सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

Qualification Pack

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

(Optional: Flux cored Arc Welder (Semi-Automatic))

QP Code: CSC/Q0209

Version: 2.0

NSQF Level: 4

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Contents

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

Brief Job Description

The incumbent in the job is responsible for performing metal inert gas/metal active gas welding (MIG/MAG) for welding joints as per welding procedure specification (WPS). The incumbent is also responsible for performing Oxy gas cutting and plasma cutting to cut metal into required specification as per welding procedure specification (WPS).

Option 1: The incumbent in the job is responsible for performing semi-automatic flux cored arc welding process for a range of standard welding job requirements and weld different materials from a selection of (carbon steel and stainless steel) in various positions as per welding procedure specification (WPS).

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/N0209: Manually weld metals by using MIG/MAG welding
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: Flux cored Arc Welder (Semi-automatic)

6. CSC/N0205: Perform semi-automatic flux cored arc welding process to prepare joints

Qualification Pack (QP) Parameters

Sector	Capital Goods

Sub-Sector	1. Machine Tools 2. Dies, Moulds and Press Tools 3. Plastics Manufacturing Machinery 4. Textile Manufacturing Machinery 5. Process Plant Machinery 6. Electrical and Power Machinery 7. Light Engineering Goods
Occupation	Welding and Cutting
Country	India
NSQF Level	4
Aligned to NCO/ISCO/ISIC Code	NCO-2015/7212.0303
Minimum Educational Qualification & Experience	10th Class Pass with 2 years of experience in the relevant field Or 10th Class Pass + ITI (welding) Or 12th Pass with 6 Months of experience in the relevant field Or Shielded Metal Arc Welder NSQF Level 3 with 2 years of experience in the relevant field
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

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

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

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, CO2, 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

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

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Maintain personal health and safety	**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	-	-
Assist in hazard management	**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	-	-
Check the first aid box, firefighting and safety equipment	**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	-	-
Assist in waste management	**3**	**8**	**-**	**-**
PC13. segregate waste into appropriate categories	1	3	-	-

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	-	-
Follow the fire safety guidelines	**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	-	-
Follow the emergency and first-aid procedures	**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	-	-
Carry out relevant documentation and review	**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	-	-
NOS Total	**30**	**70**	**-**	**-**

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	

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)

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

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

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Work effectively with co-workers	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	-	-
Communicate effectively with co-workers	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	-	-
Practice inclusion at work	4	12	-	-

PC15. empathise with Persons with Disabilities (PwD)	2	6	-	-
PC16. adopt gender-neutral behaviour at work	2	6	-	-
NOS Total	**30**	**70**	**-**	**-**

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	

CSC/N0209: Manually weld metals by using MIG/MAG welding

Description

This unit is about performing MIG/MAG welding for producing various types of joints on metal and metal alloys as per the given specifications and standards specified by the organisation.

Scope

The scope covers the following :

- Prepare for welding operations
- Perform MIG/MAG welding operations
- Perform 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. identify the tools, MIG welding machines, measuring instruments, accessories, consumables and input materials (i.e. ferrous metals/materials: carbon steel, stainless steel etc.) 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. electrode, filler wire, shielding gas etc. as per the SOP and job requirements

PC4. check the input material, tools and equipment for any defects and that they are as per the required quality standards

PC5. prepare the work area for welding activities

PC6. prepare the materials (i.e. sheet (less than 1.5 mm), plate, structural section, pipe/tube, other forms) and joint for welding process

PC7. clean wire feeder and torch tip

PC8. set the MIG welding machine and its parameters i.e. wire feed rate, amperage, gas flow rate etc. as per the WPS and SOP

PC9. connect and adjust regulators and flow meters to cylinders

PC10. choose appropriate mode of metal transfer

PC11. set pre-purge with shielding gas as required

PC12. install the work pieces and fixture on the apparatus and align them with the electrodes as per the job requirements

PC13. verify set up by running test weld on the specimen (scrap plate)

Perform MIG/MAG welding operations

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

PC14. follow safety precautions during welding work as per SOP and organizational guidelines

PC15. start the MIG welding machine for welding operations

PC16. perform MIG welding process in all welding positions as per SOP and tack weld the joint at appropriate intervals to produce joints of the specified quality, dimensions and profile

PC17. adjust wire stick-out as per requirement

PC18. produce joints of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level C of ISO 5817

PC19. ensure correct angle of torch, travel speed, direction of weld and feed during the welding operation

PC20. monitor 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. measure the final welded piece and compare with the dimensions as prescribed in the WPS and engineering drawing

