Federal Democratic Republic of Ethiopia
OCCUPATIONAL STANDARD

FOUNDRY WORKS

SUPERVISION

NTQF Level IV

Ministry of Education
February 2017

Introduction

Ethiopia has embarked on a process of reforming its TVET-System. Within the policies and strategies of the Ethiopian Government, technology transformation – by using international standards and international best practices as the basis, and, adopting, adapting and verifying them in the Ethiopian context – is a pivotal element. TVET is given an important role with regard to technology transfer. The new paradigm in the outcome-based TVET system is the orientation at the current and anticipated future demand of the economy and the labor market.

The Ethiopian Occupational Standard (EOS) is the core element of the Ethiopian National TVET-Strategy and an important factor within the context of the National TVET-Qualification Framework (NTQF). They are national Ethiopian standards, which define the occupational requirements and expected outcome related to a specific occupation without taking TVET delivery into account.

This document details the mandatory format, sequencing, wording and layout for the Ethiopia Occupational Standard which comprised of Units of Competence.

A Unit of Competence describes a distinct work activity. It is documented in a standard format that comprises:

- Occupational title and NTQF level
- Unit title
- Unit code
- Unit descriptor
- Elements and Performance criteria
- Variables and Range statement
- Evidence guide

Together all the parts of a Unit of Competence guide the assessor in determining whether the candidate is competent.

The ensuing sections of this EOS document comprise a description of the occupation with all the key components of a Unit of Competence:

- chart with an overview of all Units of Competence for the respective level including the Unit Codes and the Unit Titles
- contents of each Unit of Competence (competence standard)
- occupational map providing the Technical and Vocational Education and Training (TVET) providers with information and important requirements to consider when designing training programs for this standards and for the individual, a career path

UNIT OF COMPETENCE CHART

Occupational Standard: Foundry Works Supervision

Occupational Code: IND FWS4

NTQF Level IV

IND FWS4 01 0217 Supervise and Guide CIM Production Operations	**IND FWS4 02 0217** Manage Product Cost Estimation and Bill of Materials	**IND FWS4 03 0217** Perform Process Planning and Scheduling
IND FWS4 04 0217 Manufacture Gear, Conveyor Screw and Propeller Patterns	**IND FWS4 05 0217** Perform Prescribed Tests on Foundry Related Materials	**IND FWS4 06 0217** Supervise Ferrous and Non-ferrous Melting and Casting Operations
IND FWS4 07 0217 Supervise the Manufacturing of Advanced Patterns and Models	**IND FWS4 08 0217** Perform Centrifugal and Investment Casting Processes	**IND FWS4 09 0217** Implement and Monitor Environmentally Sustainable Work Practices
IND FWS4 10 0217 Plan and Organize Work	**IND FWS4 11 0217** Migrate to New Technology	**IND FWS4 12 0217** Establish Quality Standards
IND FWS4 13 0217 Develop Individuals and Team	**IND FWS4 14 0217** Utilize Specialized Communication Skills	**IND FWS4 15 0217** Manage Micro, Small and Medium Enterprises (MSMEs)
IND FWS4 16 0217 Apply Problem Solving Techniques and Tools		

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Supervise and Guide CIM Production Operations**
Unit Code	**IND FWS4 01 0217**
Unit Descriptor	This unit covers the competency required of supervising and guiding production operations including control of machine and processes and the capture of manufacturing data through conventional or Computer-integrated Manufacturing (CIM) processes.

Elements	Performance Criteria
1. Interpret the design brief or scope of production including CIM system	1.1. Required features and extent of integration of the CIM system are established in consultation with the client based on applicable operational regulations 1.2. Technical, commercial and environmental parameters are established to the scope of work in accordance with organizational procedures 1.3. Technical managers and senior design engineers are consulted in determining a production process in compliance with engineering standards 1.4. OHS, regulatory requirements and enterprise procedures relevant to scope of work are considered 1.5. Preliminary advice on feasibility of manual or possible CIM project are collected and presented to client based on engineering environment
2. Prepare production process including possible CIM system	2.1. Investigations and measurements are performed based on scope of work and operational standards 2.2. Required modelling and calculations are carried out using ***appropriate software and validation techniques*** according to production specifications 2.3. A range of conventional and CIM production solutions are generated using appropriate innovative and creative engineering specifications 2.4. Feasibility and evaluate solutions are checked against design criteria ensuring conformity to ***standards and codes***, technical, economic and OHS requirements 2.5. Social and sustainability implications of solutions are determined according to organizational specifications 2.6. Concept proposals is reviewed with client and identify preferred solution according to operational procedures

3. Perform supervision of conventional and /or CIM supported production	3.1. Conventional production processes are planned in comparison to CIM design based on results of external feasibility study and organizational requirements 3.2. Documentation, drawings, specifications and instructions are provided in accordance with industry standards 3.3. Client and stakeholders are consulted in accordance with company procedures 3.4. Approved drafted production process is prepared for implementation according to operational requirements and standards
4. Assure quality production process	4.1. Production standards are applied (preferable ISO 9001 and 14001…) during the manufacturing process according to industry requirements

Variable	**Range**
Appropriate software and validation techniques	May include, but not limited to: • Comparison of traditional solutions for simple design problems with software solutions to the same design problems • Review of previously implemented design challenges which were completed using the software
Standards and codes	Refer to all relevant international standards and codes applicable to a particular design task
Parameters of the brief or contract	May include, but not limited to: • Design cost and system capital cost • Maintainability and product life cycle cost • Durability, function, performance and aesthetics • Energy and environmental sustainability and social issues • Equipment availability and worksite restrictions • Other special features and limits in the design brief
Conventional manufacturing	Limited use of ICT's and the conventional part May include, but not limited to: • Analysis • Planning • Purchasing • Materials handling and management • Providing direct control • Supervision of operations.
CIM manufacturing	Using ICTs 'to control the entire production process. It may include: • Computer-aided Design/Computer-aided Manufacturing (CAD/CAM)

	• Computer-aided Process Planning (CAPP) • Computer Numerical Control (CNC) machine tools • Direct Numerical Control (DNC) machine tools • Flexible Machining Systems (FMS) • Automated Storage and Retrieval Systems (ASRS) • Automated Guided Vehicles (AGV) • use of robotics and automated conveyance • computerised scheduling • production and inventory control • a business system integrated by a common database
Range of solutions	for CIM systems may include: • Hardware options • Software options and systems
OHS, regulatory, sustainability and environmental issues	May include, but not limited to: • OHS Acts and regulations • Relevant standards • Industry codes of practice • Risk assessments • Registration requirements • Safe work practices • Minimising ecological and environmental footprint of process, plant and product • Maximising economic benefit of process plant and product to the organisation and the community • Minimising the negative OHS impact on employees, community and customer • State and territory regulatory requirements
Communications protocols	Refer to the set of standardised rules for data and signal syntax, checking and error detection. Hardware and software generated data in accordance with a protocol allows generators and receivers to understand or translate the data as information, control signals integrity and error checks.
Automation safety	Refers to the reliance on emergency stop, failsafe design, redundancy, interlocks and data integrity. Standards apply to general plant design and use as well as the functional safety of safety-related electrical, electronic and programmable electronic control systems.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills to: • Interpret features of plant and equipment and parameters to the brief or contract • Advise client based on discipline knowledge and OHS and regulatory standards

	• Research sustainability implications and current industrial design techniques • Determine OHS, regulatory and risk management requirements • Investigate and measure • Model and calculate using appropriate software and validation techniques • Generate and evaluate a range of solutions for feasibility against design criteria • Sketch a conventional and CIM system solution • Communicate, negotiate and review with stakeholders and client throughout process to obtain agreement on proposal and sign-off on design • Document design with drawings, specifications and instructions.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Current CIM design knowledge, skills and techniques, including mechanical, electrical, fluid, electronic and information technologies, sensor/transducers, controllers, interfacing and signal conditioning, networking, software, data sharing and control functions • Techniques for: ➢ continuous improvement ➢ problem solving and decision making • Root Cause Analysis (RCA) or Failure Mode and Effects Analysis (FMEA) or Design Review Based on Failure Mode (DRBFM), and Pareto analysis • Features and capability of plant, equipment, controllers, software, network and communication systems • OHS and regulatory requirements, codes of practice, standards, risk management and registration requirements • Contemporary engineering design methods • Software options for control and data sharing • Hardware options and capabilities to suit processes and products • Documentation, drawings, specifications, instructions required, process information and programming
Underpinning Skills	Demonstrate skills in: • Determining features of CIM system, including OHS, regulatory and risk management requirements • Interpreting parameters to the brief or contract • Investigating and presenting options • Investigating faults in existing designs and arriving at solutions

	• Selecting and using software and validation techniques • Creating design solutions to match client expectations of innovation as well as fitness for purpose • Supervising services, maintainability, cost, manufacturability and assembly, and ease of operation • Evaluating solutions for feasibility against design criteria, including relevant engineering and financial calculations and analysis • Communicating, negotiating and reviewing with stakeholders and client throughout process to obtain agreement on proposal and sign-off on design • Documenting design with drawings, specifications and instructions
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be accessed through: • Interview/Written test • Observation/Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the workplace or in a simulated workplace setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Manage Product Cost Estimation and Bill of Materials**
Unit Code	**IND FWS4 02 0217**
Unit Descriptor	This unit covers the competency required to manage the estimated manufacturing cost of products or projects and needed bill of materials.

