Testing
FPT	Fluorescent Penetrant Testing
IS	Indian Standards
EN	European Standards
ASME	American Society of Mechanical Engineers
ISO	International Organization for Standardization
D.C.	Direct Current
STT	Surface Tension Transfer
PQR	Process Qualification Record
CO2	Carbon Dioxide
CPR	Cardiac Pulmonary Resuscitation
PPE	Personal Protective Equipment

Qualification Pack

Glossary

Sector	Sector is a conglomeration of different business operations having similar business and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.
Sub-sector	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
Occupation	Occupation is a set of job roles, which perform similar/ related set of functions in an industry.
Job role	Job role defines a unique set of functions that together form a unique employment opportunity in an organisation.
Occupational Standards (OS)	OS specify the standards of performance an individual must achieve when carrying out a function in the workplace, together with the Knowledge and Understanding (KU) they need to meet that standard consistently. Occupational Standards are applicable both in the Indian and global contexts.
Performance Criteria (PC)	Performance Criteria (PC) are statements that together specify the standard of performance required when carrying out a task.
National Occupational Standards (NOS)	NOS are occupational standards which apply uniquely in the Indian context.
Qualifications Pack (QP)	QP comprises the set of OS, together with the educational, training and other criteria required to perform a job role. A QP is assigned a unique qualifications pack code.
Unit Code	Unit code is a unique identifier for an Occupational Standard, which is denoted by an 'N'
Unit Title	Unit title gives a clear overall statement about what the incumbent should be able to do.
Description	Description gives a short summary of the unit content. This would be helpful to anyone searching on a database to verify that this is the appropriate OS they are looking for.
Scope	Scope is a set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on quality of performance required.

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Knowledge and Understanding (KU)	Knowledge and Understanding (KU) are statements which together specify the technical, generic, professional and organisational specific knowledge that an individual needs in order to perform to the required standard.
Organisational Context	Organisational context includes the way the organisation is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
Technical Knowledge	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Core Skills/ Generic Skills (GS)	Core skills or Generic Skills (GS) are a group of skills that are the key to learning and working in today's world. These skills are typically needed in any work environment in today's world. These skills are typically needed in any work environment. In the context of the OS, these include communication related skills that are applicable to most job roles.
Electives	Electives are NOS/set of NOS that are identified by the sector as contributive to specialization in a job role. There may be multiple electives within a QP for each specialized job role. Trainees must select at least one elective for the successful completion of a QP with Electives.
Options	Options are NOS/set of NOS that are identified by the sector as additional skills. There may be multiple options within a QP. It is not mandatory to select any of the options to complete a QP with Options.