TRAINING REGULATIONS

MACHINING NC III

METALS AND ENGINEERING SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Superhighway, Taguig City, Metro Manila

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METALS AND ENGINEERING SECTOR

MACHINING NC III

TRAINING REGULATIONS FOR
MACHINING NC III

SECTION 1 MACHINING NC III QUALIFICATION

The Machining NC III Qualification consists of competencies that a person must achieve to set up and operate a variety of machine tools to perform precision machining operations.

Specifically, this Training Regulations in Machining covers turning, milling, precision grinding and bench work.

The Units of Competency comprising this qualification include the following:

Code No.	BASIC COMPETENCIES
500311109	Lead workplace communication
500311110	Lead small teams
500311111	Develop and practice negotiation skills
500311112	Solve problems related to work activities
500311113	Use mathematical concepts and techniques
500311114	Use relevant technologies

Code No.	COMMON COMPETENCIES
MEE722201	Apply safety practices
MEE722202	Interpret working drawings and sketches
MEE722203	Select/ cut workshop materials
MEE722204	Perform shop computations (Basic)
MEE722205	Measure workpiece (Basic)
MEE722206	Perform routine housekeeping
MEE722207	Perform shop computations (Intermediate)
MEE722208	Measure workpiece using angular measuring instruments
MEE 722209	Perform shop computations (Advanced)
MEE722210	Measure workpiece using gages and surface texture comparator
MEE722211	Perform preventive and corrective maintenance

Code No.	CORE COMPETENCIES
MEE722301	Perform bench work (Basic)
MEE722305	Perform bench work (Complex)
MEE722302	Turn workpiece (Basic)
MEE722306	Turn workpiece (Intermediate)
MEE722309	Turn workpiece (Advanced)
MEE722303	Mill workpiece (Basic)
MEE722307	Mill workpiece (Intermediate)
MEE722310	Mill workpiece (Advanced)
MEE722304	Grind workpiece (Basic)
MEE722308	Grind workpiece (Complex)

A person who has achieved this qualification is competent to be:

- Machinist
- Lathe operator
- Milling machine operator
- Precision grinding machine operator
- Bench worker/fitter

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the core units of competency required in MACHINING NC III.

BASIC COMPETENCIES

UNIT OF COMPETENCY : LEAD WORKPLACE COMMUNICATION

UNIT CODE : 500311109

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Communicate information about workplace processes	1.1. Appropriate ***communication method*** is selected 1.2. Multiple operations involving several topics areas are communicated accordingly 1.3. Questions are used to gain extra information 1.4. Correct sources of information are identified 1.5. Information is selected and organized correctly 1.6. Verbal and written reporting is undertaken when required 1.7. Communication skills are maintained in all situations
2. Lead workplace discussions	2.1. Response to workplace issues are sought 2.2. Response to workplace issues are provided immediately 2.3. Constructive contributions are made to workplace discussions on such issues as production, quality and safety 2.4. Goals/objectives and action plan undertaken in the workplace are communicated
3. Identify and communicate issues arising in the workplace	3.1. Issues and problems are identified as they arise 3.2. Information regarding problems and issues are organized coherently to ensure clear and effective communication 3.3. Dialogue is initiated with appropriate personnel 3.4. Communication problems and issues are raised as they arise

RANGE OF VARIABLES

VARIABLE	RANGE
1. Methods of communication	1.1. Non-verbal gestures 1.2. Verbal 1.3. Face to face 1.4. Two-way radio 1.5. Speaking to groups 1.6. Using telephone 1.7. Written 1.8. Internet

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate*:* 1.1. Dealt with a range of communication/information at one time 1.2. Made constructive contributions in workplace issues 1.3. Sought workplace issues effectively 1.4. Responded to workplace issues promptly 1.5. Presented information clearly and effectively written form 1.6. Used appropriate sources of information 1.7. Asked appropriate questions 1.8. Provided accurate information
2. Underpinning knowledge	2.1. Organization requirements for written and electronic communication methods 2.2. Effective verbal communication methods
3. Underpinning Skills	3.1. Organize information 3.2. Understand and convey intended meaning 3.3. Participate in variety of workplace discussions 3.4. Comply with organization requirements for the use of written and electronic communication methods
4. Resource Implications	The following resources **MUST** be provided: 4.1. Variety of Information 4.2. Communication tools 4.3. Simulated workplace
5. Method of Assessment	Competency may be assessed through: 5.1. Direct Observation 5.2. Interview
6. Context for Assessment	Competency may be assessed in the workplace or in simulated workplace environment

UNIT OF COMPETENCY : LEAD SMALL TEAMS

UNIT CODE : 500311110

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Provide team leadership	1.1. ***Work requirements*** are identified and presented to team members 1.2. Reasons for instructions and requirements are communicated to team members 1.3. ***Team members' queries and concerns*** are recognized, discussed and dealt with
2. Assign responsibilities	2.1. Duties, and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task and according to company policy 2.2. Duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible
3. Set performance expectations for team members	3.1. Performance expectations are established based on client needs and according to assignment requirements 3.2. Performance expectations are based on individual team members duties and area of responsibility 3.3. Performance expectations are discussed and disseminated to individual team members
4. Supervised team performance	4.1. ***Monitoring of performance*** takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2. Team members are provided with *feedback*, positive support and advice on strategies to overcome any deficiencies 4.3. ***Performance issues*** which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy 4.4. Team members are kept informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and satisfaction 4.5. Team operations are monitored to ensure that employer/client needs and requirements are met 4.6. Follow-up communication is provided on all issues affecting the team 4.7. All relevant documentation is completed in accordance with company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work requirements	1.1. Client Profile 1.2. Assignment instructions
2. Team member's concerns	2.1. Roster/shift details
3. Monitor performance	3.1. Formal process 3.2. Informal process
4. Feedback	4.1. Formal process 4.2. Informal process
5. Performance issues	5.1. Work output 5.2. Work quality 5.3. Team participation 5.4. Compliance with workplace protocols 5.5. Safety 5.6. Customer service

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Maintained or improved individuals and/or team performance given a variety of possible scenario 1.2. Assessed and monitored team and individual performance against set criteria 1.3. Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf 1.4. Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed 1.5. Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members
2. Underpinning Knowledge	2.1. Company policies and procedures 2.2. Relevant legal requirements 2.3. How performance expectations are set 2.4. Methods of Monitoring Performance 2.5. Client expectations 2.6. Team member's duties and responsibilities
3. Underpinning Skills	3.1. Communication skills required for leading teams 3.2. Informal performance counseling skills 3.3. Team building skills 3.4. Negotiating skills
4. Resource Implications	The following resources **MUST** be provided: 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or task
5. Method of Assessment	Competency may be assessed through: 5.1. Direct observations of work activities of the individual member in relation to the work activities of the group 5.2. Observation of simulation and/or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
6. Context for Assessment	6.1. Competency assessment may occur in workplace or any appropriately simulated environment 6.2. Assessment shall be observed while task are being undertaken whether individually or in-group

UNIT OF COMPETENCY: DEVELOP AND PRACTICE NEGOTIATION SKILLS

UNIT CODE : 500311111

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on ***preparing for negotiation*** is identified and included in the plan 1.2 Information on creating ***non verbal environments*** for positive negotiating is identified and included in the plan 1.3 Information on ***active listening*** is identified and included in the plan 1.4 Information on different ***questioning techniques*** is identified and included in the plan 1.5 Information is checked to ensure it is correct and up-to- date
2. Participate in negotiations	2.1 Criteria for successful outcome are agreed upon by all parties 2.2 Desired outcome of all parties are considered 2.3 Appropriate language is used throughout the negotiation 2.4 A variety of questioning techniques are used 2.5 The issues and processes are documented and agreed upon by all parties 2.6 Possible solutions are discussed and their viability assessed 2.7 Areas for agreement are confirmed and recorded 2.8 Follow-up action is agreed upon by all parties

RANGE OF VARIABLES

VARIABLE	RANGE
1. Preparing for negotiation	1.1 Background information on other parties to the negotiation 1.2 Good understanding of topic to be negotiated 1.3 Clear understanding of desired outcome/s 1.4 Personal attributes 1.4.1 self awareness 1.4.2 self esteem 1.4.3 objectivity 1.4.4 empathy 1.4.5 respect for others 1.5 Interpersonal skills 1.5.1 listening/reflecting 1.5.2 non verbal communication 1.5.3 assertiveness 1.5.4 behavior labeling 1.5.5 testing understanding 1.5.6 seeking information 1.5.7 self disclosing 1.6 Analytic skills 1.6.1 observing differences between content and process 1.6.2 identifying bargaining information 1.6.3 applying strategies to manage process 1.6.4 applying steps in negotiating process 1.6.5 strategies to manage conflict 1.6.6 steps in negotiating process 1.6.7 options within organization and externally for resolving conflict
2. Non verbal environments	2.1 Friendly reception 2.2 Warm and welcoming room 2.3 Refreshments offered 2.4 Lead in conversation before negotiation begins
3. Active listening	3.1 Attentive 3.2 Don't interrupt 3.3 Good posture 3.4 Maintain eye contact 3.5 Reflective listening
4. Questioning techniques	4.1 Direct 4.2 Indirect 4.3 Open-ended

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome 1.2 Participated in negotiation with at least one person to achieve an agreed outcome
2. Underpinning Knowledge and Attitude	2.1 Codes of practice and guidelines for the organization 2.2 Organizations policy and procedures for negotiations 2.3 Decision making and conflict resolution strategies procedures 2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation 2.5 Flexibility 2.6 Empathy
3. Underpinning Skills	3.1 Interpersonal skills to develop rapport with other parties 3.2 Communication skills (verbal and listening) 3.3 Observation skills 3.1 Negotiation skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Room with facilities necessary for the negotiation process 4.2 Human resources (negotiators)
5. Methods of Assessment	Competency may be assessed through: 5.1 Observation/demonstration and questioning 5.2 Portfolio assessment 5.3 Oral and written questioning 5.4 Third party report
6. Context for Assessment	Competency to be assessed in real work environment or in a simulated workplace setting.

UNIT OF COMPETENCY : SOLVE PROBLEMS RELATED TO WORK ACTIVITIES

UNIT CODE : 500311112

UNIT DESCRIPTOR : This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Identify the problem	1.1. Variances are identified from normal operating parameters; and product quality 1.2. Extent, cause and nature are of the problem are defined through observation, investigation and ***analytical techniques*** 1.3. ***Problems*** are clearly stated and specified
2. Determine fundamental causes of the problem	2.1. Possible causes are identified based on experience and the use of problem solving tools / analytical techniques. 2.2. Possible cause statements are developed based on findings 2.3. Fundamental causes are identified per results of investigation conducted
3. Determine corrective action	3.1. All possible options are considered for resolution of the problem 3.2. Strengths and weaknesses of possible options are considered 3.3. Corrective actions are determined to resolve the problem and possible future causes 3.4. **Action *plans*** are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures
4. Provide recommendation/s to manager	4.1. Report on recommendations are prepared 4.2. Recommendations are presented to appropriate personnel. 4.3. Recommendations are followed-up, if required

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	1.1. Brainstorming 1.2. Intuitions/Logic 1.3. Cause and effect diagrams 1.4. Pareto analysis 1.5. SWOT analysis 1.6. Gant chart, Pert CPM and graphs 1.7. Scattergrams
2. Problem	2.1. Non – routine process and quality problems 2.2. Equipment selection, availability and failure 2.3. Teamwork and work allocation problem 2.4. Safety and emergency situations and incidents
3. Action plans	3.1. Priority requirements 3.2. Measurable objectives 3.3. Resource requirements 3.4. Timelines 3.5. Co-ordination and feedback requirements 3.6. Safety requirements 3.7. Risk assessment 3.8. Environmental requirements

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Identified the problem 1.2. Determined the fundamental causes of the problem 1.3. Determined the correct / preventive action 1.4. Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Underpinning Knowledge	2.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 2.2.1. Relevant equipment and operational processes 2.2.2. Enterprise goals, targets and measures 2.2.3. Enterprise quality, OHS and environmental requirement 2.2.4. Principles of decision making strategies and techniques 2.2.5. Enterprise information systems and data collation 2.2.6. Industry codes and standards
3. Underpinning Skills	3.1. Using range of formal problem solving techniques 3.2. Identifying and clarifying the nature of the problem 3.3. Devising the best solution 3.4. Evaluating the solution 3.5. Implementation of a developed plan to rectify the problem

4. Resource Implications	Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios / case studies / what ifs will be required as well as bank of questions which will be used to probe the reason behind the observable action.
5. Method of Assessment	Competency may be assessed through: 5.1. Case studies on solving problems in the workplace 5.2. Observation The unit will be assessed in a holistic manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation. Simulation may be required to allow for timely assessment of parts of this unit of competency. Simulation should be based on the actual workplace and will include walk through of the relevant competency components.
6. Context for Assessment	In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units.