Elements	Performance Criteria
1. Plan and prepare for work	1.1. The work to be performed and managed is identified and clarified according to work requirements and/or tender 1.2. Essential time scheduling , sequences of work and labour are prepared based on available resources and specifications 1.3. Format (take off sheet) and materials ***bill of quantities*** are prepared based on technical specifications 1.4. Cost centres of all required resources in all respect of fields are determined according to operational specifications 1.5. ***Information*** regarding remarks is supplied due to operational procedures
2. Develop estimated product / project costs	2.1. Appropriate labor rates and material costs are selected and applied based on operational specifications 2.2. Estimates of unit costs, as appropriate, are determined and applied based on company reference data 2.3. Costs to the project of work cover, environmental protection agency requirements, seeking approvals, waste management fees and other statutory or additional costs are identified and applied due to requirements 2.4. Overhead recovery and margins are applied according to company policy 2.5. Completed estimated ***project costs*** for inclusion in tender or bill are calculated based on organizational computer supported cost calculation formats
3.Measure and check correct quantities of work	3.1. Measurements are quantified item by item according to technical specifications 3.2. Computation of the work to prepare the bill of quantities is done based on company policies 3.3. Incorrect data and size of parameters are checked as per accepted standards

	3.4. Corrections and adjustment are made within standard formats 3.5. Bill of quantities is finalized and documented based on organizational requirements
4.Maintain administrative control over resource acquisition process	4.1. The administration system through which resources are procured and acquired is monitored for its effectiveness due to organizational regulations 4.2. Financial responsibility is exercised over the procurement and acquisition system and its maintenance based on the cooperate procedures 4.3. Procurement reports are evaluated in preparation for management team meetings due to requirements 4.4. Regular meetings are facilitated and conducted between team members and the client to report on progress based on organizational regulations
5.Supervise the provision and withdrawal of resources	5.1. A system for the effective supply and withdrawal of resources is established and maintained based on company procedures 5.2. Strategic information on the usage and movement of resources within the production area is managed and monitored based on company regulations 5.3. Communications principles and policies between on-site personnel and providers of physical resources are established and maintained according to policies 5.4. Feedback from the operators and production staff is obtained and monitored at commencement, during and on completion of the project based on organizational guidelines
6. Assure quality and verify all data	6.1. Completed estimated production or project costs for inclusion in a tender or bill are verified in compliance with a computer supported cost calculation format 6.2. Actual costs are compared with estimated cost to identify deviations according to operational regulations and standards 6.3. Deviations are motivated or rectified according to established organizational framework, procedures and routines. 6.4. Assistance/ approval from management is obtained based on company policies

Variables	Range
Bill of quantities	Is an itemized list of materials required in constructing / producing, maintaining or repairing a specific structure
Information	May include, but not limited to: • Estimate relates to a discrete product with a limited number of operations to manufacture • Verbal or written and graphical instructions, work schedules, plans/specifications, memos, maps, Material Safety Data Sheets (MSDS), diagrams or sketches and graphics, reference data • Regulatory /legislative requirements pertaining to operations and the environment • Relevant specifications and instructions • Organization work specifications and requirements • Instructions issued by authorized personnel
Project costs	May include, but not limited to: • Organizational and subcontract labor hours • Project administration costs • Overheads • Consumable and production materials • Cost of meeting statutory requirements • Waste removal fees • Utilities/resource consumption • Communications costs
Key requirements	May include, but not limited to timing, budget, resources, overheads, production output, special conditions
Financial and business principles	May include, but not limited to: • Probity and honest dealing • Accurate and timely development and maintenance of • Financial records • Accountability and integrity • Transparency of financial processes • Compliance with all legal financial obligations
Administrative control over the procurement process	May include, but not limited to: • Agreements with subcontractors and materials suppliers • Generation of procurement documentation • Authorizing payment for services provided • Managing the raising of purchase orders

Evidence Guide	
Critical Aspects of Competence	The competence is observed through: • Identifying the materials required for a product/project • Gathering all information required to deliver the product/project

	• Interpreting measurements and calculating quantities and costs • Planning and allocating human resources • Identifying and costing other related costs such as those required to meet statutory and regulatory processes • Producing documentation which meets the timeframe sand quality standards established by the organization • Communicating effectively, both verbally and in writing
Required knowledge	Demonstrate knowledge of • Computation inclusive data organization and systematic analysis • Technical specification reading • Effective administration and monitoring of the procurement system and processes • Sequence of production operations • Types, scope and usage of labor through the employee and subcontractor systems • Operation and structure of organizational costing and contracting system • Ethiopian standards relevant to the industry sector • Government regulations/legislations and standards
Required skills	Demonstrate skills in: • Technological applications to facilitate use of the organization's software and office technology including appropriate procurement and costing software programs • Carry out numerical operations, geometry and calculations /formulae within the scope of this unit • Extrapolate labor and materials costs from written information • Read drawings and technical specifications • Plan and sequence operations • Overview the impact on cost estimates • Using proforma estimate sheets
Resource Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation/Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the workplace or in a simulated workplace setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Perform Process Planning and Scheduling**
Unit Code	**IND FWS4 03 0217**
Unit Descriptor	This unit covers the knowledge, skills and attitude required to determine production sequence, identify production requirements and capacities, and prepare production schedules of component / part. It includes the review of process specifications and continuous production improvements.

Elements	Performance Criteria
1. Determine production sequence	1.1. Steps required for the process are identified and flow charts are produced where required in accordance with standard operating procedures 1.2. Material and parts lists are prepared manually or with CAD in accordance with standard operating procedures 1.3. Tooling and/or equipment requirements are documented in accordance with standard operating procedures. 1.4. Process steps are documented and clearly represented in accordance with standard operating procedures.
2. Identify and analyze production requirements and capacities	2.1. Engineering production data are identified and obtained in accordance with workplace procedures. 2.2. Inventory capacities and requirements are identified and obtained in accordance with workplace procedures. 2.3. Procurement and supply requirements and constraints are analyzed and carried out in accordance with workplace procedures. 2.4. Production capacity and constraints are analyzed and applied in accordance with workplace procedures. 2.5. Standard times are identified and obtained in accordance with workplace procedures. 2.6. Production requirements are obtained with the existing resources and strategies are evolved to fit with it based on technical specifications
3. Prepare schedule for production of a component/part	3.1. Production of component is scheduled in accordance with production, inventory, procurements, time constraints, supply and labour capacities according to operational requirements

	3.2. Schedule is documented in accordance with accepted organization procedures and quality management.
4.Review process specifications	4.1. Supporting engineering and production data are analyzed and reviewed where required according to organizational procedures 4.2. The new ***production processes*** to be used are determined applying organizational guidelines 4.3. Specifications are obtained and examined in accordance with operational procedures
5. Assure quality workplace operations	5.1. Operations in the workplace support overall enterprise goals and quality assurance initiatives 5.2. Quality problems and issues are promptly identified and adjustments are made accordingly to company regulations 5.3. Procedures and systems are improved in consultation with colleagues to enhance constantly efficiency and effectiveness based on Kaizen 5.4. Input is provided to appropriate management regarding staffing needs according to labour laws 5.5. Workplace challenges are promptly identified and addressed accordingly to operational and customer service regulations 5.6. Follow up action is taken to monitor the effectiveness of solutions in the workplace based on company policies and standards

Variable	**Range**
Production processes	May include, but not limited to: • Work planned over a timeframe, • Available resources • Company data
Production management	These include *s*teps / activities, milestones, targets, KPI against which progress can be monitored and evaluated
Production meetings	May include, but not limited to: • Performance evaluation • Work inspection • Maintenance and repair scheduling • Register equipment maintenance • Location of potential hazards • Pre-tour safety meetings • Assist with supervision of teams

Statutory adherence	May include, but not limited to: • Occupational Health and Safety • Duty of care • Environment and Codes of practice
Communications	May include, but not limited to: • Intranet data flow • Written instruction • Oral instruction • Circulars

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Determine production sequence • Identified production requirements and capacities • Prepared schedule for production of a component/part • Reviewed process specifications
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Production processes outside and within the organization • Tooling and/or equipment requirements for workplace processes • Safe workplace practices and procedures • Scheduling techniques • Production methods • Inventory policies • Procurement, supply requirements and constraints • General staffing levels, capabilities and application of standard times • Machine set-up, capability and application of standard times • Enterprise safety requirements and directives • Quality assurance requirements
Underpinning skills	Demonstrate skills to: • Determine schedules and resources • Match personnel to tasks and roles • Facilitate problem solving associated with process variations • Analyze process parameters • Monitor process requirements • Communicate effectively within the workplace • Document, assess and transfer information • Read, interpret and follow information on work specifications, standard operating procedures and work instructions and other reference material • Maintain accurate records

	• Implement sequence of operations • Clarify and check task-related information • Carry-out work according to OHS practices
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Method of Assessment	Competence may be assessed through: • Interview / Oral Questions / Written exam • Observation/Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the workplace or in a simulated workplace setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Manufacture Gear, Conveyor Screw and Propeller Patterns**
Unit Code	**IND FWS4 04 0217**
Unit Descriptor	This unit covers laying out and manufacturing gear, conveyor screw and propeller patterns with predetermined thicknesses.

