TRAINING REGULATIONS

MACHINING NC I

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 I

TRAINING REGULATIONS FOR

MACHINING NC I

SECTION 1 MACHINING NC I QUALIFICATION

The Machining NC I 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
500311101	Receive and respond to workplace communication
500311102	Work with others
500311103	Demonstrate Work Values
500311104	Practice Housekeeping Procedures

Code No.	COMMON COMPETENCIES
MEE722201	Apply safety practices
MEE722202	Interpret working drawings and sketches
MEE722203	Select and cut workshop materials
MEE722204	Perform shop computations (Basic)
MEE722205	Measure workpiece (Basic)
MEE722206	Perform routine housekeeping
MEE722211	Perform preventive and corrective maintenance

Code No.	CORE COMPETENCIES
MEE722301	Perform bench work (Basic)
MEE722302	Turn workpiece (Basic)
MEE722303	Mill workpiece (Basic)
MEE722304	Grind workpiece (Basic)

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 basic, common and core units of competency required in MACHINING NC I.

BASIC COMPETENCIES

UNIT OF COMPETENCY: RECEIVE AND RESPOND TO WORKPLACE COMMUNICATION

UNIT CODE : 500311101

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to receive, respond and act on verbal and written communication.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Follow routine spoken messages	1.1. Required information is gathered by listening attentively and correctly interpreting or understanding information/instructions 1.2. Instructions/information are properly recorded *1.3.* Instructions are acted upon immediately in accordance with information received 1.4. Clarification is sought from workplace supervisor on all occasions when any instruction/information is not clear
2. Perform workplace duties following written notices	2.1 ***Written notices and instructions*** are read and interpreted correctly in accordance with ***organizational guidelines*** 2.2 Routine written instruction are followed in sequence 2.3 Feedback is given to workplace supervisor based on the instructions/information received

RANGE OF VARIABLES

VARIABLE	RANGE
1. Written notices and instructions	It refers to : 1.1. Handwritten and printed material 1.2. Internal memos 1.3. External communications 1.4. Electronic mail 1.5. Briefing notes 1.6. General correspondence 1.7. Marketing materials 1.8. Journal articles
2. Organizational Guidelines	It may include: 2.1. Information documentation procedures 2.2. Company policies and procedures 2.3. Organization manuals 2.4. Service manual

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Demonstrated knowledge of organizational procedures for handling verbal and written communications 1.2. Received and acted on verbal messages and instructions 1.3. Demonstrated competency in recording instructions/information
2. Underpinning Knowledge and Attitudes	2.1. Knowledge of organizational policies/guidelines in regard to processing internal/external information 2.2. Ethical work practices in handling communications 2.3. Communication process
3. Underpinning Skills	3.1. Conciseness in receiving and clarifying messages/ information/communication 3.2. Accuracy in recording messages/information
4. Resource Implications	The following resources **MUST** be provided: 4.1. Pens 4.2. Note pads
5. Methods of Assessment	Competency may be assessed through: 5.1. Direct Observation 5.2. Oral interview 5.3. Written Evaluation 5.4. Third Party Report
6. Context of Assessment	Competency may be assessed individually in the actual workplace or simulation environment in TESDA accredited institutions

UNIT OF COMPETENCY : WORK WITH OTHERS

UNIT CODE : 500311102

UNIT DESCRIPTOR : This unit cover the skills, knowledge and attitudes required to develop workplace relationship and contribute in workplace activities.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Develop effective workplace relationship	1.1 ***Duties and responsibilities*** are done in a positive manner to promote cooperation and good relationship 1.2 Assistance is sought from ***workgroup*** when difficulties arise and addressed through discussions 1.3 ***Feedback*** provided by others in the team is encouraged, acknowledged and acted upon 1.4 Differences in personal values and beliefs are respected and acknowledged in the development
2. Contribute to work group activities	2.1 ***Support is provided to team members*** to ensure workgroup goals are met 2.2 Constructive contributions to workgroup goals and tasks are made according to ***organizational requirements*** 2.3 Information relevant to work is shared with team members to ensure designated goals are met

