Iron & Steel Sector Skill Council

QUALIFICATIONS PACK - OCCUPATIONAL STANDARDS FOR IRON & STEEL INDUSTRY

Contents

What are Occupational Standards (OS)?

- OS describe what individuals need to do, know and understand in order to carry out a particular job role or function
- OS are performance standards that individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding

Introduction

Qualifications Pack – Iron & Steel - Tungsten Inert Gas Welder (GTAW)

SECTOR: Iron & Steel

SUB-SECTOR: Steel, Sponge Iron, Ferro Alloys, Re-Rollers, Refractory

REFERENCE ID: ISC/Q0911

ALIGNED TO: NCO-2014/NIL

Title of job: This job is all about performing manual TIG (GTAW) welding for a range of standard welding job requirements. This is for a skilled welder who can weld different materials (carbon steel, aluminium, nickel, titanium, copper and stainless steel) in various positions and prepare various joints including corner, butt, fillet and tee. Set-up and prepare for operations interpreting the right information from the WPS.

Personal Attributes: The candidate should possess basic communication, numerical and computational abilities. Openness to learning, ability to plan and organize own work and identify and solve problems in the course of working. Understanding the need to take initiative and manage self and work to improve efficiency and effectiveness.

Job Details

Qualifications Pack Code	ISC/Q0911		
Job Role	Iron & Steel - Tungsten Inert Gas Welder (GTAW)		
Credits(NSQF)	TBD	Version number	1.0
Industry	Iron & Steel	Drafted on	23/07/2014
Sub-sector	Steel, Sponge Iron, Ferro Alloys, Re-Rollers, Refractory	Last reviewed on	30/12/2014
Occupation	Mechanical Maintenance	Next review date	30/12/2015
NSQC Clearance on	18/06/2015		

Job Role	Iron & Steel - Tungsten Inert Gas Welder (GTAW)
Role Description	Perform manual operations for performing Tungsten Inert Arc Welding (GTAW) also known as Gas Tungsten Arc Welding (GTAW) and independently carry out TIG (GTAW) weld operations for welding joints in all positions as per Welding Procedure Specification.
NSQF level	4
Minimum Educational Qualifications	Class 10th pass
Maximum Educational Qualifications	ITI Pass
Training (Suggested but not mandatory)	• Welding Processes/fitment and precisions along with classification & Coding of welding electrodes • Selection of Tungsten Rod composition, dia, gas requirement and purging • Basic Welding Metallurgy and Weldability of metals-Ferrous & Non-Ferrous • Weld Defects/distortion - their stress, control, cause & remedies • Welding Consumables and Control of welding parameters based on welding material

Minimum Job Entry Age	18 years
Experience	• 1-2 years' experience in similar function • In lieu of minimum qualification the incumbent should have 4-5 years of relevant work experience
Occupational Standards (OS)	Compulsory: ISC/N0911: Perform Tungsten Inert Gas (TIG) Welding also known as Gas Tungsten Arc Welding (GTAW) ISC/N0910: Manually cut metal and metal alloys using oxy-fuel gases ISC/N0008: Use basic health and safety practices at the workplace ISC/N0009: Works effectively with others Optional: N/A
Performance Criteria	As described in the relevant NOS units

Definitions

Keywords /Terms	Description
Core Skills/Generic Skills	Core Skills or Generic Skills are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the NOS, these include communication related skills that are applicable to most job roles.
Function	Function is an activity necessary for achieving the key purpose of the sector, occupation, or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of NOS.
Job role	Job role defines a unique set of functions that together form a unique employment opportunity in an organization.
Knowledge and Understanding	Knowledge and Understanding are statements which together specify the technical, generic, professional and organizational specific knowledge that an individual needs in order to perform to the required standard.
National Occupational Standards (NOS)	NOS are Occupational Standards which apply uniquely in the Indian context
Occupation	Occupation is a set of job roles, which perform similar/related set of functions in an industry.
Organisational Context	Organisational Context includes the way the organization is structured and how it operates, including the extent of operative knowledge managers have of their relevant areas of responsibility.
Performance Criteria	Performance Criteria are statements that together specify the standard of performance required when carrying out a task.
Qualifications Pack(QP)	Qualifications Pack comprises the set of NOS, together with the educational, training and other criteria required to perform a job role. A Qualifications Pack is assigned a unique qualification pack code.
Qualifications Pack Code	Qualifications Pack Code is a unique reference code that identifies a qualifications pack.
Scope	Scope is the 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 the quality of performance required.
Sector	Sector is a conglomeration of different business operations having similar businesses 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.
Sub-functions	Sub-functions are sub-activities essential to fulfil the achieving the objectives of the function.
Technical Knowledge	Technical Knowledge is the specific knowledge needed to accomplish specific designated responsibilities.
Unit Code	Unit Code is a unique identifier for a NOS unit, which can be denoted with an 'N'
Unit Title	Unit Title gives a clear overall statement about what the incumbent should be able to do.
Vertical	Vertical may exist within a sub-sector representing different domain areas or the client industries served by the industry.

Acronyms

Keywords /Terms	Description
NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
OEM	Original Equipment Manufacturer
OS	Occupational Standard(s)
QP	Qualifications Pack
5 S	Technique of maintaining orderliness –Japanese terminology
CP	Control Plan
WI	Work Instructions

National Occupational Standards

Overview

This unit is about manual operations for performing tungsten inert gas (TIG) welding also known as gas tungsten arc welding (GTAW). The person would be able to independently carry out TIG (GTAW) weld operations for welding joints in all positions as per Welding Procedure Specification (WPS).

National Occupational Standard

Unit Code	ISC/N0911
Unit Title (Task)	Perform Tungsten Inert Gas (TIG) Welding also known as Gas Tungsten Arc Welding (GTAW)
Description	This unit covers the performing of manual TIG (GTAW) welding for a range of standard welding job requirements. This involves welding different materials (carbon steel, aluminium and stainless steel) in various positions. The welder can prepare various joints including corner, butt, fillet and tee. This involves setting-up and preparing for operations interpreting the right information from the WPS, obtaining the right consumables and raw materials, etc. The candidate will be expected to work with a minimum of supervision, taking personal responsibility for own actions, quality and accuracy of the work. The breakdown servicing activity may be carried out as a team effort, but the candidate would be responsible for the overall completion of the installation activities as per specifications.
Scope	This unit/task covers the following: • Working Safely at all times • Preparing for welding operations • Carrying out welding operations • Testing for quality • Post welding techniques • Dealing with contingencies

Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria
Working Safely at all times	The user/individual on the job should be able to: PC1. Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines Safety precautions (general) are: • General workshop safety • Fire prevention • General hazards • Manual lifting • Overhead lifting / mechanised lifting • Surface conditions • Stability of surrounding structures, furniture, etc. Safety precautions (TIG Welding) are: • Protection from live and other electrical components, including insulation, proper earthing, proper loading, etc.

	• Proper handling and placement of hot metal • Adequate lighting • Appropriate personal protective equipment • Suitable aprons • Welding gloves • Safety boots • Correctly fitting overalls • Suitable welding helmet • Protection of self and others from the effects of the welding arc • Fume extraction/control measures • Safety measures for elevated and trench working • Reduction in the local air concentration due to release of argon gas during welding in confined places PC2. Take necessary safety precautions for TIG welding operations PC3. Adhere to procedures and system in place for health and safety, PPER and other regulations PC4. Check all connections of machines, welding leads, gas connection arrangement, electrode holder
Preparing for welding operations	The user/individual on the job should be able to: PC5. Interpret weld procedure data sheets specifications Welding concepts and mechanisms used are: • Rated output (duty cycle) • Measurement of electrical output and continuity • Relationship between wire feed speed control and welding current • Power source characteristics (volt/ampere graph, flat characteristic, constant voltage output) • Types of current ac and dc and polarity • Ac welding (square wave forms and wave balancing) • Dc pulsed tig welding • Function of induction (principle, effect, fixed, stepped, variable control) • Return • Earth • Indirect control of welding current • Relay for electrical power Welding techniques used are: • Fine adjustment of parameters (current and gas flow) • Selection of gas nozzle if required • Selection of the outer nozzle • Correct manipulation of the torch • Blending in stops/starts and tack welds • Starting techniques PC6. Select welding machines e.g. inverters, rectifiers and generators, according to the materials and task PC7. Select proper welding torch and electrode(W) that meet the job requirement and

specification, select tungsten electrode by the colour of the tip according to base metal, and correct diameter

Selection and preparation of tungsten electrode are:

- Types and classification of tungsten electrodes for different materials
- Angle and technique of preparation of the tungsten electrode tips
- Selection of the tungsten electrode diameter as per current

Torch components are:

- Cables
- Water cooled cables
- Ceramic nozzle
- Collet
- Collet holder
- Gas lens

PC8. Obtain filler wire according to specifications

PC9. Prepare for the TIG welding process

PC10. Prepare the materials and joint in readiness for welding

Material and joint preparation activities are:

- Made rust free
- Cleaned – free from scaling, paint, oil/grease
- Chemical cleaning
- Made dry and free from moisture
- Edges to be welded prepared as per job requirement (e.g. Flat, square or bevelled)
- Use various machines and techniques for the above (e.g. Chamfering machine
- Grinding and stripping, gas and plasma cutting, etc.)
- Correctly positioned
- Positioning: devices and techniques
- Jigs and fixtures
- Restraining devices such as clamps and weights/blocks
- Setting up the joint in the correct position and alignment

PC11. Select and fit the welding shielding gases for a range of given applications including back purging

Shielding gases:

- Shielding gases for GTAW
- Applications for shielding gases/gas mixtures (argon, argon/helium mixtures, argon/hydrogen mixtures, nitrogen argon/nitrogen mixtures)
- Gas pressure requirements
- Flow rates for applications
- Back purging

Shielding gases equipment are:

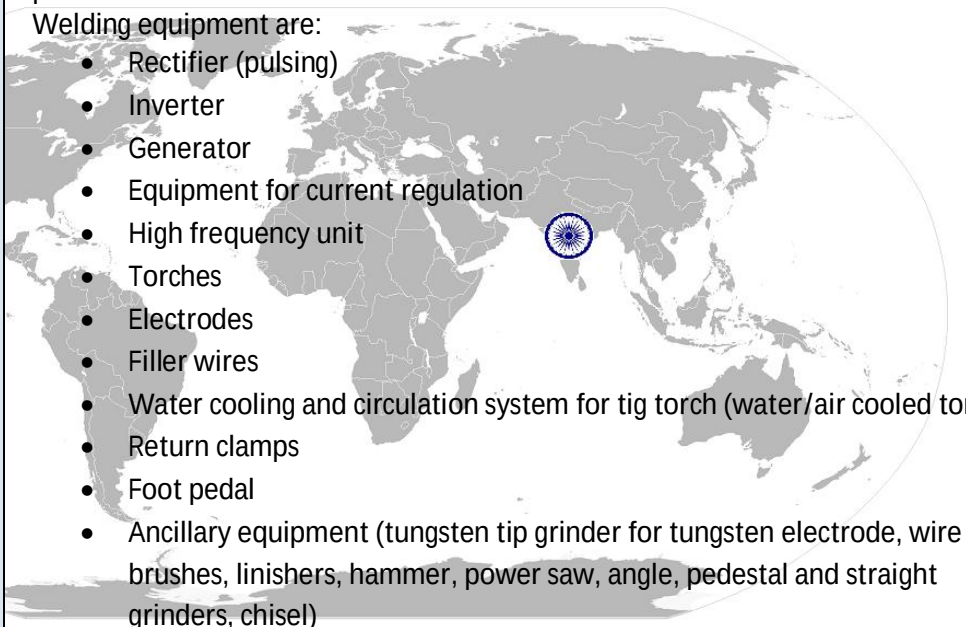
- Cylinders
- Manifold systems
- Regulators (fixed, single stage, two-stage)
- Gas flow meters
- Gas tubes and connectors
- Use of solenoid valves
- Economisers

PC12. Plan the welding activities before they start them effectively and efficiently for

	achieving specifications as per WPS Interpreting the WPS: • Welding process (ISO Codes for e.g. AWS/ASME) • Parent metal • Consumables • Pre welding joint preparation (cleaning, edge preparation, assembly, pre-heat) • Welding parameters • Welding positions (EN ISO 6947 – PA, PB, PC, PD, PE, PF, PG; ASME IX – I-6 G/1-6 F) • Number and arrangement of runs to fully fill/weld joints • Electrode (W) • Filler wire • Electrical conditions required (type of current, alternating [A.C.] direct [D.C.], electrode polarity (negative), welding current ranges, electrode polarity (positive) • Methods of arc ignition (scratch, high frequency, lift start), Carbon Block • Shielding gas (type, flow rate, pre-weld gas flow, post-weld gas flow), • Techniques (including autogenous) • Control of heat input • Inter-pass/run cleaning/back gouging methods, • Post welding activities (wiring brushing, removal of excess weld metal where required), • Post-weld heat treatment (normalising, stress relief) where permissible and restrictions Activities to be checked before start of welding are: • Correct set-up of the joint • Proper condition of electrical connections • Welding return and earthing arrangements • Operating parameters PC13. Connect torches and components PC14. Connect and adjust regulators and flow meters to cylinders PC15. Read, set and adjust current (amperage) as required PC16. Set pre-purge with shielding gas as required PC17. Prepare tungsten by sharpening or balling it to desired tip shape PC18. Set and verify gas flow rates PC19. Prepare and support the joint, using the appropriate methods PC20. Tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding, wherever required PC21. Match feed and travel speed as required
Carrying out welding operations	The user/individual on the job should be able to: PC22. Perform TIG welding operations to meet welding procedure specification requirements Basic principles of TIG welding are: • The arc burns between a non- consumable tungsten electrode and the work piece

- Exclusively inert gases (argon, helium) are used as shielding gases and other gases and gas mixtures
- Tig welding installation
- For most applications an electrode with a negative polarity is used
- For welding of aluminium, alternating current must be used
- For arc ignition a high-frequency high voltage is used

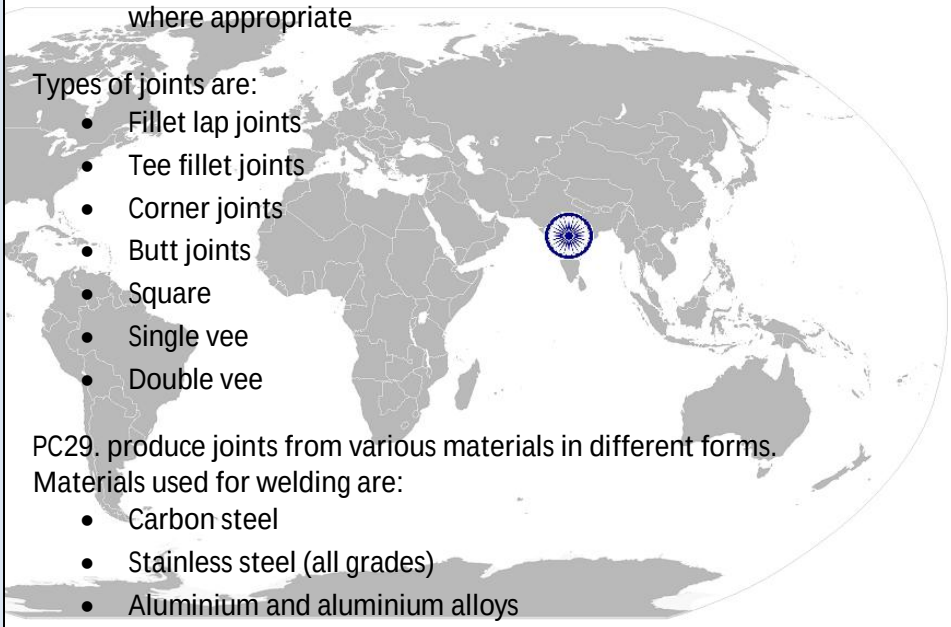
PC23. Use correct technique for starting the arc (using HF (high frequency) unit, scratching the electrode on the job material, lifting the electrode immediately after touching the job material)
PC24. Use correct angle of torch and filler wire, direction of weld and inclusion defect
PC25. Weld the joint to the specified quality, dimensions and profile.
PC26. Use manual welding and related equipment, to carry out TIG welding processes.
Welding equipment are:



- Rectifier (pulsing)
- Inverter
- Generator
- Equipment for current regulation
- High frequency unit
- Torches
- Electrodes
- Filler wires
- Water cooling and circulation system for tig torch (water/air cooled torch)
- Return clamps
- Foot pedal
- Ancillary equipment (tungsten tip grinder for tungsten electrode, wire brushes, linishers, hammer, power saw, angle, pedestal and straight grinders, chisel)
- Other equipments such as holding, jig fixtures, measuring equipments etc.

PC27. Use welding consumables appropriate to the material and application, to include AC current types and DC current types
PC28. Produce joints of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level B of ISO 5817
Weld quality check standards are:

- 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 o free from cracks
- Substantially free from porosity
- Free from any pronounced hump or crater

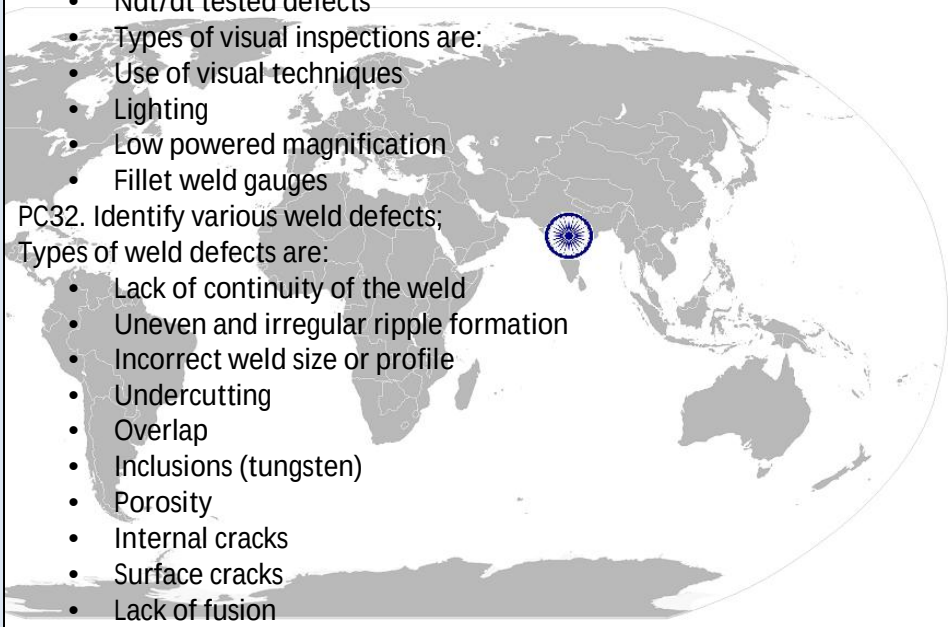
	• Substantially free from shrinkage cavities • Substantially free from arcing or chipping marks • Fillet welds are o equal in leg length • Slightly convex in profile (where applicable and preferable) • Size of the fillet equivalent to the lower thickness of the material welded • Weld contour is of linear and of uniform profile • Smooth and free from excessive undulations • Regular and has an even ripple formation • Welds are adequately fused, and there is minimal undercut, overlap and surface inclusions • Tack welds are blended in to form part of the finished weld, without excessive hump • Corner joints have minimal burn through to the underside of the joint or, where appropriate  Types of joints are: • Fillet lap joints • Tee fillet joints • Corner joints • Butt joints • Square • Single vee • Double vee PC29. produce joints from various materials in different forms. Materials used for welding are: • Carbon steel • Stainless steel (all grades) • Aluminium and aluminium alloys • Nickel and nickel alloys • Titanium • Copper and copper alloys • Forms on which welding done are: • Sheet (less than 1.5 mm) • Plate (8 mm) • Section • Pipe/tube • Other forms
Testing for quality	The user/individual on the job should be able to:

PC30. Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification
PC31. Check that the welded joint conforms to the specification, by checking various quality parameters using visual inspection
Quality parameters are:

- Shape and length of the draglines
- Smoothness of the sides
- Sharpness of the top edges
- Amount of slag adhering to the metal

Quality parameters a to be checked are:

- Dimensional accuracy
- Alignment/squareness
- Size and profile of weld
- Visual defects
- Ndt/dt tested defects
- Types of visual inspections are:
- Use of visual techniques
- Lighting
- Low powered magnification
- Fillet weld gauges



PC32. Identify various weld defects;
Types of weld defects are:

- Lack of continuity of the weld
- Uneven and irregular ripple formation
- Incorrect weld size or profile
- Undercutting
- Overlap
- Inclusions (tungsten)
- Porosity
- Internal cracks
- Surface cracks
- Lack of fusion
- Lack of penetration
- Gouges
- Stray arc strikes
- Sharp edges