UNIT OF COMPETENCY: **USE MATHEMATICAL CONCEPTS AND TECHNIQUES**

UNIT CODE : **500311113**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required in the application of mathematical concepts and techniques.

ELEMENT	Performance Criteria ***Italicized terms*** are elaborated in the Range of Variables
1. Identify mathematical tools and techniques to solve problem	1.1 Problem areas are identified based on given condition 1.2 ***Mathematical techniques*** are selected based on the given problem
2. Apply mathematical procedure/solution	2.1 Mathematical techniques are applied based on the problem identified 2.2 Mathematical computations are performed to the level of accuracy required for the problem 2.3 Results of mathematical computation is determined and verified based on job requirements
3. Analyze results	3.1 Result of application is reviewed based on expected and required specifications and outcome 3.2 ***Appropriate action*** is applied in case of error

RANGE OF VARIABLES

VARIABLE	RANGE
1. Mathematical techniques	May include but are not limited to: 1.1 Four fundamental operations 1.2 Measurements 1.3 Use/Conversion of units of measurements 1.4 Use of standard formulas
2. Appropriate action	2.1 Review in the use of mathematical techniques (e.g. recalculation, re-modeling) 2.2 Report error to immediate superior for proper action

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate identified, applied and reviewed the use of mathematical concepts and techniques to workplace problems
2. Underpinning Knowledge	2.1 Fundamental operation (addition, subtraction, division, multiplication) 2.2 Measurement system 2.3 Precision and accuracy 2.4 Basic measuring tools/devices
3. Underpinning Skills	3.1 Applying mathematical computations 3.2 Using calculator 3.3 Using different measuring tools
4. Resource Implications	The following resources **MUST** be provided: 4.1 Calculator 4.2 Basic measuring tools 4.3 Case Problems
5. Method of Assessment	Competency may be assessed through: 5.1 Authenticated portfolio 5.2 Written Test 5.3 Interview/Oral Questioning 5.4 Demonstration
6. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: USE RELEVANT TECHNOLOGIES

UNIT CODE : 500311114

UNIT DESCRIPTOR : This unit of competency covers the knowledge, skills, and attitude required in selecting, sourcing and applying appropriate and affordable technologies in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Study/select appropriate technology	1.1 Usage of different ***technologies*** is determined based on job requirements 1.2 Appropriate technology is selected as per work specification
2. Apply relevant technology	2.1 Relevant technology is effectively used in carrying out function 2.2 Applicable software and hardware are used as per task requirement 2.3 ***Management concepts*** are observed and practiced as per established industry practices
3. Maintain/enhance ~~of~~ relevant technology	3.1 Maintenance of technology is applied in accordance with the ***industry standard operating procedure***, ***manufacturer's operating guidelines*** and ***occupational health and safety procedure*** to ensure its operative ability 3.2 Updating of technology is maintained through continuing education or training in accordance with job requirement 3.3 Technology failure/ defect is immediately reported to the concern/responsible person or section for ***appropriate action***

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technology	May include but are not limited to: 1.1 Office technology 1.2 Industrial technology 1.3 System technology 1.4 Information technology 1.5 Training technology
2. Management concepts	May include but not limited to: 2.1 Real Time Management 2.2 KAIZEN or continuous improvement 2.3 5s 2.4 Total Quality Management 2.5 Other management/productivity tools
3. Industry standard operating procedure	3.1 Written guidelines relative to the usage of office technology/equipment 3.2 Verbal advise/instruction from the co-worker
4. Manufacturer's operating guidelines/ instructions	4.1 Written instruction/manuals of specific technology/ equipment 4.2 General instruction manual 4.3 Verbal advise from manufacturer relative to the operation of equipment
5. Occupational health and safety procedure	5.1 Relevant statutes on OHS 5.2 Company guidelines in using technology/equipment
6. Appropriate action	6.1 Implementing preventive maintenance schedule 6.2 Coordinating with manufacturer's technician

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Studied and selected appropriate technology consistent with work requirements 1.2 Applied relevant technology 1.3 Maintained and enhanced operative ability of relevant technology
2. Underpinning Knowledge	2.1 Awareness on technology and its function 2.2 Repair and maintenance procedure 2.3 Operating instructions 2.4 Applicable software 2.5 Communication techniques 2.6 Health and safety procedure 2.7 Company policy in relation to relevant technology 2.8 Different management concepts 2.9 Technology adaptability
3. Underpinning Skills	3.1 Relevant technology application/implementation 3.2 Basic communication skills 3.3 Software applications skills 3.4 Basic troubleshooting skills
4. Resource Implications	The following resources **MUST** be provided: 4.1 Relevant technology 4.2 Interview and demonstration questionnaires 4.3 Assessment packages
5. Method of Assessment	Competency may be assessed through: 5.1 Interview 5.2 Actual demonstration 5.3 Authenticated portfolio (related certificates of training/seminar)
6. Context for Assessment	Competency may be assessed in actual workplace or simulated environment

COMMON COMPETENCIES

UNIT OF COMPETENCY: APPLY SAFETY PRACTICES

UNIT CODE: MEE722201

UNIT DESCRIPTOR: This unit covers the competencies required to apply safety practices in the workplace.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Identify hazards	1.1 ***Hazards*** are identified correctly in accordance with OHS principles. 1.2 Safety signs and symbols are identified and adhered to.
2. Use protective clothing and devices	2.1 Appropriate ***protective clothing and devices*** correctly selected and used in accordance with OHS requirements or industry/company policy
3. Perform safe handling of tools, equipment and materials	3.1 Safety procedures for pre-use check and operation of tools and equipment followed in accordance with industry/ company policies. 3.2 Tools, equipment and materials handled safely in accordance with OHS requirements and industry/ company policies.
4. Perform first aid	4.1 First aid treatment of ***injuries*** are carried out according to recommended procedures
5. Use fire extinguisher	5.1 Fire extinguisher selected and operated correctly according to the ***type of fire***.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hazards	1.1 Cluttered tools and materials 1.2 Slippery floors (caused by oil, grease or any liquid) 1.3 Exposed electrical wires 1.4 Sharp edges 1.5 Machine without guards or with exposed moving parts 1.6 Uncollected chips or other wastes etc.
2. Protective clothing and devices	Protective clothing and devices may include but is not limited to: 2.1 safety glasses/goggles 2.2 safety shoes 2.3 overalls 2.4 cap
3. Injuries	Injuries may include: 3.1 burns/scalds 3.2 fractures 3.3 cuts and abrasions 3.4 poisoning 3.5 foreign bodies in the eye 3.6 concussion 3.7 shock
4. Type of fires	Fires involving or caused by: 4.1 common combustibles (wood, cloth, paper, rubber and plastic) 4.2 flammable liquids (gasoline, oil, solvents, paints, etc.) 4.3 energized electrical equipment (wiring, fuse boxes, circuit breakers, appliances, etc. 4.4 combustible metals (magnesium, sodium, etc.)

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 identified hazardous area 1.2 used protective clothing and devices 1.3 handled tools, equipment and materials properly 1.4 performed first aid 1.5 used fire extinguisher
2. Underpinning knowledge and attitude	2.1 Shop safety signs, symbols and alarms 2.2 Safety precautionary measures 2.3 Housekeeping 2.4 Machine tools 2.5 First aid 2.6 Engineering materials 2.7 Fire extinguishers
3. Underpinning skills	3.1 Operating machine tools 3.2 Handling tools and materials 3.3 Communicating with superiors and co-workers 3.4 Interpreting instructions
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency may be assessed through: 5.1 Demonstration 5.2 Written or oral short answer questions 5.3 Practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: INTERPRET WORKING DRAWINGS AND SKETCHES

UNIT CODE: MEE722202

UNIT DESCRIPTOR: This unit covers the competencies required to read and interpret drawings and sketches.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Interpret technical drawing	1.1 Components, assemblies or objects recognized as required. 1.2 Dimensions identified as appropriate. 1.3 Instructions identified and followed as required. 1.4 Material requirements identified as required. 1.5 Symbols recognized as appropriate in the ***drawing*.** 1.6 ***Tolerance***, limits and fits identified in the drawing.
2. Prepare freehand sketch of parts	2.1 Sketch drawn correctly and appropriately. 2.2 Sketch depicted objects or part appropriately. 2.3 Dimensions indicated in sketch are clear and correct. 2.4 Instructions included in sketch are clear and correct. 2.5 Base line or datum points indicated as required.
3. Interpret details from freehand sketch	3.1 Components, assemblies or objects recognized as required. 3.2 Dimensions identified as appropriate. 3.3 Instructions identified and followed as required. 3.4 Material requirements identified as required. 3.5 Symbols recognized as appropriate in the drawing.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawing	1.1 Drawing technique include 1.1.1 Perspective 1.1.2 Exploded view 1.1.3 Hidden view technique 1.2 Projections 1.2.1 First angle projections 1.2.2 Third angle projections
2. Tolerance	2.1 General tolerance 2.2 Angular tolerance 2.3 Geometric tolerance

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Interpreted technical drawing 1.2 Prepared sketches 1.3 Interpreted sketches.
2. Underpinning knowledge	2.1 Alphabet of lines 2.2 Projections 2.3 Drawing symbols 2.4 Dimensioning techniques 2.5 Tolerance, limits and fits 2.6 Engineering materials 2.7 Drawing tools and supplies
3. Underpinning skills	3.1 Handling tools and drawing instruments 3.2 Using measuring instruments
4. Resource implications	The following resources **MUST** be provided: 4.1 Drafting room/facilities and drafting instruments and supplies appropriate to the activity 4.2 Measuring tools 4.3 Drawings, sketches or blueprint 4.4 Specimen parts/components
5. Method of assessment	Competency may be assessed through: 5.1 direct observation 5.2 written or oral short answer questions 5.3 demonstration 5.4 project/work sample 5.5 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY **SELECT/ CUT WORKSHOP MATERIALS**

UNIT CODE: MEE722203

UNIT DESCRIPTOR: This unit covers the skills and knowledge required to select and cut workshop materials

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine requirement	1.1 ***Plans/ drawings*** are interpreted to produce component to specification 1.2 Sequence of operation is determined to produce component to specification
2. Select and measure materials	2.1 ***Materials*** are selected according to the requirement of the operation 2.2 Materials are measured to required level of accuracy using measuring tools 2.3 Measuring tools are used according to manufacturers specification
3. Cut materials	3.1 Materials are cut according to plans/drawing instruction 3.2 ***Cutting tools/equipment*** are used based on manufacturers specification, appropriate techniques or the *safety procedure*