RANGE OF VARIABLES

VARIABLE	RANGE
1. Duties and responsibilities	1.1 Job description and employment arrangements 1.2 Organization's policy relevant to work role 1.3 Organizational structures 1.4 Supervision and accountability requirements including OHS 1.5 Code of conduct
2. Work group	2.1 Supervisor or manager 2.2 Peers/work colleagues 2.3 Other members of the organization
3. Feedback on performance	3.1 Formal/Informal performance appraisal 3.2 Obtaining feedback from supervisors and colleagues and clients 3.3 Personal, reflective behavior strategies 3.4 Routine organizational methods for monitoring service delivery
4. Providing support to team members	4.1 Explaining/clarifying 4.2 Helping colleagues 4.3 Providing encouragement 4.4 Providing feedback to another team member 4.5 Undertaking extra tasks if necessary
5. Organizational requirements	5.1 Goals, objectives, plans, system and processes 5.2 Legal and organization policy/guidelines 5.3 OHS policies, procedures and programs 5.4 Ethical standards 5.5 Defined resources parameters 5.6 Quality and continuous improvement processes and standards

EVIDENCE GUIDE

1. Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1. Provided support to team members to ensure goals are met 1.2. Acted on feedback from clients and colleagues 1.3. Accessed learning opportunities to extend own personal work competencies to enhance team goals and outcomes
2. Underpinning Knowledge	2.1. The relevant legislation that affects operations, especially with regards to safety 2.2. Reasons why cooperation and good relationships are important 2.3. Knowledge of the organization's policies, plans and procedures 2.4. Understanding how to elicit and interpret feedback 2.5. Knowledge of workgroup member's responsibilities and duties 2.6. Importance of demonstrating respect and empathy in dealings with colleagues 2.7. Understanding of how to identify and prioritize personal development opportunities and options
3. Underpinning Skills	3.1. Ability to read and understand the organization's policies and work procedures 3.2. Write simple instructions for particular routine tasks 3.3. Interpret information gained from correspondence 3.4. Communication skills to request advice, receive feedback and work with a team 3.5. Planning skills to organized work priorities and arrangement 3.6. Technology skills including the ability to select and use technology appropriate to a task 3.7. Ability to relate to people from a range of social, cultural and ethnic backgrounds.

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. Methods 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
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: DEMONSTRATE WORK VALUES

UNIT CODE 500311103

UNIT DESCRIPTOR : This unit covers the knowledge, skills, and attitude in demonstrating proper work values.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Define the purpose of work	1.1 One's unique sense of purpose for working and the why's of work are identified, reflected on and clearly defined for one's development as a person and as a member of society. 1.2 Personal mission is in harmony with company's values
2. Apply work values/ethics	2.1 ***Work values/ethics/concepts*** are classified and reaffirmed in accordance with the transparent company ethical standards, policies and guidelines. 2.2 ***Work practices*** are undertaken in compliance with industry work ethical standards, organizational policy and guidelines 2.3 Personal behavior and relationships with co-workers and/or clients are conducted in accordance with ethical standards, policy and guidelines. 2.4 ***Company resources*** are used in accordance with transparent company ethical standard, policies and guidelines.
3. Deal with ethical problems	3.1 Company ethical standards, organizational policy and guidelines on the prevention and reporting of unethical conduct are accessed and applied in accordance with transparent company ethical standard, policies and guidelines. 3.2 ***Work incidents/situations*** are reported and/or resolved in accordance with company protocol/guidelines. 3.3 Resolution and/or referral of ethical problems identified are used as learning opportunities.
4. Maintain integrity of conduct in the workplace	4.1 Personal work practices and values are demonstrated consistently with acceptable ethical conduct and company's core values. 4.2 ***Instructions*** to co-workers are provided based on ethical, lawful and reasonable directives. 4.3 Company values/practices are shared with co-workers using appropriate behavior and language.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work values/ethics/ concepts	May include but are not limited to: 1.1 Commitment/ Dedication 1.2 Sense of urgency 1.3 Sense of purpose 1.4 Love for work 1.5 High motivation 1.6 Orderliness 1.7 Reliability 1.8 Competence 1.9 Dependability 1.10 Goal-oriented 1.11 Sense of responsibility 1.12 Being knowledgeable 1.13 Loyalty to work/company 1.14 Sensitivity to others 1.15 Compassion/Caring attitude 1.16 Balancing between family and work 1.17 *Pakikisama* 1.18 *Bayanihan* spirit/teamwork 1.19 Sense of nationalism
2. Work practices	2.1 Quality of work 2.2 Punctuality 2.3 Efficiency 2.4 Effectiveness 2.5 Productivity 2.6 Resourcefulness 2.7 Innovativeness/Creativity 2.8 Cost conciousness 2.9 5S 2.10 Attention to details
3. Incidents/situations	3.1 Violent/intensed dispute or argument 3.2 Gambling 3.3 Use of prohibited substances 3.4 Pilferages 3.5 Damage to person or property 3.6 Vandalism 3.7 Falsification 3.8 Bribery 3.9 Sexual Harassment 3.10 Blackmail