Elements	Performance Criteria
1. Determine job requirements	1.1. Drawings, instructions and specifications are interpreted and understood. 1.2. Appropriate material is selected to specifications. 1.3. Molding, cast techniques and foundry processes are applied in determining the type of pattern required.
2. Lay out pattern	2.1. ***Pattern parameters*** are ***calculated***. 2.2. Pattern is laid out showing tapers, machining allowances, core prints and method of construction etc. to specification. 2.3. Jigs and fixtures are developed and manufactured to aid the manufacture of the pattern form as required.
3. Manufacture pattern	3.1. Materials are marked out and construction is developed to meet specifications. 3.2. Pattern or pattern component parts are produced to size and shape and checked for compliance with specifications using acceptable wood pattern making techniques, procedures and utilizing appropriate hand and hand held power tools. 3.3. Pattern component parts are joined or fixed as required, according to specifications, using pattern making techniques and procedures. 3.4. Pattern is correctly marked, color-coded and/or tagged in compliance with specifications or standard operating procedures.

Variable	Range
Pattern parameters	May include, but not limited to: • Pitch circles, pressure angles, tooth form, left and right hand flight helix, pitch axial dimensions, angles, tapers, clearances, contraction allowances appropriate to developing various types of gear, conveyor and propeller forms

Calculation	May include, but not limited to: • The determination of contraction rates, pitch, proportions, profiles as well as general engineering calculations

Evidence Guide	
Critical Aspects of Competence	Demonstrate knowledge and skills to: • Develop and manufacture • Gear, • Conveyor screw • Patterns.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Timber, epoxy resin and composite product knowledge including features, characteristics and applications • Moulding and casting techniques for cast gears, conveyor screws and marine propellers • Tooling required for casting/moulding • Methoding techniques • The use and application of jigs and fixtures • Methods of construction • Techniques, tools and equipment to measure, mark out & produce gear, conveyor screw & propeller patterns • Mathematical calculations and formulae required to manufacture patterns/core boxes - contraction, taper, pitch, profiles, clearances, machining allowances • Identification coding and numbering • Pattern checking techniques • Mouldability i.e. Surface finish, face taper, convex or concave perspectives, undercuts, etc. • Use and application of personal protective equipment • Safe work practices and procedures • Hazards and control measures associated with developing and manufacturing gear, conveyor screw and propeller patterns
Underpinning Skills	Demonstrate skills of: • Determining job requirements from written instructions, standard operating procedures, sketches, drawings and other applicable reference documents • Planning and sequencing operations • Checking and clarifying task-related information • Selecting appropriate materials to suit the moulding/casting techniques and foundry process • Laying out the pattern/core boxes • Constructing patterns/core boxes • Joining and fixing component parts

	• Checking patterns • Calculating contraction rates/pitch/proportions/profiles • Undertaking relevant engineering calculations
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview/ Written Test • Observation/Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Perform Prescribed Tests on Foundry Related Materials**
Unit Code	**IND FWS4 05 0217**
Unit Descriptor	This unit of competency covers the competence required to perform chemical analysis and mechanical (destructive) tests on foundry related materials, compare the results and quality assure the product. It includes conducting of Optical Emission Spectroscopy (OES) testing.

Elements	Performance Criteria
1. Select appropriate testing procedures/standards	1.1. The need (or otherwise) for prescribed testing is analyzed according to prescribed standard 1.2. External testing is arranged if appropriate in accordance with company policy/ customer requirements 1.3. Appropriate and certified laboratory/test equipment are identified based on organizational requirements 1.4. Test sample is prepared according to prescribed test specifications
2.Perform prescribed tests	2.1. Check that sample or casting has been prepared as required by test method 2.2. Sample or casting is prepared due to standard 2.3. Instrument is prepared as required by procedures and regulations 2.4. Sample or casting is tested in compliance with test regulations 2.5. Test results are recorded and checked based on operational procedures 2.6. Test results are repeated if required based on standards applied
3. Arrange additional tests	3.1. Needs for additional test are identified in accordance with results or requirements 3.2. Internal or external test is arranged according to standard enterprise procedures
3. Assure quality test results	4.1. Internal test results are captured according to organizational procedures 4.2. Test results are externally conducted from provider and data verified compliant to standard 4.3. Implications of test results are determined for process or product based on company specifications

	4.4. Actions to be taken are recommended based on test results and enterprise procedures 4.5. Report is documented in accordance with enterprise standards and customer requirements

Variables	Range
Prescribed range of tests	May include, but not limited to: • Tests conducted by the foundry tradesperson • Tests performed by metallurgist or other authority • OES • Tensile/compression testing which may include testing for tensile strength, compressive strength, elongation, reduction of area, yield stress, yield point, proof stress, Young's modulus, elastic/plastic region and deformation or viscoelastic deformation • hardness testing - Vickers, Brinell, Rockwell and Durometer tests • impact testing including Izod, Charpy and Drop-weight Tear
Other tests	May include, but not limited to: • Fatigue/flex testing • Creep testing • Strain test and measurement • Static shear and bend test • UV-VIS spectrophotometry • Infrared Spectroscopy (IR) • Gas Chromatography (GC) • X-Ray Fluorescence (XRF) • flame photometry • Atomic Absorption Spectrometry (AAS) • Scanning Electron Microscopy (SEM)
Prepare sample	May include, but not limited to: • Representative sub-samples have been taken • Samples are ground and milled • Sample ready shaped for the test
Prepare instrument	May include, but not limited to: • Checking calibration • Ensuring the availability of required consumables • Curve generation where OES test is required • Setting machine conditions • Checking machine function
Materials	May include, but not limited to: • Ferrous and non-ferrous metal

	• Polymer based materials • Other solid materials on which mechanical testing is relevant

Evidence Guide	
Critical Aspects of Competence	The competence is observed through the following: • Select appropriate test methods • Obtain reproducible results • Interpret and document test results for product quality
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Testing standards and its applications • Methods of tensile testing and its applications • Methods for tensile testing e.g. international standard • Determination of tensile properties • Methods of general impact testing and its applications • Types of hardness testing and its applications • The principles of operation, uses and limitations of Optical Emission Spectroscopy (OES) otherwise known as Atomic Emission Spectroscopy (AES) • Purpose and suitability of other tests like: ➢ /flex testing ➢ creep testing ➢ strain test and measurement ➢ static shear and bend test ➢ Ultraviolet-Visible (UV-VIS) spectrophotometry ➢ Infrared Spectroscopy (IR) ➢ Gas Chromatography (GC) ➢ X-Ray Fluorescence (XRF) ➢ flame photometry ➢ Atomic Absorption Spectrometry (AAS) ➢ Scanning Electron Microscopy (SEM) • Mathematics relevant to the collation and reporting of test data • Chemical composition impact on the foundry process and product • The potential implications of the variety of adjustments that could be made in response to test results
Underpinning Skills	Demonstrate skills in: • Analysing data • Selecting and setting up appropriate tests • Solving problems • Performing tests • Interpreting results • Reporting results

Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Supervise Ferrous and Non-ferrous Melting and Casting Operations**
Unit Code	**IND FWS4 06 0217**
Unit Descriptor	The unit covers competency required in supervising advanced non-ferrous melting and casting operations of components. It includes quantity assessment, casting sequences and processes, heat treatment, and quality assurance.

Elements	Performance Criteria
1. Identify specifications for required casting	1.1. Required non-ferrous material is identified due to specification 1.2. Mold requirements are identified according to operational procedures 1.3. Any special melting and casting process are identified due to work requirements 1.4. Safety procedures are identified to follow for required melting and casting operation due to OHS and organizational specifications 1.5. Regulations and codes of practice relevant to non-ferrous foundry operations are identified and followed based on operational requirements
2. Prepare casting operation	2.1. Required charge of each component is calculated 2.2. Required components are selected to achieve standardized metal specification 2.3. Changes/additions to the charge are recommended based on operational standards 2.4. Operational condition of furnace is assured in accordance with operational regulations 2.5. Preparation of charge and the melt is monitored based on operational procedures and standards 2.6. Impurities from molten metal are removed by means of a converting process due to standards 2.7. All members of pouring crew are checked for wearing appropriate personnel protective equipment due to standard
3. Monitor pouring of molten metal	3.1. Hazards in the metal melting/pouring process are identified and checked in accordance with operational regulations

	3.2. Pouring area is secured and all non-essential personnel are excluded due to operational regulations 3.3. Ensure escape routes are known by crew involved and visually marked due to safety and hazard regulations 3.4. Check emergency pour out pit is made operational and other safety measures are in place based on safety requirements 3.5. Ensure molds are made ready to receive liquid metal, and spaces are appropriate between each mould in accordance with operational requirements 3.6. Check pouring is undertaken at correct temperature and in efficient order based on operational standards 3.7. If required heat treatment for engineering non-ferrous metals is applied in compliance with the standards
4. Assure quality casting	4.1. Required samples are transmitted for analysis and tests in accordance with organizational quality standards 4.2. Casting report is documented against organizational regulations

Variables	**Range**
Codes of practice/standards	May include, but not limited to: • Reference is made to industry codes of practice, • International standards, it is expected the latest version will be used
Moulds	May include, but not limited to: • Moulds may include sand, die and investment moulds
Cast material	May include, but not limited to: • Non-ferrous metals: Aluminum, Tin, Magnesium, Nickel, Titanium, Beryllium, Lead • Non-ferrous alloys: Aluminum alloys, Brasses, Bronzes, Copper alloys, Nickel alloys, Magnesium alloys, Zinc-Tin alloys
Contaminants	May include, but not limited to: • Non-specified metal, rubber, grease, water, paint and non-metallic, closed containers or pipes and pressure containers such as aerosols