Welding consumables used are:

- Filler wires for different base materials
- Shielding gas

Consumables classification as per:

- Sizes [diameters, lengths]
- Strength and elongation of the weld metal
- Impact properties of the weld metal
- Chemical composition of the weld metal
- Protection of bare wires

PC33. Detect surface imperfections and deal with them appropriately
PC34. Carry out DPT tests to assess fine defect open to the surface not detected by

	visual inspection (VT)
Post welding techniques	The user/individual on the job should be able to: PC35. Prepare for non-destructive testing of the welds for a range of tests Non-destructive tests (NDT) are: • Visual inspection • Leak test • Dye penetrant (dpt) • Fluorescent penetrant (fpt) • Magnetic particle (mpt) • Radiographic (rt) • Ultrasonic (ut) PC36. Prepare for destructive tests on weld specimens for select tests Destructive tests (DT) are: • Nick break test • Bend tests (such as face, root or side, as appropriate) • Metallographic (micro structure, haz, etc.) • Mechanical (peel, tensile and shear, fatigue, impact tests) and hardness in different zones • Chemical Handling specimens for tests: • Handling hot materials • Using chemicals for cleaning and etching • Using equipment to fracture welds PC37. Shut down and make safe the welding equipment and gases on completion of the welding activities, clean the area & store the accessories in designated place
Dealing with contingencies	The user/individual on the job should be able to: PC38. Detect equipment malfunctions and deal with them appropriately PC39. Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
Element	**Knowledge and Understanding**
A. Organisational Context (Knowledge of the Company/ Organisation and its processes)	The user/individual on the job needs to know and understand: KA1. Relevant legislation, standards, policies, and procedures followed in the company KA2. Key purpose of the organization KA3. Department structure and hierarchy protocols KA4. Work flow and own role in the workflow KA5. Dependencies and interdependencies in the workflow KA6. Support functions and types of support available for incumbents in this role
B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. The types of fire extinguishers and their suitable uses in case of welding related

	fires KB2. The effects of exposure to welding fume KB3. Range of welding equipment available KB4. Functions of welding equipment KB5. Different types of power source KB6. How to compare welding consumables for suitability for a range of given applications KB7. Welding consumables classification KB8. Safe working practices and procedures to be followed when preparing and using TIG welding equipment KB9. Hazards associated with TIG welding and safety precautions to minimize risk KB10. Different variants of the TIG welding (eg. orbital welding, internal bore welding, NG-TIG etc.) KB11. Personal protective equipment to be worn for the welding activities KB12. Correct handling and storage of gas cylinders KB13. Manual TIG welding process KB14. Type and thickness of base metals KB15. Current types and polarity KB16. Types of tungsten KB17. Types, selection and application of filler wires and welding electrodes KB18. Reasons for using shielding gases, and the types and application of the various gases and gas mixtures KB19. Impact of shielding gas composition and purity on welding quality KB20. Use, impact and importance of gas pressures and flow rates in relationship to the type of material being welded KB21. Pre- and post-flow purge and its importance KB22. Importance and application of back purging KB23. Types of welded joints to be produced KB24. Terminology used for the appropriate welding positions Welding Positions are: • 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 • Pipe to Pipe 5G • Pipe welding at inclined position 6G KB25. Types of torches such as air cooled and water cooled KB26. How to prepare the materials in readiness for the welding activity KB27. How to set up and restrain the joint, and the tools and techniques to be used KB28. Appropriate tack welding size and spacing (in relationship to material thickness) KB29. Checks to be made prior to welding KB30. Techniques of operating the welding equipment to produce a range of joints in the various joint positions KB31. Effects of the electrical characteristics of the TIG welding arc Electrical characteristics are: • Power source characteristics (volt/ampere graph, drooping characteristic,

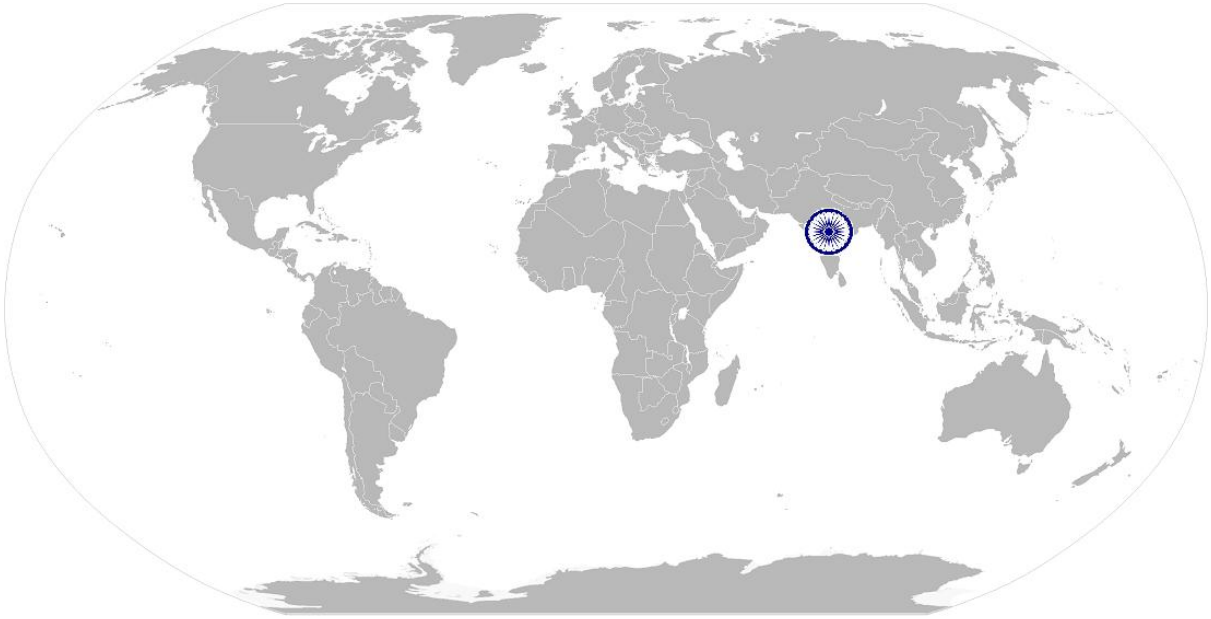
	constant current output) • Effects of types of current and electrode polarity • Heat input/distribution • Electrode • Weld bead profile • Penetration • Methods of a.c. Arc stabilisation (including: square wave) • Welding current features (pulse current, slope in, slope out) • Voltage (open circuit, arc) KB32. How to control distortion (such as welding sequence; deposition technique) KB33. Problems that can occur with the welding activities KB34. How to close down the welding equipment safely and correctly KB35. How to prepare the welds for examination KB36. How to check the welded joints for uniformity, alignment, position, weld size and profile KB37. Various procedures for visual examination of the welds for cracks / defects KB38. Non-destructive and destructive tests KB39. Methods of removing a test piece of weld from a suitable position in the joint KB40. Safe working practices and procedures to be adopted when preparing the welds for examination KB41. Importance of leaving the work area and equipment in a safe condition on completion of the welding activities KB42. Safe handling and recording of welded pieces
Skills (S) w.r.t. the scope	
Element	Skills
A. Core Skills/ Generic Skills	Communication
	The user/ individual on the job needs to know and understand how to: SA1. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, memos, etc. applicable to the job in English and/or local language SA2. Fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/or local language SA3. Convey and share technical information clearly using appropriate language SA4. Check and clarify task-related information SA5. Liaise with appropriate authorities using correct protocol SA6. Communicate with people in respectful form and manner in line with organizational protocol
	Numerical and computational skills
	The user/individual on the job needs to know and understand how to: SA7. Undertake numerical operations, geometry and calculations/ formulae (including addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages) SA8. Use appropriate measuring techniques

	SA9. Use and convert imperial and metric systems of measurements SA10. Apply appropriate degree of accuracy to express numbers SA11. Use tolerance in terms of limits of size SA12. Check measurements, angles, orientation and slopes SA13. Types of reference lines such as tangent lines, datum lines, centre lines and work points SA14. Check square of material using corner-to-corner dimensions and triangulation (3-4-5) method SA15. Select and use tools and equipment such as measuring tapes, levels, squares, protractors and dividers SA16. Ability to check dimensions of components SA17. Calculate the value of angles in a triangle
	Learning
	The user/individual on the job needs to know and understand how to: SA18. Participate in on-the-job and other learning, training and development interventions and assessments SA19. Clarify task related information with appropriate personnel or technical adviser SA20. Seek to improve and modify own work practices SA21. Maintain current knowledge of application standards, legislation, codes of practice and product/process developments
B. Professional Skills	Problem Solving
	The user/individual on the job needs to know and understand how to: SB1. Identify problems with work planning, procedures, output and behavior and their implications SB2. Prioritize and plan for problem solving SB3. Communicate problems appropriately to others SB4. Identify sources of information and support for problem solving SB5. Seek assistance and support from other sources to solve problems SB6. Identify effective resolution techniques SB7. Select and apply resolution techniques SB8. Seek evidence for problem resolution
	Plan and Organize
	The user/individual on the job needs to know and understand how to: SB9. Plan, prioritize and sequence work operations as per job requirements SB10. Organize and analyze information relevant to work SB11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimization of time
	Initiative and Enterprise
	The user/individual on the job needs to know and understand: SB12. Importance and impact of initiative and enterprise for achieving better results for self, others and organization SB13. How to undertake and express new ideas and initiatives to others SB14. Modify work plan to overcome unforeseen difficulties or developments that

	occur as work progresses SB15. Participate in improvement procedures including process, quality and internal/external customer/supplier relationships SB16. One's competencies can and should be applied in new and different situations and contexts to achieve more
	Self-Management
	The user/individual on the job needs to know and understand: SB17. Importance of taking responsibility for own work outcomes SB18. Importance of adherence to work timings, dress code and other organizational policies SB19. Importance of following laid down rules, procedures, instructions and policies SB20. Importance of exercising restraint while expressing dissent and during conflict situations SB21. How to avoid and manage distractions to be disciplined at work SB22. Importance of time management for achieving better results
	Teamwork
	The user/individual on the job needs to know and understand how to: SB23. Work in a team in order to achieve better results SB24. Identify and clarify work roles within a team SB25. Communicate and cooperate with others in the team SB26. Seek assistance from fellow team members

NOS Version Control

NOS Code	ISC/N0911		
Credits(NSQF)	TBD	Version number	1.0
Industry	Iron and steel	Drafted on	23/07/2014
Industry Sub-sector	Steel, Sponge Iron, Ferro Alloys, Re-Rollers, Refractory	Last reviewed on	30/12/2014
Occupation	Mechanical Maintenance	Next review date	30/12/2015



ISC/N0910: Manually cut metal and metal alloys using oxy-fuel gases

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National Occupational Standards

Overview

This unit is about competencies required for manual cutting operations using oxy-fuel gas. The person would be able to independently carry out oxy-fuel gas cutting operations as per welding procedure specification (WPS).