RANGE OF VARIABLES

VARIABLE	RANGE
1. Plan/drawings	1.1 Dimensions 1.2 Tolerance
2. Materials	2.1 Ferrous 2.2 Non-ferrous
3. Measuring tools	3.1 Steel rule 3.2 Pull-push rule
4. Cutting tools/equipment	4.1 Hacksaw 4.2 Power hacksaw
5. Safety procedure	Safety involves the handling of: 5.1 Equipment 5.2 Tools 5.3 Materials

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Interpreted plans/drawings 1.2 Selected natural according to the requirement 1.3 Performed cutting operation 1.4 Cutting tools/equipment used safely
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Safe handling of tools, equipment and materials 2.2 Blueprint reading 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Assembly and details of drawing 2.2.3 Dimensions 2.3 Measurement 2.3.1 Linear measuring tools 2.4 Materials and related science 2.4.1 Classification and mechanical properties of engineering materials
3. Underpinning skills	3.1 Selecting materials 3.2 Using measuring tools 3.3 Operating power hacksaw
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate processes of an activity 4.2 Materials relevant to the proposal activity 4.3 Drawings/plans
5. Method Assessment	Competency may be assessed through: 5.1 Direct observation 5.2 Oral short answer question 5.3 Practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated work environment

UNIT OF COMPETENCY: PERFORM SHOP COMPUTATIONS (BASIC)

UNIT CODE: MEE722204

UNIT DESCRIPTOR: This unit covers the competencies required to perform basic calculations using the four fundamental operation.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Perform four fundamental operations.	1.1 Simple calculations performed using *four* ***fundamental operations.*** 1.2 Simple calculations performed involving fractions and mixed numbers using four fundamental operations
2. Perform basic calculations involving fractions and decimals	2.1 Simple calculations are performed involving fractions and decimals using the four fundamental operations. 2.2 Decimal are converted into fraction (and vice versa) accurately,
3. Perform basic calculations involving percentages.	3.1 Simple calculations are performed to obtain percentages from information expressed in either fractional or decimal format
4. Perform basic calculation involving ration and proportion	4.1 Simple calculations are performed involving ratios and proportion using whole numbers, fractions and decimal fractions.
5. Perform calculations on algebraic expressions	5.1 Simple calculations are performed on ***algebraic expressions*** using the four fundamental operations. 5.2 Simple transposition of formulae is carried out to isolate the variable required, involving the four fundamental operations.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Four fundamental operations	1.1 Addition 1.2 Subtraction 1.3 Multiplication 1.4 Division
2. Algebraic expressions	Calculation using formula for determining: 2.1 tap drill size 2.2 feed 2.3 speed

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate performed calculations: 1.1 using four fundamental operations 1.2 involving fractions and mixed numbers 1.3 involving fractions and decimals 1.4 involving percentages 1.5 involving ratio and proportion 1.6 on algebraic expressions 1.7 of simple formulae
2. Underpinning knowledge and attitude	English and metric system of measurements
3. Underpinning skills	Performing calculations using pen and paper or on a calculator
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency may be assessed through: 5.1 written or oral short answer questions 5.2 practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: MEASURE WORKPIECE (BASIC)

UNIT CODE: MEE722205

UNIT DESCRIPTOR: This unit covers the competencies required to measure workpieces using measuring instruments such as steel rules, vernier calipers , micrometers, etc….

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Select and use measuring tools	1.1 ***Measuring tools*** are selected and used according to the level of accuracy required. 1.2 ***Measurements*** taken are accurate to the finest graduation of the selected measuring instrument. 1.3 Measuring technique used is correct and appropriate to the device used.
2. Clean and store measuring tools	2.1 Care and storage of devices undertaken to manufacturer's specifications or standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Measuring tools	Measuring tools include 1.1 Steel tape 1.2 Steel rule 1.3 Straight edge 1.4 Combination square 1.5 Steel square 1.6 Divider or trammel 1.7 Caliper 1.8 Protractor 1.9 Vernier caliper 1.10 Micrometer
2. Measurements	2.1 length 2.2 diameter 2.3 depth 2.4 flatness 2.5 straightness 2.6 squareness

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Selected and used measuring instruments 1.2 Cleaned and stored measuring instruments
2. Underpinning knowledge	2.1 Types, purposes and accuracy of measuring instruments 2.2 Capability of measuring instruments 2.3 Part dimensions and tolerances 2.4 Techniques for measuring dimensions 2.5 Care and storage procedure of measuring tools
3. Underpinning skills	3.1 Safe handling of measuring tools and materials
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to the activity 4.2 Specimen component or part to the proposed activity
5. Method of assessment	Competency may be assessed through: 5.1 direct observation 5.2 demonstration 5.3 written or oral short answer questions 5.4 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: PERFORM ROUTINE HOUSEKEEPING

UNIT CODE: MEE722206

UNIT DESCRIPTOR: This unit covers the competencies required to maintain an organized and clean work area.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Organize work area	1.1 Work area maintained in a safe, uncluttered and organized manner according to ***workshop policy***. 1.2 All tasks carried out safely, effectively and efficiently with minimum inconvenience according to workshop policy. 1.3 Workshop policies and procedures for tidying work areas and placing items in designated areas applied.
2. Clean work area	2.1 Shop policies and procedures applied for cleaning ***work area.*** 2.2 Wastes promptly removed and disposed of according to shop policies and environmental requirements. 2.3 Spills, wastes and other potential hazards reported to appropriate personnel and removed according to shop policies and environmental requirements. 2.4 Signage promptly displayed in regard to unsafe areas. 2.5 Consumable materials maintained and stored correctly after use. 2.6 ***Tools and equipment*** (including guards) cleaned and used in accordance with manufacturer's instructions.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Workshop policy	Shop policy and procedure in regard to: 1.1 Housekeeping practices 1.2 Maintenance and storage of cleaning equipment 1.3 Use and storage of cleaning chemicals
2. Work area	Work area may include: 2.1 Work benches 2.2 Walkways and aisles 2.3 Fixtures and other working surfaces
3. Tools and Equipment	Equipment and tools may include: 3.1 Drill Press 3.2 Pedestal Grinder 3.3 Surface plate 3.4 Layout and marking tools 3.5 Cutting tools (hacksaw, chisel, files) 3.6 Inspection and measuring tools (templates, vernier caliper, micrometer, straight edge, gages, etc…)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate organized and cleaned work area according shop policies and environmental requirements.
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.2 Machine shop equipment 2.3 Shop policies regulations 2.4 5-S 2.5 Shop cleaning equipment
3. Underpinning skills	3.1 Using and storing of cleaning equipment 3.2 Using and storing chemicals, hazardous substances and flammable liquids 3.3 Literacy and numeracy skills in reading and understanding labels and instructions for the handling and use of chemicals and hazardous substances 3.4 Communication skills 3.5 Organizing skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials and documentation relevant to the proposed activity 4.3 Shop policy and/or procedures manual on housekeeping, cleaning and occupational health and safety
5. Method of assessment	Competency may be assessed through: 5.1 direct observation 5.2 demonstration or role play 5.3 written or oral short answer questions 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: PERFORM SHOP COMPUTATIONS (INTERMEDIATE)

UNIT CODE: MEE722207

UNIT DESCRIPTOR: This unit covers the competencies required to perform calculation involving triangles and tapers.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Perform calculations involving triangles	1.1 Problems involving right triangles are performed using the ***trigonometric functions***. 1.2 Problems involving non-right triangles are performed using sine and cosine rules.
2. Calculate taper	2.1 Taper of work calculated correctly using appropriate formula.

RANGE OF VARIABLES

VARIABLE	RANGE
1. trigonometric functions	1.1 Sine 1.2 Cosine 1.3 Tangent 1.4 Cotangent 1.5 Secant 1.6 Cosecant

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate performed calculations: 1.1 Involving right triangles 1.2 Involving non-right triangles 1.3 involving tapers
2. Underpinning knowledge and attitude	2.1 English and metric system of measurements 2.2 Geometrical shapes
3. Underpinning skills	3.1 Performing calculations using pen and paper or on a calculator
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency may be assessed through: 5.1 written or oral short answer questions 5.2 practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: MEASURE WORKPIECE USING ANGULAR MEASURING INSTRUMENTS

UNIT CODE: MEE722208

UNIT DESCRIPTOR: This unit covers the competencies required to measure workpieces using angular measuring instruments.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Select and use angular measuring tools	1.1 ***Angular measuring tools*** are selected and used according to the level of accuracy required. 1.2 ***Measurements*** taken are accurate to the finest graduation of the selected measuring instrument. 1.3 Measuring technique used is correct and appropriate to the device used.
2. Maintain angular measuring tools	2.1 Measuring tools are adjusted and maintained to the required accuracy utilizing manufacturer's or worksite procedures.
3. Clean and store measuring tools	3.1 Care and storage of devices undertaken to manufacturer's specifications or standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Angular measuring tools	Measuring tools include 1.1 Bevel protractor 1.2 Gage blocks 1.3 Sine bar
2. Measurements	2.1 angle 2.2 taper

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Selected and used angular measuring instruments 1.2 Maintained/adjusted instruments 1.3 Cleaned and stored measuring instruments
2. Underpinning knowledge	2.1 Types, purposes and accuracy of angular measuring instruments 2.2 Capability of measuring tools 2.3 Techniques for measuring angles and tapers 2.4 Care and storage procedure of measuring tools
3. Underpinning skills	3.1 Safe handling of measuring tools and materials 3.2 Reading vernier scale 3.3 Reading micrometer
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to the activity 4.2 Specimen component or part to the proposed activity
5. Method of assessment	Competency may be assessed through: 5.1 direct observation 5.2 demonstration 5.3 written or oral short answer questions 5.4 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: PERFORM SHOP COMPUTATIONS (ADVANCED)

UNIT CODE: MEE722209

UNIT DESCRIPTOR: This unit covers the competencies required to perform calculation involving gear ratio, indexing problems and gearing problems.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Calculate gear ratio	1.1 ***Gear ratio*** calculated using appropriate formula
2. Solve indexing problems	2.1 ***Indexing*** problems involving number of turns, spaces and circle plate are solved using appropriate formula
3. Solve gearing problems	3.1 Gearing problems are solved using appropriate formula
4. Use geometrical principles in the solution of problems	4.1 Solution to problems is obtained by applying geometrical properties of angles, triangles and circles in the calculation.

