Zambia Qualifications Authority

NATIONAL OCCUPATIONAL STANDARD FOR WORKSHOP MACHINES OPERATORS

NOS.WMO.01
FIRST EDITION

APPROVING AUTHORITY

This National Occupational Standard has been prepared and published under the authority of the Zambia Qualifications Authority Board on 25th February 2021.

ZAMBIA QUALIFICATIONS AUTHORITY

The Zambia Qualifications Authority Act No. 13 of 2011 was enacted by the Government of the Republic of Zambia to ***"provide for the development and implementation of a national qualifications framework; establish the Zambia Qualifications Authority; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing".*** Among other functions, ZAQA is responsible for ***determining national standards for any occupation***, through various sector specific National Occupational Standards Development Teams (NOSDTs).

REVISION OF NATIONAL OCCUPATIONAL STANDARDS

National Occupational Standards shall be revised every after **5 years**, or whenever necessary, by the issue of either amendments or of revised editions. It is important that users of National Occupational Standards (NOS) should ascertain that they are in possession of the latest amendments or editions.

NOS DEVELOPMENT TEAM RESPONSIBLE

This National Occupational Standard was prepared by the Manufacturing National Occupational Standards Development Team, upon which the following organisations were represented:

1. Bigtree Beverages Ltd
2. Copperbelt University
3. Evelyn Hone College
4. Lafarge Cement (Z) Plc
5. Lusaka Business and Technical College
6. Trade Kings Group
7. University of Zambia
8. Zambia Association of Manufacturers
9. Zambian Breweries Plc
10. Zambia Bureau of Standards
11. Zambia Qualifications Authority – Secretariat.

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FOREWORD

The Zambia Qualifications Authority (ZAQA) is a statutory body under the Ministry of Higher Education established by ZAQA Act No. 13 of 2011 to "***provide for the development and implementation of a national qualifications framework; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing***".
Among other functions, ZAQA is responsible for ***"determining national standards for any occupation"***, through various sector specific National Occupational Standards Development Teams (NOSDTs) of experts composed of representation from appropriate authorities, government departments, industry, academia, regulators, consumer associations and non-governmental organisations, etc.
This National Occupational Standard (NOS) has been developed by the Manufacturing National Occupational Standards Development Team in accordance with the procedures and guidelines of ZAQA. All users should ensure that they have the latest edition of this publication as National Occupational Standards are revised from time to time.

This NOS shall be used by, among others, industry, employers, quality assurance bodies, awarding and professional bodies and education and training institutions, as a benchmark to identify training needs, develop job profiles/descriptions, develop curricula and learning programmes, in various sectors where the occupation exists. In the Mining sector, demonstration of competence against this NOS may be required in order to run a business or practice a craft or profession.

JUSTIFICATION

Workshop Machines Operators are indispensable to the manufacturing industry. Plants need Workshop Machines Operators to run equipment/machinery for production to be achieved. Some of the workshop equipment/machinery operated include Lathe Machines; Shapers; Milling Machines; Drilling Machines; CNC Machines; Workshop Cranes; Forklifts, etc. The Workshop Machines Operators also ensure the safety, maintenance and operations of all workshop equipment/machinery in a factory/processing/manufacturing plant. The Workshop Machines Operator is fundamental and critical to any operation in the Manufacturing sector. Without the Workshop Machines Operator, there can be no production to talk about for any processing plant.

This National Occupational Standard highlights core knowledge, skills, competences and personal attributes that Workshop Machines Operators must possess to be successful in their jobs.

ACRONYMS AND ABBREVIATIONS

CNC	Computer Numerical Control
CS	Core Skill
NOS	National Occupational Standard
NOSDT	National Occupational Standards Development Team
OK	Organisational Knowledge
PC	Performance Criteria
PS	Professional Skill
LM	Lathe Machine
RK	Regulatory Knowledge
RPL	Recognition of Prior Learning
TK	Technical Knowledge
WMO	Workshop Machines Operator
ZAQA	Zambia Qualifications Authority
ZQF	Zambia Qualifications Framework

GLOSSARY OF TERMS

For the purposes of these NOS, the following terms and definitions shall apply:

Core Skills/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: 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 Title: defines a unique set of functions that together form a unique employment opportunity in an organisation.

Knowledge and Understanding (K): 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.

National Occupational Standards (NOS): are statements of the standards of performance individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding. They are precise descriptions of what an individual is expected to be able to do in his/her work role.

National Occupational Standards (NOS) Code: is a unique reference code that identifies a NOS.

National Occupational Standards Development Team (NOSDT): means an established group of national stakeholders/experts responsible for the development of National Occupational Standards within a specific economic sector or occupation.

Occupation: is a set of job roles, which perform similar/related set of functions in an industry.

Organisational Context: includes the way the organisation is structured and how it operates, including the extent of operative knowledge that managers have in their relevant areas of responsibility.

Performance Criteria (PC): are statements that together specify the standard of performance required when carrying out a task.

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: 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: is derived from a further breakdown based on the characteristics and interests of its components.

Technical Knowledge (TK): is the specific knowledge needed to accomplish specific designated responsibilities.

Unit Title: gives a clear overall statement about what the incumbent should be able to do.

1. OVERVIEW

This is an introductory section providing a brief summary and specific information or commentary about the content of the NOS and the targeted sector and occupation to help the user judge whether it is relevant to them.

NOS Code	NOS.WMO.01
Occupation	Workshop Machine Operations
Job Title	Workshop Machines Operator
Job Description	Operating of Machinery/Equipment
Job Purpose	To Safely and economically Operate machinery/equipment
ZQF Level	4
Sector	Manufacturing
Sub sector	All subsectors of the Manufacturing sector
Other Economic Sector(s) in which the Occupation is Practiced	All production related sectors
Other Similar Jobs that can be performed by the Workshop Machines Operator	Draughter, Fitter, Boiler Maker, Machinist, etc.
Minimum Educational Job Entry Qualification(s)	Crafts Certificate, or equivalent
Practicing License Requirements (if any)	• Operating Permits • Membership with the Engineering Institution of Zambia (EIZ) and Practicing Licence from the Engineering Registration Board (EngRB), as applicable
Training/RPL	• Use of ICTs (Internet, Microsoft word, Excel, PowerPoint, Email, Computer Software and Hardware necessary for the job, etc.) • 5S Workplace Organisation Method
Minimum Job Entry Age	18
Prior Experience (Suggested)	1 year prior experience in a similar role
Performance Criteria	As described in the Units under Section 4

2. SCOPE

This National Occupational Standard specifies the fundamental knowledge and understanding, skills and competences that Workshop Machines Operators must possess to be successful in their jobs.

3. PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES)

This job requires the individual to work independently and be comfortable in performing procedural work. He/she should be result oriented and positive in attitude. The individual must be attentive and focused in attaining the set objectives. He/she should be able to handle multiple tasks and smart to resolve any problem emanating from machine and material handling at the level of production he/she is engaged in. He/she must be a team player and reliable.

4. UNITS AND ELEMENTS

This National Occupational Standard is divided into ten (10) Units representing the tasks that a jobholder should undertake in his/her day to day work. Each unit is further broken down into elements depicting the number of activities to be carried out for the successful execution of a particular task.

UNIT 1 [This unit covers health, safety and environment at the workplace. This includes procedures and practices that jobholders or candidates need to follow to help maintain a healthy, safe and secure work environment].

Unit No.	**01**
Unit Title	**Health, safety and environment**
Description	This unit is about knowledge and practices relating to health, safety, security and environment that jobholders or candidates need to use in the workplace. It covers responsibilities towards self, others, assets and the environment.
Scope	This Unit covers the following: • Health and safety procedure • Fire safety procedure • Emergencies, rescue and first aid procedures • Ensure sorting, streamlining, storage and documentation, cleaning, safety standards and sustenance across the plant premises of the organisation.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Health and safety	To be competent, the individual must be able to: PC1. Select appropriate PPE PC2. Wear protective clothing/equipment for specific tasks and work conditions PC3. Carry out safe working practices while dealing with hazards to ensure the safety of Self and others. PC4. Ensure good housekeeping practices at all times.
Fire safety	To be competent, the individual must be able to: PC5. Select appropriate fire extinguishers on different types of fires correctly PC6 Use the various appropriate fire extinguishers on different types of fires correctly PC7. Demonstrate rescue techniques applied during fire hazard, demonstrate good housekeeping in order to prevent fire hazards, demonstrate the correct use of a fire extinguisher.
Emergencies, rescue and first aid procedures	To be competent, the individual must be able to: PC8. Identify activities which can cause potential injury through sharp objects, burns, fall, electricity, gas leakages, radiation, poisonous fumes, chemicals, loud noise, and Identify areas in the plant which are potentially hazardous / unhygienic in nature. PC9. Conduct regular checks with support of the maintenance team on machine health to identify potential hazards due to wear and tear of machine. PC10. Inform the concerned authorities on the potential risks identified in the processes, workplace area/ layout, materials used etc., Inform the concerned authorities about machine breakdowns, damages which can potentially harm man/