National Occupational Standard

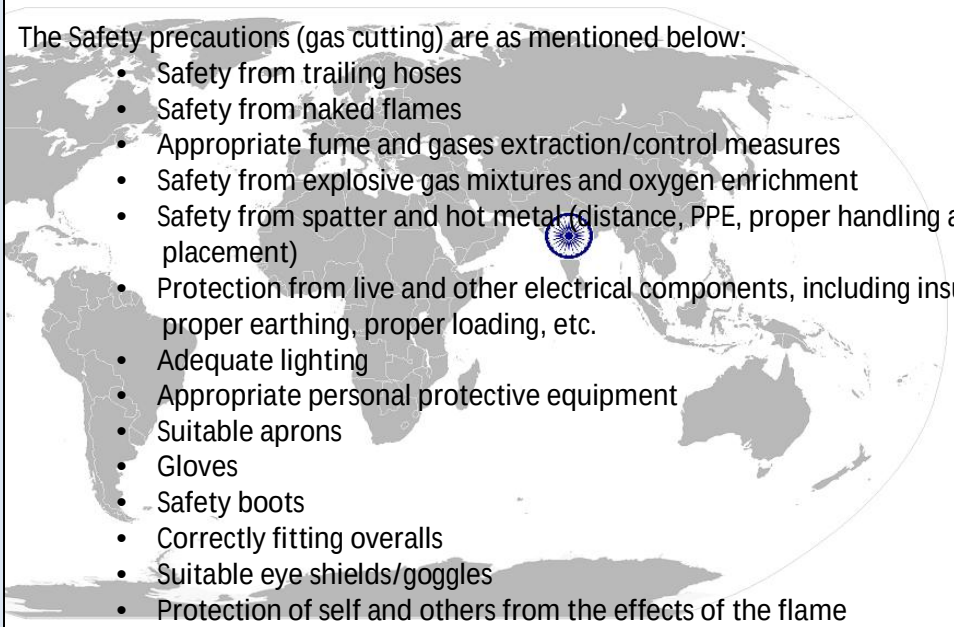
Unit Code	ISC/N0910
Unit Title (Task)	Manually cut metal and metal alloys using oxy-fuel gases
Description	This unit is about competencies required for manual cutting operations using oxy-fuel gas such as oxy-acetylene. The person would be able to independently carry out oxy-fuel cutting operations for as per welding procedure specification (WPS). The candidate will be able to cut different materials (mild carbon steel, high tensile and special steels, other materials) in various positions. The candidate cuts metal and metal alloys to required shape and size by gas flame manually. Examines material to be cut and marks it according to instruction of specification. Mounts template and sets cutting equipment to specifications. Makes necessary connections and fits required size of nozzle or burner in welding torch. Releases and regulates flow of gas in nozzle or burner, ignites and adjusts flame. Guides flame by hand along cutting line at required speed and cuts metal to required size. May use oxyacetylene or any other appropriate gas flame. This involves setting-up and preparing for operations interpreting the right information from the WPS, obtaining the right consumables and raw materials, etc.
Scope	This unit/task covers the following: • Work Safely all the time • Prepare for cutting operations • Carry out cutting operations • Carry out test for accuracy • Dealing with contingencies

Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria
Work safely all the time	The user/individual on the job should be able to: PC1. Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines PC2. Take necessary safety precautions for gas cutting operations including equipment, processes and checks
Prepare for cutting operations	The user/individual on the job should be able to: PC3. Interpret cutting procedure data sheets specifications PC4. Check regulators, hoses and check that valves are securely connected and free from leaks and damage PC5. Check equipment is calibrated and approved for use PC6. Check/fit the correct gas nozzle to the torch PC7. Ensure preheat and oxygen holes on the tips are clean PC8. Check that a flashback arrestor is fitted

PC9. Set appropriate gas pressures
PC10. Use the correct procedure for lighting, adjusting and extinguishing the flame
PC11. Adjust torch valve for type of flame such as neutral, carburizing and oxidizing
PC12. Follow sequence of operations such as pre-heating material and initiating cut
PC13. Mark out the locations for cutting accurately and as per requirement
PC14. Use appropriate and safe procedures for handling and storing of gas cylinders.

The safety precautions (general) are as mentioned below:

- General workshop safety
- Fire prevention
- General hazards
- Manual lifting
- Overhead lifting
- Surface conditions
- Stability of surrounding structures, furniture, etc.



The Safety precautions (gas cutting) are as mentioned below:

- Safety from trailing hoses
- Safety from naked flames
- Appropriate fume and gases extraction/control measures
- Safety from explosive gas mixtures and oxygen enrichment
- Safety from spatter and hot metal (distance, PPE, proper handling and placement)
- Protection from live and other electrical components, including insulation, proper earthing, proper loading, etc.
- Adequate lighting
- Appropriate personal protective equipment
- Suitable aprons
- Gloves
- Safety boots
- Correctly fitting overalls
- Suitable eye shields/goggles
- Protection of self and others from the effects of the flame
- Safety measures for elevated and trench working
- Gas cylinder safety
- Right colour coded
- Correctly labelled
- No leakage
- Away from heat or ignition source
- Never use hose other than that designed for the specified gas
- Use ferrules or clamps designed for the hose (not ordinary wire or other substitute) to connect hoses to fittings upright position (fuel gas)
- Physical care to avoid damage and falls, throws and bumps
- Move on trolleys, cap closed and without regulators
- Valves closed on empty cylinders

Emergencies (safety procedures):

- Sustained backfire in a blowpipe
- Close the oxygen valve of the blowpipe, followed by the fuel valve and then close both cylinder valves
- Investigate the cause and rectify the fault
- Re-light the blowpipe only after it is completely cooled down
- Flashback into the hose and equipment, or a hose fire or explosion, or a fire at the gas regulator connections
- Isolate the fuel gas and oxygen supplies by closing the cylinder valves only when this can be done safely
- May attempt to control the fire by fire-fighting equipment only when there is no undue risk of personal injury
- Activate the fire alarm and call for the Fire Services Department as per organizational procedures
- Fires involving acetylene cylinders
- Always best dealt with by firemen from the Fire Services Department

However, the following initial response may be appropriate:

- Cool the cylinder by spraying with water only if it is safe to do so
- Close the cylinder valve to control the fire only if it is safe to do so
- Evacuate the building by activating the fire alarm or by any other means to avoid explosion never move an acetylene cylinder involved in a fire or
- Which has been affected by heat from a nearby fire even if it seems cooled down

PC15. Prepare the work area for the cutting activities

PC16. Obtain the appropriate tools and equipment for the oxy-fuel gas cutting operations, and check that they are in a safe and usable condition

PC17. Check that the oxy-fuel gas cutting equipment is set up for the operations to be performed

Types of oxy-fuel cutting equipment are:

- Hand-held oxy-fuel gas cutting equipment
- Simple, portable, track-driven cutting equipment (electrical or mechanical)
- Fixed bench gas cutting equipment

Principles of oxy-fuel cutting used are:

- Oxygen cutting for materials which readily get oxidized
- Oxides have lower melting points than the metals
- Widely used for ferrous materials
- Oxygen cutting is not used for materials like aluminium, bronze, mild steels which resist oxidation
- Cutting of high carbon steels and cast irons require special attention due to formation of heat affected zone (HAZ) where structural transformation occurs

PC18. Adjust cylinder valves and adjust regulator for operating pressure to achieve specifications for required operations

PC19. Where appropriate, mark out the components for the required operations, using appropriate tools and techniques

PC20. Perform trial cut to check for cut defects. Kinds of cutting operations are:

	• 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 • Cutting out holes
Carry out cutting operations	The user/individual on the job should be able to: PC21. Operate the oxy-fuel gas cutting equipment to produce items/cut shapes to the dimensions and profiles specified into various forms mentioned below: • Plate • Rolled section • Pipe/tube • Solid bars PC22. Use various types of oxy-fuel gas cutting methods Various components used are: • Colour coded cylinder oxygen • Colour coded cylinder acetylene /lpg • Cylinder valve • Flashback arrestor • Set of nozzles • Gas lighter nozzle • Cutting tips • Pressure regulator • Pressure gauge • Non-return valves • Colour coded flexible hose • Trolleys • Torches (rose-bud heating, cutting, others) PC23. Perform various cutting operations correctly PC24. Produce thermal cuts in various forms of material (metal of 3mm and above) PC25. Produce cut profiles for various type of materials as mentioned under: • Mild steel • High tensile/special steel • Other appropriate metal PC26. Produce thermally-cut components which meet specified quality criteria leave the work area in a safe and tidy condition on completion of the cutting activities Quality criteria used are: • 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