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Supervise the safe operation of a melting furnace for non-ferrous metals

	• Supervise casting operation and equipment for non-ferrous metals handled by utilized personnel
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Charge calculations: • Non-ferrous metals and alloys with the focus on casting processes • Types of furnaces and their relative advantages and disadvantages for non-ferrous metals melt: • Selection of appropriate refractories for non-ferrous metals melting: • Selection of the form of linings for non-ferrous melts • Selection of the appropriate ladles/crucibles • Supervision of other staff in melting and casting safety • Furnace operation • Use of lifting and handling equipment • Types of test and control equipment • Quality control and procedures • Types of defects and prevention • Tapping and pouring operations
Underpinning Skills	Demonstrate skills of: • Applying appropriate calculations to determine charges • Checking visually furnaces for operational condition and safety risks • Supervising and leading personnel • Taking samples • Applying safety and quality procedures • Applying quality assurance standards
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Supervise the Manufacturing of Advanced Patterns and Models**
Unit Code	**IND FWS4 07 0217**
Unit Descriptor	This unit covers competence required supervising the lay - out and manufacturing of advanced patterns and models. It includes flow models, viewing models, prototype and development models and applying a wide range of model materials e.g. timber, metal plastic, fiberglass composites and processes.

Elements	Performance Criteria
1. Determine and prepare work	1.1. Drawings, instructions and specifications are interpreted and understood according to standards 1.2. Appropriate ***material*** is selected and prepared to meet specifications 1.3. Finished model design is conceptualized and planned with reference to customer's specifications applying standardized operational ***processes*** 1.4. Contractions allowances, clearances, tapers etc. are calculated to establish model parameters according to standards 1.5. Datum boards, jigs and fixtures are designed and manufactured due to requirements
2 Manufacture model	2.1. Sequence of manufacture is determined according to machine processes 2.2. Appropriate machines and machining processes are selected to shape/produce model to specifications. 2.3. Suitable hand and hand held power tools are used by ensuring the required finish according to specifications, 2.4. Where necessary, all deviations or modifications to original tooling design, prints or plans, are recorded and reported consistent with standard operating procedures
3. Assure quality model	3.1. Adequate advanced measurement/ calculations are undertaken to check final specifications 3.2. If possible a 3D scanning is performed for documentation compliant with organizational regulations

Variables	Range

Material	May include, but not limited to: • Timber, metal, plastic, fiberglass, composites etc.
Processes	May include, but not limited to: • High volume foundry tooling, injection moulding, pressure die casting etc.

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Determine and prepare work • Manufacture model • Quality assure model
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Consequences of selecting inappropriate materials • Various processes requiring models • Calculus, engineering calculations and formulae relating to developing and manufacturing precision models • Properties and uses of datum boards, datum holes or datum faces • Reasons for developing the sequence of manufacture • The range of machines and machining processes and their operations • The various checking procedures and devices including coordinate measuring and machine checking • Procedures for recording deviation or modification to original drawings or specifications • Hazards and control measures associated with developing and manufacturing precision models • Safe work practices and procedures
Underpinning Skills	Demonstrate skills of: • Reading, interpreting and following information on written work instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents • Selecting appropriate materials • Conceptualising and determining type of model required to meet specifications • Performing calculations necessary for manufacture • Developing and manufacturing datum boards, datum holes or datum faces, jigs and fixtures etc. Required for accurate manufacture • Developing a planned sequence of manufacture • Identifying areas required to be accurately manufactured by NC/CNC • Selecting and operating the appropriate range of machines

	and machining processes for manufacturing the model accurately to size, tolerance and specifications • using required hand and hand held power tools • measuring components to specified tolerances inclusive 3D scanning • carrying out checking procedures for checking to the predetermined accuracy and fine tolerances • orally reporting routine information • recording
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Perform Centrifugal and Investment Casting Processes**
Unit Code	**IND FWS4 08 0217**
Unit Descriptor	This unit covers competence in performing centrifugal and investment casting processes.

Elements	Performance Criteria
1. Prepare materials for investment and centrifugal casting	1.1. OHS and environmental protection measures are applied based on organizational regulations 1.2. Spruce/tree materials are prepared/built according to operational specifications 1.3. Assembled tree/materials are checked, if necessary 1.4. Casting methods and equipment are selected appropriate to task. 1.5. The quantity of alloy required is calculated and weighed according to industry standards 1.6. Tools and equipment are selected for the investment process according to the required casting specifications 1.7. High grade material is melted in appropriate furnaces according to casting requirements 1.8. Spin casting ***machines*** are prepared with the mould based on operational standards
2. Invest flask	2.1. Flask is assembled according to the required casting specifications 2.2. Investment is mixed according to manufacturers' specifications 2.3. Curing stage is applied according to site-specific requirements
3. Operate 'lost wax' sequence	3.1. 'Low melt' wax is evacuated by steam process according to requirements 3.2. Investment flask is positioned/stored correctly due to casting requirements 3.3. 'Burnout' cycle is selected and applied due to industry standard
4. Perform Centrifugal casting	4.1. Shell metal is poured under correct temperature in the mould according to manufactures' specification 4.2. The core metal, if needed, is poured after appropriate

	time in the mould to achieve fine grained structure base standard requirements 4.3. Heat treatment is applied , if necessary, according to specification
5. Assure quality and clean site	5.1. Casted components are tested according to engineering requirements 5.2. Cast is measured and results are documented according to organizational specifications 5.3. Tools and equipment are properly cleaned and stored 5.4. Work area/site area is thoroughly cleaned and decontaminated in accordance with enterprise standard procedures

Variable	**Range**
Machines	• High speed centrifugal vertical and horizontal spin casting machines • Various furnaces
Casting method and equipment	• Centrifugal and vacuum casting
Associated tools and equipment	May include, but not limited to: • Flasks and base • Investment Scales • Mixers • Bowls • Vacuum • Centrifugal moulds

Evidence Guide	
Critical Aspects of Competence	Assessment requires evidence that the candidate: • Select materials • Produce wax pattern • Make mould
Underpinning Knowledge and Attitudes	Demonstrate the knowledge of: • Curing/set stage requirements • Setting sequence and values for time, temperature, and/or cam settings steamer process • Determining suitability of flask/investment for burnout • Setting sequence, procedures, adjustments for variables • Setting up centrifugal casting processes • Following procedures for storage and positioning of the important for cleaning, storage and/or removal of materials

	• Necessary recording procedures • Safe work practices and procedures
Underpinning Skills	Demonstrate skills of: • Applying routine task-related information • Checking pre-assembled wax for security, size, and weight selecting/checking/cleaning spruce and investment materials • Selecting appropriate components • Recording weights • Selecting and assembling appropriate flask size • Calculating and weighing out proportions of investment material and water • Performing mixing, vibrating and vacuum procedures • Operating steamer and process • Inspecting flasks for residue prior to burn-out • Selecting appropriate burn-out procedure/equipment positioning/storing flask • Inspecting and adjusting oven/kiln cavity • Cleaning working area, and all tools and investing equipment of investment residue • Disposing of residue and material • Operating centrifugal casting machines • Installing centrifugal moulds
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Implement and Monitor Environmentally Sustainable Work Practices**
Unit Code	**IND FWS4 09 0217**
Unit Descriptor	This competency covers the outcomes required to effectively analyse the workplace in relation to environmentally sustainable work practices and to implement improvements and monitor their effectiveness.

Elements	Performance Criteria
1. Investigate current practices in relation to resource usage.	1.1. Environmental regulations applying to the enterprise are identified. 1.2. ***Procedures*** are assessed for assessing ***compliance*** with environmental regulations. 1.3. Information on environmental and resource efficiency systems and procedures are collected, and provided to the work group where appropriate. 1.4. Current resource usage is ***measured*** and recorded by members of the work group. 1.5. Current ***purchasing strategies*** are analysed and recorded. 1.6. Current work processes are analysed to access information and data and assisted in identifying areas for improvement.
2. Set targets for improvements.	2.1. Input is sought from ***stakeholders, key personnel and specialists***. 2.2. External sources of information and data are accessed, as required. 2.3. Alternative solutions are evaluated to workplace environmental issues. 2.4. Efficiency targets are set.
3. Implement performance improvement strategies.	3.1. ***Techniques and tools*** are sourced to assist in achieving targets. 3.2. Continuous improvement strategies are applied to own work area of responsibility and ideas and possible solutions communicated to the work group and management. 3.3. Environmental and resource efficiency improvement plans for own work group are integrated with other operational

	activities and implemented. 3.4. ***Suggestions*** and ideas about environmental and resource efficiency management are sought from stakeholders and act upon them where appropriate. 3.5. Costing strategies are implemented to fully value environmental assets.
4. Monitor performance.	4.1. Outcomes are documented and reports on targets communicated to key personnel and stakeholders. 4.2. Strategies are evaluated. 4.3. New targets are set and new tools and strategies investigated and applied. 4.4. Successful strategies are promoted and participants rewarded, where possible.

