

## Qualification Pack



# Senior Manual Metal Arc Welder/ Shielded Metal Arc Welder

*(Optional: Submerged Arc Welder (SAW))*

QP Code: CSC/Q0208

Version: 2.0

NSQF Level: 4

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## Qualification Pack

# CSC/Q0208: Senior Manual Metal Arc Welder/ Shielded Metal Arc Welder

## Brief Job Description

The incumbent in the job is responsible for supervising and performing MMAW/SMAW process to produce various joints on different materials (carbon steel, low alloy steel and austenitic stainless steel) and post-welding activities such as inspection of equipment condition, gauging, testing and inspection of welded work pieces.

**Option 1:** The incumbent in the job is responsible for performing mechanized submerged arc welding (SAW) process for a range of standard welding job requirements and weld different materials (carbon steel, aluminum and stainless steel) in different positions by following welding procedure specification (WPS) and organizational standards.

## Personal Attributes

The job holder must have an eye for detail as well as the patience and discipline required to carry out detailed and repetitive tasks. The candidate should be able to read and understand technical manuals, instructions and warnings.

## Applicable National Occupational Standards (NOS)

### Compulsory NOS:

1. [CSC/N1335: Use basic health and safety practices at the workplace](#)
2. [CSC/N1336: Coordinate with co-workers to achieve work efficiency](#)
3. [CSC/N0208: Supervise and perform Manual Metal Arc Welding \(MMAW\)/ Shielded Metal Arc Welding \(SMAW\)](#)
4. [CSC/N0201: Manually cut metal and metal alloys using oxy-fuel gases](#)
5. [CSC/N0207: Manually cut metal materials using plasma arc](#)

### Optional NOS:

#### Option 1: Submerged Arc Welder (SAW)

6. [CSC/N0211: Weld joints by Submerged Arc Welding process](#)

## Qualification Pack (QP) Parameters

Sector	Capital Goods
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### Qualification Pack

Sub-Sector	<ol style="list-style-type: none"> <li>1. Machine Tools</li> <li>2. Dies, Moulds and Press Tools</li> <li>3. Plastics Manufacturing Machinery</li> <li>4. Textile Manufacturing Machinery</li> <li>5. Process Plant Machinery</li> <li>6. Electrical and Power Machinery</li> <li>7. Light Engineering Goods</li> </ol>
Occupation	Welding and Cutting
Country	India
NSQF Level	4
Aligned to NCO/ISCO/ISIC Code	NCO-2015/7212.0200
Minimum Educational Qualification & Experience	<p>10th Class Pass with 2 years of experience in the relevant field</p> <p>Or</p> <p>10th Class Pass + ITI (welding)</p> <p>Or</p> <p>Shielded Metal Arc Welder NSQF Level 3 with 2 years of experience in the relevant field</p>
Minimum Level of Education for Training in School	
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	
Next Review Date	
Deactivation Date	
NSQC Approval Date	
Version	2.0
Reference code on NQR	
NQR Version	2.0

## Qualification Pack

### CSC/N1335: Follow the health and safety practices at work

#### Description

This OS unit is about following the appropriate health and safety practices at work. It covers responsibilities towards self and others to ensure a safe work environment.

#### Scope

This unit/task covers the following:

- Maintain personal health and safety
- Assist in hazard management
- Check the first aid box, firefighting and safety equipment
- Assist in waste management
- Follow the fire safety guidelines
- Follow the emergency and first-aid procedures
- Carry out relevant documentation and review

#### Elements and Performance Criteria

##### *Maintain personal health and safety*

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

- PC1. follow the recommended practices to ensure protection from infections and transmission to others, such as the use of hand sanitiser and face mask
- PC2. check the work conditions, assess the potential health and safety risks, and take appropriate measures to mitigate them
- PC3. select and use the appropriate Personal Protective Equipment (PPE) relevant to the task and work conditions
- PC4. follow the recommended techniques while lifting and moving heavy objects to avoid injury
- PC5. follow the manufacturer's instructions and workplace safety guidelines while working on heavy machinery, tools and equipment

##### *Assist in hazard management*

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

- PC6. identify existing and potential hazards at work
- PC7. assess the potential risks and injuries associated with the identified hazards
- PC8. coordinate with the supervisor or other relevant personnel to prevent or minimise the identified hazards
- PC9. handle hazardous materials safely and store them in the designated storage

##### *Check the first aid box, firefighting and safety equipment*

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

- PC10. check the first aid box to ensure it is updated with the relevant first aid supplies
- PC11. check and test the firefighting and various safety equipment to ensure they are in usable condition

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PC12. coordinate with the supervisor for the repair and replacement of firefighting and safety equipment

### *Assist in waste management*

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

PC13. segregate waste into appropriate categories

PC14. recycle the recyclable waste appropriately

PC15. dispose of the non-recyclable waste in an environment-friendly manner, complying with the applicable regulations

### *Follow the fire safety guidelines*

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

PC16. use the appropriate type of fire extinguisher to extinguish different types of fires safely

PC17. follow the recommended practices for a safe rescue during a fire emergency

PC18. coordinate with the fire department to request assistance to extinguish a serious fire

### *Follow the emergency and first-aid procedures*

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

PC19. follow the organisational health and safety guidelines during workplace emergencies to ensure own and co-workers' safety

PC20. follow the recommended practices to minimise loss to organisational property during an emergency

PC21. follow the recommended procedure to free a person from electrocution

PC22. administer appropriate first aid to the injured personnel

PC23. perform Cardiopulmonary Resuscitation (CPR) on a potential victim of cardiac arrest

PC24. coordinate with the emergency services to request medical assistance for seriously injured/ ill personnel requiring professional medical attention or hospitalisation

### *Carry out relevant documentation and review*

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

PC25. carry out appropriate documentation following a health and safety incident at work, including all the required information

PC26. coordinate with the relevant personnel to review health and safety conditions at work regularly or following an incident

PC27. assist in implementing appropriate changes to improve the health and safety conditions at work

## Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. the recommended practices to be followed to ensure protection from infections and transmission to others, such as the use of hand sanitiser and face mask

KU2. the importance and process of checking the work conditions, assessing the potential health and safety risks, and take appropriate measures to mitigate them

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- KU3. the importance and process of selecting and using the appropriate PPE relevant to the task and work conditions
- KU4. the recommended techniques to be followed while lifting and moving heavy objects to avoid injury
- KU5. the importance of following the manufacturer's instructions and workplace safety guidelines while working on heavy machinery, tools and equipment
- KU6. the importance and process of identifying existing and potential hazards at work
- KU7. the process of assessing the potential risks and injuries associated with the various hazards
- KU8. how to prevent or minimise different types of hazards
- KU9. how to handle and store hazardous materials safely
- KU10. the importance of ensuring the first aid box is updated with the relevant first aid supplies
- KU11. the process of checking and testing the firefighting and various safety equipment to ensure they are in a usable condition
- KU12. the criteria for segregating waste into appropriate categories
- KU13. the appropriate methods for recycling the recyclable waste
- KU14. the process of disposing of the non-recyclable waste safely and the applicable regulations
- KU15. use of different types of fire extinguishers to extinguish different types of fires
- KU16. the recommended practices to be followed for a safe rescue during a fire emergency
- KU17. how to request assistance from the fire department to extinguish a serious fire
- KU18. the appropriate practices to be followed during workplace emergencies to ensure safety and minimise loss to organisational property
- KU19. common health and safety hazards present in a work environment, associated risks, and how to mitigate them
- KU20. safe working practices to be followed while working at various hazardous sites and using electrical equipment
- KU21. the importance of ensuring easy access to firefighting and safety equipment
- KU22. the appropriate preventative and remedial actions to be taken in the case of exposure to toxic materials, such as poisonous chemicals and gases
- KU23. various causes of fire in different work environments and the recommended precautions to be taken to prevent fire accidents
- KU24. different methods of extinguishing fire
- KU25. different materials used for extinguishing fire, such as sand, water, foam, CO<sub>2</sub>, dry powder, etc.
- KU26. the applicable rescue techniques to be followed during a fire emergency
- KU27. the importance of placing safety signs and instructions at strategic locations in a workplace and following them
- KU28. different types of first aid treatment to be provided for different types of injuries
- KU29. potential injuries associated with incorrect manual handling
- KU30. how to move an injured person safely
- KU31. various hazards associated with the use of various machinery, tools, implements, equipment and materials