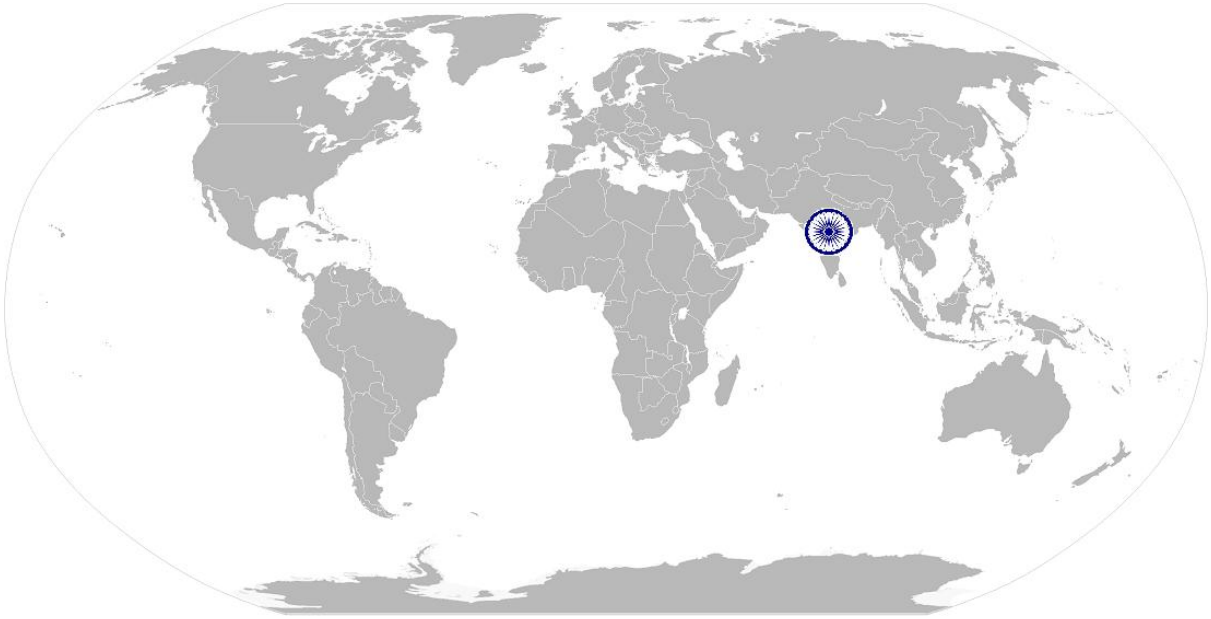
	• No drags Quality parameters are: • Shape and length of the draglines • Smoothness of the sides • Sharpness of the top edges • Amount of slag adhering to the metal PC27. Recognize and correct burn-back and flashback PC28. Detect and correct defects in cut
Carry out test for accuracy	The user/individual on the job should be able to: PC29. Check that the finished components meet the standard required PC30. Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the cut material are to the specification PC31. Identify various cutting defects
Dealing with contingencies	The user/individual on the job should be able to: PC32. Report any difficulties or problems that may arise with the cutting activities, and carry out any agreed actions PC33. Detect equipment malfunctions and deal with them appropriately PC34. Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve PC35. Shut down and make safe the cutting equipment on completion of the cutting activities PC36. In case of emergencies follow standard emergency procedures
Element	**Knowledge and Understanding**
A. Organisational Context (Knowledge of the Company/ Organisation and its processes)	The user/individual on the job needs to know and understand: KA1. Job relevant legislation, standards, policies, and procedures followed in the company KA2. Key purpose of the organization KA3. Department structure and hierarchy protocols KA4. Work flow and own role in the workflow KA5. Dependencies and interdependencies in the workflow KA6. Support functions and types of support available for incumbents in this role
B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. Types of fire extinguishers and their suitable uses in case of gas cutting related fires KB2. Specific safety precautions to be taken when working with oxy-fuel gas cutting equipment in a fabrication environment KB3. Personal protective clothing and equipment (PPE) to be worn when working with gas cutting equipment KB4. Hazards associated with carrying out gas cutting activities and how they can be

	minimized KB5. Safe working practices and procedures for using thermal equipment KB6. Principles of oxy-fuel gas cutting KB7. Procedure for obtaining the required drawings, job instructions and other related specifications KB8. How to use and extract information from engineering drawings and related specifications, work piece reference points and system of tolerances KB9. Various types of gas cutting equipment available KB10. Various components of the gas cutting equipment KB11. Construction of the heating and cutting torch KB12. Types of oxy-fuel gases such as acetylene, natural gas and propane KB13. Accessories that can be used with handheld gas cutting equipment to aid cutting operations (such as cutting guides, trammels, templates) KB14. Importance and correct procedure for marking before a cut (eg. allowances for post-cut operations, punch marks, etc.) KB15. Types of regulators such as low- and high-pressure, and single- and two-stage KB16. How to identify the gases used in the cutting process, and the colour coding of gas cylinders KB17. Type and thickness of base metals related to nozzle type KB18. Preparations prior to cutting (including checking connections for leaks, setting gas pressures, setting up the material/work piece, and checking the cleanliness of materials used) KB19. Holding methods that are used to aid thermal cutting, and the equipment that can be used. Lighting and cutting procedures are mentioned below: • Lighting the cutting torch • Adjusting gas controls to produce a neutral flame • Methods of starting the cut and controlling the cutting speed • Direction and angle of cut • Procedure for extinguishing the flame KB20. Correct procedure for lighting, cutting and extinguishing the flame KB21. Types of flames and their implication for cutting KB22. Importance of following the correct procedure for lighting, cutting and extinguishing a flame KB23. Problems that can occur with thermal cutting, and how they can be avoided (including causes of distortion during thermal cutting and methods of controlling distortion). Defects that can occur in the (oxy-fuel cutting) process are: • Distortion • Grooved, fluted or ragged cuts • Poor draglines • Rounded edges • Tightly adhering slag KB24. Effects of oil, grease, scale or dirt on the cutting process KB25. Quality parameters for gas cut materials KB26. Causes of cutting defects, how to recognize them, and methods of correction and prevention KB27. Importance of leaving the work area in a safe and clean condition on

	completion of activities KB28. Correct handling and storage of gas cylinders KB29. Emergency procedures for backfires, flashback and other fires KB30. How to close down the cutting equipment safely and correctly KB31. Purging tools and their function
Skills (S) w.r.t. the scope	
Element	Skills
A. Core Skills/ Generic Skills	Communication
	The user/ individual on the job needs to know and understand how to: SA1. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, memos, etc. applicable to the job in English and/or local language SA2. Fill up appropriate technical forms, process charts, activity logs as per organizational format in English and/or local language SA3. Convey and share technical information clearly using appropriate language SA4. Check and clarify task-related information SA5. Liaise with appropriate authorities using correct protocol SA6. Communicate with people in respectful form and manner in line with organizational protocol
	Numerical and computational skills
	The user/individual on the job needs to know and understand how to: SA7. Undertake numerical operations, geometry and calculations/ formulae (including addition, subtraction, multiplication, division, fractions and decimals, percentages and proportions, simple ratios and averages) SA8. Use appropriate measuring techniques SA9. Use and convert imperial and metric systems of measurements SA10. Apply appropriate degree of accuracy to express numbers SA11. Use tolerance in terms of limits of size SA12. Check measurements, angles, orientation and slopes SA13. Types of reference lines such as tangent lines, datum lines, centre lines and work points SA14. Check square of material using corner-to-corner dimensions and triangulation (3-4-5) method SA15. Select and use tools and equipment such as measuring tapes, levels, squares, protractors and dividers SA16. Ability to check dimensions of components SA17. Calculate the value of angles in a triangle
	Learning
	The user/individual on the job needs to know and understand how to: SA18. Participate in on-the-job and other learning, training and development interventions and assessments SA19. Clarify task related information with appropriate personnel or technical adviser

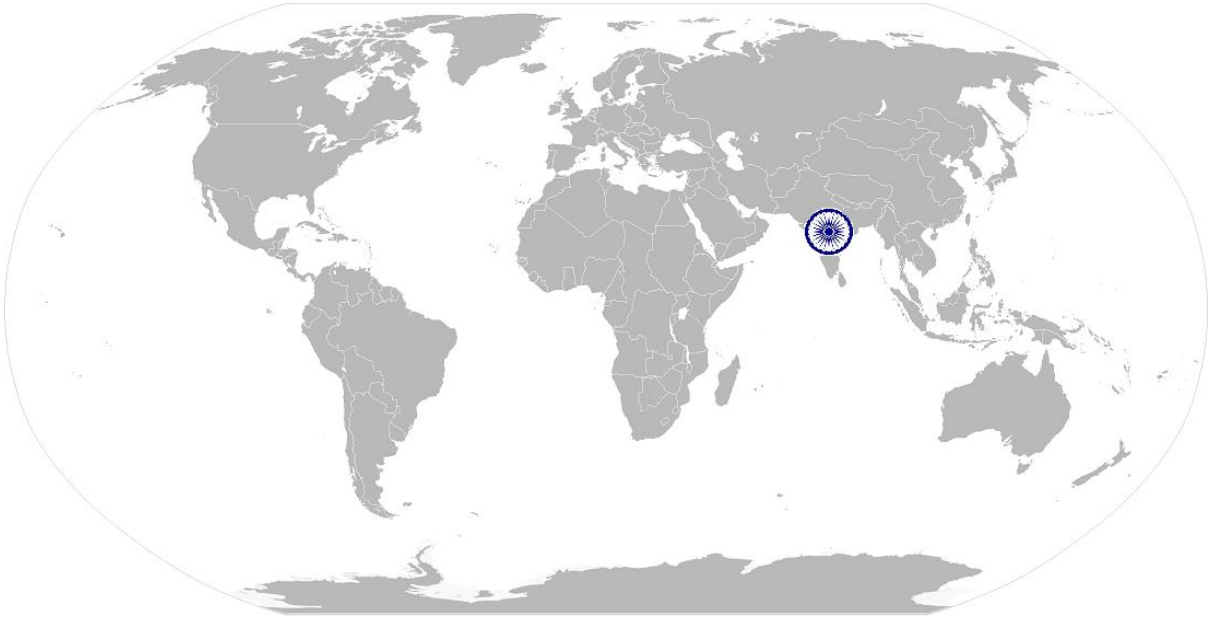
	SA20. Seek to improve and modify own work practices SA21. Maintain current knowledge of application standards, legislation, codes of practice and product/process developments
B. Professional Skills	Problem Solving
	The user/individual on the job needs to know and understand how to: SB1. Identify problems with work planning, procedures, output and behavior and their implications SB2. Prioritize and plan for problem solving SB3. Communicate problems appropriately to others SB4. Identify sources of information and support for problem solving SB5. Seek assistance and support from other sources to solve problems SB6. Identify effective resolution techniques SB7. Select and apply resolution techniques SB8. Seek evidence for problem resolution
	Plan and Organize
	The user/individual on the job needs to know and understand how to: SB9. Plan, prioritize and sequence work operations as per job requirements SB10. Organize and analyze information relevant to work SB11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimization of time
	Initiative and Enterprise
	The user/individual on the job needs to know and understand: SB12. Importance and impact of initiative and enterprise for achieving better results for self, others and organization SB13. How to undertake and express new ideas and initiatives to others SB14. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses SB15. Participate in improvement procedures including process, quality and internal/external customer/supplier relationships SB16. One's competencies can and should be applied in new and different situations and contexts to achieve more
	Self-Management
	The user/individual on the job needs to know and understand: SB17. Importance of taking responsibility for own work outcomes SB18. Importance of adherence to work timings, dress code and other organizational policies SB19. Importance of following laid down rules, procedures, instructions and policies SB20. Importance of exercising restraint while expressing dissent and during conflict situations SB21. How to avoid and manage distractions to be disciplined at work SB22. Importance of time management for achieving better results
	Teamwork

	The user/individual on the job needs to know and understand how to: SB23. Work in a team in order to achieve better results SB24. Identify and clarify work roles within a team SB25. Communicate and cooperate with others in the team SB26. Seek assistance from fellow team members



NOS Version Control

NOS Code	ISC/N0910		
Credits(NSQF)	TBD	Version number	1.0
Industry	Iron and steel	Drafted on	23/07/2014
Industry Sub-sector	Steel, Sponge Iron, Ferro Alloys, Re-Rollers, Refractory	Last reviewed on	30/12/2014
Occupation	Mechanical Maintenance	Next review date	30/12/2015



National Occupational Standards

Overview

This unit covers health, safety and security at the workplace. This includes procedures and practices that candidates need to follow to help maintain a healthy, safe and secure work environment.