PC22. remove extra material, slag etc. by using brush, chipping hammers, grinders etc., from the welded piece

PC23. shut down the welding equipment and remove the workpiece after completion of welding activities

Perform post-welding operations

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

PC24. check the work pieces as per the work instructions for product quality

PC25. identify various weld defects by conducting visual inspection, destructive and non-destructive tests on the work pieces

PC26. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair

PC27. clean and store all the tools, machine and equipment after completion of work

PC28. dispose scrap or waste material in accordance with the company policies and environmental regulations

PC29. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction

PC30. 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. MIG welding and its process flow

KU3. various types of welding joints i.e. fillet lap joints, tee fillet joints, corner joints, butt joints (square, single, vee, double vee)

KU4. various 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 MIG/MAG welding

MIG 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

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

KU10. 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)

KU11. 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. relationship between wire feed, speed control and welding current

KU13. MIG/MAG 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. various materials used for MMAW welding and their properties

KU14. SOP recommended by the organisation for operating MIG welding machine and its accessories

KU15. current and polarity required for GMAW

KU16. types, selection and application of filler wires and welding electrodes

KU17. 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

KU18. 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

KU19. methods/modes of metal transfer and their uses

Methods: globular, short circuit transfer, spray arc, pulse, surface tension transfer (STT)

KU20. purpose and correct use of anti-spatter compound

KU21. importance and procedure to clean torch tip and liner

KU22. 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

KU23. types of beads, characteristics and uses (stringer, weave, weave patterns)

Bead characteristics: spatter deposits, roughness, evenness, fill, crater, overlap

KU24. weld bead quality characteristics

Bead characteristics: spatter deposits, roughness, evenness, fill, crater, overlap, contour – convex, concave, mitre

KU25. SOP recommended by the organisation for checking irregularities in the product/work piece

KU26. 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; 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 formations); welds are adequately fused, and there is minimal undercut, overlap and surface inclusions etc.

KU27. various defects associated with the MIG welding process

KU28. how to control distortion (such as welding sequence; deposition technique)

KU29. various testing techniques like visual, destructive and non-destructive

KU30. 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 for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Prepare for welding operations	15	21	-	7
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. identify the tools, MIG welding machines, measuring instruments, accessories, consumables and input materials (i.e. ferrous metals/materials: carbon steel, stainless steel etc.) as per the requirements mentioned in WPS or drawing	3	2	-	1
PC3. select and arrange the right material, equipment, fixtures, accessories, welding torch and consumables i.e. electrode, filler wire, shielding gas etc. as per the SOP and job requirements	2	3	-	1
PC4. check the input material, tools and equipment for any defects and that they are as per the required quality standards	2	3	-	1
PC5. prepare the work area for welding activities	1	1	-	-
PC6. prepare the materials (i.e. sheet (less than 1.5 mm), plate, structural section, pipe/tube, other forms) and joint for welding process	1	1	-	1
PC7. clean wire feeder and torch tip	-	1	-	-
PC8. set the MIG welding machine and its parameters i.e. wire feed rate, amperage, gas flow rate etc. as per the WPS and SOP	1	2	-	1
PC9. connect and adjust regulators and flow meters to cylinders	1	1	-	-
PC10. choose appropriate mode of metal transfer	1	1	-	-
PC11. set pre-purge with shielding gas as required	1	1	-	1
PC12. install the work pieces and fixture on the apparatus and align them with the electrodes as per the job requirements	1	2	-	-
PC13. verify set up by running test weld on the	-	1	-	-

specimen (scrap plate)				
MIG/MAG Welding operations	**8**	**17**	**-**	**8**
PC14. follow safety precautions during welding work as per SOP and organizational guidelines	-	1	-	-
PC15. start the MIG welding machine for welding operations	1	2	-	-
PC16. perform MIG welding process in all welding positions as per SOP and tack weld the joint at appropriate intervals to produce joints of the specified quality, dimensions and profile	2	4	-	2
PC17. adjust wire stick-out as per requirement	1	1	-	1
PC18. produce joints of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level C of ISO 5817	1	4	-	2
PC19. ensure correct angle of torch, travel speed, direction of weld and feed during the welding operation	1	1	-	1
PC20. monitor 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. measure the final welded piece and compare with the dimensions as prescribed in the WPS and engineering drawing	1	1	-	1
PC22. remove extra material, slag etc. by using brush, chipping hammers, grinders etc., from the welded piece	-	1	-	-
PC23. shut down the welding equipment and remove the workpiece after completion of welding activities	-	1	-	-
Perform post-welding operations	**7**	**12**	**-**	**5**
PC24. check the work pieces as per the work instructions for product quality	1	2	-	1
PC25. identify various weld defects by conducting visual inspection, destructive and non-destructive tests on the work pieces	2	3	-	2
PC26. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair	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	1	-	-
PC29. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction	1	2	-	-
PC30. report to the supervisor about any problems faced or anticipated during the complete process	-	1	-	-
NOS Total	**30**	**50**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0209
NOS Name	Manually weld metals by using MIG/MAG welding
Sector	Capital Goods
Sub-Sector	1. Machine Tools 2. Dies, Moulds and Press Tools 3. Plastics Manufacturing Machinery 4. Textile Manufacturing Machinery 5. Process Plant Machinery 6. Electrical and Power Machinery 7. Light Engineering Goods
Occupation	Welding and Cutting
NSQF Level	4
Credits	TBD
Version	2.0
Last Reviewed Date	NA
Next Review Date	NA
NSQC Clearance Date	