	machine during operations. PC11. Create awareness amongst others by sharing information on the identified risks.
Ensure sorting, streamlining, storage and documentation, cleaning, standardisation and sustenance across the plant premises of the Organisation	To be competent, the individual must be able to: PC12. Follow the sorting process and check that the tools, fixtures and jigs that are lying on workstations are the ones in use and un- necessary items are not cluttering the workbenches or work surfaces. PC13. Ensure segregation of waste in hazardous/ non Hazardous waste as per the sorting work instructions PC14. Follow the technique of waste disposal and waste storage in the proper bins as per SOP PC15. Segregate the items which are labelled as red tag items for the process area and keep them in the correct places PC16. Sort the tools/ equipment/ fasteners/ spare parts as per specifications/ utility into proper trays, cabinets, lockers as mentioned in the 5S guidelines/ work instructions PC17. Ensure that areas of material storage are not overflowing PC18. Ensure properly stack the various types of boxes and containers as per the size/ utility to avoid any fall of items/ breakage and also enable easy sorting when required PC19. Return of extra material and tools to the designated sections and make sure that no additional material/ tool is lying near the work area PC20. Follow the floor markings/ area markings used for demarcating the various sections in the plant as per the prescribed instructions and standards PC21. Follow the proper labelling mechanism of instruments/ boxes/ containers and maintaining reference files/ documents with the codes and the lists PC22. Ensure to check the items in the respective areas have been identified as broken or damaged PC23. Follow the given instructions and check for labelling of fluids, oils, lubricants, solvents, chemicals, etc. and proper storage of the same to avoid spillage, leakage, fire, etc. PC24. Make sure that all material and tools are stored in the designated places and in the manner indicated in the 5S instructions
Knowledge and Understanding	
A. Organisational Context (Knowledge of the company/ Organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. The relevant standards, procedures and policies related to Health, Safety and Environment followed in the company OK2. The emergency handling procedures and hierarchy for escalation

B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. The basic knowledge of risks/hazards associated with each occupation in the Organisation TK2. The knowledge of personal hygiene and how an individual contribute towards creating a highly safe and clean working environment the individual on the job needs to know and understand. TK3. The meaning of “hazards” and “risks” TK4. The health and safety hazards commonly present in the work environment and related precautions TK5. The possible causes of risk, hazard or accident in the workplace and why risk and/or accidents are possible TK6. The Possible causes of risk and accident (due to oil leakage) TK7. Methods of accident prevention TK8. Safe working practices when working with tools and machines TK9. Safe working practices while working at various hazardous sites TK10. The general health and safety equipment in the workplace TK11. Various dangers associated with the use of electrical equipment TK12. Preventative and remedial actions to be taken in the case of exposure to toxic materials TK13. The Importance of using protective clothing/equipment while working TK14. Precautionary activities to prevent the fire accident TK15. Various causes of fire TK16. The techniques of using the different fire extinguishers TK17. Different methods of extinguishing fire TK18. Different materials used for extinguishing fire TK19. Rescue techniques applied during a fire hazard TK20. Various types of safety signs and what they mean TK21. Appropriate basic first aid treatment relevant to the condition e.g. shock, electrical shock, bleeding, breaks to bones, minor burns, resuscitation, poisoning, eye injuries TK22. The content of written accident report TK23. Potential injuries and ill health associated with incorrect manual handing TK24. Safe lifting and carrying practices TK25. Personal safety, health and dignity issues relating to the movement of a person by others TK26. Potential impact to a person who is moved incorrectly TK27. 5S procedures TK28. Various types of 5S practices followed in various areas TK29. 5S checklists provided in the department/ team TK30. The useful and non-useful items

	TK31. To have knowledge of labels , signs and colours used as indicators TK32. To have knowledge on how to sort and store various types of tools, equipment, material etc. TK33. About identification of various types of waste products TK34. The impact of waste/dirt/dust/unwanted substances on the process/environment/machinery/human body. TK35. To have knowledge of best ways of cleaning and waste disposal
C. Regulatory Context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Reading Skills**
	The individual on the job must be able to: CS1. Read English and the major local languages used at the plant or factory CS2. Read and interpret instructional Signage and Symbols CS3. Safety instructions put up across the plant premises CS4. Read, understand and write Safety precautions and instructions outlined in equipment/machinery manuals and panels and related and associated potential risks CS5. Read equipment manuals and process documents to understand the equipment's Safety requirements CS6. Read internal information sent by supervisor/other teams
	Writing Skills
	The individual on the job must be able to: CS7. Note down observations (if any) related to Safety and share the same with the supervisor CS8. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS9. Write in English and the major local languages used at the plant or factory CS10. Prepare and interpret safety and general signage, tags, etc. provided at the workplace
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS11. Discuss safety task lists, schedules, and work-loads with co-workers CS12. Effectively communicate with the team members CS13. Question supervisor/other co-workers appropriately in order to understand the nature of the problem and make a diagnosis on Safety Issues

	CS14. Attentively listen and comprehend the information given by the speaker CS15. Listen and interpret communication/instructions from co-workers CS16. Convey information clearly and concisely to the co-workers communicate information to team members effectively CS17. Inform employees in the plant and concerned functions about events, Incidents and potential risks observed related to Safety, Health and Environment. CS18. Question operator/ supervisor in order to understand the safety related issues
B. Professional Skills	**Plan and Organise**
	The individual on the job must be able to: PS1. Plan and organise the work instruction and jobs received from the supervisor/other teams PS2. Organise all process/equipment manuals so that sorting out/accessing information is easy PS3. Support the supervisor in scheduling tasks for helpers
	Judgment and Critical Thinking
	The individual on the job must be able to: PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to detect any potential problems which could arise
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS7. Follow instructions and work on areas of improvement identified PS8. Complete the assigned tasks with minimum supervision PS9. Complete the job defined/assigned by the supervisor within the timelines and quality norms
	Problem Solving and Decision Making
	The individual on the job must be able to: PS10. Detect problems in day to day tasks PS11. Discuss possible solutions to address problems, with the supervisor PS12. Support supervisor in using specific problem solving techniques and detailing out the problems PS13. Make decisions in emergency situations in the absence of the supervisor (as per the authority matrix defined by the organisation)

UNIT 2 [This unit covers designs, drawings, process planning and co-ordination in the workplace for the machining of components, making of tools and dies].

Unit No.	**02**
Unit Title	**Using the basic concepts, design, drawings and planning for machining components, making tools and dies and coordinating with others**
Description	This unit is about the planning and co-ordinating for machining components, and manufacturing of tools and dies as per given dimensions.
Scope	This unit/task covers the following: • Understanding design requirements and planning • Co-coordinating with others
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria (PC)**
Understanding design requirements and planning	To be competent, the individual must be able to: PC1. Obtain sample component/ drawings and other engineering information as per company procedures PC2. Identify requirements by analysing sample component, design and drawing PC3. Plan sequence of operations for machining component keeping in mind various considerations like requirements, timelines, resources available, interdependencies, constraints, compliances, etc. PC4. Report and rectify cases of inappropriate information in design documents as per Organisational procedures PC5. Ensure the dimensions, sizes, shapes and tolerances of machining component are as per specifications and as per company procedures PC6. Determine the information such as number of parts to make, engineered components and material to be used, and machines to be used PC7. Identify and confirm resources required such as components, machinery, range of materials and processes PC8. Identify the operations that will be required for machining components based on design requirements PC9. Identify type of equipment required for machining components based on the operations selected PC10. Estimate timelines for each task accurately PC11. Establish work completion time by determining a schedule of operations PC12. Obtain necessary approvals for the action plan PC13. Allocate responsibilities to Workshop Machines Operators as per the operations selected PC14. Ensure that the Workshop Machines Operators are clear about the sequence of activities, priorities and considerations

Co-ordinating with others	To be competent, the individual must be able to: PC15. Identify and select machines for machining components based on design and drawings PC16. Identify and select cutting tools based on design and drawings PC17. Select and procure appropriate metals to be used for machining components as per design requirement PC18. Hand over cutting tools and raw material for machining to the other crafts/supervisors PC19. Handle all clarifications sought by the supervisor and others PC20. Collect jobs from the supervisor PC21. Check the jobs as per drawing/instruction PC22. Ensure in-process inspection of the machining component
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the Company/ Organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. The policies and procedures followed in the company relevant to own employment and performance conditions OK2. Health and safety requirements in the work place OK3. Working procedure in clean and safe environment OK4. Job responsibilities and information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting mechanism, department functions and procedures in the work place OK6. Related workforce and their responsibilities within the work area OK7. Procedures for reporting at work and employment related issues OK8. Documentation and related procedures applicable related to employment and work OK9. Documentation in context of employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. The sources for information about job specifications TK2. Preparing various types of job specification documents for job requirements TK3. Hazards associated with the activities TK4. The various fitting activities to be carried out TK5. How to extract and use information from engineering drawings and related specifications in relation to work undertaken TK6. Various hand fitting methods TK7. How to interpret first and third angle drawings TK8. machining methods TK9. Basic knowledge of accessing computer drawing using Auto-Cad software to be used for viewing designs drawings TK10. Factors that affect the selection of cutting speed, feed and depth of cut