National Occupational Standard

Unit Code	ISC/N0008
Unit Title (Task)	Use basic health and safety practices at the workplace
Description	This OS unit is about knowledge and practices relating to health, safety and security that candidates need to use in the workplace. It covers responsibilities towards self, others, assets and the environment. It includes understanding of risks and hazards in the workplace, along with common techniques to minimize risk, deal with accidents, emergencies, etc.
Scope	This unit/task covers the following: • Health and safety procedures • Fire safety procedures • Emergencies, rescue and first aid procedures

Performance Criteria (PC) w.r.t. the Scope	
Element	Performance Criteria
Health and safety procedures	The user/individual on the job should be able to: PC1. Use protective clothing/equipment for specific tasks and work conditions Protective clothing includes: • Leather or asbestos gloves • Flame proof aprons • Flame proof overalls buttoned to neck • Cuff less (without folds) trousers • Reinforced footwear • Helmets/hard hats • Cap and shoulder covers • Ear defenders/plugs • Safety boots • Knee pads • Particle masks • Glasses/gloves/visors Equipment includes: • Hand shields • Machine guards • Residual current devices • Shields • Dust sheets • Respirator

PC2. State the name and location of people responsible for health and safety in the workplace

Various areas are listed below:

- On chemical containers
- Equipment
- Packages
- Inside buildings
- Open areas and public spaces, etc.

PC3. State the names and location of documents that refer to health and safety in the workplace

PC4. Identify job-site hazardous work and state possible causes of risk or accident in the workplace

Hazards include:

- Working with electrical and thermal tools and equipment
- Sharp edged and heavy tools
- Heated metals
- Oxyfuel and gas cylinders
- Welding radiation
- Surfaces: sharp, slippery, uneven, chipped, broken, etc.
- Substances: chemicals, gas, oxy-fuel, fumes, dust, etc.
- Physical: working at heights, large and heavy objects and machines, sharp and piercing objects, tolls and machines, intense light, load noise, obstructions in corridors, by doors, blind turns, noise, over stacked shelves and packages, etc.
- Electrical: power supply and points, loose and naked cables and wires, electrical machines and appliances, etc.

PC5. Carry out safe working practices while dealing with hazards to ensure the safety of self and others state methods of accident prevention in the work environment of the job role

Safe working practices include:

- Using protective clothing and equipment
- Putting up and reading safety signs
- Handle tools in the correct manner and store and maintain them properly
- Keep work area clear of clutter, spillage and unsafe object lying casually
- While working with electricity take all electrical precautions like insulated clothing, adequate equipment insulation, use of control equipment, dry work area, switch off the power supply when not required, etc.
- Safe lifting and carrying practices
- Use equipment that is working properly and is well maintained
- Take due measures for safety while working in confined places, trenches or at heights, etc. Including safety harness, fall arrestors, etc.

Methods are:

- Training in health and safety procedures
- Using health and safety procedures
- Use of equipment and working practices (such as safe carrying procedures)

	• Safety notices, advice • Instruction from colleagues and supervisors PC6. State location of general health and safety equipment in the workplace PC7. Inspect for faults, set up and safely use steps and ladders in general use Faults : • Corrosion of metal components • Deterioration • Splits and cracks timber components • Imbalance • Loose rungs • Nuts or bolts, etc. Set up: • Firm/level base • Clip/lash down • Leaning at the correct angle, etc. PC8. Work safely in and around trenches, elevated places and confined areas PC9. Lift heavy objects safely using correct procedures PC10. Apply good housekeeping practices at all times. Good housekeeping practices: • Clean/tidy work areas • Removal/disposal of waste products • Protect surfaces PC11. Identify common hazard signs displayed in various areas PC12. Retrieve and/or point out documents that refer to health and safety in the workplace
Fire safety procedures	The user/individual on the job should be able to: PC13. Use the various appropriate fire extinguishers on different types of fires correctly. Fire extinguishers: • Sand • Water • Foam • Co2 • Dry powder Fires: • Class A: Ordinary solid combustibles, e.g. wood, paper, cloth, plastic, charcoal etc. • Class B: Flammable liquids and gases, e.g. gasoline, propane, diesel fuel, tar, cooking oil and similar substances • Class C: Electrical equipment e.g. appliances, wiring, breaker panels etc. (these categories of fires become Class A, B, and D fires when the electrical equipment that initiated the fire is no longer receiving electricity) • Class D: Combustible metals such as magnesium, titanium, and sodium (these fires burn at extremely high temperatures and require special suppression agents)

	Causes of fires: • Heating of metal • Spontaneous ignition • Sparking, • Electrical heating • Loose fires (eg. Smoking, welding, etc.) • Chemical fires, etc. PC14. Demonstrate rescue techniques applied during fire hazard PC15. Demonstrate good housekeeping in order to prevent fire hazards PC16. Demonstrate the correct use of a fire extinguisher
Emergencies, rescue and first-aid procedures	The user/individual on the job should be able to: PC17. Demonstrate how to free a person from electrocution PC18. Administer appropriate first aid to victims as required e.g. in case of bleeding, burns, choking, electric shock, poisoning etc. PC19. Demonstrate basic techniques of bandaging PC20. Respond promptly and appropriately to an accident situation or medical emergency in real or simulated environments . few General health and safety equipment are mentioned below : • Fire extinguishers • First aid equipment • Safety instruments and clothing • Safety installations, e.g. Fire exits, exhaust fans etc. PC21. Perform and organize loss minimization or rescue activity during an accident in real or simulated environments PC22. Administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock, before the arrival of emergency services in real or simulated cases PC23. Demonstrate the artificial respiration and the CPR Process PC24. Participate in emergency procedures. Emergency procedures are: • Raising alarm • Safe/efficient evacuation • Correct means of escape • Correct assembly point • Roll call • Correct return to work PC25. Complete a written accident/incident report or dictate a report to another person, and send report to person responsible Incident Report should capture: • Name • Date/time of incident • Date/time of report, • Location • Environment conditions • Persons involved • Sequence of events • Injuries sustained • Damage sustained

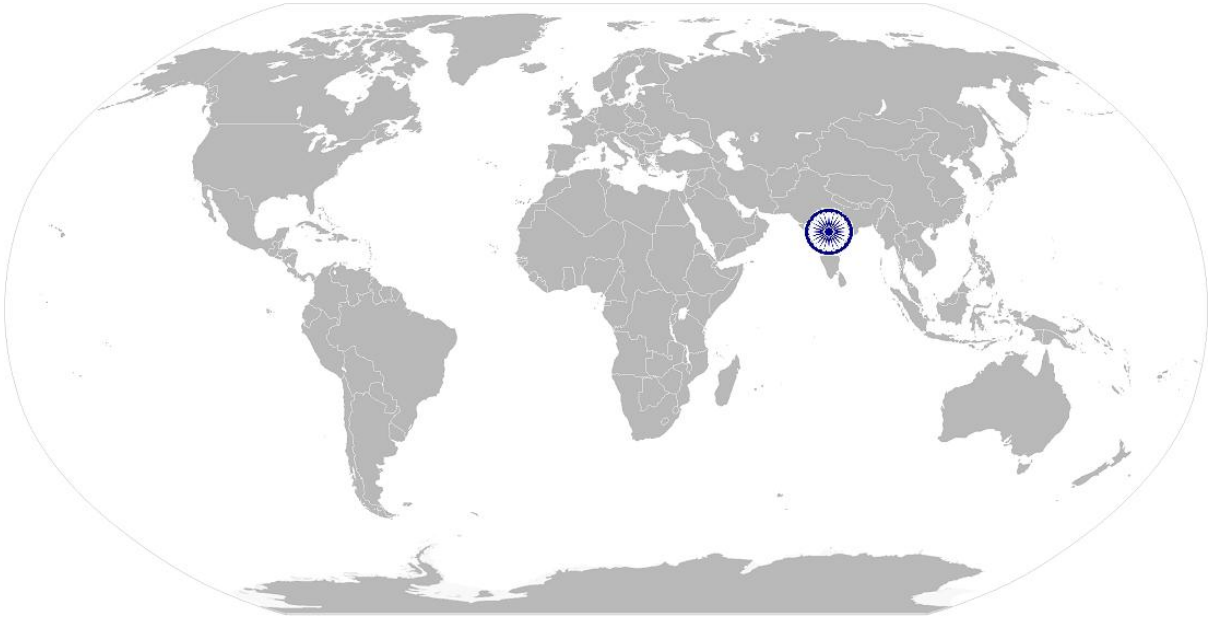
	• Actions taken • Witnesses • Supervisor/manager notified Documents: • Fire notices • Accident reports • Safety instructions for equipment and procedures • Company notices and documents • Legal documents (e.g. Government notices) Job titles: • Health and safety officer • First aid officer • Fire officer PC26. Demonstrate correct method to move injured people and others during an emergency
Element	**Knowledge and Understanding**
A. Organisational Context (Knowledge of the Company/ Organisation and its processes)	The user/individual on the job needs to know and understand: KA1. State the names (and job titles if applicable), and describe where to find, all the people responsible for health and safety in a workplace KA2. State the names and location of documents that refer to health and safety in the workplace
B. Technical Knowledge	The user/individual on the job needs to know and understand: KB3. Meaning of "hazards" and "risks" KB4. Health and safety hazards commonly present in the work environment and related precautions KB5. Possible causes of risk, hazard or accident in the workplace and why risk and/or accidents are possible KB6. Activities and causes of risk and accident KB7. Methods of accident prevention KB8. Safe working practices when working with tools and machines KB9. Safe working practices while working at various hazardous sites KB10. Where to find all the general health and safety equipment in the workplace KB11. Various dangers associated with the use of electrical equipment KB12. Preventative and remedial actions to be taken in the case of exposure to toxic materials. • Exposure: ingested, contact with skin, inhaled • Preventative action: ventilation, masks, protective clothing/equipment • Remedial action: immediate first aid, report to supervisor • Materials: solvents, flux, lead KB13. Importance of using protective clothing/equipment while working KB14. Precautionary activities to prevent the fire accident Activities and causes: • Physical actions