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

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

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

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Prepare for cutting operations	**15**	**21**	**-**	**9**
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	-	-
Perform oxy-gas cutting operations	**9**	**17**	**-**	**6**
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

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	-	-
Perform post-cutting operations	**6**	**12**	-	**5**
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	-	-
NOS Total	**30**	**50**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0201
NOS Name	Manually cut metal and metal alloys using oxyfuel gas
Sector	Capital Goods
Sub-Sector	1. Machine Tools 2. Dies, Moulds and Press Tools 3. Plastics Manufacturing Machinery 4. Textile Manufacturing Machinery 5. Process Plant Machinery 6. Electrical and Power Machinery 7. Light Engineering Goods
Occupation	Manually cut metal and metal alloys using oxyfuel gas
NSQF Level	2
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
NSQC Clearance Date	

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

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_2, 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, duel gas

KU10. factors that impact nozzle life

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

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Prepare for cutting operations	**15**	**21**	**-**	**9**
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	-	-
Perform plasma arc cutting operations	**9**	**17**	**-**	**6**
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

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	-	-
Perform post-cutting operations	**6**	**12**	-	**5**
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	-	-
NOS Total	**30**	**50**	-	**20**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0207
NOS Name	Manually cut metal materials using plasma arc
Sector	Capital Goods
Sub-Sector	1. Machine Tools 2. Dies, Moulds and Press Tools 3. Plastics Manufacturing Machinery 4. Textile Manufacturing Machinery 5. Process Plant Machinery 6. Electrical and Power Machinery 7. Light Engineering Goods
Occupation	Welding and Cutting
NSQF Level	4
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
NSQC Clearance Date	

CSC/N0205: Perform semi-automatic flux cored arc welding (FCAW) process to prepare joints

Description

This unit is about performing of semi-automatic flux cored arc welding process for producing various welding joints and meeting standard welding job requirements 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, FCAW welding machines, measuring instruments, accessories, consumables and input materials (i.e. carbon steel, stainlesssteel, alloy steels, hard facing alloys etc.) 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. electrode, shielding gas etc. as per the SOP and job requirements

PC4. check the input material, tools and equipment for any defects and that they are as per the required quality standards

PC5. plan the welding activities effectively and efficiently for achieving specifications as per WPS

PC6. prepare the materials (sheet (less than 3 mm), plate, structural section, pipe/tube, other forms) and joint for welding as per job requirement (e.g.. as flat, square or bevelled)

PC7. check the joint for accuracy before starting welding process

PC8. clean wire feeder and torch tip using correct procedures

PC9. set the FCAW welding machine and its parameters i.e. wire feed rate, amperage, gas flow rate etc. as per the WPS and SOP

PC10. connect cables and ground clamps to power source, torch and its components, welding leads/cables, hoses, shielding gas supply and wire feed mechanisms by following SOP

PC11. connect and adjust regulators and flow meters to cylinders correctly

PC12. set pre-purge with shielding gas as required

PC13. install the work pieces and fixture on the apparatus and align them with the electrodes as per the job requirements

PC14. verify that heat treatment has been done appropriately as per requirement

Perform welding operations

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

PC15. follow safety precautions during welding work as per SOP and organizational guidelines

PC16. ensure that supplies of components and consumables are adequate and correctly prepared before starting welding work

PC17. start the FCAW welding machine for welding operations

PC18. perform FCAW welding process in all welding positions as per SOP and weld the joint at appropriate intervals to produce joints of the specified quality, dimensions and profile

PC19. ensure correct work and travel angles, flow rate, travel speed and electrode extensions as required for the job