	TK11. The Metric systems of measurement TK12. Geometric dimensioning and tolerance TK13. How to plan and organise the team TK14. Machine operations and sequencing TK15. Machine capacity and capabilities TK16. Types of machine tools such as lathes, milling, drills, grinding, TK17. Work holding devices and equipment TK18. Machining accessories TK19. Limits and capabilities of tooling, accessories and holding devices TK20. How to check the work piece and the measuring instruments. TK21. Need to check that the component using calibrated measuring instrument TK22. Properties of metals TK23. Basic heat treatment processes of tool steel
C. Regulatory Context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Oral Communication (Listening and Speaking skills)**
	The individual on the job must be able to: CS1. Convey and share technical information clearly using appropriate language CS2. Check and clarify task-related information CS3. Liaise with appropriate authorities using correct protocol CS4. Communicate with people in respectful form and manner in line with Organisational protocol
	Reading Skills
	The individual on the job must be able to: CS5.Read and interpret information correctly from various job specification documents, manuals, health and Safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams

	Writing Skills
	The individual on the job must be able to: CS10. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS11. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS12. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Numerical and computational skills
	The individual on the job must be able to: CS13. Apply mathematical calculations and geometry CS14. Use appropriate measuring techniques CS15. Apply mathematical calculations to a degree of accuracy that is appropriate to the value being calculated CS16. Use a calculator to raise a number to a power and determine square roots CS17. Calculate the value of angles in a triangle
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: CS18. Maintain current knowledge of process developments CS19. Clarify job related information with appropriate personnel or technical adviser CS20. Seek to improve and modify own work practices
	Computer Basics
	The individual on the job must be able to: CS22. Perform basic operations on a computer such as switching it on/off, using the mouse and keyboard, accessing, opening and closing files, creating and deleting, folders, etc. CS23. Use basic office applications like spreadsheet, word processor, PowerPoint presentations, etc. CS24.Use email to communicate within or outside the organisation as per organisation guidelines CS25. Retrieve and enter data using standard system forms and templates CS26. Make printouts and photocopies of documents
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution methods PS7. Select and apply resolution techniques

	PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. Plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Apply basic concepts of shop-floor work productivity including minimising rejection and optimising of time
	Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Demonstrate one's competencies in new and different situations and contexts to achieve more
	Self-Management
	The individual on the job must be able to: PS15. Exercise restraint while expressing dissent and during conflict situations PS16. Avoid and manage distractions to be disciplined at work PS17. Manage own time to achieving better results
	Teamwork
	The individual on the job must be able to: PS18. Work in a team in order to achieve better results PS19. Identify and clarify work roles within a team PS20. Communicate and cooperate with others in the team for better results PS21. Seek assistance from fellow team members
	Critical Thinking
	The individual on the job must be able to: PS22. Apply, analyse, and evaluate the information gathered from observation, experience, reasoning or communication, as a guide to thought and action

UNIT 3 [This unit covers fitting operations on machining components using hand tools to make shape of the component from raw materials as per given drawing specifications].

Unit No.	**03**
Unit Title	**Perform fitting operations on machining components using hand tools**
Description	This unit covers fitting of machining components using hand tools and manually operated machines to form the shape of a component from raw materials, as per given specifications in a drawing.
Scope	This unit/task covers the following: • Preparing for fitting operations • Marking components • Performing fitting operations
Performance Criteria (PC) With respect to the Scope	
Element	**Performance Criteria (PC)**
Preparing for fitting Operations	To be competent, the individual must be able to: PC1. Obtain job specification from a valid and approved source PC2. Read and understand job requirements from the job specification document properly PC3. Report and rectify incorrect information in job specification documents as per job requirement PC4. Preparation for the fitting operations as per procedure PC5. Ensure that all calibrated measuring instruments used. PC6. Ensure that the components used are free from foreign objects, dirt and corrosion PC7. Obtain correct work pieces and consumables as per job requirements PC8. Obtain appropriate tools and measuring instruments. PC9. Set the work pieces as per job requirements using appropriate holding devices
Marking components	To be competent, the individual must be able to: PC10. Mark the specified features with the help of marking-out methods on the work pieces as per job specification by using appropriate measuring and marking tools. PC11. Mark out templates for tracing/transferring the specified features on the work pieces as per drawing PC12. Trace or transfer the specified features from the templates onto the work pieces as per drawing
Performing fitting operations on machining components using hand tools	To be competent, the individual must be able to: PC13. Perform fitting operations on various forms of metal components using a range of hand tools and manually operated machines PC14. Follow the specified machining sequence and procedure as per job specifications PC15. Check the machined components to ensure completeness of work

	PC16. Check the quality of the output as per required standards, using visual checks and measurement of dimensional parameters using measuring instruments. PC17. Produce components with various features as per standards applicable to the process PC18. Check the finished components as per job requirement PC19. Complete documentation during and post operations as per procedures PC20. Return all tools and equipment to the correct location on completion of the fitting activities PC21. Leave the work area in a safe and tidy condition on completion of job activities
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the Company/ Organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Policies and procedures followed in the company relevant to own employment and performance conditions OK2. Health and safety requirements in the work place OK3. Working in clean and safe environment OK4. Job responsibilities and information related to employment terms, entitlements, job role and responsibilities OK5. Reporting mechanism, department functions and procedures in the work place OK6. Related workforce and their responsibilities within the work area OK7. Procedures for reporting at work and employment related issues OK8. Documentation and related procedures applicable related to employment and work OK9. Documentation in connection with employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Specific safe working practices, fitting procedures TK2. Hazards associated with carrying out the fitting operations and how can they be minimised TK3. Personal protective equipment to be used during the fitting activities and where can it be obtained TK4. Types and sources of appropriate job specifications TK5. Common terminology used in fitting TK6. Importance of following specified fitting sequences and procedures TK7. Importance and procedures of ensuring suitability of work piece and consumables for the specified job TK8. Tools and equipment used for the fitting operations TK9. Importance and procedures to ensure that tools and equipment are in a safe and usable condition TK10. Correct techniques and procedures to carry out specific fitting operations by hand tools and manually

	operated machines TK11. Importance of securing the work piece correctly using appropriate devices and mechanisms TK12. Common problems that can occur in the fitting operations and their implications TK13. Correct procedures to address problems commonly encountered during fitting operations TK14. Importance of reporting problems immediately and accurately TK15. Meaning and importance of quality in relation to final and intermediate job output TK16. How to check the correctness of the shaped components against the specified quality standards TK17. Range of materials used in relevant fitting applications TK18. Relevant mechanical properties of metals and implications for job TK19. Importance of using correct procedures as per type and form of materials and metal components
C. Regulatory Context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams

	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution techniques PS7. Select and apply resolution techniques PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Take Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and customer relationships PS15. Demonstrate competencies in new and different situations to achieve more
	Self-Management
	The individual on the job must be able to: PS16. Exercise restraint while expressing dissent and during conflict situations PS17. Avoid and manage distractions to be disciplined at work PS18. Manage the time to achieve better results

	Teamwork
	The individual on the job must be able to: PS19. Work in a team in order to achieve better results PS20. Identify and clarify work roles within a team PS21. Communicate and cooperate with others in the team for better results PS22. Seek assistance from fellow team members

UNIT 4 This unit covers machining a range of metal components that combine different features by carrying out drilling operations on Drilling Machines.

Unit No.	**04**
Unit Title	**Operating Drilling Machines**
Description	This unit is about carrying out operations on Drilling Machines to produce a range of ferrous and nonferrous metals that combine a number of different features e.g. drilled, bored and reamed holes.
Scope	This unit/task covers the following: • Preparing for Drilling Machine operations • Carrying out operations on a Drilling Machine
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria (PC)**
Preparing for Drilling Machine operations	To be competent, the individual must be able to: PC1. Ensure that all measuring equipment is within calibration due date PC2. Ensure availability of job specification from a valid source/Drawings PC3. Read and establish job requirements from the job specification document PC4. Prepare and maintain the work area as per procedure or operation specification PC5. Plan to carry out the required drilling activities and the sequence of operations as per specifications PC6. Apply safe working practices and procedures at all times PC7. Obtain all the appropriate materials, cutting tools and measuring equipment's required for the drilling operations PC8. Confirm that the machine is ready for production PC9. Prepare for the Drilling activities by mounting, positioning and correctly setting a range of work holding devices and cutting tools PC10. Seek any necessary instruction/training on the operation of the machine, where required PC11. Hold components securely, without distortion PC12. Ensure that machine settings are adjusted as and when required to maintain the required accuracy
Carrying out operations on a Drilling Machine	To be competent, the individual must be able to: PC13. Obtain the component drawings, specifications, job instructions required for the components to be machined PC14. Use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate ISO standards in relation to work undertaken) PC15. Set and adjust the machine tool speeds and feeds to achieve the component specification