RANGE OF VARIABLES

VARIABLE	RANGE
1. gear ratio	1.1 addendum 1.2 clearance 1.3 dedendum 1.4 diametral pitch 1.5 module 1.6 outside diameter 1.7 pitch diameter 1.8 root diameter 1.9 number of teeth etc.
2. indexing	2.1 direct indexing 2.2 simple indexing 2.3 compound indexing 2.4 differential indexing

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate performed calculations: 1.1 involving gear ratio 1.2 involving indexing problems 1.3 involving gearing problems 1.4 involving geometrical properties of angles, triangles and circles
2. Underpinning knowledge and attitude	2.1 English and metric system of measurements 2.2 Geometrical shapes 2.3 Gear types
3. Underpinning skills	3.1 Performing calculations using pen and paper or on a calculator 3.2 Reading and interpreting working drawings
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency may be assessed through: 5.1 written or oral short answer questions 5.2 practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: MEASURE WORKPIECE USING GAGES AND SURFACE TEXTURE COMPARATOR

UNIT CODE: MEE722210

UNIT DESCRIPTOR: This unit covers the competencies required to measure workpieces using fixed and adjustable gages.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Select and use fixed and adjustable gages	1.1 Appropriate ***gages*** are selected and used to undertake the required comparison or measurement using standard operating procedures. 1.2 Consistent and accurate ***measurements*** obtained conforms to drawing specification 1.3 Measuring technique used is correct and appropriate to the device used.
2. Perform surface texture measurements	2.1 Surface texture are measured according worksite procedures. 2.2 Measurements taken are within the level of accuracy required.
3. Clean and store measuring tools	3.1 Care and storage of devices undertaken to manufacturer's specifications or standard operating procedures.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Gages	Fixed and adjustable gages include: 1.1 Gage blocks 1.2 Telescoping gages 1.3 Center gages 1.4 Thread gages 1.5 Dial bore gages 1.6 Height gages 1.7 Radius gages 1.8 Go-no-go gages 1.9 Depth gages
2. Measurements	Measurements undertaken may include: 2.1 Linear dimensions 2.2 Diameters 2.3 Depths 2.4 Fits 2.5 Tapers 2.6 Threads 2.7 Radius 2.8 Squareness 2.9 Surface texture etc

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Selected and used fixed and adjustable gages 1.2 Performed surface texture measurements 1.3 Cleaned and stored measuring instruments
2. Underpinning knowledge	2.1 Types and application of fixed and adjustable gages 2.2 Gage limits and accuracy 2.3 Techniques for measuring components 2.4 Care and storage procedure of measuring tools
3. Underpinning skills	3.1 Safe handling of measuring tools and materials 3.2 Verifying measurements with drawing specifications
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to the activity 4.2 Specimen component or part to the proposed activity 4.3 Drawing
5. Method of assessment	Competency may be assessed through: 5.1 direct observation 5.2 demonstration 5.3 written or oral short answer questions 5.4 portfolio
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY **PERFORM PREVENTIVE AND CORRECTIVE MAINTENANCE**

UNIT CODE: MEE722211

UNIT DESCRIPTOR: This unit covers the knowledge and skills required in performing preventive and corrective maintenance such as inspection and repair of hand tools, cleaning and lubrication of machine parts and changing drive pulley and belts.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Perform inspection of machine	1.1 ***Machine*** inspected ***according to worksite procedures.*** 1.2 Status/Report recorded on proforma or reported orally according to worksite procedure.
2. Perform cleaning and lubricating of machine	2.1 ***Machines*** lubricated as per manufacturer's recommendation using appropriate ***tools and materials*** 2.2 Fluids and lubricants replaced and/or topped up according to prescribed schedule.
3. Perform minor machine repair and adjustments	3.1 Minor machine repairs performed according to manufacturer's instruction or worksite procedures. 3.2 Machine moving parts adjusted to manufacturer's specifications.
4. Maintain hand tools	4.1 Tool cutting ground to recommended specifications 4.2 Hand tools lubricated and stored according to prescribed procedure .

RANGE OF VARIABLES

VARIABLES	RANGE
1. Inspected	Inspected machine parts include: 1.1 V-belt 1.2 Bearing 1.3 Gears 1.4 Clutch 1.5 Drive pulley
2. Machines	Machine include but not limited to: 2.1 Lathe machine 2.2 Milling machine 2.3 Grinding machine
2. Tools and materials	Tools and materials used include: 3.1 Lubricants 3.2 Oil can 3.3 Grease gun 3.4 Oil 3.5 Coolant or compound

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that that the candidate: 1.1 Performed inspection of machine 1.2 Performed cleaning and lubricating of machine 1.3 Performed minor machine repairs and adjustments
2. Underpinning knowledge	2.1 Proper cleaning and oiling 2.2 Kinds of oil 2.3 Parts and function of machine tools 2.4 Cutting oil, coolant or compound 2.5 Pulleys and belts 2.6 Location of main switches of the machine 2.7 Handling and storage of tools 2.8 Checklist of safe working conditions 2.9 Procedures in cleaning and disposal of waste materials
3. Underpinning skills	3.1 Inspecting and repairing hand tools 3.2 Inspecting and changing drive pulleys and belts 3.3 Replacing and adjusting machine parts 3.4 Distinguishing old and new coolant 3.5 Distinguishing odor of polluted coolant 3.6 Selecting coolant, cutting oil or compounds 3.7 Changing coolant 3.8 Inspecting work area for safe working environment 3.9 Cleaning work area 3.10 Disposing metal scraps, chips and waste materials.
4. Resource Implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of Assessment	Competency **may** be assessed through: 5.1 direct observation of activities 5.2 oral or written questioning
6. Context for Assessment	Competency may be assessed in the workplace or in simulated workplace environment.

CORE COMPETENCIES

UNIT OF COMPETENCY: **Perform Bench Work (Basic)**

UNIT CODE: **MEE722301**

UNIT DESCRIPTOR: This unit covers the competencies required to determine job requirements, perform basic bench work operations (i.e. layout; cutting with hacksaw and chisel; filing; drilling; tapping etc…) and check the components for conformance to specifications.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Layout and mark dimensions/ features on workpiece	1.1 ***Materials*** are selected according to the requirements specified in the drawing. 1.2 Dimensions/features are laid out and marked in accordance with drawing specifications using ***bench work tools and equipment.*** 1.3 Layouting and marking are performed applying knowledge on safety procedures and using personal protective devices.
2. Cut, chip and file flat, rectangular or round blocks	2.1 Workpieces are clamped in ***workholding devices*** to avoid damage and accidents. 2.2 Workpieces are cut, chipped or filed to within tolerance specified in the drawing. 2.3 Broken or dull hacksaw blades are replaced according to requirements 2.4 ***Bench work operations*** are performed applying knowledge on safety procedures and using personal protective devices.
3. Drill, ream and lap holes	3.1 Hole is drilled, reamed, spot-faced and lapped to drawing specification. 3.2 Drilling, reaming or lapping holes are performed according to recommended sequence. 3.3 Operations are performed applying knowledge on safety procedures and using personal protective devices.
4. Cut threads using tap and stock and die	4.1 Thread is cut to fit gage or mating screw, within tolerance given in the blueprint 4.2 Thread is cut in accordance with the recommended tapping sequence 4.3 Thread cutting operations are performed applying knowledge on safety procedures and using personal protective devices.

5. Off-hand grind cutting tools	5.1 Cut edges are honed and free of burrs. 5.2 Cutter is sharpened to conform with specifications. 5.3 Cutters are ground using appropriate cooling agents. 5.4 Cutting tool grinding is performed applying knowledge on safety procedures and using personal protective devices.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Materials	Materials used in benchwork operations include 1.1 Ferrous 1.2 Non Ferrous
2. Bench work tools and Equipment	Equipment and tools may include 2.1 Drill Press 2.2 Pedestal Grinder 2.3 Surface plate 2.4 Layout and marking tools 2.5 Cutting tools (hacksaw, chisel, files) 2.6 Drills, reamers, laps 2.7 Thread cutting tools (taps and stock and die) 2.8 Inspection and measuring tools (templates, vernier caliper, micrometer, straight edge, gages, etc…)
3. Workholding Devices	Workholding devices include the use of 3.1 Clamps 3.2 Vises
4. Bench work operations	Bench work operations 4.1 Layout and marking 4.2 Cutting 4.3 Chipping 4.4 Filing 4.5 Drilling, boring, counterboring, spot-facing 4.6 Lapping 4.7 Reaming 4.8 Thread cutting 4.9 Off-hand grinding

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Laid-out and marked dimensions/features on the workpiece 1.2 Cut, chipped and filed workpiece. 1.3 Drilled, reamed and lapped holes. 1.4 Cut threads 1.5 Performed off-hand grinding
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing/Plans 2.2.1 Standard drawing symbols 2.2.2 Orthographic and isometric drawings 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Trigonometric functions 2.3.6 Computation of feed, cutting speed and machine rpm 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer, height gage) 2.4.2 Geometrical tolerances 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.6 Bench work Theory, use and care of hand tools for: 2.6.1 Layout and marking tools 2.6.2 Sawing, chipping, filing, lapping 2.6.3 Drilling, reaming, tapping 2.6.4 External threading 2.6.5 Off-hand grinding

3. Underpinning skills	3.1 Using bench work tools and equipment 3.2 Using measuring instruments 3.3 Operating drill press and grinders
4. Resource implications	The following resources **MUST** be provided: 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of bench work activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 project work 5.5 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: **Perform Bench Work (Complex)**

UNIT CODE: **MEE722305**

UNIT DESCRIPTOR: This unit covers the competencies required to select and use hand and power tools to perform complex bench work operation.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Chip workpiece	1.1 ***Chisels*** are selected according to requirements of the operation. 1.2 Workpieces are ***chipped*** to drawing specifications
2. File workpieces	2.1 ***File*** selected is appropriate to requirement of the operation. 2.2 Workpieces are ***filed*** to drawing specifications. 2.3 Files are cleaned and stored according worksite procedures.
3. Remove damaged and broken threaded fasteners.	3.1 ***Extractors*** are selected according to the requirements of the operation. 3.2 Damaged threaded fastener is removed according to worksite procedures.
4. Repair damaged threads	4.1 Taps and or dies are selected according to the requirements of the operation. 4.2 ***Thread*** is repaired according to worksite procedures. 4.3 Thread is repaired to conform with drawing specifications.
5. Scrape and hone holes	5.1 ***Scrapers*** are selected according to requirements of the operation. 5.2 Honing flushing agent is selected and applied according the requirements of the operation. 5.3 Workpieces are scraped and honed according to drawing specifications.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Chisels	Chisels include 1.1 Flat cold chisel 1.2 Cape chisel 1.3 Diamond-point chisel 1.4 Round nose chisel
2. Chipped	2.1 grooves 2.2 slots 2.3 keyways
3. File	File types based on 3.1 teeth cut (single cut, double cut, rasp and curved tooth) 3.2 cut (bastard, second cut) 3.3 cross section (square, round, triangular, half-round) 3.4 shape (flat, hand, pillar, mill)
4 Filed	Filing operations 4.1 Contoured outline 4.2 Contoured holes
5. Extractors	5.1 Screw extractor 5.2 Stud extractors
6. Thread	6.1 Internal threads 6.2 External threads
7. Scrapers	Scraper for 7.1 Flat surface (flat scraper, hook scraper) 7.2 Curve surface (half-round bent scraper, three-cornered scraper)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 chipped grooves, slots and keyways on workpiece 1.2 filed contoured outline and hole. 1.3 removed damaged and broken threaded fasteners 1.4 repaired threads 1.5 scraped and honed holes
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.2 Drawing/Plans 2.2.1 Standard drawing symbols 2.2.2 Orthographic and isometric drawings 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.4 Percentages and ratios 2.3.5 Conversion of units (English to metric) 2.3.6 Trigonometric functions 2.4 Measurements 2.4.1 Measuring tools (rules, vernier, micrometer, height gage, profile gage) 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.6 Benchwork Theory, use and care of hand tools for: 2.6.1 layout and marking tools 2.6.2 chipping, filing, scraping and honing 2.6.3 cutting threads 2.6.4 extracting fasteners
3. Underpinning skills	3.1 Using benchwork tools and equipment 3.2 Using measuring tools 3.3 Operating drill press and grinder
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint

5. Method of assessment	Competency may be assessed through: 5.1 direct observation of bench work activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 project work 5.5 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: **Turn Workpiece (Basic)**