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- KU32. the importance of ensuring no obstruction and free access to fire exits
- KU33. how to free a person from electrocution safely
- KU34. how to administer appropriate first aid to an injured person
- KU35. how to perform Cardiopulmonary Resuscitation (CPR)
- KU36. the importance of coordinating with the emergency services to request urgent medical assistance for persons requiring professional medical attention or hospitalisation
- KU37. the appropriate documentation to be carried out following a health and safety incident at work, and the relevant information to be included
- KU38. the importance and process of reviewing the health and safety conditions at work regularly or following an incident
- KU39. the importance and process of implementing appropriate changes to improve the health and safety conditions at work

### Generic Skills (GS)

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

- GS1. maintain work-related notes and records
- GS2. communicate clearly and politely with co-workers and clients
- GS3. read the relevant literature to get the latest updates about the field of work
- GS4. listen attentively to understand the information being shared
- GS5. plan and prioritise tasks to ensure timely completion
- GS6. take quick decisions to deal with workplace emergencies and accidents
- GS7. identify possible disruptions to work and take appropriate preventive measures
- GS8. coordinate with the co-workers to achieve the work objectives
- GS9. evaluate all possible solutions to a problem to select the best one



## Qualification Pack

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Maintain personal health and safety</i>	7	12	-	-
PC1. follow the recommended practices to ensure protection from infections and transmission to others, such as the use of hand sanitiser and face mask	2	3	-	-
PC2. check the work conditions, assess the potential health and safety risks, and take appropriate measures to mitigate them	1	2	-	-
PC3. select and use the appropriate Personal Protective Equipment (PPE) relevant to the task and work conditions	1	2	-	-
PC4. follow the recommended techniques while lifting and moving heavy objects to avoid injury	1	3	-	-
PC5. follow the manufacturer's instructions and workplace safety guidelines while working on heavy machinery, tools and equipment	2	2	-	-
<i>Assist in hazard management</i>	4	10	-	-
PC6. identify existing and potential hazards at work	1	1	-	-
PC7. assess the potential risks and injuries associated with the identified hazards	1	3	-	-
PC8. coordinate with the supervisor or other relevant personnel to prevent or minimise the identified hazards	1	3	-	-
PC9. handle hazardous materials safely and store them in the designated storage	1	3	-	-
<i>Check the first aid box, firefighting and safety equipment</i>	3	7	-	-
PC10. check the first aid box to ensure it is updated with the relevant first aid supplies	1	2	-	-
PC11. check and test the firefighting and various safety equipment to ensure they are in usable condition	1	3	-	-
PC12. coordinate with the supervisor for the repair and replacement of firefighting and safety equipment	1	2	-	-
<i>Assist in waste management</i>	3	8	-	-
PC13. segregate waste into appropriate categories	1	3	-	-

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PC14.recycle the recyclable waste appropriately	1	3	-	-
PC15.dispose of the non-recyclable waste in an environment-friendly manner, complying with the applicable regulations	1	2	-	-
<i>Follow the fire safety guidelines</i>	3	12	-	-
PC16.use the appropriate type of fire extinguisher to extinguish different types of fires safely	1	4	-	-
PC17.follow the recommended practices for a safe rescue during a fire emergency	1	4	-	-
PC18.coordinate with the fire department to request assistance to extinguish a serious fire	1	4	-	-
<i>Follow the emergency and first-aid procedures</i>	7	12	-	-
PC19.follow the organisational health and safety guidelines during workplace emergencies to ensure own and co-workers' safety	1	2	-	-
PC20.follow the recommended practices to minimise loss to organisational property during an emergency	1	3	-	-
PC21.follow the recommended procedure to free a person from electrocution	1	2	-	-
PC22.administer appropriate first aid to the injured personnel	1	2	-	-
PC23.perform Cardiopulmonary Resuscitation (CPR) on a potential victim of cardiac arrest	1	2	-	-
PC24.coordinate with the emergency services to request medical assistance for seriously injured/ ill personnel requiring professional medical attention or hospitalisation	2	1	-	-
<i>Carry out relevant documentation and review</i>	3	9	-	-
PC25.carry out appropriate documentation following a health and safety incident at work, including all the required information	1	3	-	-
PC26.coordinate with the relevant personnel to review health and safety conditions at work regularly or following an incident	1	3	-	-
PC27.assist in implementing appropriate changes to improve the health and safety conditions at work	1	3	-	-
<b>NOS Total</b>	<b>30</b>	<b>70</b>	-	-

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### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1335
NOS Name	Follow the health and safety practices at the work
Sector	Capital Goods
Sub-Sector	Generic
Occupation	Generic
NSQF Level	3
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

## Qualification Pack

### CSC/N1336: Coordinate with co-workers to achieve work efficiency

#### Description

This OS unit is about working in coordination with co-workers to achieve the work objectives efficiently. It also covers practising inclusion at work.

#### Scope

This unit/task covers the following:

- Work effectively with co-workers
- Communicate effectively with co-workers
- Practice inclusion at work

#### Elements and Performance Criteria

##### *Work effectively with co-workers*

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

- PC1. plan daily tasks at work to ensure their timely completion and efficient use of time
- PC2. carry out work responsibilities adhering to the limits of authority
- PC3. follow the supervisor's instructions to ensure adherence to the applicable quality standards and timescales
- PC4. coordinate with the co-workers to achieve the work objectives efficiently
- PC5. prepare the relevant documents and reports as per the supervisor's instructions, providing appropriate information clearly and systematically
- PC6. coordinate with the supervisor or relevant personnel to deal with out of authority tasks and concerns
- PC7. mentor and assist subordinates in the execution of their work responsibilities
- PC8. identify possible disruptions to work through coordination with the relevant stakeholders and take appropriate preventive measures
- PC9. use various resources efficiently to ensure maximum utilisation and minimum wastage
- PC10. follow the recommended practices to avoid and resolve conflicts at work
- PC11. follow the relevant organisational policies to ensure disciplined behaviour with maximum productivity at work

##### *Communicate effectively with co-workers*

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

- PC12. follow the organisational policy for the efficient and timely dissemination of information to the authorised personnel
- PC13. communicate clearly and politely to ensure effective communication with co-workers
- PC14. follow the appropriate techniques for active listening during interactions

##### *Practice inclusion at work*

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

- PC15. empathise with Persons with Disabilities (PwD)

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PC16. adopt gender-neutral behaviour at work

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1. the importance and process of effective communication in the workplace
- KU2. the barriers to effective communication and how to overcome them
- KU3. the importance of teamwork in an organisation's and individual's success
- KU4. the importance of active listening in the work environment
- KU5. the appropriate techniques to be followed for active listening
- KU6. importance of tone and pitch in effective communication
- KU7. importance of avoiding casual expletives and unpleasant terms while communicating professional circles
- KU8. the importance of maintaining discipline and ethical behaviour at work
- KU9. the common reasons for interpersonal conflict and how to resolve them
- KU10. the importance of developing effective working relationships for professional success
- KU11. how expressing and addressing grievances appropriately and effectively
- KU12. the importance and process of planning daily tasks to ensure their timely completion and efficient use of time
- KU13. the importance of adhering to the limits of authority at work
- KU14. the importance of following the applicable quality standards and timescales at work
- KU15. the importance of coordinating with the co-workers to achieve the work objectives efficiently
- KU16. the relevant documentation requirements
- KU17. the importance of providing appropriate information clearly and systematically in work documents
- KU18. the escalation matrix to be followed to deal with out of authority tasks and concerns
- KU19. the importance and process of mentoring and assisting subordinates in the execution of their work responsibilities
- KU20. how to identify possible disruptions to work prevent them
- KU21. how to use various resources efficiently to ensure maximum utilisation and minimum wastage
- KU22. the recommended practices to be followed at work to avoid and resolve conflicts at work
- KU23. the importance and process of efficient and timely dissemination of information to the authorised personnel
- KU24. how to communicate clearly and politely to ensure effective communication
- KU25. the importance of following the recommended practices to ensure an inclusive environment for PwD and all genders at work