Variables	**Range**
Procedures	include all relevant workplace procedures, work instructions, temporary instructions and relevant industry and government codes and standards. Where reference is made to industry codes of practice, and/or Ethiopian/international standards, the latest version must be used.
Compliance	includes meeting relevant federal, state and local government laws, by-laws, regulations and codes of practice.
Measurement	May include, but not limited to: • Material fed to/consumed by plant/equipment • Plant meters and gauges • Job cards including kanbans • Examination of invoices from suppliers • Measurements made under different conditions • Examination of relevant information and data • Others as appropriate to the specific industry contexts.
Purchasing strategies	May include, but not limited to: • Influencing suppliers to take up environmental sustainability • Selecting materials/components with a lower environmental profile.
Stakeholders**,** key personnel and specialists	May include, but not limited to individuals and groups both inside and outside the organisation that have some direct interest in the enterprise's conduct, actions, products and services, including: • Employees at all levels of the organisation • Customers

	• Suppliers • Other organisations • Key personnel within the organisation, and specialists outside it who may have particular technical expertise
Techniques and tools	May include, but not limited to: • Visual workplace concepts • Measurement, display and/or recording devices • Changed work practices/procedures • Competence development and awareness training • Process and equipment items
Suggestions	May include, but not limited to: • Prevent and minimise environmental risks and maximise opportunities • Reduce emissions of greenhouse gases • Reduce use of non-renewable resources • Make more efficient use of energy, water and other resources • Maximise opportunities to reuse and recycle materials • Identify strategies to offset or mitigate environmental impacts. E.g. Purchasing of carbon credits • Express purchasing power through the selection of suppliers with improved environmental performance. E.g. Purchasing renewable energy and materials with lower embedded carbon • Eliminate the use of hazardous and toxic materials increasing the reusability/recyclability of wastes/products.
Environmental and resource efficiency issues	May include, but not limited to: • Addressing environmental and resource sustainability initiatives such as Environmental Management Systems, action plans, surveys and audits • Reference to standards, guidelines and approaches such as: ➢ ISO 14001 Environmental Management Systems ➢ Life Cycle Analyses ➢ Cradle to cradle ➢ Global Reporting Initiative ➢ Ecological foot printing ➢ Triple Bottom Line reporting and Product Stewardship • Determining enterprise's most appropriate waste treatment including waste to landfill, recycling, re-use and wastewater treatment • Applying the waste management hierarchy in the workplace • Initiating and/or maintaining appropriate enterprise

	procedures for operational energy consumption, including stationary energy and non-stationary (transport) • Efficient use of water • Minimising greenhouse gas emissions • Use of controls to minimise the risk of environmental damage from hazardous substances
Incidents	May include, but not limited to: • Breaches or potential breaches of regulations • Occurrences outside of standard procedure which may lead to lower environmental performance

Evidence Guide	
Critical Aspects of Competence	A person must be able to demonstrate: • Provide evidence of the ability to implement and monitor integrated environmental and resource efficiency management policies and procedures within an organisation. • Monitor and investigate current resource usage • Develop plans to improve sustainability • Implement environmental improvements. Consistent performance should be demonstrated. For example, look to see that: • Environmental performance is routinely monitored and investigated • Areas for improvements are followed through and the implemented changes are in turn monitored and investigated.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • How to access and use relevant environmental and resource efficiency systems, tools and procedures • Understanding of best practice approaches relevant to own area of responsibility • Strategies to maximise opportunities and minimise impacts relevant to own work area • Relevant environmental and resource efficiency issues specific to industry practices • Methods for measuring and calculating resource usage
Underpinning Skills	Demonstrate skills of: • Using relevant environmental and resource efficiency systems, tools and procedures • Applying quality assurance systems relevant to own work area • Applying relevant supply chain procedures • Measurement and calculation techniques

	• Communication/consultation skills to ensure information is supplied to the work group • Reading and writing is required to comprehend documentation and interpret environmental and energy efficiency requirements and to document and maintain records • Numeracy is required to interpret numeric workplace information, readings and measurements, handle data as required and complete numeric components of workplace forms/reports.
Resource Implications	For assessment include: • workplace or fully equipped assessment location with necessary tools, equipment and consumable material
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation/Demonstration with Oral questioning
Context for Assessment	Competence may be assessed in the workplace or in a simulated work environment.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Plan and Organize Work**
Unit Code	**IND FWS4 10 0217**
Unit Descriptor	This unit covers the knowledge, skills and attitude required in planning and organizing work activities in a production application. It may be applied to a small independent operation or to a section of a large organization.

Elements	Performance Criteria
1. Set objectives	1.1. ***Objectives*** are planned consistent with and linked to work activities in accordance with organizational aims. 1.2. Objectives are stated as measurable targets with clear time frames. 1.3. Support and commitment of team members are reflected in the objectives. 1.4. Realistic and attainable objectives are identified.
2. Plan and schedule work activities	2.1. Tasks/work activities to be completed are identified and prioritized as directed. 2.2. Tasks/work activities are broken down into steps in accordance with set time frames and achievable components. 2.3. Task/work activities are assigned to appropriate team or individuals in accordance with agreed functions. 2.4. ***Resources*** are allocated as per requirements of the activity. 2.5. ***Schedule of work activities*** is coordinated with personnel concerned.
3. Implement work plans	3.1. ***Work methods and practices*** are identified in consultation with personnel concerned. 3.2. ***Work plans*** are implemented in accordance with set time frames, resources and ***standards***.
4. Monitor work activities	4.1. Work activities are monitored and compared with set objectives. 4.2. Work performance is monitored. 4.3. Deviations from work activities are reported and recommendations are coordinated with appropriate personnel and in accordance with set standards. 4.4. Reporting requirements are complied with in accordance with recommended format.

	4.5. Timeliness of report is observed. 4.6. Files are established and maintained in accordance with standard operating procedures.
5. Review and evaluate work plans and activities	5.1. Work plans, strategies and implementation are reviewed based on accurate, relevant and current information. 5.2. Review is done based on comprehensive consultation with appropriate personnel on outcomes of work plans and reliable feedback. 5.3. Results of review are provided to concerned parties and formed as the basis for adjustments/simplifications to be made to policies, processes and activities. 5.4. Performance appraisal is conducted in accordance with organization rules and regulations. 5.5. Performance appraisal report is prepared and documented regularly as per organization requirements. 5.6. Recommendations are prepared and presented to ***appropriate personnel/authorities***. 5.7. ***Feedback mechanisms*** are implemented in line with organization policies.

Variable	**Range**
Objectives	May include, but not limited to: • Specific • General
Resources	May include, but not limited to: • Personnel • Equipment and technology • Services • Supplies and materials • Sources for accessing specialist advice • Budget
Schedule of work activities	May include, but not limited to: • Daily • Work-based • Contractual and Regular
Work methods and practices	May include, but not limited to: • Legislated regulations and codes of practice • Industry regulations and codes of practice • Occupational health and safety practices
Work plans	May include, but not limited to: • Daily work plans

	• Project plans • Program plans • Resource plans • Skills development plans • Management strategies and objectives
Standards	May include, but not limited to: • Performance targets • Performance management and evaluation systems • Occupational standards • Employment contracts • Client contracts • Discipline procedures • Workplace assessment guidelines • Internal quality assurance • Internal and external accountability and auditing requirements • Training Regulation Standards and Safety Standards
Appropriate personnel/ authorities	May include, but not limited to: • Appropriate personnel include: • Management and Line Staff
Feedback mechanisms	May include, but not limited to: • Verbal feedback • Informal feedback • Formal feedback • Questionnaire • Survey and Group discussion

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Set objectives • Plan and schedule work activities • Implement work plans • Monitor work activities • Review and evaluate work plans and activities
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Organization's strategic plan, policies rules and regulations, laws and objectives for work unit activities and priorities • Organizations policies, strategic plans, guidelines related to the role of the work unit • Team work and consultation strategies
Underpinning Skills	Demonstrates skill to: • Plan • Lead

	• Organize • Coordinate • Communicate • Inter-and intra-person/motivation skills • Present
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview/ Written Test • Observation/ Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Migrate to New Technology**
Unit Code	**IND FWS4 11 0217**
Unit Descriptor	This unit defines the competence required to apply skills and knowledge in using new or upgraded technology. The rationale behind this unit emphasizes the importance of constantly reviewing work processes, skills and techniques in order to ensure that the quality of the entire business process is maintained at the highest level possible through the appropriate application of new technology. To this end, the person is typically engaged in on-going review and research in order to discover and apply new technology or techniques to improve aspects of the organization's activities.

Elements	Performance Criteria
1. Apply existing knowledge and techniques to technology and transfer	1.1. Situations are identified where existing knowledge can be used as the basis for developing new skills. 1.2. New or upgraded technology skills are acquired and used to enhance learning. 1.3. New or upgraded equipment are identified, classified and used where appropriate, for the benefit of the organization.
2. Apply functions of technology to assist in solving organizational problems	2.1. Testing of new or upgraded equipment is conducted according to the specification manual. 2.2. Features of new or upgraded equipment are applied within the organization. 2.3. Features and functions of new or upgraded equipment are used for solving organizational problems. 2.4. Sources of information relating to new or upgraded equipment are accessed and used.
3. Evaluate new or upgraded technology performance	3.1. New or upgraded equipment is evaluated for performance, usability and against OHS standards. 3.2. ***Environmental considerations*** are determined from new or upgraded equipment. 3.3. ***Feedback*** is sought from users where appropriate.