VARIABLE	RANGE
4. Company resources	4.1 Consumable materials 4.2 Equipment/Machineries 4.3 Human 4.4 Time 4.5 Financial resources
5. Instructions	5.1 Verbal 5.2 Written

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Defined one's unique sense of purpose for working 1.2 Clarified and affirmed work values/ethics/concepts consistently in the workplace 1.2 Demonstrated work practices satisfactorily and consistently in compliance with industry work ethical standards, organizational policy and guidelines 1.4 Demonstrated personal behavior and relationships with co-workers and/or clients consistent with ethical standards, policy and guidelines 1.5 Used company resources in accordance with company ethical standard, policies and guidelines. 1.6 Followed company ethical standards, organizational policy and guidelines on the prevention and reporting of unethical conduct/behavior
2. Underpinning Knowledge	2.1 Occupational health and safety 2.2 Work values and ethics 2.3 Company performance and ethical standards 2.4 Company policies and guidelines 2.5 Fundamental rights at work including gender sensitivity 2.6 Work responsibilities/job functions 2.7 Corporate social responsibilities 2.8 Company code of conduct/values 2.9 Balancing work and family responsibilities
3. Underpinning Skills	3.1 Interpersonal skills 3.2 Communication skills 3.3 Self awareness, understanding and acceptance 3.4 Application of good manners and right conduct
4. Resource Implications	The following resources **MUST** be provided: 4.1 Workplace or assessment location 4.2 Case studies/Scenarios
5. Methods of Assessment	Competency may be assessed through: 5.1 Portfolio Assessment 5.2 Interview 5.3 Third Party Reports
6. Context of Assessment	Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY: PRACTICE HOUSEKEEPING PROCEDURES

UNIT CODE : 500311104

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to apply the basic housekeeping procedures.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Sort and remove unnecessary items	1.1 Reusable, recyclable materials are sorted in accordance with company/office procedures 1.2 ***Unnecessary items*** are removed and disposed of in accordance with company or office procedures
2. Arrange items	2.1 Items are arranged in accordance with company/office housekeeping procedures 2.2 Work area is arranged according to job requirements 2.3 Activities are prioritized based on instructions. 2.4 Items are provided with clear and visible ***identification marks*** based on procedure 2.5 Safety equipment and evacuation passages are kept clear and accessible based on instructions
3. Maintain work area, tools and equipment	3.1 Cleanliness and orderliness of work area is maintained in accordance with company/office procedures 3.2 Tools and equipment are cleaned in accordance with manufacturer's instructions/manual 3.3 ***Minor repairs*** are performed on tools and equipment in accordance with manufacturer's instruction/manual 3.4 Defective tools and equipment are reported to immediate supervisor
4. Follow standardized work process and procedures	4.1 Materials for common use are maintained in designated area based on procedures 4.2 Work is performed according to standard work procedures 4.3 Abnormal incidents are reported to immediate supervisor
5. Perform work spontaneously	5.1 Work is performed as per instruction 5.2 Company and office ***decorum*** are followed and complied with 5.3 Work is performed in accordance with occupational health and safety (OHS) requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Unnecessary items	May include but are not limited to: 1.1 Non-recyclable materials 1.2 Unserviceable tools and equipment 1.3 Pictures, posters and other materials not related to work activity 1.4 Waste materials
2. Identification marks	2.1 Labels 2.2 Tags 2.3 Color coding
3. Decorum	3.1 Company/ office rules and regulations 3.2 Company/ office uniform 3.3 Behavior
4. Minor repair	Minor repair include but not limited to: 4.1 Replacement of parts 4.2 Application of lubricants 4.3 Sharpening of tools 4.4 Tightening of nuts, bolts and screws