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### Generic Skills (GS)

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

- GS1. maintain work-related notes and records
- GS2. read work-related and other relevant literature
- GS3. communicate politely and -professionally
- GS4. listen attentively to understand the information or instructions being shared
- GS5. plan and prioritise tasks to ensure timely completion
- GS6. take prompt decisions to deal with workplace emergencies and accidents
- GS7. evaluate all possible solutions to a problem to select the best one

## Qualification Pack

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Work effectively with co-workers</i>	20	24	-	-
PC1. plan daily tasks at work to ensure their timely completion and efficient use of time	2	4	-	-
PC2. carry out work responsibilities adhering to the limits of authority	2	4	-	-
PC3. follow the supervisor's instructions to ensure adherence to the applicable quality standards and timescales	2	4	-	-
PC4. coordinate with the co-workers to achieve the work objectives efficiently	2	4	-	-
PC5. prepare the relevant documents and reports as per the supervisor's instructions, providing appropriate information clearly and systematically	2	4	-	-
PC6. coordinate with the supervisor or relevant personnel to deal with out of authority tasks and concerns	2	4	-	-
PC7. mentor and assist subordinates in the execution of their work responsibilities	2	4	-	-
PC8. identify possible disruptions to work through coordination with the relevant stakeholders and take appropriate preventive measures	2	4	-	-
PC9. use various resources efficiently to ensure maximum utilisation and minimum wastage	2	4	-	-
PC10. follow the recommended practices to avoid and resolve conflicts at work	1	4	-	-
PC11. follow the relevant organisational policies to ensure disciplined behaviour with maximum productivity at work	1	3	-	-
<i>Communicate effectively with co-workers</i>	6	15	-	-
PC12. follow the organisational policy for the efficient and timely dissemination of information to the authorised personnel	2	5	-	-
PC13. communicate clearly and politely to ensure effective communication with co-workers	2	5	-	-
PC14. follow the appropriate techniques for active listening during interactions	2	5	-	-
<i>Practice inclusion at work</i>	4	12	-	-



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PC15. empathise with Persons with Disabilities (PWD)	2	6	-	-
PC16. adopt gender-neutral behaviour at work	2	6	-	-
<b>NOS Total</b>	<b>30</b>	<b>70</b>	-	-





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### National Occupational Standards (NOS) Parameters

NOS Code	CSC/N1336
NOS Name	Coordinate with co-workers to achieve work efficiency
Sector	Capital Goods
Sub-Sector	Generic
Occupation	Generic
NSQF Level	3
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
Deactivation Date	
NSQC Clearance Date	

## Qualification Pack

# CSC/N0208: Supervise and perform Manual Metal Arc Welding (MMAW)/ Shielded Metal Arc Welding (SMAW)

## Description

This unit is about supervising and performing MMAW/SMAW process and post-welding operations as per the given specifications and standards specified by the organisation.

## Scope

This unit/task covers the following:

- Prepare for welding operations
- Perform MMAW/SMAW operations
- Manage post-welding operations

## Elements and Performance Criteria

### *Prepare for welding operations*

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

- PC1. identify the work to be done and product specifications by interpreting the product drawing, Welding Procedure Specification (WPS) and job orders
- PC2. prepare plan and schedule to meet the production target and give instructions to welders and helpers about the processes required to be performed for achieving the same
- PC3. select the tools, welding machines, measuring instruments, accessories, consumables and input materials (i.e. carbon steel, low alloy steel and austenitic stainless steel) as per the SOP and job requirements
- PC4. ensure that all the tools, welding machines, measuring instruments, accessories, consumables and input materials (carbon steel, low alloy steel and austenitic stainless steel) required for the job are in stock, functioning properly and are available on the shop floor
- PC5. ensure that input materials are as per the requirements and meet required quality standards
- PC6. plan the welding activities before starting the actual process as per WPS
- PC7. guide the welders and helpers in setting of the MMAW machine and its parameters as per the WPS and SOP
- PC8. check that welding apparatus is set for operation, workpieces and fixtures are installed on apparatus and aligned with the electrodes properly as per the job requirements
- PC9. ensure that electrodes distance, contact area, pressure, application etc. are maintained as specified in Work Instructions (WI)
- PC10. verify set up by running test weld on the specimen (scrap plate)
- PC11. obtain clearance from quality control for weld joint before welding

### *Perform MMAW/SMAW operations*

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

- PC12. follow safety precautions during welding work as per SOP and organizational guidelines
- PC13. strike and maintain a stable arc by applying correct technique (i.e. scratch start, tapping techniques) and to avoid welding defects

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- PC14. weld the first component and inspect it for conformance to required specifications by using precision gauges
- PC15. check the output for quality and correct the welding machine settings to meet the required quality output
- PC16. support the welders and helpers in performing MMAW process using appropriate welding techniques as per SOP
- PC17. supervise the welding operations and mass production process of component to ensure delivery as per plan
- PC18. monitor that welders and helpers are producing joints of the specified dimensional accuracy and required weld quality
- PC19. ensure that welding operators and technicians are following the do's and don'ts of the manufacturing process as defined in SOPs/WI
- PC20. ensure the welding process parameters (air pressure, electrode force, electrode distance, gas flow, etc.) are within standards by reading the various gauges and correct them if not within standards
- PC21. support the welders and helpers in comparing the dimensions of the final welded piece as prescribed in the WPS and engineering drawing

#### *Manage post-welding operations*

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

- PC22. conduct random sampling and quality checks on the finished products and report the same to the relevant authorities or take action for its improvement
- PC23. support the welders and helpers in conducting visual inspection, destructive and non-destructive tests on the work pieces
- PC24. ensure that the welders and helpers are segregating and storing the welded components properly by following organisational procedures
- PC25. ensure that the welders and helpers are disposing scrap or waste material in accordance with the company policies and environmental regulations
- PC26. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction
- PC27. prepare and maintain records related to welding and maintenance conducted

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1. relevant legislation, standards, policies, and procedures followed in the organization
- KU2. the basic principle of welding process
- KU3. MMAW welding and its process flow
- KU4. various types of welding joints (i.e. fillet lap joints, tee fillet joints, corner joints, butt joints (square, single, vee, double vee)) and welding positions (i.e. 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)
- KU5. how to read and interpret WPS, welding drawings and symbols
- KU6. welding specific equipment requirements for MMAW/SMAW welding

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**MMAW equipment:** transformers, rectifiers, generators, invertors;

**Consumables** - electrodes, dyes;

**Welding accessories** - holders, cables, welding torch and accessories;

**Ancillary equipment** - power saw, angle, pedestal and straight grinders, tong tester; etc.

KU7. SOP recommended by the manufacturer for using tools, measuring instruments, accessories, MMAW welding machine etc. during the welding process

KU8. main components and controls of welding equipment

KU9. type of current used and implication

KU10. ISO colour codes for welding apparatus such as gas cylinder, hoses, electric cables, etc.

KU11. **joint preparation process:** 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) impact of various welding parameters like voltage, current, gas flow rate, speed, pressure, torch angle, cycle time, electrode distance etc. on the quality and quantity of welding

KU12. various materials used for MMAW and their properties

KU13. SOP recommended by the organisation for operating MMAW machine and its accessories

KU14. use, impact and importance of gas pressures and flow rates in relationship to the type of material being welded and the consumables used

KU15. purpose and importance of pre-heating requirements for base metals

KU16. 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)

KU17. SOP recommended by the organisation for checking irregularities in the product/work piece

KU18. 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 etc.