Variables	Range
Environmental Considerations	May include but is not limited to recycling, safe disposal of packaging (e.g. cardboard, polystyrene, paper, plastic) and correct disposal of waste materials by an authorized body

Feedback	May include, but is not limited to: • surveys, • questionnaires, • interviews and meetings

Evidence Guide	
Critical Aspects of Competence	Competence must confirm the ability to transfer the application of existing skills and knowledge to new technology
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Broad awareness of current technology trends and directions in the industry (e.g. systems/procedures, services, new developments, new protocols) • Vendor product directions • Ability to locate appropriate sources of information regarding metal manufacturing and new technologies • Current industry products/services, procedures and techniques with knowledge of general features • Information gathering techniques
Underpinning Skills	Demonstrate skills of: • Research skills for identifying broad features of new technologies • Ability to assist in the decision making process • Literacy skills in regard to interpretation of technical manuals • Ability to solve known problems in a variety of situations and locations • Evaluate and apply new technology to assist in solving organizational problems • General analytical skills in relation to known problems
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Establish Quality Standards**
Unit Code	**IND FWS4 12 0217**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to establish quality specifications for work outcomes and work performance. It includes monitoring and participation in maintaining and improving quality, identifying critical control points in the production of quality output and assisting in planning and implementing of quality assurance procedures.

Elements	Performance Criteria
1. Establish quality specifications for product	1.1. Market specifications are ***sourced*** and ***legislated requirements*** identified. 1.2. Quality specifications are developed and agreed upon. 1.3. Quality specifications are documented and introduced to organization staff / personnel in accordance with the organization policy. 1.4. Quality specifications are updated when necessary.
2. Identify hazards and critical control points	2.1. Critical control points impacting on quality are identified. 2.2. Degree of risk for each hazard is determined. 2.3. Necessary documentation is accomplished in accordance with organization quality procedures
3. Assist in planning of quality assurance procedures	3.1. Procedures for each identified control point are developed to ensure optimum quality. 3.2. Hazards and risks are minimized through application of appropriate controls. 3.3. Processes are developed to monitor the effectiveness of quality assurance procedures.
4. Implement quality assurance procedures	4.1. Responsibilities for carrying out procedures are allocated to staff and contractors. 4.2. Instructions are prepared in accordance with the enterprise's quality assurance program. 4.3. Staff and contractors are given induction training on the quality assurance policy. 4.4. Staff and contractors are given in-service training relevant to their allocated ***safety procedures***.
5. Monitor quality of work outcome	5.1. Quality requirements are identified.

	5.2. Inputs are inspected to confirm capability to meet quality requirements. 5.3. Work is conducted to produce required outcomes. 5.4. Work processes are monitored to confirm quality of output and/or service. 5.5. Processes are adjusted to maintain outputs within specification.
6. Participate in maintaining and improving quality at work	6.1. Work area, materials, processes and product are routinely monitored to ensure compliance with quality requirements. 6.2. Non-conformance in inputs, process, product and/or service is identified and reported according to workplace reporting requirements. 6.3. Corrective action is taken within level of responsibility, to maintain quality standards. 6.4. Quality issues are raised with designated personnel.
7. Report problems that affect quality	7.1. Potential or existing quality problems are recognized. 7.2. Instances of variation in quality are identified from specifications or work instructions. 7.3. Variation and potential problems are reported to supervisor/manager according to enterprise guidelines.

Variable	**Range**
Sourced	May include, but is not limited to: • End-users • Customers or stakeholders
Legislated requirements	May include, but is not limited to: • Verification of product quality as part of consumer legislation or specific legislation related to product content or composition.
Safety procedures.	May include, but is not limited to: • Use of tools and equipment for fabrication/production/ manufacturing works • Workplace environment and handling of material safety, • Following occupational health and safety procedures designated for the task • Respect the policies, regulations, legislations, rule and procedures for manufacturing/production/fabrication works

Evidence Guide

Critical Aspect of Competence	Demonstrates skills and knowledge to: • Monitor quality of work • Establish quality specifications for product • Participate in maintaining and improving quality at work • Identify hazards and critical control points in the production of quality product • Assist in planning of quality assurance procedures • Report problems that affect quality • Implement quality assurance procedures
Underpinning Knowledge	Demonstrates knowledge of: • Work and product quality specifications • Quality policies and procedures • Improving quality at work • Hazards and critical points of operation • Obtaining and using information • Applying federal and regional legislation within day-today work activities • Accessing and using management systems to keep and maintain accurate records • Requirements for correct preparation and operation • Technical writing
Underpinning Skills	Demonstrates skills to: • Monitor quality of work • Establish quality specifications for product • Participate in maintaining and improving quality at work • Identify hazards and critical control points in the production of quality product • Assist in planning of quality assurance procedures • Report problems that affect quality • Implement quality assurance procedures
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Develop Individuals and Team**
Unit Code	**IND FWS4 13 0217**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to determine individual and team development needs and facilitate the development of the workgroup.

Elements	Performance Criteria
1. Provide team leadership	1.1. ***Learning and development needs*** are systematically identified and implemented in line with ***organizational requirements***. 1.2. Learning plan to meet individual and group training and developmental needs is collaboratively developed and implemented. 1.3. Individuals are encouraged to self-evaluate performance and identify areas for improvement. 1.4. ***Feedback on performance*** of team members is collected from relevant sources and compared with established team learning process.
2. Foster individual and organizational growth	2.1. Learning and development program goals and objectives are identified to match the specific knowledge and skills requirements of Competence standards. 2.2. ***Learning delivery methods*** are made appropriate to the learning goals, the learning style of participants and availability of equipment and resources. 2.3. Workplace learning opportunities and coaching/ mentoring assistance are provided to facilitate individual and team achievement of competencies. 2.4. Resources and timelines required for learning activities are identified and approved in accordance with organizational requirements.
3. Monitor and evaluate workplace learning	3.1. Feedback from individuals or teams is used to identify and implement improvements in future learning arrangements. 3.2. Outcomes and performance of individuals/teams are assessed and recorded to determine the effectiveness of development programs and the extent of additional support. 3.3. Modifications to learning plans are negotiated to improve the efficiency and effectiveness of learning. 3.4. Records and reports of competence are maintained within organizational requirement.

4. Develop team commitment and cooperation	4.1. Open communication processes to obtain and share information is used by team. 4.2. Decisions are reached by the team in accordance with its agreed roles and responsibilities. 4.3. Mutual concern and camaraderie are developed in the team.
5. Facilitate accomplishment of organizational goals	5.1. Team members are actively participated in team activities and communication processes. 5.2. Individual and joint responsibility is developed by team's members for their actions. 5.3. Collaborative efforts are sustained to attain organizational goals.

Variable	**Range**
Learning and development needs	May include, but is not limited to: • Coaching, monitoring and/or supervision • Formal/informal learning program • Internal/external training provision • Work experience/exchange/opportunities • Personal study • Career planning/development • Performance evaluation • Workplace skills assessment • Recognition of prior learning
Organizational requirements	May include, but is not limited to: • Quality assurance and/or procedures manuals • Goals, objectives, plans, systems and processes • Legal and organizational policy/guidelines and requirements • Safety policies, procedures and programs • Confidentiality and security requirements • Business and performance plans • Ethical standards • Quality and continuous improvement processes and standards
Feedback on performance	May include, but is not limited to: • Formal/informal performance evaluation • Obtaining feedback from supervisors and colleagues • Obtaining feedback from clients • Personal and reflective behavior strategies • Routine and organizational methods for monitoring service delivery

Learning delivery methods	May include, but is not limited to: • On the job coaching or monitoring • Problem solving • Presentation/demonstration • Formal course participation • Work experience and involvement in professional networks • Conference and seminar attendance

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Identify and implement learning opportunities for others • Give and receive feedback constructively • Facilitate participation of individuals in the work of the team • Negotiate plans to improve the effectiveness of learning • Prepare learning plans to match skill needs • Access and designate learning opportunities
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • Coaching and monitoring principles • How to work effectively with team members who have diverse work styles, aspirations, cultures and perspective • How to facilitate team development and improvement • Methods and techniques to obtain and interpreting feedback • Methods for identifying and prioritizing personal development opportunities and options • Career paths and competence standards in the industry
Underpinning Skills	Demonstrates skills to: • Read and understand a variety of texts, preparing general information and documents according to target audience; spell with accuracy; use grammar and punctuation effective relationships and conflict management • Communicate including receiving feedback and reporting, maintaining effective relationships and conflict management • Plan and organize required resources and equipment to meet learning needs • Coach and mentor skills to provide support to colleagues • Report to organize information; assess information for relevance and accuracy; identify and elaborate on learning outcomes • Facilitate and conduct small group training sessions • Relate to people from a range of social, cultural, physical and mental backgrounds

Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Utilize Specialized Communication Skills**
Unit Code	**IND FWS4 14 0217**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to use specialized communication skills to meet specific needs of internal and external clients, conduct interviews, facilitate group discussions, and contribute to the development of communication strategies.