EVIDENCE GUIDE

1. Critical Aspects of Competency	Assessment requires evidence that the candidate practiced the basic procedures of 5S
2. Underpinning Knowledge and Attitudes	2.1 Principles of 5S 2.2 Work process and procedures 2.3 Safety signs and symbols 2.4 General OH&S principles and legislation 2.5 Environmental requirements relative to work safety 2.6 Accident/Hazard reporting procedures
3. Underpinning Skills	3.1 Basic communication skills 3.2 Interpersonal skills 3.3 Reading skills required to interpret instructions 3.4 Reporting/recording accidents and potential hazards
4. Resource Implications	The following resources **MUST** be provided: 4.1 Facilities, materials tools and equipment necessary for the activity
5. Methods of Assessment	Competency may be assessed through: 5.1 Third party report 5.2 Interview 5.3 Demonstration with questioning
6. Context for Assessment	Competency may be assessed in the work place or in a simulated work place setting

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 job 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 2.2 operations. 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 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
3. 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 bench work 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. Work holding Devices	Work holding 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, counter boring, 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: **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. 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 7.4 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: **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
6 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: **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 Work holding 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 I.

3.1 CURRICULUM DESIGN

Course Title: **MACHINING** NC Level: **NC I**

Nominal Training Duration : 374 Hours

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

It covers the competencies required to Perform Bench work (Basic) ,Turn Workpiece (Basic), Mill Workpiece (Basic) and Grind workpiece (Basic).

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. Receive and respond to workplace communication	1.1 Explain routinary speaking & messages in a workplace 1.2 Follow routinary speaking & messages 1.3 Perform work duties following written notices	• Group discussion • Interaction	• Interviews/ questioning • Observation
2. Work with others	2.1 Develop effective workplace relationship 2.2 Contribute to work group activities	• Group discussion • Interaction	• Interviews/ questioning • Demonstration • Observation
3. Demonstrate work values	3.1 Define the purpose of work 3.2 Apply work values/ ethics 3.3 Deal with ethical problems 3.4 Maintain integrity of conduct in the workplace	• Group discussion • Interaction	• Demonstration • Observation • Interviews/ questioning

4. Practice housekeeping procedures	4.1 Sort and remove unnecessary items 4.2 Arrange items 4.3 Maintain work areas, tools and equipment 4.4 Follow standardize work process and procedures 4.5 Perform work spontaneously	• 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 fundamental operations 4.2 Perform basic calculations involving fractions and decimals 4.3 Perform basic calculations involving percentages 4.4 Perform basic calculations 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 preventive and corrective maintenance	7.1 Perform inspection of machine 7.2 Perform cleaning and lubricating of machine 7.3 Perform minor machine repair and adjustments 7.4 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. Perform Bench work	1.1 Layout and mark dimensions / features on workpiece • Observed general shop safety practices • Read linear measuring tools • Identify layout tools • Care and use of measuring and layout tools 1.2 Cut, chip and file flat, rectangular or round blocks • Identify kinds and uses of hacksaw blades • Observed safety practices in cutting with hacksaw • Identify kinds and uses of chisels • Observed safety practices in chipping • Identify kinds and uses of files • Observed safety practices in filing	• Demonstration • Discussion	• Direct Observation • Written or oral • Demonstration