KU1. 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. how to control distortion (such as welding sequence; deposition technique)

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KU20. various testing techniques like visual, destructive and non-destructive

KU21. safety requirements during the welding work

### Generic Skills (GS)

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

- GS1. read and interpret drawings, work instructions, equipment manuals and process documents
- GS2. communicate the welding process requirements to the supervisor and co-workers
- GS3. attentively listen and comprehend the information given by the supervisor/team members
- GS4. write any work related information in English/regional language
- GS5. recognise a workplace problem and take suitable action
- GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently
- GS7. plan and organize tools, machines and consumables for carrying out welding job
- GS8. complete the assigned tasks with minimum supervision
- GS9. report to the supervisor or deal with a colleague individually, depending on the type of concern

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Prepare for welding operations</i>	12	19	-	8
PC1. identify the work to be done and product specifications by interpreting the product drawing, Welding Procedure Specification (WPS) and job orders	1	2	-	1
PC2. prepare plan and schedule to meet the production target and give instructions to welders and helpers about the processes required to be performed for achieving the	1	3	-	1

### Qualification Pack

same				
PC3. select the tools, welding machines, measuring instruments, accessories, consumables and input materials (i.e. carbon steel, low alloy steel and austenitic stainless steel) as per the SOP and job requirements	3	2	-	2
PC4. ensure that all the tools, welding machines, measuring instruments, accessories, consumables and input materials (carbon steel, low alloy steel and austenitic stainless steel) required for the job are in stock, functioning properly and are available on the shop floor	2	3	-	1
PC5. ensure that input materials are as per the requirements and meet required quality standards	1	1	-	-
PC6. plan the welding activities before starting the actual process as per WPS	1	1	-	-
PC7. guide the welders and helpers in setting of the MMAW machine and its parameters as per the WPS and SOP	1	2	-	1
PC8. check that welding apparatus is set for operation, workpieces and fixtures are installed on apparatus and aligned with the electrodes properly as per the job requirements	1	2	-	1
PC9. ensure that electrodes distance, contact area, pressure, application etc. are maintained as specified in Work Instructions (WI)	1	1	-	1
PC10. verify set up by running test weld on the specimen (scrap plate)	-	1	-	-
PC11. obtain clearance from quality control for weld joint before welding	-	1	-	-
<i>Perform Tungsten Inert Gas (TIG) Welding operations</i>	<b>11</b>	<b>19</b>	-	<b>6</b>
PC12. follow safety precautions during welding work as per SOP and organizational guidelines	-	1	-	-
PC13. strike and maintain a stable arc by applying correct technique (i.e. scratch start, tapping techniques) and to avoid welding defects	1	2	-	-
PC14. weld the first component and inspect it for conformance to required specifications by using precision gauges	2	4	-	2

### Qualification Pack

PC15. check the output for quality and correct the welding machine settings to meet the required quality output	1	2	-	-
PC16. support the welders and helpers in performing MMAW process using appropriate welding techniques as per SOP	2	3	-	1
PC17. supervise the welding operations and mass production process of component to ensure delivery as per plan	1	2	-	1
PC18. monitor that welders and helpers are producing joints of the specified dimensional accuracy and required weld quality	1	2	-	1
PC19. ensure that welding operators and technicians are following the do's and don'ts of the manufacturing process as defined in SOPs/WI	1	-	-	-
PC20. ensure the welding process parameters (air pressure, electrode force, electrode distance, gas flow, etc.) are within standards by reading the various gauges and correct them if not within standards	1	1	-	1
PC21. support the welders and helpers in comparing the dimensions of the final welded piece as prescribed in the WPS and engineering drawing	1	2	-	-
<i>Manage post-welding operations</i>	<b>7</b>	<b>12</b>	-	<b>6</b>
PC22. conduct random sampling and quality checks on the finished products and report the same to the relevant authorities or take action for its improvement	1	2	-	1
PC23. support the welders and helpers in conducting visual inspection, destructive and non-destructive tests on the work pieces	2	5	-	2
PC24. ensure that the welders and helpers are segregating and storing the welded components properly by following organisational procedures	1	2	-	1
PC25. ensure that the welders and helpers are disposing scrap or waste material in accordance with the company policies and environmental regulations	1	1	-	-
PC26. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/ maintenance team for correction	1	1	-	2



### Qualification Pack

PC27.prepare and maintain records related to welding and maintenance conducted	1	1	-	1
NOS Total	30	50	-	20



## Qualification Pack

### National Occupational Standards (NOS) Parameters

<b>NOS Code</b>	CSC/N0208
<b>NOS Name</b>	Supervise and perform Manual Metal Arc Welding (MMAW)/ Shielded Metal Arc Welding (SMAW)
<b>Sector</b>	Capital Goods
<b>Sub-Sector</b>	<ol style="list-style-type: none"> <li>1. Machine Tools</li> <li>2. Dies, Moulds and Press Tools</li> <li>3. Plastics Manufacturing Machinery</li> <li>4. Textile Manufacturing Machinery</li> <li>5. Process Plant Machinery</li> <li>6. Electrical and Power Machinery</li> <li>7. Light Engineering Goods</li> </ol>
<b>Occupation</b>	Welding and Cutting
<b>NSQF Level</b>	4
<b>Credits</b>	TBD
<b>Version</b>	2.0
<b>Last Reviewed Date</b>	
<b>Next Review Date</b>	
<b>NSQC Clearance Date</b>	

## Qualification Pack

# CSC/N0201: Manually cut metal and metal alloys using oxy-fuel gases

## Description

This unit is about performing gas cutting and post-cutting operations as per the given work order and the standards specified by the organization.

## Scope

This unit/task covers the following:

- Prepare for cutting operations
- Perform oxy-gas cutting operations
- Perform post-cutting operations

## Elements and Performance Criteria

### *Prepare for cutting operations*

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

- PC1. identify the cutting work to be done by interpreting the engineering drawing, Welding Procedure Specification (WPS) and job orders
- PC2. identify the tools, cutting torch, machine, measuring instruments, accessories, consumables and input materials (mild carbon steel, high tensile and special steels, other materials) as per the requirements mentioned in WPS or drawing
- PC3. select and arrange the right material, equipment, fixtures, accessories such as regulators, hoses and valve and consumables such as shielding gas etc. as per the SOP and job requirements
- PC4. select the correct type of nozzle, consumables, gases and oxy-gas cutting equipment required for the job by following WPS and drawing
- PC5. check the input material, tools, equipment and accessories for any defects, leakages and that they are as per the required quality standards
- PC6. prepare the work area for cutting activities
- PC7. set the oxy-gas cutting apparatus and its parameters as per the WPS and SOP
- PC8. ensure that a flashback arrestor is fitted with the apparatus
- PC9. use correct technique for lighting, adjusting and extinguishing the arc
- PC10. adjust torch valve for the type of flame such as neutral, carburizing and oxidizing
- PC11. mark the correct measurements on the workpiece by using appropriate tools and measuring instruments as specified in drawing or WPS

### *Perform oxy-gas cutting operations*

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

- PC12. follow safety precautions during cutting work as per SOP and organizational guidelines
- PC13. start the gas cutting machine for cutting operations
- PC14. adjust cylinder valves and regulator for operating pressure to achieve required specifications

### Qualification Pack

- PC15. perform oxy-gas cutting process as per SOP and produce items/cut shapes to the dimensions and profiles specified in WPS and drawing
- PC16. perform various cutting operations correctly and produce thermal cuts in various forms of material (metal of 3mm and above) which meet specified quality criteria i.e. 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
- PC17. recognize and correct burn-back and flashback
- PC18. measure the final workpiece and compare with the dimensions as prescribed in the WPS and engineering drawing
- PC19. shut down the cutting equipment and remove the workpiece after completion of cutting activities