Elements	Performance Criteria
1. Meet common and specific communication needs of clients and colleagues	1.1. Specific communication needs of clients and colleagues are identified and met. 1.2. Different approaches are used to meet communication needs of clients and colleagues. 1.3. Conflict is addressed promptly and in a timely way and in a manner which does not compromise the standing of the organization.
2. Contribute to the development of communication strategies	2.1. ***Strategies*** for internal and external dissemination of information are developed, promoted, implemented and reviewed as required. 2.2. Channels of communication are established and reviewed regularly. 2.3. Coaching in effective communication is provided 2.4. Work related network and relationship are maintained as necessary. 2.5. Negotiation and conflict resolution strategies are used where required. 2.6. Communication with clients and colleagues is made appropriate to individual needs and organizational objectives.
3. Represent the organization	3.1. When participating in internal or external fora, presentation is relevant, appropriately researched and presented in a manner to promote the organization. 3.2. Presentation is made clear and sequential and delivered within a predetermined time. 3.3. Appropriate media is utilized to enhance presentation. 3.4. Differences in views are respected. 3.5. Written communication is made consistent with organizational standards.

	3.6. Inquiries are responded in a manner consistent with organizational standard.
4. Facilitate group discussion	4.1. Mechanisms which enhance ***effective group interaction*** are defined and implemented. 4.2. Strategies which encourage all group members to participate are used routinely. 4.3. Objectives and agenda are routinely set and followed for meetings and discussions. 4.4. Relevant information are provided to group to facilitate outcomes. 4.5. Evaluation of group communication strategies is undertaken to promote participation of all parties. 4.6. Specific communication needs of individuals are identified and addressed.
5. Conduct interview	5.1. A range of appropriate communication strategies are employed in ***interview situations***. 5.2. Different ***types of interview*** is conducted in accordance with the organizational procedures. 5.3. Records of interviews are made and maintained in accordance with organizational procedures. 5.4. Effective questioning, listening and nonverbal communication techniques are used to ensure that required message is communicated.

Variable	**Range**
Strategies	May include, but is not limited to: • Recognizing own limitations • Utilizing techniques and aids • Providing written drafts • Verbal and non verbal communication
Effective group interaction	May include, but is not limited to: • Identifying and evaluating what is occurring within an interaction in a non-judgmental way • Using active listening • Making decision about appropriate words, behavior • Putting together response which is culturally appropriate • Expressing an individual perspective • Expressing own philosophy, ideology and background and exploring impact with relevance to communication

Interview situations	May include, but is not limited to: • Establish rapport • obtain facts and information • Facilitate resolution of issues • Develop action plans • Diffuse potentially difficult situation
Types of Interview	May include, but is not limited to: • Related to staff issues • Routine • Confidential • Evidential • Non-disclosure • Disclosure

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Demonstrate effective communication skills with clients and work colleagues accessing service • Adopt relevant communication techniques and strategies to meet client particular needs and difficulties
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Communication process • Dynamics of groups and different styles of group leadership • Relevant to client groups
Underpinning Skills	Demonstrates skills to: • full range of communication techniques including: ➢ active listening ➢ feedback ➢ interpretation ➢ role boundaries setting ➢ negotiation ➢ establishing empathy ➢ communication strategies • communicate to fulfill job roles as specified by the organization
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Manage Micro, Small and Medium Enterprises (MSMEs)**
Unit Code	**IND FWS4 15 0217**
Unit Descriptor	This unit covers knowledge, skills and attitude required in running Micro, Small and Medium enterprises. The strategies involve developing, monitoring and managing work activities and financial information, developing effective work habits, and adjusting work schedules as needed.

Elements	Performance Criteria
1. Develop and communicate Strategic work plan	1.1. The importance of planning is sensitized before acting and about the importance of plans to reduce risks and to inhibit impulsive actions and discussed. 1.2. The basics of planning and beginning with goal setting are communicated. 1.3. The achievement of measurable and realistic short-term business objective is addressed. 1.4. How to develop realistic activities plans and schedule is discussed. 1.5. ***Major components of work plan*** are introduced and understood. 1.6. The importance of constant reviewing their plans is understood by monitoring the results.
2. Identify daily work requirements and Develop effective work habits	2.1. Basic concept about effect working culture is discussed and understood. 2.2. Different approaches to work culture are developed and understood. 2.3. Work requirements are identified for a given time period by taking into consideration of ***resources*** and constraints. 2.4. Work activities are prioritized based on business needs, requirements and deadlines. 2.5. If appropriate, work is allocated to relevant staff or contractors to optimize efficiency. 2.6. Work and personal priorities are identified and a balance is achieved between competing priorities using appropriate ***time management strategies***. 2.7. Input is sought from ***internal and external sources*** and used to develop and refine new ideas and approaches. 2.8. Business or inquiries is/are responded to promptly and effectively.

	2.9. Information is presented in a format appropriate to the industry and audience.
3. Manage Marketing of MSMEs	3.1. Information on market and business needs is analyzed and market opportunities identified. 3.2. Marketing mix and components are evaluated. 3.3. Marketing mix for specific target market is determined. 3.4. Marketing mix is monitored and continual adjusted against marketing performance.
4. Manage Human Resources	4.1. ***Human resource rules, regulations law and procedures*** are identified and determined. 4.2. The existing human resource is audited, and gaps are identified. 4.3. Recruitment and selection are conducted based on the organizational requirements. 4.4. Selected candidates are oriented and placed for the appropriate position. 4.5. Appraisal of employees' performance is conducted. 4.6. Appraisal result is used for training and development, promotion, compensation, disciplinary measures and other purposes as required. 4.7. ***Employee relations*** are maintained.
5. Manage production and Operation	5.1. Production /operation plan is developed and implemented. 5.2. Required inputs are purchased and adequate inventories maintained. 5.3. Production /operation process is checked and controlled. 5.4. Quality control is applied and maintained.
6. Maintain financial records and use for decision making	6.1. The objective and benefits of financial records are discussed and understood. 6.2. Asset, liabilities and capital are identified and recorded. 6.3. Balance sheet and different journals are discussed. 6.4. Business transactions are discussed, analyzed, classified and recorded. 6.5. Daily financial records are maintained correctly in accordance with legal and accounting requirements. 6.6. Invoices and payments are prepared and distributed in timely manner and in accordance with legal requirements. 6.7. Outstanding accounts are collected or followed-up.

	6.8. Revenue, expense and costs are identified and discussed. 6.9. Different ledgers and subsidiary ledgers are discussed and maintained. 6.10. Profit and loss report is prepared. 6.11. Financial interpretation is conducted with assistant from the appropriate person. 6.12. Financial manual is prepared.
7. Monitor, Manage and Evaluate work performance	7.1. People, resources and/or equipment are coordinated to provide optimum results. 7.2. Staff, clients and/or contractors are communicated within a clear and regular manner, to monitor work in relation to ***business goals*** or timelines. 7.3. ***Problem solving techniques*** are applied to work situations to overcome difficulties and achieve positive outcomes. 7.4. Opportunities for improvements are monitored according to business demands. 7.5. Work schedules are adjusted to incorporate necessary modifications to existing work and routines or changing needs and requirements. 7.6. Proposed changes are clearly communicated and recorded to aid in future planning and evaluation. 7.7. Relevant codes of practice are used to guide an ethical approach to workplace practices and decisions.

Variable	**Range**
Major components of work plan	May include, but is not limited to: • Objective • Responsibilities • Resources (human, materials, finance, time, etc) • Activities
Resources	May include, but is not limited to: • Human resource • Money • Time • Machines • Equipment and Space
Time management strategies	May include, but is not limited to: • Prioritizing and anticipating

	• Short term and long term planning and scheduling • Creating a positive and organized work environment • Clear timelines and goal setting that is regularly reviewed and adjusted as necessary • Breaking large tasks into smaller tasks • Getting additional support if identified and necessary
Internal and external sources	May include, but is not limited to: • Staff and colleagues • Management, supervisors, advisors or head office • Relevant professionals such as lawyers, accountants, management consultants • Professional associations
Human resource rules , regulations law and procedures	May include, but is not limited to: • Recruitment and selection • Orientation and placement • Training and development • Performance appraisal and reward system • Disciplinary procedures • Movement and separation • Industrial relation
Employee relations	May include, but is not limited to: • Relationship within employees • Relationship among employees and management and labor union • Relationship between labor union and government
Business goals	May include, but is not limited to: • Sales targets • Budgetary targets • Team and individual goals • Production targets • Reporting deadlines
Problem solving techniques	May include, but is not limited to: • Brainstorming • Fish bone • Focus group discussion and Problem tree

Evidence Guide	
Critical Aspects of Competence	A person must be able to demonstrate: • Ability to identify daily work requirements and allocate work appropriately • Ability to interpret financial documents in accordance with legal requirements • The ability to prepare strategic plan • The ability to develop effective work habit

	• The ability to manage marketing of MSEs • The ability to manage human resources of MSEs • the ability to manage production/operation of MSEs • The ability to maintain financial records of MSEs • The ability to manage, monitor and evaluate work performance of MSMEs
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Strategic plan • Working culture • Time management strategy • Marketing Mix • Relevant marketing, operation/production, human resource and financial management • Human resource functions • Production/operation functions • Monitoring and evaluation • Problem solving techniques • Federal and Local Government legislative requirements affecting business operations, especially in regard to OHS, equal employment opportunity, industrial relations and anti-discrimination • Relevant industry code of practice • Planning techniques to establish realistic timelines and priorities • Identification of relevant performance measures • Quality assurance principles and methods
Underpinning Skills	Demonstrate skills to: • Technical or specialist skills relevant to the business operation • Interpret legal requirements, company policies and procedures and immediate, day-to-day demands • Strategic planning skills • Human relation skills • Communicate using questioning, clarifying, reporting, and giving and receiving constructive feedback • Numeracy skills for performance information, setting targets and interpreting financial documents and reports • Technical skills to interpret business document, reports and financial statements and projections • Relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities • Solve problem and develop contingency plans • Use computers and software packages to record and manage data and to produce reports

	• Evaluate using assessment work and outcomes • Observe for identifying appropriate people, resources and to monitor work
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Foundry Works Supervision Level IV	
Unit Title	**Apply Problem Solving Techniques and Tools**
Unit Code	**IND FWS4 16 0217**
Unit Descriptor	This unit of competency covers the knowledge, skills and attitude required to apply scientific problem solving techniques and tools to enhance quality, productivity and other kaizen elements on continual basis.