	PC16. Mount and set the required work holding devices, work piece and cutting tools PC17. Operate the machine tool controls safely and correctly, in line with operational procedures PC18. Control the machine in both hand and power modes for normal operations PC19. Stop the machine in both normal and emergency situations correctly, and follow right procedure for restarting after an emergency PC20. Use drilling machine accessories that consists of vices, drill chuck, sleeves, clamps, tool holders. PC21. Position and secure work holding devices to the machine spindle PC22. Perform drilling operations using various equipment's to produce components with various features PC23. Produce components as per given quality standards PC24. Plan and work to achieve given production targets PC25. Overcome the effects of backlash in machine slides and screws PC26. Perform the technique of trial cut for checking dimensional accuracy PC27. Apply roughing and finishing cuts, considering the effect on tool life, surface finish and dimensional accuracy PC28. Use cutting fluids for different materials PC29. Use range of measuring instruments to check critical parameters PC30. Clamp the work piece in a chuck/work holding device PC31. Perform the checks to be carried out on the components before removing them from the machine, and the equipment needed for this activity PC32. Ensure that the quality control procedures are used while operating the equipment
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company / Organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Policies, and procedures followed in the company relevant to own employment and performance conditions OK2. Relevant health and safety requirements applicable in the work place OK3. Importance of working in clean and safe environment OK4. Own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting structure, inter-dependent functions, lines and procedures in the work area OK6. Relevant people and their responsibilities within the work area OK7. Procedures for reporting work and employment related issues

	OK8. Documentation and related procedures applicable in the context of employment and work OK9. Importance and purpose of documentation in context of employment and work

B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Appropriate personal protective equipment to be worn can be obtained TK2. Where to obtain the component drawings, specifications and/or job instructions required for them components to be machined TK3. Hazards associated with the drilling operations and how they can be minimised TK4. Meaning and purpose of drilling TK5. Safety mechanisms on the machine, and the procedure for checking that they function correctly TK6. How to tighten all the bolts and other securing devices securely TK7. Importance of keeping the work area clean and tidy TK8. How to use metric systems of measurement TK9. Main features of the Drilling machine and the accessories that can be used TK10. Classification and purpose of various accessories TK11. Tool materials (classification, properties and use) TK12. How to identify the factors that affect the selection of cutting feeds and speeds, and the depth of cut that can be taken TK13. The drilling operations that can be performed using various equipment, and the component features produced on metal and non-metal components TK14. Effects of backlash in machine slides and screws, and how this can be overcome TK15. Safety instructions and warning signs on the machine TK16. Types of cutting fluids and their properties TK17. Effects of clamping the work piece in a chuck/work holding device, and how this can cause distortion in the finished components TK18. Problems that can occur with the drilling and how these can be overcome TK19. Correct equipment and procedure to use for checking critical quality parameters TK20. Production cost, machine hour rate, raw material cost, tool cost, coolant cost, overheads, cycle time, idle time, cost of machine idling, part rejection cost TK21. Selection of cutting tools, tool materials, selecting cutting parameters from tool catalogues, selecting coolant. TK22. Relationship between surface finish, tool angle, speed and feed rate. TK23. Impact of depth of cut on chatter, surface finish.
	TK24. Extent of their own authority and to whom they should report if they have problems that they cannot resolve

C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
	Numerical and computational skills
	The individual on the job must be able to: CS14. Undertake numerical operations and calculations CS15. Identify and draw various basic, compound and solid shapes as per dimensions given CS16. Use appropriate measuring techniques and units of measurement CS17. Use appropriate units and number systems to express degree of accuracy CS18. Use metric system of measurement

B. Professional Skills	**Plan and Organise**
	The individual on the job must be able to: PS9. Plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Apply basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Judgment and Critical Thinking
	The individual on the job must be able to: PS4. Use common sense and make judgments in day to day activities PS5. Use reasoning skills to identify and resolve basic problems PS6. Use intuition to detect any potential problems which could arise
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13.Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and internal/external customer/supplier relationships PS15. Demonstrate one's competencies in new and different situations and contexts to achieve more
	Problem Solving and Decision Making
	The individual on the job must be able to: PS16. Identify problems with work planning, procedures, output and behaviour and their implications PS17. Prioritise and plan for problem solving PS18. Communicate problems appropriately to others PS19. Identify sources of information and support for problem solving PS20. Seek assistance and support from other sources to solve problems PS21. Identify effective resolution techniques PS22. Select and apply resolution techniques PS23. Seek evidence for problem resolution

UNIT 5: [This unit covers fitting operations on machining components using hand tools to make shapes of the components from raw materials as per given drawing specifications].

Unit No.	**05**
Unit Title	**Operating Shaping Machines**
Description	This unit is covers operating a Shaping Machine to produce a range of ferrous and nonferrous metals that combine a number of different features e.g. parallel, stepped and angular machining.
Scope	This unit/task covers the following: • Preparing for Shaping Machine operations • Carrying out operations on a Shaping Machine
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria (PC)**
Preparing for Shaping Machine operations	To be competent, the individual must be able to: PC1. Ensure that all measuring equipment is within calibration due date PC2. Ensure availability of job specification from a valid source/Drawings PC3. Read and establish job requirements from the job specification document PC4. Ensure that the incoming components used are free from foreign objects, dirt or other contamination PC5. Prepare and maintain the work area as per procedure or operation specification PC6. Plan to carry out the required shaping activities and the sequence of operations as per specifications PC7. Apply safe working practices and procedures at all times PC8. Obtain all the appropriate materials, cutting tools and measuring equipment's required for the shaping operations PC9. Confirm that the machine is ready for production PC10. Prepare for the shaping activities by mounting, positioning and correctly setting a range of work holding devices and cutting tools PC11. Seek any necessary instruction/training on the operation of the machine, where required PC12. Hold components securely, without distortion PC13. Ensure that machine settings are adjusted as and when required to maintain the required accuracy
Carrying out operations on a Shaping Machine	To be competent, the individual must be able to: PC14. Obtain the component drawings, specifications, job instructions required for the components to be machined PC15. Use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate ISO standards in relation to work undertaken) PC16. Set and adjust the machine tool speeds and feeds to

	achieve the component specification PC17. Mount and set the required work holding devices, work piece and cutting tools PC18. Operate the machine tool controls safely and correctly, in line with operational procedures PC19. Control the machine in both hand and power modes for normal operations PC20. Stop the machine in both normal and emergency situations correctly, and follow right procedure for restarting after an emergency PC21. Use shaping machine accessories that consists of vices, clamps, tool holders. PC22. Position and secure work holding devices to the machine ram PC23. Perform shaping operations using various equipment's to produce components with various features PC24. Produce components as per given quality standards PC31. Plan and work to achieve given production targets PC25. Overcome the effects of backlash in machine slides PC26. Perform the technique of trial cut for checking dimensional accuracy PC27. Apply roughing and finishing cuts, considering the effect on tool life, surface finish and dimensional accuracy PC28. Use cutting fluids for different materials PC29. Use range of measuring instruments to check critical parameters PC30. Clamp the work piece in a chuck/work holding device PC31. Perform the checks to be carried out on the components before removing them from the machine, and the equipment needed for this activity PC32. Ensure that the quality control procedures are used while operating the
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Policies, and procedures followed in the company relevant to own employment and performance conditions OK2. Relevant health and safety requirements applicable in the work place OK3. Importance of working in clean and safe environment OK4. Own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting structure, inter-dependent functions, lines and procedures in the work area OK6. Relevant people and their responsibilities within the work area OK7. Procedures for reporting work and employment related issues OK8. Documentation and related procedures applicable in the

	context of employment and work OK9. Importance and purpose of documentation in context of employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Appropriate personal protective equipment to be worn can be obtained TK2. Where to obtain the component drawings, specifications and/or job instructions required for them components to be machined TK3. Hazards associated with the shaping operations and how they can be minimised TK4. Meaning and purpose of shaping TK5. Safety mechanisms on the machine, and the procedure for checking that they function correctly TK6. How to tighten all the bolts and other securing devices securely TK7. Importance of keeping the work area clean and tidy TK8. How to use metric systems of measurement TK9. Main features of the shaper and the accessories that can be used TK10. Classification and purpose of various accessories TK11. Tool materials (classification, properties and use) TK12. How to identify the factors that affect the selection of cutting feeds and speeds, and the depth of cut that can be taken TK13. The shaping operations that can be performed using various equipment, and the component features produced on metal and non-metal components TK14. Effects of backlash in machine slides and screws, and how this can be overcome TK15. Safety instructions and warning signs on the machine TK16. Types of cutting fluids and their properties TK17. Effects of clamping the work piece in a work holding device, and how this can cause distortion in the finished components TK18. Problems that can occur with the shaping and how these can be overcome TK19. Correct equipment and procedure to use for checking critical quality parameters TK20. Production cost, machine hour rate, raw material cost, tool cost, coolant cost, overheads, cycle time, idle time, cost of machine idling, part rejection cost TK21. Selection of cutting tools, tool materials, selecting cutting parameters from tool catalogues, selecting coolant. TK22. Relationship between surface finish, tool angle, speed and feed rate. TK23. Impact of depth of cut on chatter, surface finish. TK24. Extent of their own authority and to whom they should report if they have problems that they cannot resolve

C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution techniques PS7. Select and apply resolution techniques

	PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Take Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and customer relationships PS15. Demonstrate competencies in new and different situations to achieve more
	Self-Management
	The individual on the job must be able to: PS16. Exercise restraint while expressing dissent and during conflict situations PS17. Avoid and manage distractions to be disciplined at work PS18. Manage the time to achieve better results
	Teamwork
	The individual on the job must be able to: PS19. Work in a team in order to achieve better results PS20. Identify and clarify work roles within a team PS21. Communicate and cooperate with others in the team for better results PS22. Seek assistance from fellow team members

UNIT 6: [This unit covers machining a range of metal components that combine different features by carrying out turning operations on Lathe Machines such as centre lathes].