#### *Perform post-cutting operations*

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

- PC20. check the work pieces as per the work instructions for product quality
- PC21. identify defects in the completed workpiece by using appropriate methods and equipment
- PC22. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair
- PC23. clean and store all the tools, machine and equipment after completion of work
- PC24. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction
- PC25. dispose scrap or waste material in accordance with the company policies and environmental regulations
- PC26. report to the supervisor about any problems faced or anticipated during the complete process

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1. relevant legislation, standards, policies, and procedures followed in the organization
- KU2. the basic principle of oxy-gas process and its process flow
- KU3. SOP recommended by the manufacturer for using tools, measuring instruments, accessories, gas cutting apparatus etc. during the cutting process
- KU4. various materials such as mild steel, high tensile/special steel and other appropriate metal and their properties used for gas cutting
- KU5. various forms of material used for cutting are plate, rolled section, pipe/tube, solid bars etc.
- KU6. different cutting gases used in oxy-gas cutting and their selection criteria
- KU7. various cutting operations i.e. 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, Bevelled edge - weld preparations and Cutting out holes
- KU8. ISO colour codes for cutting apparatus such as gas cylinder, hoses, electric cables, etc.
- KU9. impact of various cutting parameters on the quality and quantity of output

### Qualification Pack

- KU10. holding methods that are used to aid thermal cutting
- KU11. types of flames and their implication for cutting
- KU12. various quality check parameters i.e. shape and length of the draglines, smoothness of the sides, sharpness of the top edges and amount of slag adhering to the metal
- KU13. effects of oil, grease, scale or dirt on the cutting process
- KU14. various types of cutting defects such as distortion, grooved, fluted or ragged cuts, poor draglines, rounded edges, tightly adhering slag, etc. and their remedies
- KU15. effects of oil, grease, scale or dirt on the cutting process
- KU16. emergency procedures for backfires, flashback and other fires
- KU17. safety requirements during the cutting work

### Generic Skills (GS)

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

- GS1. read and interpret drawings, work instructions, equipment manuals and process documents
- GS2. communicate the welding process requirements to the supervisor and co-workers
- GS3. attentively listen and comprehend the information given by the supervisor/team members
- GS4. write any work related information in English/regional language
- GS5. recognise a workplace problem and take suitable action
- GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently
- GS7. plan and organize tools, machines and consumables for carrying out welding job
- GS8. complete the assigned tasks with minimum supervision
- GS9. report to the supervisor or deal with a colleague individually, depending on the type of concern

## Qualification Pack

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Prepare for cutting operations</i>	<b>15</b>	<b>21</b>	-	<b>9</b>
PC1. identify the cutting work to be done by interpreting the engineering drawing, Welding Procedure Specification (WPS) and job orders	1	2	-	1
PC2. identify the tools, cutting torch, machine, measuring instruments, accessories, consumables and input materials (mild carbon steel, high tensile and special steels, other materials) as per the requirements mentioned in WPS or drawing	3	2	-	2
PC3. select and arrange the right material, equipment, fixtures, accessories such as regulators, hoses and valve and consumables such as shielding gas etc. as per the SOP and job requirements	2	3	-	1
PC4. select the correct type of nozzle, consumables, gases and oxy-gas cutting equipment required for the job by following WPS and drawing	1	2	-	1
PC5. check the input material, tools, equipment and accessories for any defects, leakages and that they are as per the required quality standards	2	2	-	1
PC6. prepare the work area for cutting activities	1	2	-	-
PC7. set the oxy-gas cutting apparatus and its parameters as per the WPS and SOP	1	2	-	1
PC8. ensure that a flashback arrestor is fitted with the apparatus	1	-	-	1
PC9. use correct technique for lighting, adjusting and extinguishing the arc	1	2	-	1
PC10. adjust torch valve for type of flame such as neutral, carburizing and oxidizing	1	2	-	-
PC11. mark the correct measurements on the workpiece by using appropriate tools and measuring instruments as specified in drawing or WPS	1	2	-	-
<i>Perform oxy-gas cutting operations</i>	<b>9</b>	<b>17</b>	-	<b>6</b>
PC12. follow safety precautions during cutting work as per SOP and organizational guidelines	-	1	-	-
PC13. start the gas cutting machine for cutting operations	1	2	-	1

### Qualification Pack

PC14.adjust cylinder valves and regulator for operating pressure to achieve required specifications	1	2	-	1
PC15.perform oxy-gas cutting process as per SOP and produce items/cut shapes to the dimensions and profiles specified in WPS and drawing	2	4	-	1
PC16.perform various cutting operations correctly and produce thermal cuts in various forms of material (metal of 3mm and above) which meet specified quality criteria i.e. 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	2	4	-	2
PC17.recognize and correct burn-back and flashback	1	1	-	1
PC18.measure the final workpiece and compare with the dimensions as prescribed in the WPS and engineering drawing	1	2	-	-
PC19.shut down the cutting equipment and remove the workpiece after completion of cutting activities	1	1	-	-
<i>Perform post-cutting operations</i>	<b>6</b>	<b>12</b>	-	<b>5</b>
PC20.check the work pieces as per the work instructions for product quality	1	2	-	1
PC21.identify defects in the completed workpiece by using appropriate methods and equipment	2	3	-	1
PC22.separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair	1	1	-	1
PC23.clean and store all the tools, machine and equipment after completion of work	1	2	-	1
PC24.check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/ maintenance team for correction	1	2	-	1
PC25.dispose scrap or waste material in accordance with the company policies and environmental regulations	-	1	-	-
PC26.report to the supervisor about any problems faced or anticipated during the complete process	-	1	-	-
<b>NOS Total</b>	<b>30</b>	<b>50</b>	-	<b>20</b>

## Qualification Pack

### National Occupational Standards (NOS) Parameters

<b>NOS Code</b>	CSC/N0201
<b>NOS Name</b>	Manually cut metal and metal alloys using oxyfuel gas
<b>Sector</b>	Capital Goods
<b>Sub-Sector</b>	<ol style="list-style-type: none"> <li>1. Machine Tools</li> <li>2. Dies, Moulds and Press Tools</li> <li>3. Plastics Manufacturing Machinery</li> <li>4. Textile Manufacturing Machinery</li> <li>5. Process Plant Machinery</li> <li>6. Electrical and Power Machinery</li> <li>7. Light Engineering Goods</li> </ol>
<b>Occupation</b>	Manually cut metal and metal alloys using oxyfuel gas
<b>NSQF Level</b>	2
<b>Credits</b>	TBD
<b>Version</b>	2.0
<b>Last Reviewed Date</b>	
<b>Next Review Date</b>	
<b>NSQC Clearance Date</b>	

## Qualification Pack

### CSC/N0207: Manually cut metal materials using plasma arc

#### Description

This unit is about performing plasma arc cutting and post-cutting operations as per the given work order and the standards specified by the organization.