	1.3 Drill, ream and lap holes • Orient parts and function of drill press • Observed safety in drilling • Identify parts of drill bits • Identify kinds and care of reamers • Observed safety in reaming • Identify kinds of lapping tools • Safety in lapping 1.4 Cut threads using tap and stock and die • Identify standard taps and die • Observed safety practices in using taps and die 1.5 Off-hand grind cutting tools • Identify parts and function of off-hand grinder • Observed safety in sharpening • Sharpen lathe cutting tools, scribers, chisels and drill bits		
2. Turn Work piece	2.1 Determine job requirements: • Observed safety on lathe work • Orient lathe machine parts and function • Identify lathe accessories, fixture and attachments • Mount and remove lathe chuck and accessories • Identify the uses of lathe cutting tools 2.2 Setup Workpiece (per operation) 2.3 Perform turning Operations: • Face -Face both ends of work to length using 4-jaw chuck • Straight turn - Straight turn whole length of workpiece using 4 jaw chuck	• Demonstration • Discussion	• Written /Oral • Direct Observation • Demonstration

	• Cut recess and grooves • Drill, bore, countersink and ream - Drill through holes - Bore through holes - Countersink holes - ream holes (straight) • Knurl • Cut single-start external vee and acme thread • Part – off • Cut threads using taps and stock and die • Cut external taper using compound slide or formed tool 2.4 Check / Measure work piece • Procedure and techniques in measuring work piece		
3. Mill Workpiece	3.1 Determine job requirements • Observed milling machine safety precaution • Orient milling machine parts and function • Identify milling cutting tools • Mount and remove milling arbors, collets, adaptor, cutters, plain vice, circular vice and other accessories 3.2 Setup Workpiece (per operation) 3.3 Perform milling operations: • Drill • Bore • Spot face • Mill slot and keyways • Mill serrations • Mill vees • Part – off • Mill circular slots	• Demonstration • Discussion	• Direct Observation • Written / Oral • Demonstration

4. Grind Workpiece	3. 4 Check / Measure workpiece • Perform procedure and techniques in measuring work piece 4.1 Determine job requirements: • Observed grinding machine safety precaution • Identify grinding machine types and specifications - Horizontal spindle surface grinder - Vertical spindle surface grinder • Orient grinding machine parts and functions • Identify grinding machine work holding devices • Identify the use of grinding machine accessories, fixture and attachments • Mount and remove grinding wheels 4.2 Select wheels and accessories 4.3.Perform grinding operations: • Grind parallel surfaces • Grind square surfaces • Grind angles • Grind to a square shoulder • Grind radii • Grind to cut-off parts 4.4 Check / Measure workpiece Perform the procedure and techniques in measuring work piece	• Demonstration • Discussion	• Direct observation • Written / Oral examination • Demonstration

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 high school graduate
- With good moral character
- Ability to communicate
- Physically and mentally fit

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS MACHINING NC I

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

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	2sset	• Drawing pencil
5 pcs.	• 45 degrees triangle	5 pcs.	• Scale Ruler 12 "		•
Layout Tools:					
1 pc.	• Surface Plate 500x500 mm	1 pc.	• Trammel	2 pcs	• Steel square 12 "
2 sets	• Center punch	2 sets	• Combination set	1 pc.	• Steel square 24 "
2 sets	• Prick punch	2 units	• Vernier Height gauge 12 "	10 pcs	• Ball peen hammer 12 ounce
2 sets	• Scriber	4 pcs.	• Parallel clamps	2 pcs	• Angle iron precision 100x100 mm
5 pcs.	• Divider	5 pcs.	• Steel square 6 "	2 pcs	• V-block 50x75 mm
5 pcs.	• Soft hammer				
Measuring Tools:					
10 pcs	• Vernier caliper 150mm	5 pcs.	• Micrometer 0-25	3 Sets	• Dial Indicator Plunger type with magnetic stand
5 pcs.	• Vernier caliper 200mm	3 pcs.	• Micrometer 25-50	2 pcs	• Drill gauge
2 pcs.	• Vernier caliper 150mm	2 pcs.	• Micrometer 50-75	2 pcs.	• Screw pitch gauge
2 pcs.	• Drill gauge				