UNIT CODE: **MEE722302**

UNIT DESCRIPTOR: This unit covers the skills required to setup and turn workpiece to drawing specifications . It details the requirements for performing lathe operations such as facing and straight turning; cutting grooves, drilling and boring, knurling; cutting single start external vee- and ACME threads; and cutting tapers using compound slide and formed tools.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 ***Cutting tools*** are selected according to the requirements of the operation.
2. Setup workpiece	2.1 ***Workpiece*** is mounted and centered on chuck to required level of accuracy using tools and equipment in accordance with worksite procedures. 2.2 Workpiece is setup to required level of accuracy using ***instruments/equipment*** according to work site procedures. 2.3 Setup operations are performed applying knowledge on safety procedures and using personal protective devices.
3. Perform turning operations	3.1 Speeds and feeds are calculated using appropriate mathematical techniques and reference material. 3.2 ***Lathe accessories*** used are appropriate to the requirements of the operation. 3.3 ***Lathe operations*** are performed to produce component to specifications in the drawing. 3.4 Operations are performed applying knowledge on safety procedures and using personal protective devices.
4. Check/Measure workpiece	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, ***measuring tools*** and equipment.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawings	Reading and interpretation 1.1 Views and projections 1.2 Drawing symbols 1.3 Dimensions and features 1.4 Tolerances
2. Cutting Tools	Cutting tools used in lathe operations include: 2.1 Tool bits 2.1.1 High speed steel 2.1.2 Inserts 2.2 Drills 2.3 Reamers
3. Workpiece	Workpiece materials used in turning operations 3.1 Ferrous metals 3.2 Non-ferrous metals
4. Setup Instruments/ equipment	4.1 Surface gage 4.2 Dial indicator on magnetic stand
5. Lathe Accessories	5.1 3- and 4-jaw chucks 5.2 Lathe centers 5.3 Drill chucks 5.4 Knurling tools 5.5 Boring bar
6. Lathe Operations	Basic lathe operations 6.1 facing 6.2 straight turning 6.3 cutting recess, shoulders, grooves and chamfers 6.4 drilling, boring, counterboring, countersinking, reaming 6.5 knurling 6.6 single-start external vee and ACME thread cutting 6.7 parting-off 6.8 cutting external taper using compound slide or formed tool
7 Measuring Tools	7.1 Steel rule 7.2 Vernier caliper 7.3 Micrometer caliper Gages (thread, drill, surface finish, radius, screw pitch, taper)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 setup the workpiece . 1.3 performed turning operations 1.4 checked/measured the workpiece
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Orthographic and isometric drawings 2.2.3 1st and 3rd angle projections 2.2.4 Assembly and detail drawings 2.2.5 Interpreting tolerances, limits and fits 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Angle measuring tools 2.4.3 Geometrical tolerances 2.4.4 Dial indicator 2.4.5 Slip gages 2.4.6 Precision levels 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.6 Lathe machine operations 2.6.1 Lathe types and specifications 2.6.2 Lathe parts and functions 2.6.3 Setting cutting speed, rpm, feed rate 2.6.4 Workholding and tool holding devices 2.6.5 Turning tools and tool geometry 2.6.6 Tooling, set up and parameters in turning operations 2.6.7 Lathe accessories, fixtures and attachments

3. Underpinning skills	3.1 Selecting and grinding cutting tools 3.2 Using measuring instruments 3.3 Verifying workpiece specifications 3.4 Computation of feed, cutting speed and machine rpm
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of lathe setting activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: **Turn Workpiece (Intermediate)**

UNIT CODE: **MEE722306**

UNIT DESCRIPTOR: This unit covers the skills required to setup and turn workpiece to drawing specifications . It details the requirements for performing lathe operations such as cutting tapers by offsetting tailstock or using taper attachment; machining components using collet chuck and follower rest; and cutting internal vee and internal and external ACME threads.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 ***Cutting tools*** are selected according to the requirements of the operation.
2. Setup workpiece	2.1 ***Workpiece*** is mounted and centered on chuck to required level of accuracy using tools and equipment in accordance with worksite procedures. 2.2 Workpiece is setup using instruments/equipment according to recommended procedure. 2.3 Setup operations are performed applying knowledge on safety procedures and using personal protective devices.
3. Perform turning operations	3.1 Speeds and feeds are calculated using appropriate mathematical techniques and reference material. 3.2 ***Lathe accessories*** used are appropriate to the requirements of the operation. 3.2 ***Lathe operations*** are performed to produce component to specifications in the drawing. 3.4 Operations are performed applying knowledge on safety procedures and using personal protective devices.
4. Check/Measure workpiece	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques**,** ***measuring tools*** **and equipment**.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Cutting Tools	Cutting tools used in lathe operations include: 1.1 High speed steel 1.2 Inserts 1.3 drills
2. Workpiece	Workpiece materials used in turning operations 2.1 ferrous 2.2 non-ferrous
3. Lathe Accessories	3.1 3- and 4-jaw chucks 3.2 face plates and weights 3.3 lathe centers 3.4 drill chucks 3.5 lathe dogs 3.6 boring bar 3.7 follower rest
4. Lathe Operations	Machining operations 4.1 facing 4.2 straight turning 4.3 drilling, boring 4.4 parting-off 4.5 face and turn external shapes (radii, cones) 4.6 external square thread cutting 4.7 multi-start external thread cutting 4.8 cutting taper using taper turning attachment or offset tailstock method 4.9 turning diameters between centers
5. Safety Procedures	Shop safety involves the handling of 5.1 Equipment 5.2 Tools 5.3 Materials
6. Measuring Tools	6.1 Steel rule 6.2 Vernier caliper 6.3 Micrometer caliper 6.4 Gages (thread, drill, depth, surface finish, radius, screw pitch, slip or block, taper)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 setup the workpiece . 1.3 performed turning operations 1.4 checked/measured the workpiece
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Orthographic and isometric drawings 2.2.3 1st and 3rd angle projections 2.2.4 Assembly and detail drawings 2.2.5 Interpreting tolerances, limits and fits 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Angle measuring tools 2.4.3 Geometrical tolerances 2.4.4 Dial indicator 2.4.5 Slip gages 2.4.6 Precision levels 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.6 Lathe machine operations 2.6.1 Lathe types and specifications 2.6.2 Lathe parts and functions 2.6.3 Setting cutting speed, rpm, feed rate 2.6.4 Workholding and tool holding devices 2.6.5 Turning tools and tool geometry 2.6.6 Tooling, set up and parameters in turning operations 2.6.7 Lathe accessories, fixtures and attachments

3. Underpinning skills	3.1 Selecting and grinding cutting tools 3.2 Using measuring instruments 3.3 Verifying workpiece specifications 3.4 Computation of feed, cutting speed and machine rpm
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of lathe setting activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: Turn Workpiece (Advanced)

UNIT CODE: MEE722309

UNIT DESCRIPTOR: This unit covers the competencies required to turn workpiece to drawing specifications. . It details the requirements for performing lathe operations such machining components using steady rest; cutting contours; and cutting internal square, ACME and multi-start threads.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 ***Drawings*** are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 ***Cutting tools*** are selected according to the requirements of the operation.
2. Setup workpiece	2.1 ***Workpiece*** *is* mounted and centered in chuck to required level of accuracy using ***instruments/equipment*** in accordance with 2.2 worksite procedures. ***Setup*** operations are performed applying knowledge on safety procedures and using personal protective devices***.***
3. Perform turning operations	3.1 Speeds and feeds are calculated using appropriate mathematical techniques and reference material. 3.2 ***Lathe accessories*** used are appropriate to the requirements of the operation. 3.2 ***Lathe operations*** are performed to produce component to specifications in the drawing. 3.4 Operations are performed applying knowledge **on *safety procedures*** and using ***personal protective devices***.
4. Check/Measure workpiece	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, ***measuring tools*** **and equipment**.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawings	1.1 Views and projections 1.2 Drawing symbols 1.3 Dimensions and features 1.4 Tolerances and fits
2. Cutting Tools	Cutting tools used in lathe operations include: 2.1 Cutting tools 2.1.1 High speed steel 2.1.2 Inserts 2.2 Drills
3. Workpiece	Workpiece materials used in turning operations 3.1 Ferrous 3.2 Non-ferrous
4. Setup	Setup instrument/tools include 4.1 Surface gage 4.2 Dial indicator on magnetic stand
5. Lathe Accessories	5.1 3- and 4-jaw chucks 5.2 lathe centers 5.3 face plates 5.4 drill chucks 5.5 lathe dogs and counterweights 5.6 boring bar 5.7 steady rest
6. Lathe Operations	Machining operations 6.1 turning diameters using steady rest 6.2 turning eccentric diameters 6.3 turn internal shapes and surfaces (cylinders, chamfers, grooves and radii) 6.4 turn internal tapers 6.5 drilling and boring 6.6 cutting internal square, ACME and multi-start threads 6.7 boring holes on stationary workpiece 6.8 parting-off
7. Safety Procedures	Shop safety involves the handling of 7.1 Equipment 7.2 Tools 7.3 Materials
8 Personal Protective Devices	PPE include 8.1 Safety shoes 8.2 Face shield/safety goggles
9 Measuring Tools	9.1 steel rule 9.2 vernier caliper 9.3 micrometer caliper 9.4 vernier height gage 9.5 gages (thread, drill, depth, surface finish, radius, screw pitch, slip or block, taper)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 setup the workpiece . 1.3 performed turning operations 1.4 checked/measured the workpiece
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Standard drawing scales, symbols and abbreviations 2.2.2 Orthographic and isometric drawings 2.2.3 1st and 3rd angle projections 2.2.4 Assembly and detail drawings 2.2.5 Interpreting tolerances, limits and fits 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Angle measuring tools 2.4.3 Geometrical tolerances 2.4.5 Dial indicator 2.4.6 Slip gages 2.4.7 Precision levels 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials

	2.6 Lathe machine operations 2.6.1 Lathe types and specifications 2.6.2 Lathe parts and functions 2.6.3 Setting cutting speed, rpm, feed rate 2.6.4 Workholding and tool holding devices 2.6.5 Turning tools and tool geometry 2.6.6 Tooling, set up and parameters in turning operations 2.6.7 Lathe accessories, fixtures and attachments
3. Underpinning skills	3.1 Selecting and sharpening cutting tools 3.2 Using measuring instruments 3.3 Verifying workpiece specifications 3.4 Computation of feed, cutting speed and machine rpm
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of lathe setting activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETNCY: Mill Workpiece (Basic)