#### Scope

This unit/task covers the following:

- Prepare for cutting operations
- Perform plasma arc cutting operations
- Perform post-cutting operations

#### Elements and Performance Criteria

##### *Prepare for cutting operations*

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

- PC1. identify the cutting work to be done by interpreting the engineering drawing, Cutting Procedure Specification (CPS) and job orders
- PC2. identify the tools, plasma cutting equipment, measuring instruments, accessories, consumables and input materials (mild steel; high alloy steel; stainless steel; aluminium and its alloys; other appropriate metal) as per the requirements mentioned in WPS or drawing
- PC3. select and arrange the right material, plasma cutting equipment, fixtures, accessories such as cutting guides, regulators, hoses and valve and consumables such as plasma cutting gas etc. as per the SOP and job requirements
- PC4. select the correct type of nozzle, consumables, gases and plasma cutting equipment required for the job by following the WPS and drawing
- PC5. check the input material, tools, equipment and accessories for any defects, leakages and that they are as per the required quality standards
- PC6. prepare the work area for cutting activities
- PC7. set the plasma arc cutting apparatus and its parameters as per the WPS and SOP
- PC8. use the correct procedure for lighting, adjusting and extinguishing the arc
- PC9. mark the correct measurements on the workpiece by using appropriate tools and measuring instruments as specified in drawing or CPS

##### *Perform plasma arc cutting operations*

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

- PC10. follow safety precautions during cutting work as per SOP and organizational guidelines
- PC11. start the plasma cutting machine for cutting operations
- PC12. perform plasma arc cutting process as per SOP and produce items/cut shapes to the dimensions and profiles specified in CPS and drawing
- PC13. perform various cutting operations correctly and produce thermal cuts in various forms of material which meet specified quality criteria i.e. dimensional accuracy is within the



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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

- PC14. ensure correct angles of torch and right speed for cutting during the cutting operations
- PC15. measure the final workpiece and compare with the dimensions as prescribed in the CPS and engineering drawing
- PC16. shut down the cutting equipment and remove the workpiece after completion of cutting activities

#### *Perform post-cutting operations*

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

- PC17. check the work pieces as per the work instructions for product quality
- PC18. identify defects in the completed workpiece by using appropriate methods and equipment
- PC19. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair
- PC20. clean and store all the tools, machine and equipment after completion of work
- PC21. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction
- PC22. dispose scrap or waste material in accordance with the company policies and environmental regulations
- PC23. report to the supervisor about any problems faced or anticipated during the complete process

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1. relevant legislation, standards, policies, and procedures followed in the organization
- KU2. the basic principle of plasma arc cutting process and its process flow
- KU3. SOP recommended by the manufacturer for using tools, measuring instruments, accessories, plasma arc cutting apparatus etc. during the cutting process
- KU4. various materials such as mild steel, high tensile/special steel and other appropriate metal and their properties used for plasma arc cutting
- KU5. various forms of material used for cutting are plate, rolled section, pipe/tube, solid bars etc.
- KU6. 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 (CO<sub>2</sub>, Compressed Air)
- KU7. types of regulators such as low- and high-pressure, and single- and two-stage
- KU8. nozzle type as per type and thickness of base materials
- KU9. importance of torch to arc distance in relation to thickness of materials, types of torches and gases  
**Torches:** air plasma, oxygen injected, dual gas
- KU10. factors that impact nozzle life

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- KU11. cutting techniques: stand-off, circle cutting, profile cutting, edge, stenting hole, piercing technique
- KU12. various cutting operations i.e. 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, Bevelled edge - weld preparations and Cutting out holes
- KU13. ISO colour codes for cutting apparatus such as gas cylinder, hoses, electric cables, etc.
- KU14. impact of various cutting parameters on the quality and quantity of output
- KU15. holding methods that are used to aid thermal cutting
- KU16. various quality check parameters i.e. shape and length of the draglines, smoothness of the sides, sharpness of the top edges and amount of slag adhering to the metal
- KU17. various types of cutting defects such as distortion, grooved, fluted or ragged cuts, poor draglines, rounded edges, tightly adhering slag, etc. and their remedies
- KU18. effects of oil, grease, scale or dirt on the cutting process
- KU19. gouging and back gouging principles, methods and procedures
- KU20. safety requirements during the cutting work

### Generic Skills (GS)

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

- GS1. read and interpret drawings, work instructions, equipment manuals and process documents
- GS2. communicate the welding process requirements to the supervisor and co-workers
- GS3. attentively listen and comprehend the information given by the supervisor/team members
- GS4. write any work related information in English/regional language
- GS5. recognise a workplace problem and take suitable action
- GS6. analyse and apply the information gathered from observation, experience, reasoning or communication to act efficiently
- GS7. plan and organize tools, machines and consumables for carrying out welding job
- GS8. complete the assigned tasks with minimum supervision
- GS9. report to the supervisor or deal with a colleague individually, depending on the type of concern

## Qualification Pack

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Prepare for cutting operations</i>	<b>15</b>	<b>21</b>	-	<b>9</b>
PC1. identify the cutting work to be done by interpreting the engineering drawing, Welding Procedure Specification (WPS) and job orders	1	2	-	1
PC2. identify the tools, plasma cutting equipment, measuring instruments, accessories, consumables and input materials (mild steel; high alloy steel; stainless steel; aluminium and its alloys; other appropriate metal) as per the requirements mentioned in WPS or drawing	4	3	-	2
PC3. select and arrange the right material, plasma cutting equipment, fixtures, accessories such as cutting guides, regulators, hoses and valve and consumables such as plasma cutting gas etc. as per the SOP and job requirements	2	3	-	2
PC4. select the correct type of nozzle, consumables, gases and plasma cutting equipment required for the job by following the WPS and drawing	1	2	-	1
PC5. check the input material, tools, equipment and accessories for any defects, leakages and that they are as per the required quality standards	2	2	-	1
PC6. prepare the work area for cutting activities	1	2	-	-
PC7. set the plasma arc cutting apparatus and its parameters as per the WPS and SOP	2	3	-	1
PC8. use correct technique for lighting, adjusting and extinguishing the arc	1	2	-	1
PC9. mark the correct measurements on the workpiece by using appropriate tools and measuring instruments as specified in drawing or WPS	1	2	-	-
<i>Perform plasma arc cutting operations</i>	<b>9</b>	<b>17</b>	-	<b>6</b>
PC10. follow safety precautions during cutting work as per SOP and organizational guidelines	-	1	-	-
PC11. start the plasma cutting machine for cutting operations	1	2	-	1

### Qualification Pack

PC12. perform plasma arc cutting process as per SOP and produce items/cut shapes to the dimensions and profiles specified in WPS and drawing	2	3	-	1
PC13. perform various cutting operations correctly and produce thermal cuts in various forms of material which meet specified quality criteria i.e. 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	2	4	-	2
PC14. ensure correct angles of torch and right speed for cutting during the cutting operations	2	4	-	2
PC15. measure the final workpiece and compare with the dimensions as prescribed in the WPS and engineering drawing	1	2	-	-
PC16. shut down the cutting equipment and remove the workpiece after completion of cutting activities	1	1	-	-
<i>Perform post-cutting operations</i>	<b>6</b>	<b>12</b>	-	<b>5</b>
PC17. check the work pieces as per the work instructions for product quality	1	2	-	1
PC18. identify defects in the completed workpiece by using appropriate methods and equipment	2	3	-	1
PC19. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair	1	1	-	1
PC20. clean and store all the tools, machine and equipment after completion of work	1	2	-	1
PC21. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction	1	2	-	1
PC22. dispose scrap or waste material in accordance with the company policies and environmental regulations	-	1	-	-
PC23. report to the supervisor about any problems faced or anticipated during the complete process	-	1	-	-
<b>NOS Total</b>	<b>30</b>	<b>50</b>	-	<b>20</b>

## Qualification Pack

### National Occupational Standards (NOS) Parameters

<b>NOS Code</b>	CSC/N0207
<b>NOS Name</b>	Manually cut metal materials using plasma arc
<b>Sector</b>	Capital Goods
<b>Sub-Sector</b>	<ol style="list-style-type: none"> <li>1. Machine Tools</li> <li>2. Dies, Moulds and Press Tools</li> <li>3. Plastics Manufacturing Machinery</li> <li>4. Textile Manufacturing Machinery</li> <li>5. Process Plant Machinery</li> <li>6. Electrical and Power Machinery</li> <li>7. Light Engineering Goods</li> </ol>
<b>Occupation</b>	Welding and Cutting
<b>NSQF Level</b>	4
<b>Credits</b>	TBD
<b>Version</b>	2.0
<b>Last Reviewed Date</b>	
<b>Next Review Date</b>	
<b>NSQC Clearance Date</b>	

## Qualification Pack

# CSC/N0211: Weld joints by Submerged Arc Welding (SAW) process

## Description

This unit is about performing submerged arc welding (SAW) process to produce welding joints on fabricated metal products as per welding procedure specification (WPS).