PC20. adjust wire stick-out as per requirement

PC21. produce joints and components of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level C of ISO 5817

PC22. monitor the welding process and 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

PC23. measure the final welded component and compare with the dimensions as prescribed in the WPS and engineering drawing

PC24. remove extra material, slag etc. by using brush, chipping hammers, grinders etc., from the welded component

PC25. 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:

PC26. check the work pieces for product quality, all dimensional and geometrical aspects of the weld by following work instructions

PC27. identify various weld defects by conducting visual inspection, destructive and non-destructive tests on the work pieces

PC28. detect surface imperfections and deal with them appropriately

PC29. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair

PC30. clean and store all the tools, machine and equipment after completion of work

PC31. dispose scrap or waste material in accordance with the company policies and environmental regulations

PC32. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/maintenance team for correction

PC33. 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 FCAW welding including fusion welding

KU3. FCAW 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)

KU5. various 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

KU6. how to read and interpret WPS, PQR, welding drawings and symbols

KU7. hazards associated with FCAW welding machines and how they can be minimized including use of PPE

KU8. tools and FCAW apparatus required during welding process

FCAW 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 pliers

KU9. difference in self-shielded and gas shielded FCAW equipment and consumables

KU10. SOP recommended by the manufacturer for using tools, measuring instruments, accessories, FCAW welding machine etc. during the welding process

KU11. selection criteria of welding torch and consumable depending on whether self-shielded or gas shielded FCAW

KU12. types of weld beads and uses (stringer, weave, weave patterns)

KU13. weld bead quality characteristic

Characteristics: spatter deposits, roughness, evenness, fill, crater, overlap, contour convex, concave, mitre

KU14. designation types of flux wires and their appropriate use in FCAW

KU15. procedures and techniques used to deposit a weld bead using FCAW welding equipment

KU16. 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; thickness of material

KU17. electrode extension and appropriate travel speed and angle for the weld job

KU18. how to control gas flow rates and its importance in FCAW welding

KU19. uses, classification and considerations for usage of consumables such as filler wires and shielding gases

KU20. correct procedures to store consumables used for FCAW

KU21. use, features and impact of power sources (DC) in FCAW welding

KU22. how to set up and align the work piece, and the equipment to be used

KU23. methods used to set up and restrain the joint to achieve correct location of components and control of distortion

KU24. importance of checking equipment calibration and procedure to deal with non-calibrated equipment

KU25. techniques of welding and operation of the welding equipment to produce a range of joints in the various joint positions

Welding technique: 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

KU26. problems that can occur with the welding activities and explain how these can be overcome

KU27. purpose and correct use of anti-spatter compound

KU28. importance and procedure to clean torch tip and liner

KU29. effects of heat on base metal and job due to welding

KU30. significance of diffusible hydrogen for welds and how it is measured

KU31. importance, principles, methods and procedures of gouging and back gouging

KU32. heat procedures for performing FCAW welds

Heat procedures: preheating, interpass temperature, post weld heat treatment, stress relieving, using temperature measuring devices

KU33. pre-heat, inter-pass and post-heat treatment requirements in FCAW welding

KU34. purpose and importance of pre-heating requirements for base metals for welding

KU35. purpose and importance of post-heating in welding

KU36. methods to achieve pre-heat and post heat requirements for weld jobs

KU37. tools and methods to measure temperature for pre-heat and post-heat welding requirements such as thermal chalk, thermocouple, etc.

KU38. organizational quality systems used and weld standards to be achieved

KU39. various defects associated with the FCAW welding process

KU40. causes of distortion and methods of control

Distortion: 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)

KU41. slag removal tools and techniques

Slag removal tools and techniques: chipping hammer, welding hammer, wire brush, angle grinder, etc.

KU42. weld inspection techniques and test procedures for visual inspection of weld job

Visual inspections: use of visual techniques, distance of observation, angel of observation, adequate lighting, low powered magnification, fillet weld gauges

KU43. types and procedure of destructive and non-destructive methods of testing 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, hardness, fatigue, impact tests), chemical