	• Reading • Listening to and giving instructions • Inattention • Sickness and incapacity (e.g. Drunkenness) • Health hazards (e.g. Untreated injuries and contagious illness) KB15. Various causes of fire KB16. Techniques of using the different fire extinguishers KB17. Different methods of extinguishing fire KB18. Rescue techniques applied during a fire hazard KB19. Various types of safety signs and what they mean KB20. Appropriate basic first aid treatment relevant to the condition e.g. Shock, electrical shock, bleeding, breaks to bones, minor burns, resuscitation, poisoning, eye injuries KB21. Content of written accident report KB22. Potential injuries and ill health associated with incorrect manual handing KB23. Safe lifting and carrying practices KB24. Personal safety, health and dignity issues relating to the movement of a person by others KB25. Potential impact to a person who is moved incorrectly
Skills (S) w.r.t. the scope	
Element	Skills
A. Core Skills/ Generic Skills	Reading and Writing Skills
	The user/individual on the job needs to know and understand how to: SA1. Read and comprehend basic content to read labels, charts, signages SA2. Read and comprehend basic English to read manuals of operations SA3. Read and write an accident/incident report in local language or English
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA4. Question co-workers appropriately in order to clarify instructions and other issues SA5. Give clear instructions to co-workers, subordinates others
	Decision Making
	The user/individual on the job needs to know and understand how to: SA6. Make appropriate decisions pertaining to the concerned area of work with respect to intended work objective, span of authority, responsibility, laid down procedure and guidelines
B. Professional Skills	Plan and Organize
	The user/individual on the job needs to know and understand: SB1. Plan and organize their own work schedule, work area, tools, equipment and

	materials to maintain decorum and for improved productivity
	Working with others
	The user/individual on the job needs to know and understand how to: SB2. Remain congenial while discussing and debating issues with co-workers SB3. Follow appropriate protocols for communication based on situation, hierarchy, organizational culture and practice SB4. Ask for, provide and receive required assistance where possible to ensure achievement of work related objectives SB5. Thank co-workers for any assistance received SB6. Offer appropriate respect based on mutuality and respect for fellow workmanship and authority
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Think through the problem, evaluate the possible solution(s) and suggest an optimum /best possible solution(s) SB8. Identify immediate or temporary solutions to resolve delays SB9. Identify sources of support that can be availed of for problem solving for various kind of problems SB10. Seek appropriate assistance from other sources to resolve problems SB11. Report problems that you cannot resolve to appropriate authority
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB12. Identify cause and effect relations in their area of work SB13. Use cause and effect relations to anticipate potential problems and their solution

NOS Version Control

NOS Code	ISC/N0008		
Credits(NSQF)	TBD	Version number	1.0
Industry	Iron and steel	Drafted on	23/07/2014
Industry Sub-sector	All departments	Last reviewed on	30/12/2014
Occupation	Mechanical Maintenance	Next review date	30/12/2015



National Occupational Standards

Overview

This unit covers basic practices that improve effectiveness of working with others in an organisational set-up.

National Occupational Standard

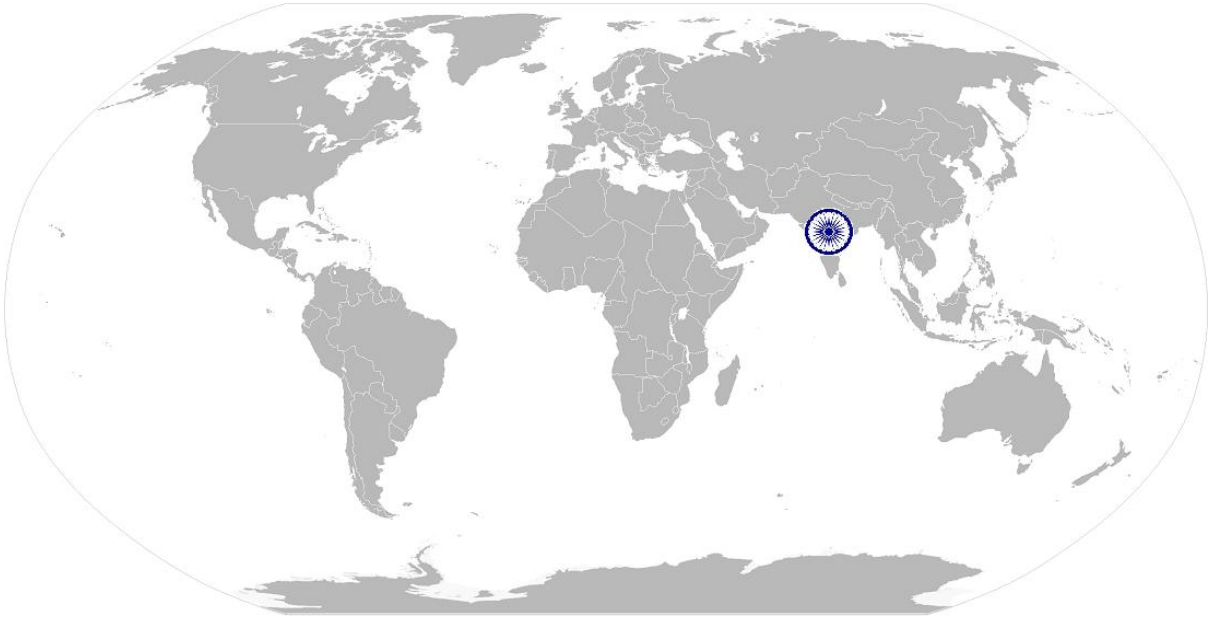
Unit Code	ISC/N0009
Unit Title (Task)	Works effectively with others
Description	This unit covers basic etiquette and competencies that a candidate is required to possess and demonstrate in their behaviour and interactions with others at the workplace.
Scope	This unit/task covers the following: • Ensure appropriate communication with superiors, peers and others as applicable at work place • Demonstrate appropriate behaviour and etiquette at work place
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria**
Ensure appropriate communication with superiors, peers and others as applicable at work place	The user/individual on the job should be able to: PC1. Accurately receive information and instructions from the supervisor and fellow workers, getting clarification where required PC2. Accurately pass on information to authorized persons who require it and within agreed timescale and confirm its receipt PC3. Provide information to others clearly, at a pace and in a manner that helps them to understand
Demonstrate appropriate behaviour and etiquette at work place	The user/individual on the job should be able to: PC4. Display helpful behaviour by assisting others in performing tasks in a positive manner, where required and possible PC5. Consult with and assist others to maximize effectiveness and efficiency in carrying out tasks PC6. Display appropriate communication etiquette while working PC7. Display active listening skills while interacting with others at work PC8. Use appropriate tone, pitch and language to convey politeness, assertiveness, care and professionalism PC9. Demonstrate responsible and disciplined behaviours at the workplace PC10. Escalate grievances and problems to supervisor
Element	**Knowledge and Understanding**
A. Organisational Context (Knowledge of the Company/ Organisation and its processes)	The user/individual on the job needs to know and understand: KA1. Legislation, standards, policies, and procedures followed in the company relevant to own employment and performance conditions KA2. Reporting structure, inter-dependent functions, lines and procedures in the work area KA3. Relevant people and their responsibilities within the work area KA4. Escalation matrix and procedures for reporting work and employment related issues

B. Technical Knowledge	The user/individual on the job needs to know and understand: KB1. Various categories of people that one is required to communicate and co-ordinate with in the organization KB2. Importance of effective communication in the workplace KB3. Importance of teamwork in organizational and individual success KB4. Various components of effective communication KB5. Key elements of active listening KB6. Value and importance of active listening and assertive communication KB7. Barriers to effective communication KB8. Importance of tone and pitch in effective communication KB9. Importance of avoiding casual expletives and unpleasant terms while communicating professional circles KB10. How poor communication practices can disturb people, environment and cause problems for the employee, the employer and the customer KB11. Importance of ethics for professional success KB12. Importance of discipline for professional success KB13. What constitutes disciplined behaviour for a working professional KB14. Common reasons for interpersonal conflict KB15. Importance of developing effective working relationships for professional success KB16. Expressing and addressing grievances appropriately and effectively KB17. Importance and ways of managing interpersonal conflict effectively
Skills (S) w.r.t. the scope	
Element	Skills
A. Core Skills/ Generic Skills	Reading and Writing Skills
	The user/individual on the job needs to know and understand how to: SA1. Read and comprehend basic content to read labels, charts, signage's SA2. Read and comprehend basic English to read manuals of operations SA3. Read and write an accident/incident report in local language or English
	Oral Communication (Listening and Speaking skills)
	The user/individual on the job needs to know and understand how to: SA4. Question co-workers appropriately in order to clarify instructions and other issues SA5. Provide clear instructions to co-workers, subordinates others
	Decision Making
	The user/individual on the job needs to know and understand how to: SA6. Make appropriate decisions pertaining to the concerned area of work with respect to intended work objective, span of authority, responsibility, laid down

	procedure and guidelines
B. Professional Skills	Plan and Organize
	The user/individual on the job needs to know and understand: SB1. Plan and organize their own work schedule, work area, tools, equipment and materials to maintain decorum and for improved productivity
	Working with others
	The user/individual on the job needs to know and understand how to: SB2. Remain congenial while discussing and debating issues with co-workers SB3. Follow appropriate protocols for communication based on situation, hierarchy, organizational culture and practice SB4. Ask for, provide and receive required assistance where possible to ensure achievement of work related objectives SB5. Thank co-workers for any assistance received SB6. Offer appropriate respect based on mutuality and respect for fellow workmanship and authority
	Problem Solving
	The user/individual on the job needs to know and understand how to: SB7. Think through the problem, evaluate the possible solution(s) and suggest an optimum /best possible solution(s) SB8. Identify immediate or temporary solutions to resolve delays SB9. Identify sources of support that can be availed of for problem solving for various kind of problems SB10. Seek appropriate assistance from other sources to resolve problems SB11. Report problems that you cannot resolve to appropriate authority
	Analytical Thinking
	The user/individual on the job needs to know and understand how to: SB12. Identify cause and effect relations in their area of work SB13. Use cause and effect relations to anticipate potential problems and their solution

NOS Version Control

NOS Code	ISC/N0009		
Credits(NSQF)	TBD	Version number	1.0
Industry	Iron and steel	Drafted on	23/07/2014
Industry Sub-sector	All departments	Last reviewed on	30/12/2014
Occupation	Mechanical Maintenance	Next review date	30/12/2015



CRITERIA FOR ASSESSMENT OF TRAINEES

Job Role: Iron & Steel - Tungsten Inert Gas Welder (GTAW)
Qualification Pack: ISC/Q0911
Sector Skill Council: Indian Iron & Steel Sector Skill Council

Guidelines for Assessment:

1. Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2. The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below)
4. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on this criteria.
5. To pass the Qualification Pack , every trainee should score a minimum of 60% in every NOS.
6. In case of successfully passing only certain number of NOS's, the trainee is eligible to take subsequent assessment on the balance NOS's to pass the Qualification Pack.