## Scope

This unit/task covers the following:

- Prepare for welding operations
- Perform welding operations
- Perform post-welding activities

## Elements and Performance Criteria

### *Prepare for welding operations*

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

- PC1. identify the work to be done and product specifications by interpreting the product drawing, Welding Procedure Specification (WPS), Procedure Qualification Record (PQR) and job orders
- PC2. identify the tools, SAW machines, measuring instruments, accessories, consumables and input materials (i.e. carbon steel, aluminum and stainless steel) as per the requirements mentioned in WPS or drawing
- PC3. select and arrange the right material, equipment, fixtures, accessories, welding torch and consumables i.e. wire feed rolls; flux supply and hopper; indicators; wire reel etc. as per the SOP and job requirements
- PC4. check the tools and equipment for any defects and that they are functioning properly
- PC5. ensure that input materials are clean, free from contaminants and ready for use
- PC6. select suitable wire/flux combination and re-dry it at the suitable temperature as per manufacturers guidelines
- PC7. set the SAW machine and its parameters as per the WPS and SOP  
**Welding parameters and mechanisms:** electrical parameters (type, amperage, voltage); welding speed; flux dispensing and recovery mechanisms; safety devices; wire feed rate; electrode stick-out; single pass or multi-pass; mechanical functions (handling, loading, work holding, transfer mode etc.
- PC8. ensure that welding material surface is appropriately prepared with required heat treatment methods
- PC9. verify set up by running test welds specimen

### *Perform welding operations*

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

- PC10. follow safety precautions during welding work as per SOP and organizational guidelines
- PC11. fill the flux in the hopper and direct the nozzle or gravity feed over weld line
- PC12. position the welding line parallel to carriage and turn the control levers or push buttons to align the electrode and the welding head over the weld joint for linear joints

### Qualification Pack

- PC13. adjust length of radial arm to position electrode over weld joint for radial joints
- PC14. clamp cylindrical work pieces onto turning rolls under stationary head for circular joints
- PC15. start the SAW machine for welding operations
- PC16. adjust welding head to set specified angle of electrode
- PC17. perform SAW process in all welding positions on specified materials and forms as per SOP and produce joints and components covering different joint configurations, specified quality, dimensions and profile
- PC18. ensure correct work and travel angles, flow rate, travel speed, current, voltage, and slope, and synchronize feed of wire and electrode extensions as required for the job
- PC19. adjust wire stick-out and machine setup to vary size, location, and penetration of bead
- PC20. monitor the machine operations in accordance with specifications and job instructions
- PC21. monitor the process operation and machine functions, and make adjustments as required to welding parameters and mechanisms within their permitted authority and tolerance
- PC22. remove extra material, slag, spatter etc. by using brush, chipping hammers, hand scraper grinders etc., from the welded component
- PC23. shut down the welding equipment and remove the component after completion of welding activities

#### *Perform post-welding activities*

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

- PC24. check the welded component and ensure that it is meeting the required quality and dimensional accuracy within specified tolerances
- PC25. identify various weld defects by conducting visual inspection, destructive and non-destructive tests on the work pieces
- PC26. re-weld the defective joints, using manual welding equipment
- PC27. store the weldments securely as per requirement by following organizational procedures
- PC28. clean and store all the tools, machine and equipment after completion of work
- PC29. dispose scrap or waste material in accordance with the company policies and environmental regulations
- PC30. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction
- PC31. report to the supervisor about any problems faced or anticipated during the complete process

### Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

- KU1. relevant legislation, standards, policies, and procedures followed in the organization
- KU2. basic principles and fundamentals of mechanized and automated submerged arc welding (SAW)
- KU3. how to extract the necessary information from drawings and welding procedure specifications; welding symbols and abbreviations used
- KU4. effects of dilution on fully fused joints in dissimilar metals
- KU5. key components and features of the equipment used in SAW

## Qualification Pack

**Key components and features:** power source; electrical parameters such as arc voltage, current, wire dispensing and feed mechanisms; flux dispensing and recovery; control and storage of consumables; how variations in the parameters influence weld features, quality and output)

**KU6.** various weld features and appropriate related terminology

**Features:** face, root, HAZ (heat affected zone), convex fillet profile, concave fillet profile, mitred fillet profile, root face, root gap, root radius (U butt profile), land (U butt profile), bevel angle, included angle, weld width, leg length(s), fusion zone (depth of fusion), excess weld metal, penetration, throat thickness, fusion line (boundary)

**KU7.** characteristics of an electric arc used for welding purposes

**Electric arc:** voltage distribution across the arc; heat generation of the weld joint; arc characteristics (alternating current [A.C.], direct current [D.C.]); effects and influence of magnetic fields; factors that influence metal transfer (surface tension, gravity, electromagnet [Lorentz] force)

**KU8.** uses, classification and considerations for usage of consumables such as fluxes and wires

**KU9.** effects of fluxes and electrode coverings/cores upon welding processes

**Effects:** facilitates arc striking; stabilizes the arc; protects filler metal from atmospheric contamination during transfer; protects deposited metal from contamination; provides appropriate weld contour; prevents rapid cooling of weld metal (thermal blanket effect); provides a flux for the molten pool to remove oxides and impurities

**KU10.** importance of speed, voltage and amperage on weld parameters (depth, deposition rate, width)

**KU11.** type and thickness of base metals and its impact on welding operations

**Base metals:** carbon steel and stainless steel

**KU12.** flux preparation methods (e.g.. fused, agglomerated) and its importance (Flux characteristics: basic, acid, neutral)

**KU13.** pre-weld heat, inter-pass and post weld-heat treatment requirements

**KU14.** purpose and importance of pre-heating requirements for base metals

**KU15.** methods such as annealing and tempering to achieve pre-heat and post heat requirements for welding

**KU16.** tools and methods to measure temperature for pre-heat and post-heat requirements such as thermal chalk, thermocouple, etc.

**KU17.** significance of diffusible hydrogen for welds and how it is measured

**KU18.** use and features of SAW equipment such as drive rolls, contact tips and barrels

**KU19.** functions and impact of sub-arc tractors

**KU20.** different welding cable sizes, use and impact

**KU21.** uses of cables and ground clamps

**KU22.** use, features and impact of power sources such as AC and DC

**KU23.** operation of the machine controls and their function

**KU24.** how to set up and align the work piece, and the equipment to be used

**KU25.** how to recognize problems and action to be taken

**KU26.** problems that can occur with the welding activities (distortion, material and weld defects)



### Qualification Pack

- KU27. methods of distortion control and rectification
- KU28. residual stress and its effect on welding
- KU29. how to prepare the welds for examination
- KU30. how to check the welded joints for uniformity, alignment, position, weld size and profile
- KU31. various procedures for visual examination of the welds for cracks
- KU32. types and requirements for non-destructive and destructive tests
  - Non-destructive tests (NDT):** visual inspection, radiographic (RT), ultrasonic (UT);
  - Destructive tests (DT):** sample preparations to perform DT, metallographic, mechanical (tensile, guided bend, charpy, impact), chemical
- KU33. safety requirements during the welding work

### Generic Skills (GS)

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

- GS1. read and interpret drawings, work instructions, equipment manuals and process documents
- GS2. fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/or local language
- GS3. communicate with people in respectful form and manner in line with organizational protocol
- GS4. plan, prioritize and sequence work operations as per job requirements
- GS5. organize and analyse information relevant to work
- GS6. avoid and manage distractions to be disciplined at work
- GS7. manage own time for achieving better results
- GS8. work in a team in order to achieve better results
- GS9. communicate and cooperate with others in the team for better results
- GS10. seek assistance from fellow team members
- GS11. identify problems with work planning, procedures, output and behaviour and their implications
- GS12. prioritize and plan for problem solving
- GS13. communicate problems appropriately to others
- GS14. identify sources of information and support for problem solving
- GS15. identify effective resolution techniques
- GS16. undertake and express new ideas and initiatives to others
- GS17. enhance ones competencies in new and different situations and contexts to achieve more
- GS18. seek to improve and modify own work practices