Unit No.	**06**
Unit Title	**Operating a Lathe Machine**
Description	This unit is covers performing turning operations on Lathe Machines such as centre lathes to produce a range of ferrous and nonferrous metals that combine a number of different features e.g. parallel, stepped and taper turning, machining diameters, drilled, bored and reamed holes, internal, external threading operation and turning special form profiles.
Scope	This unit/task covers the following: • Preparing for Lathe Machine operations • Carrying out operations on a Lathe Machine
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria (PC)**
Preparing for Lathe Machine operations	To be competent, the individual must be able to: PC1. Ensure that all measuring equipment is within calibration due date PC2. Ensure availability of job specification from a valid source/Drawings PC3. Read and establish job requirements from the job specification document PC4. Ensure that the incoming components used are free from foreign objects, dirt or other contamination PC5. Prepare and maintain the work area as per procedure or operation specification PC6. Plan to carry out the required turning activities and the sequence of operations as per specifications PC7. Apply safe working practices and procedures at all times PC8. Obtain all the appropriate materials, cutting tools and measuring equipment's required for the turning operation PC9. Confirm that the machine is ready for production PC11. Prepare for the turning activities by mounting, positioning and correctly setting a range of work holding devices and cutting tools PC12. Seek any necessary instruction/training on the operation of the machine, where required PC13. Hold components securely, without distortion PC14. Ensure that machine settings are adjusted as and when required to maintain the required accuracy
Carrying out operations on a Lathe Machine	To be competent, the individual must be able to: PC15. Obtain the component drawings, specifications, job instructions

	required for the components to be machined PC16. Use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate ISO standards in relation to work undertaken) PC17. Set and adjust the machine tool speeds and feeds to achieve the component specification PC18. Mount and set the required work holding devices, work piece and cutting tools PC19. Operate the machine tool controls safely and correctly, in line with operational procedures PC20. Control the machine in both hand and power modes for normal operations PC21. Stop the machine in both normal and emergency situations correctly, and follow right procedure for restarting after an emergency PC22. Use lathes and the accessories that consists of saddle, capstan/turret head, compound slide, tailstock, taper turning attachments, profile attachments, fixed and travelling steadies PC23. Position and secure work holding devices to the machine spindle PC24. Perform turning operations using various equipment's to produce components with various features PC25. Produce components as per given quality standards PC26. Plan and work to achieve given production targets PC27. Overcome the effects of backlash in machine slides and screws PC28. Perform the technique of trial cut for checking dimensional accuracy PC29. Apply roughing and finishing cuts, considering the effect on tool life, surface finish and dimensional accuracy PC30. Use cutting fluids for different materials PC31. Use range of measuring instruments to check critical parameters PC32. Clamp the work piece in a chuck/work holding device PC33. Perform the checks to be carried out on the components before removing them from the machine, and the equipment needed for this activity PC34. Ensure that the quality control procedures are used while operating the equipment
Knowledge and Understanding	
A. Organisational Context (Knowledge of the Company/ Organisation	The individual on the job must demonstrate knowledge and understanding of: OK1. Policies, and procedures followed in the company relevant to own employment and performance conditions OK2. Relevant health and safety requirements applicable in the work place

	OK3. Importance of working in clean and safe environment OK4. Own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting structure, interdependent functions, lines and procedures in the work area OK6. Relevant people and their responsibilities within the work area OK7. Procedures for reporting work and employment related issues OK8. Documentation and related procedures applicable in the context of employment and work OK9. Importance and purpose of documentation in context of employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Appropriate personal protective equipment to be worn can be obtained TK2. Where to obtain the component drawings, specifications and/or job instructions required for them components to be machined TK3. Hazards associated with the turning operations and how they can be minimised TK4. Meaning and purpose of turning TK5. Safety mechanisms on the machine, and the procedure for checking that they function correctly TK6. How to tighten all the bolts, cam locks or other securing devices securely TK7. importance of keeping the work area clean and tidy TK8. How to use metric systems of measurement TK9. Main features of the lathes and the accessories that can be used TK10. Classification and purpose of various accessories TK11. Tool materials (classification, properties and use) TK12. How to identify the factors that affect the selection of cutting feeds and speeds, and the depth of cut that can be taken TK13. The Turning operations that can be performed using various equipment, and the component features produced on metal and non-metal components TK14. Effects of backlash in machine slides and screws, and how this can be overcome TK15. Safety instructions and warning signs on the machine TK16. Types of cutting fluids and their properties TK17. Effects of clamping the work piece in a chuck/work holding device, and how this can cause distortion in the finished components TK18. Problems that can occur with the turning activities, and how these can be overcome

	TK19. Correct equipment and procedure to use for checking critical quality parameters TK20. Production cost, machine hour rate, raw material cost, tool cost, coolant cost, overheads, cycle time, idle time, cost of machine idling, part rejection cost TK21. Selection of cutting tools, tool materials, chip breaker geometry, selecting Cutting parameters from tool catalogues, selecting coolant TK22. Relationship between surface finish, tool nose radius, speed and feed rate TK23. Impact of depth of cut on chatter, surface finish. TK24. Extent of their own authority and to whom they should report if they have problems that they cannot resolve
C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information

	CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
	Numerical and computational skills
	The individual on the job must be able to: CS14. Undertake numerical operations and calculations CS15. Identify and draw various basic, compound and solid shapes as per dimensions given CS16. Use appropriate measuring techniques and units of measurement CS17. Use appropriate units and number systems to express degree of accuracy CS18. Use metric system of measurement
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution techniques PS7. Select and apply resolution techniques PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. Plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Apply basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and internal/external customer/supplier relationships PS15. Demonstrate one's competencies in new and different situations and contexts to achieve more
	Judgment and Critical Thinking
	The individual on the job must be able to: PS16. Use common sense and make judgments in day to day activities

	PS17. Use reasoning skills to identify and resolve basic problems PS18. Use intuition to detect any potential problems which could arise
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS19. Follow instructions and work on areas of improvement identified PS20. Complete the assigned tasks with minimum supervision PS21. Complete the job defined/assigned by the supervisor within the timelines and quality norms

UNIT 7 [This unit covers producing a range of components by carrying out machining operations on Milling Machines].

Unit No.	**07**
Unit Title	**Operating a Milling Machine**
Description	This unit is about performing milling operations on a Milling Machine to produce a range of components that combine a number of different features (e.g. flat faces, parallel faces, faces that are flat and square to each other, angular faces, steps, slots, drilling and special forms).
Scope	This unit covers the following: • Preparing for Milling Machine operations • Carrying out operations on a Milling Machine
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Preparing for Milling Machine operations	To be competent, the individual must be able to: PC1. Ensure that all measuring instruments are within calibration due date PC2. Ensure that the components used are free from foreign objects, dirt or other contamination PC3. Ensure availability of job specification from a valid source PC4. Read and establish job requirements from the job specification document PC5. Prepare and maintain the work area as per procedure or operation specification PC6. Confirm that the machine is ready for production PC7. Seek any necessary instruction/training on the operation of the various milling machines, where appropriate PC8. Ensure that machine guards are in place and are correctly adjusted PC9. Identify different types of cutters used in horizontal and vertical milling machines PC10. Identify different parts of the vertical and horizontal milling machine PC11. Hold components securely, without distortion PC12. Ensure that machine settings are adjusted as and when required to maintain the required accuracy and quality standards: components to be free from false tool cuts, burrs and sharp edges; dimensional tolerance 0.020 to 0.030 mm; flatness and squareness within 0.125mm; surface finish 1.6µm; angles within +/- 1 degree
Carrying out operations on a Milling Machine	To be competent, the individual must be able to: PC13. Obtain the component drawings, specifications and job instructions required for the components to be machined PC14. Use and extract information from engineering drawings and related specifications to include symbols and conventions to appropriate ISO standards in relation to work undertaken

	PC15. Operate the machine controls in both hand and power modes PC16. Stop the machine in both normal and emergency situations, and use correct procedure for restarting after an emergency PC17. Use imperial and metric systems of measurement PC18. Perform various milling operations to produce various features on metal and non-metal components PC19. Produce components as per given quality standards PC20. Achieve given production targets PC21 Overcome the effects of backlash in machine slides and screws PC22. Apply roughing and finishing cuts considering the effect on tool life, surface finish and dimensional accuracy PC23. Apply cutting fluids with regard to a range of different materials PC24. Clamp the work piece securely and without distortion in a chuck/work holding device such as vice, V-block, clamp, angle plate, etc. PC25. Ensure that the quality control procedures are used on the equipment PC26. Use range of equipment to check critical parameters
Knowledge and Understanding (K)	
A. Organisation-al Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Standards, policies, and procedures followed in the company relevant to own employment and performance conditions OK2. Relevant health and safety requirements applicable in the work place OK3. Importance of working in clean and safe environment OK4. Own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting structure, inter-dependent functions, lines and procedures in the work area OK6. Relevant people and their responsibilities within the work area OK7. Escalation matrix and procedures for reporting work and employment related issues OK8. Documentation and related procedures applicable in the context of employment and work OK9. Importance and purpose of documentation in context of employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Where personal protective equipment to be worn can be obtained TK2. Hazards associated with the milling operations and how they can be minimised