Bench Tools					
10 pcs	• Hack saw frame	10 pcs	• Bench vice	10 pcs	• Flat cold chisel
3 pcs	• Cape chisel	3 pcs	• Diamond point chisel	3 pcs	• Round nose chisel
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	1 set	• Reamer 6 mm to 20 mm	2 Set	• Drills 4 mm to 12 mm
1 set	• Counter boring tool	1 set	• Spot- facing tool	1 set	• Counter-sinking tool
2 sets	• Taps 4 mm to 12 mm		• Stock and die 4 mm to 12 mm	5 pcs	▪ Adjustable Wrench 10”
1 set	• Tap wrench handle M1 to M10 M1 to M12	5 pcs	• Vice grip length175 mm	2 set	• Screw driver length 140 & 160
2 sets	• Philips screw driver	2 sets	• Allen wrench 4 to 10 mm	2 sets	• Open end wrench 4 mm to 20 mm
5 pcs	• Combination pliers 150 mm long	6 pcs	• Oil can		
Lathe Tools					
1Sets	• Thread gage – Vee and Acme	1 set	• Taper gauge	2 pcs.	• Center gage
Milling Tools					
1 set	• Inside micrometer		• Surface finish gauge block	2 pcs	• Precision square 8 “
Grinding Tools:					
2 pcs	• Wheel dresser	1 set	• Radius gauge	1 set	▪ Gauge blocks
Safety Device:					
1 box	• First –Aid kit	25 pcs	• Safety goggle	5 pcs	• Safety shield
4 cyl	• Fire extinguisher		▪		

EQUIPMENT					
QTY		**QTY**		**QTY**	
2 units	• Two Head Bench Grinder	2 units	• Milling Machine Universal Complete w/ accessories per machine:	1 unit	Horizontal Spindle Surface Grinder with complete accessories – Magnetic chuck - Vise - Clamps - Angle plate - Parallel - Diamond Wheel dresser
2 units	• Bench Drill Machine complete with accessories: - Chuck – Chuck key – Drill vice		-1 set Clamping bolt -Milling Vise - Angle plate - Rotary table - Boring Head - 1 set Parallels		
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		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	1 unit	Vertical Spindle Surface Grinder with complete accessories: – Magnetic chuck - Vise - Clamps - Angle plate - Parallel - Diamond Wheel dresser
		1 unit	Power Hack Saw		
		5 units	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				

Lathe work materials:

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

Milling and Grinding work materials:

1 pcs	Steel plate 25mm x 100 mm x 2 M	1 pcs	Steel plate 50mm x 50 mm x 2 M	1 pc	Steel plate 12mm x 50 mm x 6 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
MACHINING NC I

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 I

TRAINER QUALIFICATION (TQ I)

- Must be a holder of Machining NC II
- Must have undergone training on Training Methodology I (TM I)
- 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 I, 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 I must acquire Certificates of Competency in all the 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 Turn workpiece (Basic)

4.2.3 Mill workpiece (Basic)

4.2.4 Grind workpiece (Basic)

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.