KU44. 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

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Prepare for welding operations	**15**	**21**	**-**	**7**
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, FCAW welding machines, measuring instruments, accessories, consumables and input materials (i.e. carbon steel, stainless steel, alloy steels, hard facing alloys etc.) as per the requirements mentioned in WPS or drawing	2	2	-	1
PC3. select and arrange the right material, equipment, fixtures, accessories, welding torch and consumables i.e. electrode, shielding gas etc. as per the SOP and job requirements	2	3	-	1
PC4. check the input material, tools and equipment for any defects and that they are as per the required quality standards	1	2	-	1
PC5. plan the welding activities effectively and efficiently for achieving specifications as per WPS	1	1	-	-
PC6. prepare the materials (sheet (less than 3 mm), plate, structural section, pipe/tube, other forms) and joint for welding as per job requirement (e.g.. as flat, square or bevelled)	1	1	-	1
PC7. check the joint for accuracy before starting welding process	-	1	-	-
PC8. clean wire feeder and torch tip using correct procedures	1	1	-	1
PC9. set the FCAW welding machine and its parameters i.e. wire feed rate, amperage, gas flow rate etc. as per the WPS and SOP	1	2	-	1
PC10. connect cables and ground clamps to power source, torch and its components, welding leads/cables, hoses, shielding gas supply and wire feed mechanisms by following SOP	1	1	-	-
PC11. connect and adjust regulators and flow meters to cylinders correctly	1	1	-	-

PC12. set pre-purge with shielding gas as required	1	1	-	-
PC13. install the work pieces and fixture on the apparatus and align them with the electrodes as per the job requirements	1	2	-	-
PC14. verify that heat treatment has been done appropriately as per requirement	1	1	-	-
Perform welding operations	**8**	**17**	**-**	**8**
PC15. follow safety precautions during welding work as per SOP and organizational guidelines	-	1	-	-
PC16. ensure that supplies of components and consumables are adequate and correctly prepared before starting welding work	-	1	-	-
PC17. start the FCAW welding machine for welding operations	1	1	-	-
PC18. perform FCAW welding process in all welding positions as per SOP and weld the joint at appropriate intervals to produce joints of the specified quality, dimensions and profile	2	3	-	2
PC19. ensure correct work and travel angles, flow rate, travel speed and electrode extensions as required for the job	1	2	-	2
PC20. adjust wire stick-out as per requirement	1	1	-	1
PC21. produce joints and components of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level C of ISO 5817	1	3	-	1
PC22. monitor the welding process and 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	2	-	1
PC23. measure the final welded component and compare with the dimensions as prescribed in the WPS and engineering drawing	1	1	-	1
PC24. remove extra material, slag etc. by using brush, chipping hammers, grinders etc., from the welded component	-	1	-	-
PC25. shut down the welding equipment and remove the component after completion of welding activities	-	1	-	-
Perform post-welding operations	**7**	**12**	**-**	**5**

PC26. check the work pieces for product quality, all dimensional and geometrical aspects of the weld by following work instructions	1	2	-	1
PC27. identify various weld defects by conducting visual inspection, destructive and non-destructive tests on the work pieces	2	3	-	2
PC28. detect surface imperfections and deal with them appropriately	1	1	-	-
PC29. separate the defective pieces which can be repaired/ reworked and pieces which are beyond repair	1	1	-	1
PC30. clean and store all the tools, machine and equipment after completion of work	1	2	-	1
PC31. dispose scrap or waste material in accordance with the company policies and environmental regulations	-	1	-	-
PC32. check the machine operations for any malfunctions/defects in the component and immediately inform the supervisor/ maintenance team for correction	1	1	-	-
PC33. report to the supervisor about any problems faced or anticipated during the complete process	-	1	-	-
NOS Total	**30**	**50**	**-**	**20**

National Occupational Standards (NOS) Parameters

NOS Code	CSC/N0205
NOS Name	Perform semi-automatic flux cored arc welding process to prepare joints
Sector	Capital Goods
Sub-Sector	1. Machine Tools 2. Dies, Moulds and Press Tools 3. Plastics Manufacturing Machinery 4. Textile Manufacturing Machinery 5. Process Plant Machinery 6. Electrical and Power Machinery 7. Light Engineering Goods
Occupation	Welding and Cutting
NSQF Level	4
Credits	TBD
Version	2.0
Last Reviewed Date	
Next Review Date	
NSQC Clearance Date	

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 practicesat the workplace	30	70	-	-	100	10
CSC/N1336. Coordinate with co-workers to achieve work efficiency	30	70	-	-	100	10
CSC/N0209.Manually weld metals by using MIG/MAG welding	30	50	-	20	100	35
CSC/N0201. Manually cut metal and metal alloys using oxy-fuel gases	30	50	-	20	100	20

CSC/N0207. Manually cut metal materials using plasma arc	30	50	-	20	100	25
Option 1: CSC/N0205. Perform semi-automatic flux cored arc welding process to prepare joints	30	50	-	20	100	35
Total	**180**	**340**	**-**	**80**	**600**	**135**

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
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

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.

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.