	TK3. Importance of keeping the work area clean and tidy TK4. Where to obtain the component drawings, specifications and/or job instructions required for them components to be machined TK5. How to read and interpret first and third angle component drawings TK6. How to extract information from engineering drawings or data and related specifications TK7. How to use imperial and metric systems of measurement TK8. Main parts of milling machines and the accessories that can be used TK9. Purpose and applications of milling TK10. Different types of milling cutters and their uses TK11. Various milling operations that can be performed, and the features produced on metal and non-metal components TK12. Processes of milling e.g. up milling, down milling, face milling, end milling, etc. TK13. Effects of backlash in machine slides and screws, and how this can be overcome TK14. Effects of clamping the work piece in a chuck/work holding device, and how this can cause distortion in the finished components TK15. Production cost, machine hour rate, raw material cost, tool cost, coolant cost, overheads, cycle time, idle time, cost of machine idling, part rejection cost TK16. Selection of cutting tools, tool materials, chip breaker geometry, selecting cutting parameters from tool catalogues, selecting coolant TK17. Relationship between metal cutting results, tool Nose radius, speed and feed rate TK18. Recognise machining faults and how to identify when tools need re-sharpening TK19. Problems that can occur with the milling activities, and how these can be overcome TK20. Extent of their own authority and to whom they should report if they have problems that they cannot resolve TK21. Safe working practices and environmental regulations that must be observed TK22. Importance of reporting problems in a timely manner
C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident

Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution techniques PS7. Select and apply resolution techniques PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. plan, prioritise and sequence work operations as per job requirements

	PS10. Organise and analyse information relevant to work PS11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Take Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and customer relationships PS15. Demonstrate competencies in new and different situations to achieve more
	Self-Management
	The individual on the job must be able to: PS16. Exercise restraint while expressing dissent and during conflict situations PS17. Avoid and manage distractions to be disciplined at work PS18. Manage the time to achieve better results
	Teamwork
	The individual on the job must be able to: PS19. Work in a team in order to achieve better results PS20. Identify and clarify work roles within a team PS21. Communicate and cooperate with others in the team for better results PS22. Seek assistance from fellow team members

UNIT 8 [This unit covers grinding of various components required in the manufacturing sector using Grinding Machines].

Unit No.	**08**
Unit Title	**Operating a Grinding Machine**
Description	This unit is about grinding of various components required in the manufacturing sector using different types of Grinding machines. This involves carrying out grinding operations such as on horizontal and vertical surfaces, as well as cylindrical, angular and taper surfaces. It also encompasses grinding of single point and multipoint cutters in accordance with approved procedures using different types of grinding machines such as surface grinder, cylindrical grinder, pedestal grinder, bench grinder, as well as tool and cutter grinder.
Scope	This unit/task covers the following: • Operating a Grinding Machine • Handling of unresolved problems • Processing compliances
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Operating a Grinding Machine	To be competent, the individual must be able to: PC1. Check that all measuring instruments are within calibration due date PC2. Obtain and prepare the appropriate materials, tools and measuring instruments PC3. Mount the work-piece safely and securely, in line with instructions PC4. Set and adjust the grinding machine speed and feed, in line with instructions PC5. Use the grinding machine controls safely and correctly, in line with operational procedures PC6. Check that the finished components meet the drawing dimensions as required PC12. Report any difficulties or problems that may arise during grinding activities, and carry out suitable actions PC7. Shut down the machine to a safe condition on completion of the grinding activities PC8. Prepare grinding wheels through various methods PC9. Grind components to produce various features: PC10. Check the quality of output, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. PC11. Check the machined component for accuracy in dimensions, parallelism and surface texture as per job specifications
Handling of unresolved problems	To be competent, the individual must be able to: PC12. Refer the problem to a competent internal specialist if it cannot be resolved PC13. Obtain help or advice from specialist if the problem is outside his/her area of competence or experience

Processing Compliances	To be competent, the individual must be able to: PC14. Comply with relevant standards, policies and procedures
Knowledge and Understanding (K)	
A. Organisation-al Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Standards, policies, and procedures followed in the company relevant to own employment and performance conditions OK2. Relevant health and safety requirements applicable in the work place OK3. Importance of working in clean and safe environment OK4. Own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting structure, interdependent functions, lines and procedures in the work area OK6. Relevant people and their responsibilities within the work area OK7. Procedures for reporting work and employment related issues OK8. Documentation and related procedures applicable related to employment and work OK9. Importance and purpose of documentation related to employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Safety mechanisms on the machine, and the procedure for checking that they function correctly TK2. Correct operation of the grinding machine controls in both manual and power modes; how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency TK3. Importance of keeping the work area clean and tidy (e.g. cleaning the machine, disposal of waste, ensuring any spilt cutting fluids are correctly dealt with) TK4. How to use and extract information from engineering drawings and related specifications (to include ISO standard symbols and abbreviations, imperial and metric systems of measurement, workpiece reference points and system of tolerance) TK5. How to mount the workpiece in the work holding devices TK6. Effects of clamping the work-piece in a chuck/work holding device, and how this can cause damage or distortion in the finished components TK7. How to check that the grinding wheels are in a safe and serviceable condition (e.g. free from damage, cracks and correctly balanced) TK8. Need for ‘trueing up’ and dressing of wheels to prevent

	glazing and burning of the workpiece, and methods of forming the wheels to the required profile (e.g. use of pantograph and diamond dressing units) TK9. Effects of backlash in machine slides and screws, and how this can be overcome TK10. Techniques of taking trial cuts and checking dimensional accuracy TK11. Application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy TK12. Types of grinding wheels, cutting feeds and speeds to be used, and the depth of cut that can be taken TK13. Application of cutting fluids with regard to a range of different materials, and why some materials do not require cutting fluids to be used TK14. How to recognise grinding faults, and how to identify when grinding wheels need dressing TK15. Checks to be carried out on the components before removing them from the machine (e.g. have all operations been completed, dimensional checks, surface finish checks) TK16. Problems that can occur with the grinding activities and how to address them TK17. Importance of leaving the machine in a safe condition on completion of activities TK18. Safe working practices and procedures to be followed when preparing and using grinding machines TK19. Hazards associated with the grinding operations and how they can be minimised TK20. Personal protective equipment (PPE) to be worn for the grinding activities and personal safety measures taken
C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills** The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.

	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
	Numerical and computational skills
	The individual on the job must be able to: CS14. Undertake numerical operations and calculations CS15. Identify and draw various basic, compound and solid shapes as per dimensions given CS16. Use appropriate measuring techniques and units of measurement CS17. Use appropriate units and number systems to express degree of accuracy CS18. Use metric system of measurement
	Learning
	The individual on the job must be able to: CS19. Participate in on-the-job and other learning, training and development interventions and assessments CS20. Clarify task related information with appropriate personnel or technical adviser CS21. Seek to improve and modify own work practices CS22. Maintain current knowledge of application standards, codes of practice and product/process developments
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Detect problems in day to day tasks PS2. Discuss possible solutions to address problems, with the supervisor PS4. Support supervisor in using specific problem solving techniques and detailing out the problems PS5. Make decisions in emergency situations in the absence of the supervisor (as per the authority matrix defined by the organisation)

	Plan and Organise
	The individual on the job must be able to: PS6.Process the work order and jobs received from the internal customers. PS7. Design documents received from internal customers PS8. Understand and organise all process/ equipment manuals so that sorting out information is fast.
	Judgment and Critical Thinking
	The individual on the job must be able to: PS9. Use common sense and make judgments in day to day activities PS10. Use reasoning skills to identify and resolve basic problems PS11. Use intuition to detect any potential problems which could arise
	Desire to Learn and Take Initiatives
	The individual on the job must be able to: PS12. Follow instructions and work on areas of improvement identified PS13. Complete the assigned tasks with minimum supervision PS14. Complete the job defined/assigned by the supervisor within the timelines and quality norms

UNIT 9 [This unit covers carrying out programming and machining operations on ferrous and nonferrous metals using CNC Lathe, CNC Milling and CNC EDM Machines as per the prescribed procedure and drawing].