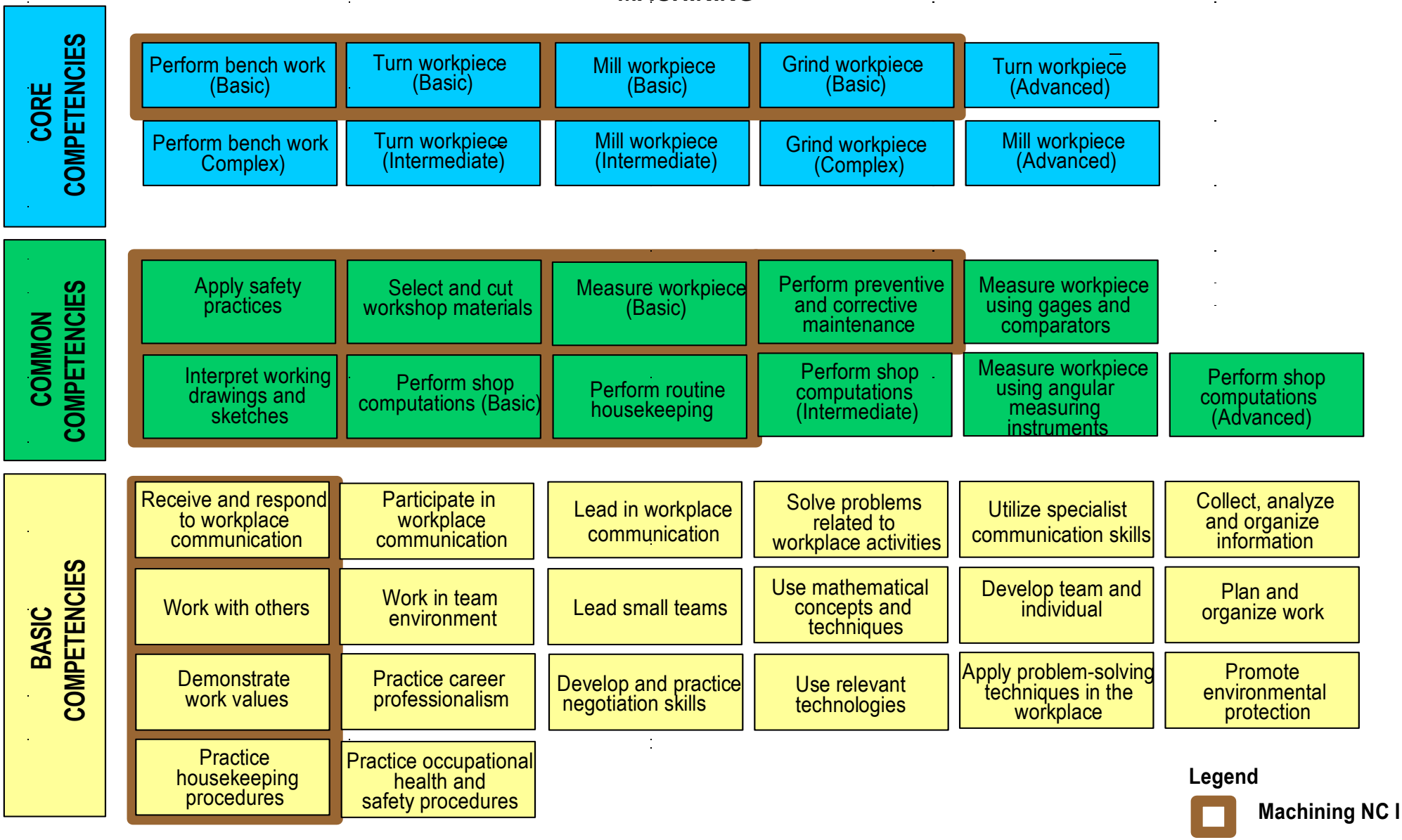
4.5 The following are qualified to apply for assessment and certification:

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
counter boring	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 work holding device and rotating it under power against a suitable cutting tool

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TESDA ADVISORY PANEL (TAP) – METALS AND ENGINEERING SECTOR

MR. BENJAMIN MA. AYCARDO†
TAP Chairman
Unimagma Philippines, Inc.
Laguna

MR. CARLOS MEDINA, JR.
Member - Academe
Don Bosco Technical College
Mandaluyong City

MR. JIMMY LIBO-ON RUZGAL
Member – Labor, FFW
MFI, Ortigas Ave., Pasig City

MR. RAUL M. CONSUNJI
Member - Industry
RMC Consultancy Services, Inc.
Blue Ridge, Cubao, Quezon City

MR. EDUARDO R. LACBAY
Member -Academe
MIRDC, Bicutan, Taguig City

TESDA EXPERT PANEL (TEP) – MACHINING

MR. EDUARDO CHUA KO KIONG
Sankei Philippines, Inc.

MR. REY FERNANDEZ
Meralco Foundation, Inc.

MR. JERRY R. OMALLAO
Reynolds Philippines Corp

MR. AGUSTIN M. PAYAD
Technological University of the Philippines

MR. TIMOTEO INTALAN
Directric Industries, Inc.

MR. CLETO JIMENEZ
Reynolds Philippines Corp.

MR. ELSO CLARETE
Don BOSCO Technical College

The PARTICIPANTS in the National Validation of this Training Regulations

- **Region I**
- **CAR**
- **Region VI**
- **CARAGA**

Members of the TESDA Board

The TESDA Executive Committee

The MANAGEMENT and STAFF of the TESDA Secretariat

- **SSCO**
- **NITVET**
- **OFTVET**
- **ONFTVET**