				Marks Allocated	
NOSs	PCs	Total Marks 1000	Out Of	Theory	Practical
ISC/N0911: Perform Tungsten Inert Gas (TIG) Welding also known as Gas Tungsten Arc Welding (GTAW)	PC1. Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines	450	6	2	4
	PC2. Take necessary safety precautions for TIG welding operations		6	2	4
	PC3. Adhere to procedures and system in place for health and safety, PPER and other regulations		6	2	4
	PC4. Check all connections of machines, welding leads, gas connection arrangement, electrode holder		7	2	5
	PC5. Interpret weld procedure data sheets specifications		15	5	10

	PC6. Select welding machines e.g. inverters, rectifiers and generators, according to the materials and task		10	5	5
	PC7. Select proper welding torch and electrode(W) that meet the job requirement and specification, select tungsten electrode by the colour of the tip according to base metal, and correct diameter		15	5	10
	PC8. Obtain filler wire according to specifications		7	2	5
	PC9. Prepare for the TIG welding process		5	0	5
	PC10. Prepare the materials and joint in readiness for welding		7	2	5
	PC11. Select and fit the welding shielding gases for a range of given applications including back purging		10	5	5
	PC12. Plan the welding activities before they start them effectively and efficiently for achieving specifications as per WPS		7	2	5
	PC13. Connect torches and components		5	0	5
	PC14. Connect and adjust regulators and flow meters to cylinders		5	0	5
	PC15. Read, set and adjust current (amperage) as required		15	5	10
	PC16. Set pre-purge with shielding gas as required		15	5	10
	PC17. Prepare tungsten by sharpening or balling it to desired tip shape		5	0	5
	PC18. Set and verify gas flow rates		15	5	10
	PC19. Prepare and support the joint, using the appropriate methods		15	5	10
	PC20. Tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding, wherever required		15	5	10
	PC21. Match feed and travel speed as required		15	5	10
	PC22. Perform TIG welding operations to meet welding procedure specification requirements		15	5	10

	PC23. Use correct technique for starting the arc (using HF (high frequency) unit, scratching the electrode on the job material, lifting the electrode immediately after touching the job material)		15	5	10
	PC24. Use correct angle of torch and filler wire, direction of weld and inclusion defect		15	5	10
	PC25. Weld the joint to the specified quality, dimensions and profile		15	5	10
	PC26. Use manual welding and related equipment, to carry out TIG welding processes		15	5	10
	PC27. Use welding consumables appropriate to the material and application, to include AC current types and DC current types		15	5	10
	PC28. Produce joints of the required quality and of specified dimensional accuracy which achieve a weld quality equivalent to Level B of ISO 5817		15	5	10
	PC29. produce joints from various materials in different forms		15	5	10
	PC30. Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification		15	5	10
	PC31. Check that the welded joint conforms to the specification, by checking various quality parameters using visual inspection		15	5	10
	PC32. Identify various weld defects		7	2	5
	PC33. Detect surface imperfections and deal with them appropriately		7	2	5
	PC34. Carry out DPT tests to assess fine defect open to the surface not detected by visual inspection (VT)		15	5	10
	PC35. Prepare for non-destructive testing of the welds for a range of tests		15	5	10
	PC36. Prepare for destructive tests on weld specimens for select tests		15	5	10

	PC37. Shut down and make safe the welding equipment and gases on completion of the welding activities, clean the area & store the accessories in designated place		15	5	10
	PC38. Detect equipment malfunctions and deal with them appropriately		15	5	10
	PC39. Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve		5	0	5
		Total	450	143	307
ISC/N0910: Manually cut metal and metal alloys using oxy-fuel gases	PC1. Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines	300	10	5	5
	PC2. Take necessary safety precautions for gas cutting operations including equipment, processes and checks		10	5	5
	PC3. Interpret cutting procedure data sheets specifications		10	5	5
	PC4. Check regulators, hoses and check that valves are securely connected and free from leaks and damage		5	0	5
	PC5. Check equipment is calibrated and approved for use		5	0	5
	PC6. Check/fit the correct gas nozzle to the torch		5	0	5
	PC7. Ensure preheat and oxygen holes on the tips are clean		10	5	5
	PC8. Check that a flashback arrestor is fitted		15	5	10
	PC9. Set appropriate gas pressures		5	0	5
	PC10. Use the correct procedure for lighting, adjusting and extinguishing the flame		5	0	5
	PC11. Adjust torch valve for type of flame such as neutral, carburizing and oxidizing		5	0	5

	PC12. Follow sequence of operations such as pre-heating material and initiating cut		10	5	5
	PC13. Mark out the locations for cutting accurately and as per requirement		5	0	5
	PC14. Use appropriate and safe procedures for handling and storing of gas cylinders.		5	0	5
	PC15. Prepare the work area for the cutting activities		5	0	5
	PC16. Obtain the appropriate tools and equipment for the oxy-fuel gas cutting operations, and check that they are in a safe and usable condition		10	5	5
	PC17. Check that the oxy-fuel gas cutting equipment is set up for the operations to be performed		5	0	5
	PC18. Adjust cylinder valves and adjust regulator for operating pressure to achieve specifications for required operations		10	0	10
	PC19. Where appropriate, mark out the components for the required operations, using appropriate tools and techniques		10	0	10
	PC20. Perform trial cut to check for cut defects		5	0	5
	PC21. Operate the oxy-fuel gas cutting equipment to produce items/cut shapes to the dimensions and profiles specified into various forms		10	5	5
	PC22. Use various types of oxy-fuel gas cutting methods		10	5	5
	PC23. Perform various cutting operations correctly		5	0	5
	PC24. Produce thermal cuts in various forms of material (metal of 3mm and above)		5	0	5
	PC25. Produce cut profiles for various type of materials		15	5	10

	PC26. Produce thermally-cut components which meet specified quality criteria leave the work area in a safe and tidy condition on completion of the cutting activities		5	0	5
	PC27. Recognize and correct burn-back and flashback		10	5	5
	PC28. Detect and correct defects in cut		5	0	5
	PC29. Check that the finished components meet the standard required		15	5	10
	PC30. Use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the cut material are to the specification		10	0	10
	PC31. Identify various cutting defects		15	5	10
	PC32. Report any difficulties or problems that may arise with the cutting activities, and carry out any agreed actions		10	5	5
	PC33. Detect equipment malfunctions and deal with them appropriately		5	0	5
	PC34. Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve		10	5	5
	PC35. Shut down and make safe the cutting equipment on completion of the cutting activities		10	5	5
	PC36. In case of emergencies follow standard emergency procedures		10	5	5
		Total	300	85	215
ISC/N0008: Use basic health and safety practices at the workplace	PC1. Use protective clothing/equipment for specific tasks and work conditions	150	9	4	5
	PC2. State the name and location of people responsible for health and safety in the workplace		6	1	5
	PC3. State the names and location of documents that refer to health and safety in the workplace		2	1	1

	PC4. Identify job-site hazardous work and state possible causes of risk or accident in the workplace		8	4	4
	PC5. Carry out safe working practices while dealing with hazards to ensure the safety of self and others state methods of accident prevention in the work environment of the job role		6	1	5
	PC6. State location of general health and safety equipment in the workplace		6	1	5
	PC7. Inspect for faults, set up and safely use steps and ladders in general use		6	1	5
	PC8. Work safely in and around trenches, elevated places and confined areas		6	1	5
	PC9. Lift heavy objects safely using correct procedures		6	1	5
	PC10. Apply good housekeeping practices at all times		2	1	1
	PC11. Identify common hazard signs displayed in various areas		6	5	1
	PC12. Retrieve and/or point out documents that refer to health and safety in the workplace		5	1	4
	PC13. Use the various appropriate fire extinguishers on different types of fires correctly		9	4	5
	PC14. Demonstrate rescue techniques applied during fire hazard		8	4	4
	PC15. Demonstrate good housekeeping in order to prevent fire hazards		2	1	1
	PC16. Demonstrate the correct use of a fire extinguisher		6	1	5
	PC17. Demonstrate how to free a person from electrocution		6	1	5
	PC18. Administer appropriate first aid to victims as required e.g. in case of bleeding, burns, choking, electric shock, poisoning etc.		8	3	5
	PC19. Demonstrate basic techniques of bandaging		6	1	5

	PC20. Respond promptly and appropriately to an accident situation or medical emergency in real or simulated environments		7	2	5
	PC21. Perform and organize loss minimization or rescue activity during an accident in real or simulated environments		6	1	5
	PC22. Administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock, before the arrival of emergency services in real or simulated cases		6	1	5
	PC23. Demonstrate the artificial respiration and the CPR Process		6	1	5
	PC24. Participate in emergency procedures		6	1	5
	PC25. Complete a written accident/incident report or dictate a report to another person, and send report to person responsible		4	1	3
	PC26. Demonstrate correct method to move injured people and others during an emergency		2	1	1
		Total	150	45	105
ISC/N0009: Works effectively with others	PC1. Accurately receive information and instructions from the supervisor and fellow workers, getting clarification where required	100	10	5	5
	PC2. Accurately pass on information to authorized persons who require it and within agreed timescale and confirm its receipt		10	5	5
	PC3. Provide information to others clearly, at a pace and in a manner that helps them to understand		10	0	10
	PC4. Display helpful behaviour by assisting others in performing tasks in a positive manner, where required and possible		10	5	5

	PC5. Consult with and assist others to maximize effectiveness and efficiency in carrying out tasks		10	5	5
	PC6. Display appropriate communication etiquette while working		10	0	10
	PC7. Display active listening skills while interacting with others at work		10	0	10
	PC8. Use appropriate tone, pitch and language to convey politeness, assertiveness, care and professionalism		10	5	5
	PC9. Demonstrate responsible and disciplined behaviours at the workplace		15	5	10
	PC10. Escalate grievances and problems to supervisor		5	0	5
		Total	100	30	70