Unit No.	**09**
Unit Title	**Programming and operating CNC Machines**
Description	This unit covers making programs for and proving out of parts on Computer Numerically Controlled (CNC) Lathes, Milling and EDM Machines. Programming can be done manually or using CAM software.
Scope	This task covers the following: • Preparing for programming CNC Lathes, Milling and EDM Machines for production • Carrying out programming for CNC Machines • Test run and proving the program on CNC Machines
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria (PC)**
Preparing for programming CNC Lathes, Milling and EDM Machines for production	To be competent, the individual must be able to: PC1. Obtain job specification from a valid and approved source PC2. Read and establish job requirements from the job specification document accurately PC3. Follow job instructions, assembly drawings and laid down procedures at all times PC4. Report and rectify incorrect and inconsistent information in job specification documents as per Organisation procedures PC5. Use and extract information from reference charts, tables, graphs and standards PC6. Prepare the work area as per procedure or operational specification PC7. Conduct a preliminary check of the readiness of the program so that the CNC machine operates correctly PC8. Determine what operational objectives and targets need to be achieved and how best the machine needs to be programmed to achieve this PC9. Extract and use information from engineering drawings and related specifications in relation to work undertaken PC10. Identify tool requirements from tooling layout and assess their suitability PC11. Identify suitable work holding or fixturing device as per the job requirement PC12. Ensure the correct and latest part-program is uploaded onto the CNC system PC13. Use Electric Discharge Machining to hole out blind spots and also to create hole in the die formation plate/ work piece PC14. Setup the electrodes of the EDM machine and measure the distance between the electrodes as mentioned

	in the Work Instructions PC15. Ensure that the correct current and voltage are selected for the EDM process PC16. Ensure that the work piece/ metal piece is carefully loaded on the EDM machine surface tables/ work platform using manual/ automatic tools PC17. Ensure that there is uniform flow of dielectric liquid i.e. flushing of the dielectric liquid to remove any debris which would have collected during the EDM process PC18. Ensure that the machine operations are regularly monitored to detect any malfunctions in machine operations or any out of tolerance machining PC19. Ensure that the electrode properties like surface, dimensions, metallurgical properties are periodically checked as per the checklist provided PC20. Ensure that the electrodes are changed in case there is a deviation from the specifications
Carrying out programming for CNC Machines	To be competent, the individual must be able to: PC21. Prepare the CNC program with commands for tool motions, spindle motions, miscellaneous functions and tool change, in syntax corresponding to the machine and control system on which the component will be machined. PC22. Apply various methods of making a CNC program such as by writing it on paper or in a computer's text editor, or using CAM software or controllers on the machine PC23. Ensure that the part program is efficient and results in minimal cycle time, with optimal cutting parameters and no unnecessary tool motions PC24. Use subprograms and canned cycles, to reduce program size and input time and avoid memory overflow on the machine PC25. Transfer the program to the machine by entering it at the console or transmitting it through a wired link or through a data transfer device PC26. Follow the correct procedures for calling up the program and dealing with any error messages or faults PC27. Handle the typical problems that can occur with the programming, loading and editing activities effectively using approved procedures PC28. Save the proven program in the appropriate storage medium – paper, computer hard disk, etc. PC29. Complete relevant documentation as per procedure PC30. Leave the work area in a safe and tidy condition on completion of the activities
Test run and proving the program on CNC Machines	To be competent, the individual must be able to: PC31. Obtain appropriate equipment or tools needed as per job requirements PC32. Ensure that all measuring equipment is calibrated and approved for usage PC33. Ensure that the tools and fixtures are in usable

	condition (e.g. free from breakage, damage, calibration, etc.) PC34. Pre-set the tooling appropriately using setting jigs/fixtures PC35. Seek any necessary instruction/training on the operation of the machine where required PC36. Mount tools in the correct positions in the tool turret or magazine PC37. Check that the tools have been mounted in positions corresponding to tool numbers in the part program PC38. Measure tool and work offset data - X and Z offsets for lathes; work offsets, length offsets and tool radius for machining centers. PC39. Ensure that the component is free of burrs, chips or other material adhering to its butting surfaces PC40. Mount the part on machine firmly in the specified work holding devices, with the appropriate clamping forces. PC41. Enter work offset and tool data on the machine – X and Z offsets, tool orientation and Nose radius for lathes; length offsets and tool radius for machining centers. PC42. Ensure that tool data has been entered in offset number corresponding to the tool offset numbers in the part program PC43. Deal with error messages and faults on the program or equipment PC44. Cut a trial part using single block run, dry run and feed and speed override controls PC45. Edit the program and adjust tool and wear offsets to correct any dimensional errors on the part PC46. Ensure that the trial part conforms to drawing specifications in terms of dimensions, surface finishes and geometrical parameters like concentricity, parallelism, run out, etc. PC47. Hand-over the machine to the Workshop Machines Operator for machining the batch of parts, along with relevant instructions and documentation on periodic inspection of components, change of worn out tools PC48. Correct the tool wear offsets whenever required, based on the results of the period inspection PC49. Change worn out tools and indexable inserts whenever required PC50. After every change of a worn out tool or insert, cut a trial part and correct any dimensional inaccuracies by adjusting the tool offsets or wear offsets PC51. Return worn out cutting tools, work holding device / fixtures / instruments/drawings to store PC52. Ensure that there is no damage to the tool/fixture while doing the prove-out PC53. Shut down the equipment to a safe condition on conclusion of the activities

	PC54. Deal promptly and effectively with problems within span of responsibility and control and report those that cannot be solved
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company / Organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Standards, policies, and procedures followed in the company relevant to own employment and performance conditions OK2. Relevant health and safety requirements applicable in the work place OK3. Importance of working in clean and safe environment OK4. Own job role and responsibilities and sources for information pertaining to employment terms, entitlements, job role and responsibilities OK5. Reporting structure, inter-dependent functions, lines and procedures in the work area OK6. Relevant people and their responsibilities within the work area OK7. Procedures for reporting work and employment related issues OK8. Documentation and related procedures applicable related to employment and work OK9. Importance and purpose of documentation in context of employment and work
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Specific safe working practices, CNC programming procedures and environmental regulations that must be observed TK2. Hazards associated with carrying out the machining operations on a CNC machine and how can they be minimised TK3. Personal protective equipment to be used during the machining activities on a CNC machine and where can it be obtained TK4. Safety mechanism on the machine and how to check if they are functioning properly TK5. Types and sources of appropriate job specifications TK6. Common terminology used in CNC programming features of produced CNC program TK7. Selection of strategies based on material and fixturing, holding and clamping force TK8. The factors which will determine selection and use of tungsten carbide and tips TK9. Importance of tool selection based on material, finish required and tolerances achieved TK10. Importance of cutter engagement and exit TK11. Factors affecting tool life TK12. Importance and effect of the depth of cut, RPM and

	feed TK13. How to read and interpret first and third angle component drawings TK14. How to extract information from engineering drawings or data and related specifications TK15. How to use the function keys and user interface of the machine control system TK16. Determination and entry of work and tool offsets, tool wear data TK17. Main features and working parts of the CNC machine, and the accessories that can be used TK18. Importance of following specified machining sequences and procedures TK19. Importance of ensuring suitability of workpieces/materials and consumables for the specified job and related procedures TK20. Importance and procedures to ensure that tools and equipment are in a safe and usable condition TK21. Various CNC operations that can be performed, and the methods and equipment used TK22. Methods of setting the work-holding devices, and the tools and equipment that can be used TK23. Various tool holding devices that are used, and the methods of correctly mounting and securing the cutting tools to the tool holders TK24. How to set the machine controller in the program and editing mode, and enter or download the prepared program TK25. Automatic tool changers, pallet changers, rotary tables and part auto loaders used TK26. How to position and identify the tools in relationship to the operating program TK27. Function of error messages, and appropriate subsequent action TK28. Importance of proving the program, how to do it and selecting the correct proving tools in CNC-Milling an CNC–Lathe TK28. Proper selection of Copper, graphite electrode in CNC-EDM, spark-gap TK29. Need for storing program tapes and disks safely and correctly, away from contaminants and electromagnetic sources TK30. Quality control procedures that are used, inspection checks to be carried out, and the equipment that will need to be used TK31. Importance to report problems in a timely manner TK32. Importance of writing programs that are easily editable or correctable by the next person TK33. Methods of checking quality of the shaped components against the required quality standards TK34. Production cost, machine hour rate, raw material

	cost, tool cost, coolant cost, overheads, cycle time, idle time, cost of machine idling, part rejection cost TK35. Selection of cutting tools, tool materials, chip breaker geometry, selecting cutting parameters from tool catalogues, selecting coolant TK36. Relationship between surface finish, tool Nose radius and feed rate TK37. Impact of depth of cut on chatter, surface finish TK38. Range of materials used in common engineering applications TK39. How to identify materials by their physical properties
C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and

	manner in line with organisational protocol
	Numerical and computational skills
	The individual on the job must be able to: CS14. Undertake numerical operations and calculations CS15. Identify and draw various basic, compound and solid shapes as per dimensions given CS16. Use appropriate measuring techniques and units of measurement CS17. Use appropriate units and number systems to express degree of accuracy CS18. Use metric system of measurement
	Learning
	The individual on the job must be able to: CS19. Participate in on-the-job and other learning, training and development interventions and assessments CS20. Clarify task related information with appropriate personnel or technical adviser CS21. Seek to improve and modify own work practices CS22. Maintain current knowledge of application standards, codes of practice and product/process developments
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution techniques PS7. Select and apply resolution techniques PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Take Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and customer relationships PS15. Demonstrate competencies in new and different

	situations to achieve more
	Self-Management
	The individual on the job must be able to: PS16. Exercise restraint while expressing dissent and during conflict situations PS17. Avoid and manage distractions to be disciplined at work PS18. Manage the time to achieve better results
	Teamwork
	The individual on the job must be able to: PS19. Work in a team in order to achieve better results PS20. Identify and clarify work roles within a team PS21. Communicate and cooperate with others in the team for better results PS22. Seek assistance from fellow team members

UNIT 10 [This unit covers basic practices that improve effectiveness of working with others in an organisational setup].