## Qualification Pack

### Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
<i>Prepare for welding operations</i>	12	17	-	8
PC1. identify the work to be done and product specifications by interpreting the product drawing, Welding Procedure Specification (WPS), Procedure Qualification Record (PQR) and job orders	1	2	-	1
PC2. identify the tools, SAW machines, measuring instruments, accessories, consumables and input materials (i.e. carbon steel, aluminum and stainless steel) as per the requirements mentioned in WPS or drawing	3	2	-	2
PC3. select and arrange the right material, equipment, fixtures, accessories, welding torch and consumables i.e. wire feed rolls; flux supply and hopper; indicators; wire reel etc. as per the SOP and job requirements	1	2	-	1
PC4. check the tools and equipment for any defects and that they are functioning properly	1	2	-	1
PC5. ensure that input materials are clean, free from contaminants and ready for use	1	1	-	-
PC6. select suitable wire/flux combination and re-dry it at the suitable temperature as per manufacturers guidelines	1	2	-	1
PC7. set the SAW machine and its parameters as per the WPS and SOP  <b>Welding parameters and mechanisms:</b> electrical parameters (type, amperage, voltage); welding speed; flux dispensing and recovery mechanisms; safety devices; wire feed rate; electrode stick-out; single pass or multi-pass; mechanical functions (handling, loading, work holding, transfer mode etc.	2	3	-	1
PC8. ensure that welding material surface is appropriately prepared with required heat treatment methods	1	1	-	1
PC9. verify set up by running test welds specimen	1	2	-	-
<i>Perform welding operations</i>	11	20	-	7
PC10. follow safety precautions during welding work as per SOP and organizational guidelines	-	1	-	-

### Qualification Pack

PC11. fill the flux in the hopper and direct the nozzle or gravity feed over weld line	1	2	-	-
PC12. position the welding line parallel to carriage and turn the control levers or push buttons to align the electrode and the welding head over the weld joint for linear joints	1	2	-	1
PC13. adjust length of radial arm to position electrode over weld joint for radial joints or clamp cylindrical work pieces onto turning rolls under stationary head for circular joints	1	1	-	-
PC14. start the SAW machine for welding operations	1	1	-	1
PC15. adjust welding head to set specified angle of electrode	1	1	-	1
PC16. perform SAW process in all welding positions on specified materials and forms as per SOP and produce joints and components covering different joint configurations, specified quality, dimensions and profile	2	4	-	2
PC17. ensure correct work and travel angles, flow rate, travel speed, current, voltage, and slope, and synchronize feed of wire and electrode extensions as required for the job	1	2	-	1
PC18. adjust wire stick-out and machine setup to vary size, location, and penetration of bead	1	2	-	1
PC19. monitor the machine operations in accordance with specifications and job instructions	1	1	-	-
PC20. monitor the process operation and machine functions, and make adjustments as required to welding parameters and mechanisms within their permitted authority and tolerance	1	1	-	-
PC21. remove extra material, slag, spatter etc. by using brush, chipping hammers, hand scraper grinders etc., from the welded component	-	1	-	-
PC22. shut down the welding equipment and remove the component after completion of welding activities	-	1	-	-
<i>Perform post-welding operations</i>	<b>7</b>	<b>13</b>	-	<b>5</b>
PC23. check the welded component and ensure that it is meeting the required quality and dimensional accuracy within specified tolerances	1	2	-	1
PC24. identify various weld defects by conducting visual inspection, destructive and non-destructive tests on the work pieces	2	3	-	2

### Qualification Pack

PC25.re-weld the defective joints, using manual welding equipment	1	2	-	-
PC26.store the weldments securely as per requirement by following organizational procedures	1	1	-	1
PC27.clean and store all the tools, machine and equipment after completion of work	1	2	-	1
PC28.dispose scrap or waste material in accordance with the company policies and environmental regulations	-	1	-	-
PC29.check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction	1	1	-	-
PC30.report to the supervisor about any problems faced or anticipated during the complete process	-	1	-	-
<b>NOS Total</b>	<b>30</b>	<b>50</b>	<b>-</b>	<b>20</b>

## Qualification Pack

### National Occupational Standards (NOS) Parameters

<b>NOS Code</b>	CSC/N0211
<b>NOS Name</b>	Weld joints by Submerged Arc Welding process
<b>Sector</b>	Capital Goods
<b>Sub-Sector</b>	<ol style="list-style-type: none"> <li>1. Machine Tools</li> <li>2. Dies, Moulds and Press Tools</li> <li>3. Plastics Manufacturing Machinery</li> <li>4. Textile Manufacturing Machinery</li> <li>5. Process Plant Machinery</li> <li>6. Electrical and Power Machinery</li> <li>7. Light Engineering Goods</li> </ol>
<b>Occupation</b>	Welding and Cutting
<b>NSQF Level</b>	4
<b>Credits</b>	TBD
<b>Version</b>	2.0
<b>Last Reviewed Date</b>	
<b>Next Review Date</b>	
<b>NSQC Clearance Date</b>	

## Qualification Pack

### 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.
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/N1335. Use basic health and safety practices at the workplace	30	70	-	-	100	15
CSC/N1336. Coordinate with co-workers to achieve work efficiency	30	70	-	-	100	15
CSC/N0208: Supervise and perform Manual Metal Arc Welding (MMAW)/ Shielded Metal Arc Welding (SMAW)	30	50	-	20	100	35

### Qualification Pack

CSC/N0201. Manually cut metal and metal alloys using oxy-fuel gases	30	50	-	20	100	15
CSC/N0207. Manually cut metal materials using plasma arc	30	50	-	20	100	20
<b>Option 1:</b> CSC/N0211. Weld joints by Submerged Arc Welding process	30	50	-	20	100	25
<b>Total</b>	<b>180</b>	<b>340</b>	<b>-</b>	<b>80</b>	<b>600</b>	<b>125</b>

## Qualification Pack

### Acronyms

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
MMAW	Manual Metal Arc Welding
SMAW	Shielded Metal Arc Welding
WPS	Welding Procedure Speciation
IS	Indian Standards
EN	European Standards
ASME	American Society Of Mechanical Engineers
AC / DC	Alternating Current / Direct Current
VT	Visual Testing
NDT	Non-Destructive Testing
DT	Destructive Testing
RT	Radiographic Testing
UT	Ultrasonic Testing
DPT	Dye Penetration Testing
MPT	Magnetic Particle Testing
FPT	Fluorescent Penetrant Testing
CO <sub>2</sub>	Carbon Dioxide
CPR	Cardiac Pulmonary Resuscitation
ISO	International Organization For Standardization
PQR	Process Qualification Record



## Qualification Pack

### Glossary

<b>Sector</b>	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.
<b>Sub-sector</b>	Sub-sector is derived from a further breakdown based on the characteristics and interests of its components.
<b>Occupation</b>	Occupation is a set of job roles, which perform similar/ related set of functions in an industry.
<b>Job role</b>	Job role defines a unique set of functions that together form a unique employment opportunity in an organisation.
<b>Occupational Standards (OS)</b>	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.
<b>Performance Criteria (PC)</b>	Performance Criteria (PC) are statements that together specify the standard of performance required when carrying out a task.
<b>National Occupational Standards (NOS)</b>	NOS are occupational standards which apply uniquely in the Indian context.
<b>Qualifications Pack (QP)</b>	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.
<b>Unit Code</b>	Unit code is a unique identifier for an Occupational Standard, which is denoted by an 'N'
<b>Unit Title</b>	Unit title gives a clear overall statement about what the incumbent should be able to do.
<b>Description</b>	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.
<b>Scope</b>	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.

## Qualification Pack

<b>Knowledge and Understanding (KU)</b>	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.
<b>Organisational Context</b>	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.
<b>Technical Knowledge</b>	Technical knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
<b>Core Skills/ Generic Skills (GS)</b>	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.
<b>Electives</b>	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.
<b>Options</b>	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.