UNIT CODE: MEE722303

UNIT DESCRIPTOR: This unit covers the skills required to setup and mill workpiece to drawing specifications . It details the requirements for performing milling operations such as drilling, boring, reaming and spot facing holes; milling blocks, shoulder, parallel and angled faces; milling slots, keys, serrations; and milling castings and circular slots and external radius.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications***.*** 1.3 ***Cutting tools*** are selected according to the requirements of the operation***.***
2. Setup workpiece	2.1 ***Workpiece*** is setup to required level of accuracy using instruments/equipment according to work site procedures. 2.2 Setup operations are performed applying knowledge on safety procedures and using personal protective devices.
3. Perform milling operations	3.1 Speeds and feeds are set to requirements of the job. 3.2 ***Milling machine accessories*** used are appropriate to the requirements of the operation. 3.3 ***Milling operations*** are performed to produce component to specifications in the drawing. 3.4 Milling operations are performed applying knowledge on ***safety procedures*** and using ***personal protective devices***.
4. Check/Measure workpiece	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, ***measuring tools*** and equipment.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Cutting Tools	Cutting tools used in milling operations include: 1.1 Drills 1.2 Reamers 1.3 Slab mills 1.4 End mills 1.5 Shell mills 1.6 Side and face cutters 1.7 Formed cutter 1.8 Slitter 1.9 T-slot cutter
2. Workpiece	Workpiece materials used in milling operations 2.1 Ferrous 2.2 Non-ferrous
3. Milling machine accessories	3.1 Workholding devices 3.1.1 clamps 3.1.2 vises 3.1.3 angle plates 3.2 Rotary tables
4. Milling Operations	Basic milling operations 4.1 drilling 4.2 boring 4.3 spot facing 4.4 milling slot and keyways 4.5 milling serrations 4.6 milling vees 4.7 parting-off 4.8 milling circular slots
5. Safety Procedures	Shop safety involves the handling of 5.1 Equipment 5.2 Tools 5.3 Materials
5 Measuring Tools	6.1 Steel rule 6.2 Vernier caliper 6.3 Micrometer caliper 6.4 Gages (bore, surface finish, radius, depth)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 setup the workpiece . 1.3 performed turning operations 1.4 checked/measured the workpiece
2. Underpinning knowledge	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Alphabet of lines 2.2.2 Drawing symbols 2.2.3 Projections and views 2.2.4 Fits and tolerances 2.2.5 Surface texture 2.2.6 Sketches and mechanical drawing 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Dial indicator 2.4.3 Precision square 2.4.4 Bevel protractor 2.4.5 Vernier height gage 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.5.2 Lubricants and coolants 2.6 Milling operations 2.6.1 Milling types and specifications 2.6.2 Milling machine parts and functions 2.6.3 Milling cutters and holders 2.6.4 Setting cutting speed, rpm, feed rate 2.6.5 Workholding devices 2.6.6 Milling machine accessories, fixtures and attachments

3. Underpinning skills	3.1 Selecting and setting cutting tools 3.2 Using measuring instruments 3.3 Verifying workpiece specifications 3.4 Computation of feed, cutting speed and machine rpm
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of milling activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: **Mill Workpiece (Intermediate)**

UNIT CODE: **MEE722307**

UNIT DESCRIPTOR: This unit covers the skills required to setup and mill workpiece to drawing specifications . It details the requirements for performing milling operations such as indexing, milling splines, equally-spaced grooves, 45° serrations in cylindrical workpiece, spur gear and rack, ratchets, converging faces, large radial slots, internal radii and plain bevel gear.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 ***Cutting tools*** are selected according to the requirements of the operation**.**
2. Setup workpiece	2.1 ***Workpiece*** is setup to required level of accuracy using instruments/equipment according to work site procedures. 2.2 Setup operations are performed applying knowledge on safety procedures and using personal protective devices.
3. Perform milling operations	3.1 Speeds and feeds are set appropriate to the job. 3.2 ***Milling machine accessories*** used are appropriate to the requirements of the operation. 3.2 ***Milling operations*** are performed to produce component to specifications in the drawing. 3.4 Milling operations are performed applying knowledge on safety procedures and using personal protective devices.
4. Check/Measure workpiece	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, ***measuring tools*** and equipment.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Cutting Tools	Cutting tools used in milling operations include: 1.1 Side and face cutters 1.2 Gear cutter and other formed cutter 1.3 Slitter 1.4 Slot cutter
2. Workpiece	Workpiece materials used in milling operations 2.1 Ferrous 2.2 Non-ferrous
3. Milling machine accessories	3.1 Workholding devices 3.1.1 clamps 3.1.2 vises 3.1.3 angle plates 3.2 Rotary tables 3.3 Indexing head 3.4 Footstock
4. Milling Operations	Milling operations 4.1 indexing 4.2 straddle-milling 4.3 milling using fly cutter 4.4 milling splines 4.5 milling equally-spaced grooves 4.6 milling 45° serrarions on cylindrical workpiece 4.7 milling spur gear and rack 4.8 milling bevel gear 4.9 milling ratchet 4.10 milling converging faces 4.11 milling large radial slots 4.12 milling internal radii
5. Measuring Tools	5.1 Steel rule 5.2 Vernier caliper 5.3 Micrometer caliper 5.4 Gages (bore, surface finish, radius, depth) 5.5 Gear tooth caliper

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 setup the workpiece . 1.3 performed milling operations 1.4 checked/measured the workpiece
2. Underpinning knowledge	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Alphabet of lines 2.2.2 Drawing symbols 2.2.3 Projections and views 2.2.4 Fits and tolerances 2.2.5 Surface texture 2.2.6 Sketches and mechanical drawing 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Dial indicator 2.4.3 Precision square 2.4.4 Bevel protractor 2.4.5 Vernier height gage 2.4.6 Gear tooth caliper 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.5.2 Lubricants and coolants

	2.6 Milling operations 2.6.1 Milling types and specifications 2.6.2 Milling machine parts and functions 2.6.3 Milling cutters and holders 2.6.4 Setting cutting speed, rpm, feed rate 2.6.5 Workholding devices 2.6.6 Milling machine accessories, fixtures and attachments 2.6.7 Indexing
3. Underpinning skills	3.1 Selecting and setting cutting tools 3.2 Using measuring instruments 3.3 Verifying workpiece specifications 3.4 Computation of feed, cutting speed and machine rpm
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of milling activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: Mill Workpiece (Advanced)

UNIT CODE: MEE722310

UNIT DESCRIPTOR: This unit covers the skills required to setup and mill workpiece to drawing specifications . It details the requirements for performing milling operations such as milling helical gear, helical bevel gear, milling ratchet using differential indexing and performing spiral milling.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 ***Drawings*** are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 ***Cutting tools*** are selected according to the requirements of the operation.
2. Setup workpiece	2.1 ***Workpiece*** is setup to required level of accuracy using ***instruments/equipment*** according to work 2.2 site procedures. Setup operations are performed applying knowledge on safety procedures and using personal protective devices.
3. Perform milling operations	3.1 Speeds and feeds are set appropriate to the job. 3.2 ***Milling machine accessories*** used are appropriate to the requirements of the operation. 3.3 ***Milling operations*** are performed to produce component to specifications in the drawing. 3.4 Milling operations are performed applying knowledge on ***safety procedures*** and using ***personal protective devices***.
4. Check/Measure workpiece	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, ***measuring tools*** and equipment.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawings	Reading and interpretation 1.1 Views and projections 1.2 Drawing symbols 1.3 Dimensions and features 1.4 Tolerances
2. Cutting Tools	Cutting tools used in milling operations include: 2.1 Side and face cutters 2.2 Gear cutter and other formed cutters 2.3 Slitter 2.4 Slot cutter
3. Workpiece	Workpiece materials used in milling operations 3.1 Ferrous 3.2 Non-ferrous
4. Setup Instruments/ equipment	4.1 Dial indicator 4.2 Dial test indicator 4.3 Magnetic stand
5. Milling machine accessories	5.1 Workholding devices 5.1.1 clamps 5.1.2 vises 5.1.3 angle plates 5.2 Indexing head and footstock 5.3 Differential indexing accessories
6. Milling Operations	Milling operations 6.1 Milling helical gear 6.2 Milling helical bevel gear 6.3 Milling ratchet using differential indexing 6.4 Performing spiral milling
7. Safety Procedures	Shop safety involves the handling of 7.1 Equipment 7.2 Tools 7.3 Materials
8 Personal Protective Devices	PPE include 8.1 Safety shoes 8.2 Face shield/safety goggles
9 Measuring Tools	9.1 Steel rule 9.2 Vernier caliper 9.3 Micrometer caliper 9.4 Gages (bore, surface finish, radius, depth) 9.5 Gear tooth caliper

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 setup the workpiece . 1.3 performed milling operations 1.4 checked/measured the workpiece
2. Underpinning knowledge and attitude	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Alphabet of lines 2.2.2 Drawing symbols 2.2.3 Projections and views 2.2.4 Fits and tolerances 2.2.5 Surface texture 2.2.6 Sketches and mechanical drawing 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Dial indicator 2.4.3 Precision square 2.4.4 Bevel protractor 2.4.5 Vernier height gage 2.4.6 Gear tooth caliper 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.5.2 Lubricants and coolants

	2.6 Milling operations 2.6.1 Milling types and specifications 2.6.2 Milling machine parts and functions 2.6.3 Milling cutters and holders 2.6.4 Setting cutting speed, rpm, feed rate 2.6.5 Workholding devices 2.6.6 Tool point geometry 2.6.7 Milling machine accessories, fixtures and attachments 2.6.8 Indexing
3. Underpinning skills	3.1 Selecting and setting cutting tools 3.2 Using measuring instruments 3.3 Verifying workpiece specifications 3.4 Computation of feed, cutting speed and machine rpm
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of milling activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY: **Grind Workpiece (Basic)**

UNIT CODE: **MEE722304**

UNIT DESCRIPTOR: This unit covers the skills required to setup and grind workpiece to drawing specifications . It details the requirements for grinding parallel surfaces, square surfaces, angles, radii and cutting off parts.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 Workholding devices are selected according to the requirements of the operation**.**
2. Select wheels and accessories	2.1 ***Grinding wheels*** are selected, inspected, mounted, dressed and trued according to worksite procedures to produce component to specifications. 2.2 ***Accessories*** selected are appropriate to the requirements of the operation. 2.3 Machine guards, coolant and dust extraction devices are checked according to worksite procedure.
3. Perform grinding operations	3.1 ***Grinding machine*** is setup and adjusted in accordance with worksite procedures. 3.2 Workpiece is held or clamped to avoid damage. 3.3 Grinding operations are performed safely, utilizing guards, safety procedures and personal protective clothing and devices. 3.4 ***Grinding operations*** are performed to produce component to specifications in the drawing.
4. Check/Measure component	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, measuring tools and equipment.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Grinding wheels	Wheels are selected according to: 1.1 types 1.2 grades 1.3 sizes
2. Accessories	2.1 magnetic chuck 2.2 vices 2.3 clamps 2.4 angle plates 2.5 adapter plates 2.6 parallels 2.7 wheel dresser
3. Grinding machine	3.1 Horizontal spindle surface grinder 3.2 Vertical spindle surface grinder
4. Grinding operations	Grinding 4.1 parallel faces 4.2 square surfaces 4.3 angles 4.4 to a square shoulder 4.5 radii 4.6 to cut off parts

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 selected wheels and accessories . 1.3 performed grinding operations 1.4 checked/measured the workpiece
2. Underpinning knowledge	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Alphabet of lines 2.2.2 Drawing symbols 2.2.3 Projections and views 2.2.4 Fits and tolerances 2.2.5 Surface texture 2.2.6 Sketches and mechanical drawing 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.3.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Applying trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Dial indicator 2.4.3 Precision square 2.4.4 Bevel protractor 2.4.5 Vernier height gage 2.4.6 Gage blocks 2.4.7 Sine bar 2.4.8 Radius gage 2.4.9 Precision square 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.5.2 Lubricants and coolants

	2.6 Grinding operations 2.6.1 Grinding machine types and specifications 2.6.2 Grinding machine parts and functions 2.6.3 Grinding wheels 2.6.4 Workholding devices 2.6.5 Grinding machine accessories, fixtures and attachments
3. Underpinning skills	3.1 Using measuring instruments 3.2 Verifying workpiece specifications
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of milling activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT TITLE: **Grind Workpiece (Complex)**