Unit No.	**10**
Unit Title	**Working effectively with others**
Description	This unit is about basic etiquette and competencies that an individual is required to possess and demonstrate in their behaviour and interactions with others in the workplace.
Scope	This unit/task covers the following: • Working effectively with others
Performance Criteria (PC) w.r.t. the Scope	
Element	**Performance Criteria (PC)**
Working effectively with others	To be competent, the individual must be able to: PC1. Display appropriate communication etiquette while working PC2. Display active listening skills while interacting with others at work PC3. Demonstrate responsible and disciplined behaviours at the workplace PC4. Accurately receive information and instructions from the supervisor and fellow workers, getting clarification where required PC5. Accurately pass on information to authorised persons who require it and within agreed timescale and confirm its receipt PC6. Display helpful behaviour by assisting others in performing tasks in a positive manner, where required and possible PC7. Consult with and assist others to maximise effectiveness and efficiency in carrying out tasks PC8. Escalate grievances and problems to appropriate authority as per procedure to resolve them and avoid conflict.
Knowledge and understanding (K)	
A. Organisational context (Knowledge of the company/ Organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Policies and procedures followed in the company for working with others in an Organisational setup. OK2. Grievance/ conflict handling mechanism of the company OK3. Relevant people and their responsibilities within the work area
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Importance of effective communication in the workplace TK2. Importance of teamwork in organisational and individual success TK3. Barriers to effective communication

	TK4. Importance of avoiding casual expletives and unpleasant terms while communicating professional circles TK5. Various categories of people that one is required to communicate and co- ordinate within the organisation TK6. Importance of discipline for professional success TK7. Importance of ethics for professional success TK8. Disciplined behaviour for a working professional TK7. Importance of ethics for professional success TK8. Disciplined behaviour for a working professional TK9. Common reasons for interpersonal conflict TK10. Importance and ways of managing interpersonal conflict effectively TK11. Importance of developing effective working relationships for professional success TK12. Expression and address the grievances appropriately and effectively
C. Regulatory context (Knowledge of Rules and Regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Occupational Health and Safety Act RK2. Workers' Compensation Act RK3. Industrial Safety Procedures RK4. Safety regulations, how and where to take shelter in case of any accident
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Fill in appropriate technical forms, process charts, log sheet as per Organisational format CS2. Note down observations (if any) related to the machine being operated and share the same with the supervisor CS3. Note down the data for the respective shifts in the log sheets/ online systems as per applicability in the organisation CS4. Prepare requisitions to procurement/stores on the requirement of apparatus, tools etc.
	Reading Skills
	The individual on the job must be able to: CS5. Read and interpret information correctly from various job specification documents, manuals, health and safety instructions, etc. CS6. Read and interpret engineering drawings CS7. Read and interpret symbols and measuring instruments CS8. Read equipment manuals and process documents to understand the equipment and processes better CS9. Read internal information sent by supervisor/other teams
	Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS10. Convey and share technical information clearly using

	appropriate language CS11. Check and clarify task-related information CS12. Liaise with appropriate authorities using correct protocol CS13. Communicate with people in respectful form and manner in line with organisational protocol
	Numerical and computational skills
	The individual on the job must be able to: CS14. Undertake numerical operations and calculations CS15. Identify and draw various basic, compound and solid shapes as per dimensions given CS16. Use appropriate measuring techniques and units of measurement CS17. Use appropriate units and number systems to express degree of accuracy CS18. Use metric system of measurement
	Learning
	The individual on the job must be able to: CS19. Participate in on-the-job and other learning, training and development interventions and assessments CS20. Clarify task related information with appropriate personnel or technical adviser CS21. Seek to improve and modify own work practices CS22. Maintain current knowledge of application standards, codes of practice and product/process developments
B. Professional Skills	**Problem Solving and Decision Making**
	The individual on the job must be able to: PS1. Identify problems with work planning, procedures, output and behaviour and their implications PS2. Prioritise and plan for problem solving PS3. Communicate problems appropriately to others PS4. Identify sources of information and support for problem solving PS5. Seek assistance and support from other sources to solve problems PS6. Identify effective resolution techniques PS7. Select and apply resolution techniques PS8. Seek evidence for problem resolution
	Plan and Organise
	The individual on the job must be able to: PS9. plan, prioritise and sequence work operations as per job requirements PS10. Organise and analyse information relevant to work PS11. Basic concepts of shop-floor work productivity including waste reduction, efficient material usage and optimisation of time
	Take Initiative and Enterprise
	The individual on the job must be able to: PS12. Undertake and express new ideas and initiatives to others

	PS13. Modify work plan to overcome unforeseen difficulties or developments that occur as work progresses PS14. Participate in improvement procedures including process, quality and customer relationships PS15. Demonstrate competencies in new and different situations to achieve more
	Self-Management
	The individual on the job must be able to: PS16. Exercise restraint while expressing dissent and during conflict situations PS17. Avoid and manage distractions to be disciplined at work PS18. Manage the time to achieve better results
	Teamwork
	The individual on the job must be able to: PS19. Work in a team in order to achieve better results PS20. Identify and clarify work roles within a team PS21. Communicate and cooperate with others in the team for better results PS22. Seek assistance from fellow team members

5. EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS

These include, but not limited to: personal protective equipment, equipment being operated (i.e. Drilling Machines; Lathe Machines; Shaping Machines; Milling Machines; Grinding Machines; CNC Machines; Fork Lifts; Cranes etc.), green energy sources, lifting equipment, locks and lockout systems, toolkits, first aid kit, stretcher, medical kit, safety warning and general information signs, climbing ladders, lamp/torch, safety tools and equipment such as fire extinguishers and barricades, company's safety policy/procedure, lubricating oils, company's standard operating procedures, reporting templates, etc.

6. DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER

Dilemmas associated with the job of Workshop Machines Operator include working in dangerous areas and operating hazardous machinery/equipment, working in confined areas, lifting/pulling/pushing relatively heavy materials, long working hours, pressure from supervisors and colleagues, pressure from government regulators, working in extreme weather such as hot and cold conditions, working in noisy, wet and dusty environments, etc.

6.1 Alternative Choices (Solutions) to Dilemmas and Complexities

Solutions to dilemmas include wearing protective clothing and ensuring their availability and use by other employees, exercising regularly to maintain physical fitness, participating in workplace safety sensitisation and awareness meetings/training sessions, adhering to company's safety and standard operating procedures at all times, consulting extensively within and outside one's department/team on machine operating safety issues, etc.

7. WORKING CONDITIONS/ENVIRONMENT

Working conditions include processing/manufacturing plants, underground and open cast mines, cold, hot and wet conditions, climbing heights, stand/walk for long hours, lifting materials, working in day or night shifts, areas that are noisy and dusty, areas with limited lighting and ventilation, etc.

8. PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE

8.1 Internal/Within the Organisation

Supervisors, trainers, safety team, other colleagues, etc.

8.2 External/Outside the Organisation

Government regulators, trainers, suppliers of equipment/tools/consumables, fellow Workshop Machines Operators from other companies, labour unions/occupational health and safety associations, etc.

9. PHYSICAL DEMANDS ON THE BODY

- Physique to sustain strenuous conditions;
- Be able to walk and stand for long periods of time;
- Bend, stretch, twist, or reach out;
- Be able to lift relatively heavy materials, tools and equipment;
- Be able to use fingers, hands and feet with ease to complete the assigned task (dexterity);
- Etc.

ANNEX A
Criteria for Assessments based on this NOS

A.1 Guidelines for Assessment

A.1.1 Criteria for assessment for curricula and learning programmes based on this NOS will be created by curricula and programmes developers. Each Performance Criteria (PC) will be assigned marks proportional to its importance in the NOS. Curricula and programmes developers will also lay down proportion of marks for theory and practical skills for each performance criteria, giving more weight to practical skills.

There shall be allocated the 'Total Mark', which will be the sum of all marks in each Unit, distributed across the number of PCs in that particular Unit. The 'out of' mark will be the mark allocated to each PC, which will be shared between theory and skills practical assessments.

A.1.2 Individual awarding/assessment bodies or institutions and other users of the NOS will create unique question papers for the theory part and evaluations for skill practical part for their respective candidates.

ANNEX B
NOS Version Control

This Annex gives details necessary for the tracking of the NOS versions based on the number of revisions.

NOS Code	NOS.WMO.01		
ZQF Level	4	**Version Number**	01
Sector	Manufacturing	**Date of Approval**	February, 2021
Sub Sector	All subsectors in the Manufacturing sector	**Date of Last Review**	N/A
Occupation	Workshop Machines Operations	**Date of Next Review**	March, 2026

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