Elements	Performance criteria
1. Identify and select theme/problem.	1.1. ***Safety requirements*** are followed in accordance with safety plans and procedures. 1.2. All possible problems related to the process /Kaizen elements are listed using ***statistical tools and techniques***. 1.3. All possible problems related to kaizen elements are identified and listed on Visual Management Board/Kaizen Board. 1.4. Problems are classified based on obviousness of cause and action. 1.5. Critical factors like the number of customers affected, Potentials for bottlenecks, and number of complaints etc… is selected. 1.6. Problems related to priorities of ***Kaizen Elements*** are given due emphasis and selected.
2. Grasp current status and set goal.	2.1. The extent of the problem is defined. 2.2. Appropriate and achievable goal is set.
3. Establish activity plan.	3.1. The problem is confirmed. 3.2. High priority problem is selected. 3.3. The extent of the problem is defined. 3.4. Activity plan is established as per ***5W1H***.
4. Analyze causes of a problem.	4.1. All possible causes of a problem are listed. 4.2. Cause relationships are analyzed using***4M1E***. 4.3. Causes of the problems are identified. 4.4. Root causes are selected. 4.5. The root cause which is most directly related to the problem is selected. 4.6. All possible ways are listed using ***creative idea***

	generation to eliminate the most critical root cause. 4.7. The suggested solutions are carefully tested and evaluated for potential complications. 4.8. Detailed summaries of the action plan are prepared to implement the suggested solution.
5. Examine countermeasures and their implementation.	5.1. Action plan is implemented by ***medium KPT*** members. 5.2. Implementation is monitored according to the agreed procedure and activities are checked with preset plan.
6. Assess effectiveness of the solution.	6.1. ***Tangible and intangible results*** are identified. 6.2. The results are verified over time. 6.3. Tangible results are compared with targets using ***various types of diagram***.
7. Standardize and sustain operation.	7.1. If the goal is achieved, the new procedures are standardized and made part of daily activities. 7.2. All employees are trained on the new ***Standard Operating Procedures (SOPs)***. 7.3. SOP is verified and followed by all employees. 7.4. The next problem is selected to be tackled by the team.

Variables	**Range**
Safety requirements	May include, but not limited to: • OHS requirements include legislation, material safety, managements system, hazardous substances and dangerous goods code and local safe operating procedures • Work is carried out in accordance with legislative obligations, environmental legislations, relevant health regulation, manual handling procedure and organization insurance requirements
Statistical tools and techniques	May include, but not limited to: • 7 QC tools may include: ➢ Stratification ➢ Pareto Diagram ➢ Cause and Effect Diagram ➢ Check Sheet ➢ Control Chart/Graph ➢ Histogram ➢ Scatter Diagram • QC techniques may include: ➢ Brain storming

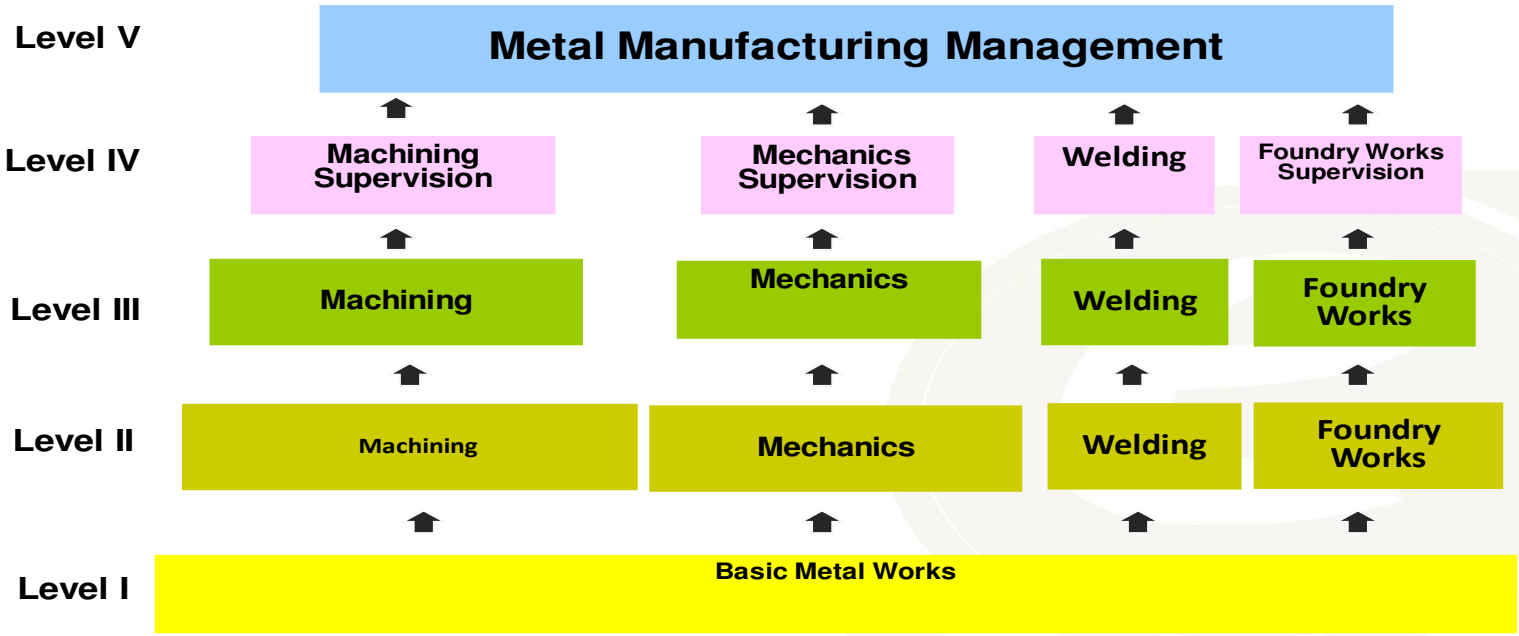
	➢ Why analysis ➢ What if analysis ➢ 5W1H
Kaizen Elements	May include, but not limited to: • Quality • Cost • Productivity • Delivery • Safety • Moral • Environment and Gender equality
5W1H	May include, but not limited to: • Who: person in charge • Why: objective • What: item to be implemented • Where: location • When: time frame • How: method
4M1E	May include, but not limited to: • Man • Machine • Method • Material and • Environment
Creative idea generation	May include, but not limited to: • Brainstorming • Exploring and examining ideas in varied ways • Elaborating and extrapolating • Conceptualizing
Medium KPT	May include, but not limited to: • 5S • 4M (Machine, Method, Material and Man) • 4p (Policy, Procedures, People and Plant) • PDCA cycle • Basics of IE tools and techniques
Tangible and intangible results	May include, but not limited to: • Tangible result may include quantifiable data • Intangible result may include qualitative data
Various types of diagram	May include, but not limited to: • Line graph • Bar graph • Pie-chart

	• Scatter and Affinity diagrams
Standard Operating Procedures (SOPs)	May include, but not limited to: • The customer demand • The most efficient work routine (steps) • The cycle times required to complete work elements • All process quality checks required to minimize defects/errors • The exact amount of work in process required

Evidence Guide	
Critical Aspects of Assessment	Demonstrates skills and knowledge competencies to: • Apply all relevant procedures and regulatory requirements to ensure quality and productivity of an organization. • Detect non-conforming products/services in the work area • Apply effective problem solving approaches/strategies. • Implement and monitor improved practices and procedures • Apply statistical quality control tools and techniques.
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • QC story/PDCA cycle/ • QC story/ Problem solving steps • QCC techniques • 7 QC tools • Basic IE tools and techniques. • SOP • Quality requirements associated with the individual's job function and/or work area • Workplace procedures associated with the candidate's regular technical duties • Relevant health, safety and environment requirements • organizational structure of the enterprise • Lines of communication • Methods of making/recommending improvements. • Reporting procedures
Underpinning Skills	Demonstrates skills to: • Apply problem solving techniques and tools • Apply statistical analysis tools • Apply Visual Management Board/Kaizen Board. • Detect non-conforming products or services in the work area • Document and report information about quality, productivity and other kaizen elements. • Contribute effectively within a team to recognize and recommend improvements in quality, productivity and

	other kaizen elements. • Implement and monitor improved practices and procedures. • Organize and prioritize activities and items. • Read and interpret documents describing procedures • Record activities and results against templates and other prescribed formats.
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

METALS MANUFACTURING



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