UNIT CODE: **MEE722308**

UNIT DESCRIPTOR: This unit covers the skills required to setup and grind workpiece to drawing specifications . It details the requirements for grinding tapers, internal radii and recess, to remove warp, and polishing components.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings are interpreted to produce component to specifications. 1.2 Sequence of operation is determined to produce component to specifications. 1.3 Workholding devices are selected according to the requirements of the operation.
2. Select wheels and accessories	2.1 ***Grinding wheels*** are selected, balanced and dressed to the required form and size as required. 2.2 ***Accessories*** selected are appropriate to the requirements of the operation. 2.3 Machine guards, coolant and dust extraction devices are checked according to worksite procedure.
3. Perform grinding operations	3.1 ***Grinding machine*** is setup and adjusted in accordance with worksite procedures. 3.2 Workpiece is set up and held or clamped to required level of accuracy as per specifications. 3.2 ***Grinding operations*** are performed safely, utilizing guards, safety procedures and personal protective clothing and devices. 3.4 Grinding operations are performed to produce component to specifications in the drawing.
4. Check/Measure component	4.1 Workpiece is checked/measured for conformance to specification using appropriate techniques, measuring tools and equipment.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Grinding wheels	Wheels are selected according to: 1.1 types 1.2 grades 1.3 sizes
2. Accessories	2.1 magnetic chuck 2.2 vices 2.3 clamps 2.4 angle plates 2.5 adapter plates 2.6 parallels 2.7 wheel dresser 2.8 mandrels 2.9 balancing stand with weights 2.10 de-burring tools 2.11 templates 2.12 headstock/footstock 2.13 centers
3. Grinding machine	3.1 Horizontal spindle surface grinder 3.2 Vertical spindle surface grinder 3.3 Plain cylindrical grinder 3.4 Universal cylindrical grinder 3.5 Center-less grinder 3.6 Universal tool and cutter grinder
4. Grinding operations	Grinding 4.1 external and internal tapers 4.2 internal radii 4.3 internal recess 4.4 to remove warp

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 determined job requirements 1.2 selected wheels and accessories . 1.3 performed grinding operations 1.4 checked/measured the workpiece
2. Underpinning knowledge	2.1 Shop safety practices 2.1.1 Safe working habits 2.1.2 Identification of hazardous areas 2.1.3 Protective clothing and devices 2.1.4 Safe handling of tools, equipment and materials 2.1.5 Housekeeping 2.1.6 First-aid 2.1.7 Fire extinguishers 2.2 Drawing interpretation 2.2.1 Alphabet of lines 2.2.2 Drawing symbols 2.2.3 Projections and views 2.2.4 Fits and tolerances 2.2.5 Surface texture 2.2.6 Sketches and mechanical drawing 2.3 Shop mathematics 2.3.1 Basic arithmetic operations 2.3.2 Fractions and decimals 2.2.3 Percentages and ratios 2.3.4 Conversion of units (English to metric) 2.3.5 Trigonometric functions 2.4 Measurements 2.4.1 Linear measuring tools (rules, vernier, micrometer) 2.4.2 Dial indicator 2.4.3 Precision square 2.4.4 Bevel protractor 2.4.5 Vernier height gage 2.4.6 Gage blocks 2.4.7 Sine bar 2.4.8 Radius gage 2.4.9 Precision square 2.4.10 Bore gage 2.4.11 Optical comparator 2.4.12 Gage block 2.5 Materials and related science 2.5.1 Classification and mechanical properties of engineering materials 2.5.2 Lubricants and coolants

	2.6 Grinding operations 2.6.1 Grinding machine types and specifications 2.6.2 Grinding machine parts and functions 2.6.3 Grinding wheels 2.6.4 Workholding devices 2.6.5 Grinding machine accessories, fixtures and attachments
3. Underpinning skills	3.1 Using measuring instruments 3.2 Verifying workpiece specifications
4. Resource implications	The following resources **MUST** be provided 4.1 Tools, equipment and facilities appropriate to processes or activities 4.2 Materials relevant to the proposed activity 4.3 Drawings, sketches or blueprint
5. Method of assessment	Competency may be assessed through: 5.1 direct observation of milling activities 5.2 written or oral short answer questions 5.3 practical exercises 5.4 identify colleagues/clients who can be approached for the collection of competency evidence, where appropriate
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

SECTION 3. TRAINING STANDARDS

These guidelines are set to provide the Technical and Vocational Education and Training (TVET) providers with information and other important requirements to consider when designing training programs for MACHINING NC III

3.1 CURRICULUM DESIGN

Course Title: **MACHINING** NC Level: **NC III**

Nominal Training Duration: 342 Hours

Course Description:

This qualification is designed to develop knowledge, desirable attitudes and skills of Machinist NC III.

It covers the competencies required to Turn Workpiece (Advanced) and Mill Workpiece (Advanced).

To obtain this, all units of competency prescribed for this qualification must be achieved.

BASIC COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Lead workplace communication	1.1 Communicate information about workplace processes 1.2 Lead workplace discussions Identify and communicate issues arising in the workplace	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
2. Lead small teams	2.1 Provide team leadership 2.2 Assign responsibilities 2.3 Set performance expectations for team members 2.4 Supervised team performance	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning

3. Develop and practice negotiation skills	3.1 Plan negotiations 3.2 Participate in negotiations	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
4. Solve problems related to work activities	4.1 Identify the problem 4.2 Determine fundamental causes of the problem 4.3 Determine corrective action 4.4 Provide recommendation/s to manager	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
5. Use mathematical concepts and techniques	5.1 Identify mathematical tools and techniques to solve problem 5.2 Apply procedure / solution 5.3 Analyze results	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ Questioning
6. Use relevant technologies	6.1 Study / select appropriate technology 6.2 Apply relevant technology 6.3 Maintain / enhance relevant technology	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ questioning

COMMON COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Apply safety practices	1.1 Identify hazards 1.2 Use protective clothing and devices 1.3 Perform safe handling of tools, equipment and materials 1.4 Perform first aid 1.5 Use fire extinguisher	• Lecture • Group discussion • Interaction • Role playing / Simulation	• Observation • Demonstration • Interview / Questioning
2. Interpret working drawing and sketches	2.1 Interpret technical drawing 2.2 Prepare freehand sketch of parts 2.3 Interpret details from freehand sketch	• Lecture • Group discussion • Interaction	• Observation • Interview / Questioning
3. Select / cut workshop materials	3.1 Determine requirement 3.2 Select and measure materials 3.3 Cut materials	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
4. Perform shop computations (Basic)	4.1 Perform four fundamentals operations 4.2 Perform basic calculations involving fractions and decimals 4.3 Perform basic calculations involving percentages 4.4 Perform basic calculation involving ration and proportion 4.5 Perform calculations on algebraic expressions	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning

5. Measure workpiece (Basic)	5.1 Select and use measuring tools 5.2 Clean and store measuring tools	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
6. Perform routine housekeeping	6.1 Organize work area 6.2 Clean Work area	• Lecture • Group discussion • Simulation • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
7. Perform Shop computations (Intermediate)	7.1 Perform calculations involving triangles 7.2 Calculate taper	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
8. Measure workpiece using angular measuring instruments	8.1 Select and use angular measuring tools 8.2 Maintain angular measuring tools 8.3 Clean and store measuring tools	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
9. Perform shop Computation (Advanced)	9.1 Calculate gear ratio 9.2 Solve indexing problems 9.3 Solve gearing problems 9.4 Use geometrical principles in the solution of problems	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning

10. Measure workpiece using gages and surface texture comparator	10.1 Select and use fixed and adjustable gages 10.2 Perform surface texture measurements 10.3 Clean and store measuring tools	• Lecture • Demonstration • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning
11. Perform preventive and corrective maintenance	11.1 Perform inspection of machine 11.2 Perform cleaning and lubricating of machine 11.3 Perform minor machine repair and adjustments 11.4 Maintain hand tools	• Lecture • Demonstration • Group discussion • Practical exercise	• Demonstration • Observation • Performance test • Interview / Questioning

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Turn workpiece	1.1 Determine job requirements: • Determine causes and effect of vibration on machining • Explain the use of counter weights 1.2 Setup Workpiece (per operation) 1.3 Perform turning operations: • Turn diameters using steady rest • Turn eccentric diameters • Perform drilling and boring Drill deep holes Bore both ends of shaft for bearing • Cut internal square, acme and multi – start threads • Bore hole on stationary workpiece • Part – off workpiece 1.4 Check / Measure work piece • Perform procedure and techniques in measuring work piece	• Demonstration • Discussion	• Direct Observation • Written or oral • Demonstration
2. Mill Workpiece	2.1 Determine job requirements: • Compute lead of workpiece • Identify gear cutters and other form cutters • Solve differential indexing problems 2.2 Setup Workpiece (per operation)	• Demonstration • Discussion	• Direct Observation • Written / Oral • Demonstration

	2.3 Perform milling operations: • Mill helical gear • Mill bevel gear • Mill ratchet using differential indexing • Perform spiral milling 2.4 Check / Measure work piece • Perform procedure and techniques in measuring work piece		

3.2 TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery should be guided by the 10 basic principles of Competency-Based TVET.

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is individualized and self-paced;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and curriculum modules;
- Assessment is based in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the –job component;
- Allows for the recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit ; and
- Approved training programs are nationally accredited.
- The competency-based TVET system recognizes various types of delivery modes, both on and off-the–job as long as the learning is driven by the competency standards specified by the industry. The following training modalities may be adopted when designing training programs:
- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in school and in-industry training of fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations
- Modular / self-paced learning is a competency- based training modality wherein the trainee is allowed to progress at his own pace. The trainer facilitates the training delivery
- Peer teaching / mentoring is training modality wherein fast learners are given the opportunity to assist the slow learners.
- Supervised industry training or on-the-hob training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire specific competencies prescribed in the training regulations.

- Distance learning is formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, or audio, video or computer technologies.

3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and educational experience. Other requirements like health and physical requirements are also stated. Passing entry written examinations may also be indicated if necessary.

- Must be holder of Machining NCII
- Must be high school graduate
- With good moral character
- Ability to communicate
- Physically and mentally fit

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS
MACHINING NC III

Recommended list of tools, equipment and materials for the training of 25 trainees for Machining NC III

TOOLS					
QTY		**QTY**		**QTY**	
Drawing Instruments:					
5 pcs.	• Drawing table	5 pcs.	• Protractor	5 pcs	• Compass
5 pcs.	• 30 x 60 degrees triangle	5 pcs	• Ruler	2set	• Drawing pencil
5 pcs.	• 45 degrees triangle	5 pcs.	• Scale Ruler 12 "		
Layout Tools:					
1 pc.	• Surface Plate 500x500 mm	5 pcs.	• Divider	5 pcs.	• Steel square 6 "
2 sets	• Center punch	2 sets	• Combination set	2 pcs	• V-block 50x75 mm
2 sets	• Prick punch	2 units	• Vernier Height gauge 12 "	10 pcs	• Ball peen hammer 12 ounce
2 sets	• Scriber	5 pcs.	• Soft hammer		
Measuring Tools:					
10 pcs	• Vernier caliper 150mm	5 pcs.	• Micrometer Caliper 0-25	3 Sets	• Dial Indicator Plunger type with magnetic stand
5 pcs.	• Vernier caliper 200mm	3 pcs.	• Micrometer Caliper 25-50	2 pcs	• Drill gauge
2 pcs.	• Vernier caliper 150mm	2 pcs.	• Micrometer Caliper 50-75	2 pcs.	• Screw pitch gauge
2 pcs.	• Drill gauge	1 pc.	• Bore gauge		

Bench Tools:					
10 pcs	• Hack saw frame	10 pcs	• Bench vice	6 pcs	• Oil can
3 pcs	• Anvil	10 pcs	• Flat file	10 pcs	• Square file
10 pcs	• Round file	10 pcs	• Triangular file	10 pcs	• Half round file
2 sets	• Needle file	2 sets	• Allen wrench 4 to 10 mm	2 Set	• Drills 4 mm to 12 mm
2 sets	• Open end wrench 4 mm to 20 mm	2 set	• Screw driver length 140 & 160	5 pcs	▪ Adjustable Wrench 10”
2 pcs.	• Wheel dreeser				
Lathe Tools:					
1Sets	• Thread gage – Vee and Acme	1 set	• Taper gauge	2 pcs.	• Center gage
Milling Tools:					
1 set	• Inside micrometer	1 set	• Surface finish gauge block	1 pcs	• Gear tooth caliper
1 set	• Radius gauge				
Safety Device:					
1 box	• First –Aid kit	25 pcs	• Safety goggle	5 pcs	• Safety shield
4 cyl	• Fire extinguisher				

EQUIPMENT					
QTY		**QTY**		**QTY**	
3 units	• Lathe Machine 10"" swing Complete with : - 3-jaw chuck - 4- jaw chuck - Tool holder facing, straight, RH, LH, cut-off - 1set Knurling tool - Face Plate - 1 set lathe dog - Revolving Center - Drill Chucks w/ key -Dead Center - 1 Set Boring Bars -Follower rest -Steady Rest -Surface gage - Sleeve	2 units	• Milling Machine Universal Complete w/ accessories per machine: -1 set Clamping bolt -Milling Vise - Angle plate - Rotary table - Boring Head - 1 set Parallels - Indexing head universal complete w/: 3-jaw chuck, foot stock and gearing Milling Cutters: • 2pcs- Side and face mill • 2pcs- T-slot cutter • 1 set-End mills • 2pcs-Slab mill ▪ 2pcs- Shell mill ▪ 2pcs- Form cutter ▪ 2pcs- Slitter cutter ▪ 2pcs- T-Slot Cutter ▪ 2 pcs. 45 degrees cutter ▪ Gear cutters M 1 one set M 1.5 one set M 1.75 one set	2 units 2 units 1 unit 5 units	Two Head Bench Grinder Bench Drill Machine complete with accessories: - Chuck – Chuck key – Drill vice Power Hack Saw Working Bench heavy duty 1m x 1.5 m

MATERIALS

Bench work materials:

1 quart	• Layout dye	1 doz	▪ power Hack saw blade	1 pc.	▪ Steel plate gauge 10 4'x8'
6 pcs	• Brush ½"	5 gal	• Lubricating oil	2 pcs.	▪ CRS 12 mm dia x 6M
6 doz.	▪ Hack saw blade	2 pcs	Split bearing (project)	1 pcs	Steel plate 25mm x 100 mm x 2 M

Lathe work materials:

25 pcs.	High speed steel Cutter 3/8x3/8x2"	2 pcs.	• CRS 12mm dia x 6M	2 Sets	▪ Drills 3 mm to 12 mm
25 pcs. 25 pcs.	1/4x1/4x 2" 1/8" x 1" x 4"	2 pcs.	• CRS 25mm dia.x 6M	5 pcs.	▪ Carbide insert
2 pcs.	• CRS 19mm dia x 6M	10 pcs.	▪ Center drill # 2	10 pcs	▪ File Card brush
1 pc.	• CRS 50 mm dia.x 6M	10 pcs	▪ Center drills # 3	1 pc.	CRS 100mm x 1M

Milling work materials:

1 pcs	CRS 50mm dia.x 2 M	1 pcs	CRS 75 mm Dia x 1 M	1 pc.	CRS 100 mm dia x 1 M

Training materials:

	▪ Reference books ▪ Manuals		▪ Catalogs ▪ Brochures / LE s		▪ CD s / Video tape

Housekeeping materials:

20 pcs	▪ Brooms	10 k	▪ Clean rags	5 pcs	▪ Dustpan
10 pcs	▪ Scrapers	10 pcs	▪ Mops	2 pcs.	▪ Trash can
10 gal	▪ Kerosene oil	2 bars	▪ Soap		

3.5 TRAINING FACILITIES

The machining workshop must be of concrete structure. Based on class size of 25 students/trainees the space requirements for the teaching/learning and circulation areas are as follows:

SPACE REQUIREMENT	SIZE IN METERS	AREA IN SQ. METERS	TOTAL AREA IN SQ. METERS
• Building (permanent)	10 M X 30 M		300 Sq. M
▪ Trainee working space	2 M X 2 M	4 Sq.M / trainee	100 sq. M.
▪ Lecture Room	8 M X 10 M	80 Sq. M.	80 Sq. M
▪ Learning Resource Center	4 M X 8 M.	32 Sq. M	32 Sq. M
▪ Facilities/ Equipment/ Circulation Area			88 Sq. M.

3.6 TRAINER'S QUALIFICATIONS FOR METALS AND ENGINEERING SECTOR

MACHINING NC III

TRAINER QUALIFICATION (TQ III)

- Must be a holder of Machining NC III
- Must have undergone training on Training Methodology III (TM III)
- Must be computer literate
- Must be physically and mentally fit
- *Must have at least 2 years job/industry experience
- Must be a civil service eligible (for government position or appropriate professional license issued by the Professional Regulatory Commission)

* Optional. Only when required by the hiring institution.

Reference: TESDA Board Resolution No. 2004 03

3.7 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their achievement of units of competency. A certificate of achievement is issued for each unit of competency.

SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1 To attain the National Qualification of Machining NC III, the candidate must demonstrate competence in all the units of competency listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2 Individuals aspiring to be awarded the qualification of Machining NC III must acquire Certificates of Competency in all the following core units of the Qualification. Candidates may apply for assessment in any accredited assessment center:

4.2.1 Perform bench work (Basic)

4.2.2 Perform bench work (Complex)

4.2.3 Turn workpiece (Basic)

4.2.4 Turn workpiece (Intermediate)

4.2.5 Turn workpiece (advanced)

4.2.6 Mill workpiece (Basic)

4.2.7 Mill workpiece (Intermediate)

4.2.8 Mill workpiece (Advanced)

4.2.9 Grind workpiece (Basic)

4.2.10 Grind workpiece(Complex)

Successful candidates shall be awarded Certificates of Competency (COC).

4.3 Accumulation and submission of all COCs acquired for the relevant units of competency comprising a qualification, an individual shall be issued the corresponding National Certificate.

4.4 Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

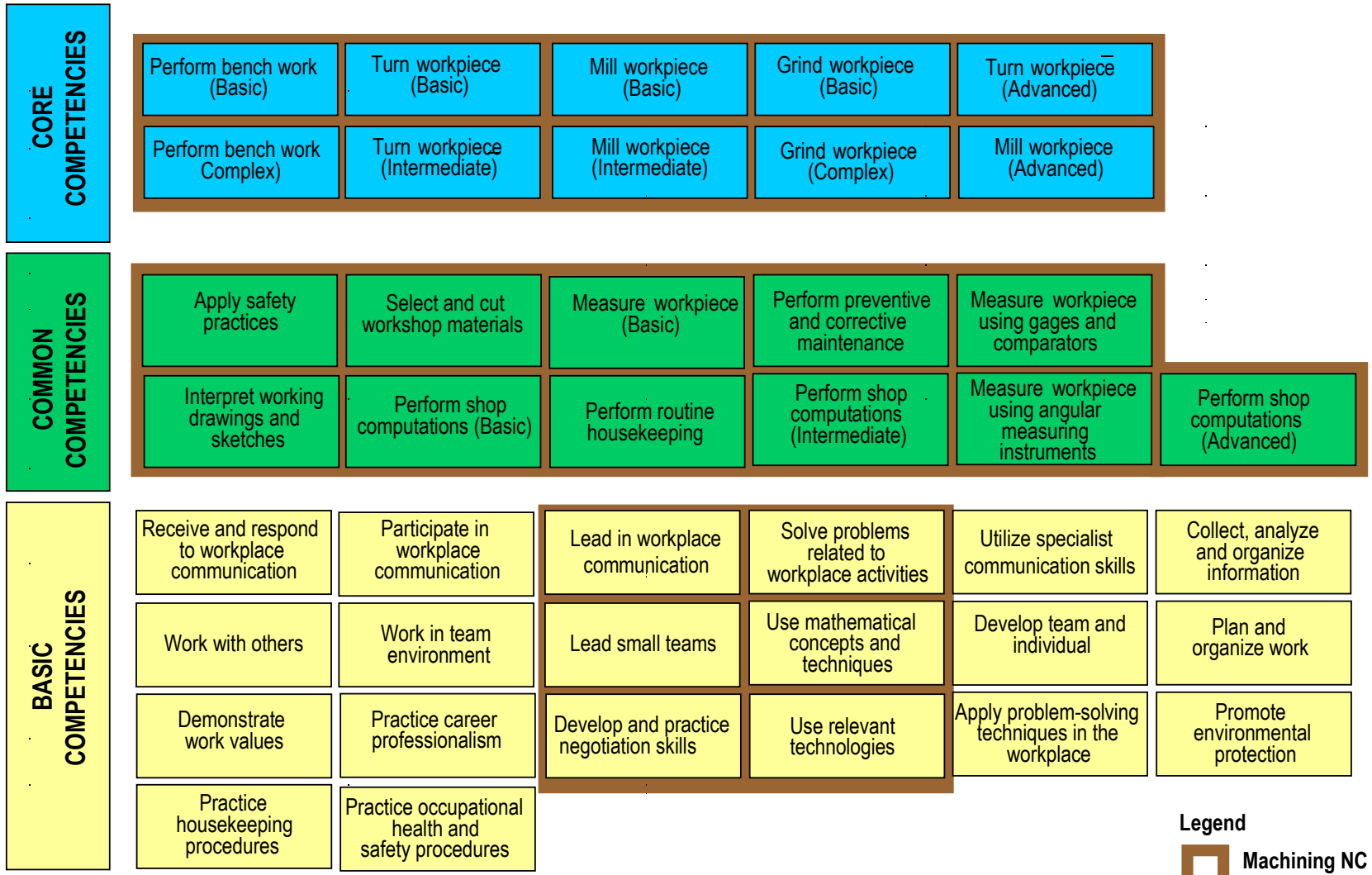
4.5 The following are qualified to apply for assessment and certification:

4.5.1 Graduates of formal, non-formal and informal including enterprise-based training programs.

4.5.2 Experienced workers (wage employed or self employed)

4.6 The guidelines on assessment and certification are discussed in detail in the "Procedures Manual on Assessment and Certification" and "Guidelines on the Implementation of the Philippine TVET Qualification and Certification System (PTOQS)".

Supermarket of Competencies
Metals and Engineering Sector
MACHINING



Definition of Terms

bench work	the operations incident to the process of laying out, fitting, assembling, etc… when the work is placed on the bench or in a bench vise
boring	is the operation of enlarging a hole by means of an adjustable cutting tool with only one cutting edge
chipping	is the operation of removing/cutting metal using hammer and chisel
counterboring	is the operation of enlarging the end of a hole cylindrically
drilling	is the operation of producing a circular hole by removing solid metal
facing	the lathe operation of finishing the ends of the work, to make the piece the right length. Also known as squaring
grinding	refers to the removal of material from a workpiece with grinding wheel
laying out	term used to include the marking or scribling of center points, circles, arcs, or straight lines upon metal surfaces, either curved or flat, for the guidance of the worker
milling	refers to removal of metal by feeding a workpiece through the periphery of rotating circular cutter
reaming	is an operation of sizing and finishing a hole by means of a cutting tool having several cutting edges. reaming serves to make the hole smoother, straighter, and more accurate
spot-facing	is the operation of smoothing and squaring the surface around a hole
tapping	is the operation of forming internal threads by means of a tool called tap
turning	refers to shaping a workpiece by gripping it in a workholding device and rotating it under power against a suitable cutting tool

ACKNOWLEDGEMENTS

The Technical Education and Skills Development Authority (TESDA) wishes to extend thanks and appreciation to the many representatives of business, industry, academe and government agencies who donated their time and expertise to the development and validation of this Training Regulation.

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