

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**MECHANICAL PRODUCTION MACHINE OPERATOR**

**LEVEL 4**

**PROGRAMME CODE: 07 15 354A**

# FOREWORD

The provision of quality education and training is fundamental to the government’s overall strategy for social economic development. Quality education and training will contribute to achievement of Kenya’s development blueprint, Vision 2030 and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution of Kenya 2010 and this resulted in the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training.

This policy document requires that training in TVET institutions be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery to allow for multiple entry and exit in TVET programmes. These reforms demand that industry takes a leading role in occupational standards development to ensure it addresses competence needs.

It is against this background that these Occupational Standards have been developed for a competency-based mechanical production standard. These Occupational Standards will also be the basis for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a key role towards development of competent human resource for the engineering sector’s growth and development.

# PREFACE

Kenya Vision 2030 aims to transform the country into “a newly industrializing, middle-income country providing a high-quality life to all its citizens by the year 2030”. Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace competency-based education and training (CBET).

The Technical and Vocational Education and Training (TVET) Act No. 29 of 2013 and Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need to reform curriculum development, assessment and certification. This called for a shift to CBET in order to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

Incumbent mechanical engineering industry experts in conjunction with expert subject trainers and other related stakeholders have developed these Occupational Standards for CNC Milling Operator level 4. These standards will be the basis for development of competency-based curriculum for Mechanical Production Machine Operator

The Occupational Standards are designed and organized with clear performance criteria for each element of a unit of competency. These standards also outline the required knowledge and skills as well as evidence guide.

I am grateful to everyone who participated in the development of these Occupational Standards.

# ACRONYMS

CBET Competency Based Education and Training

OSHA Occupation Safety and Health Act

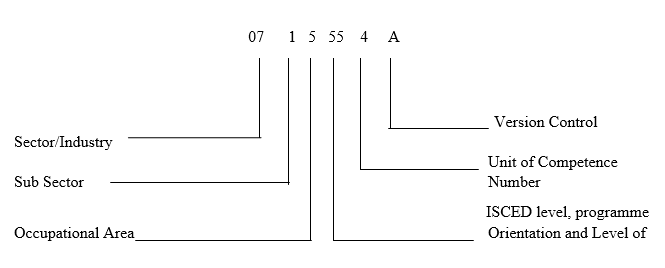
PPE Personal Protective Equipment

PPE Personal Protective Equipment

TVET Technical and Vocational Education and Training

WIBA Work Injury Benefits Act

# KEY TO UNIT CODE



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TABLE OF CONTENTS

[FOREWORD i](#_Toc195529919)

[PREFACE ii](#_Toc195529920)

[ACRONYMS iii](#_Toc195529921)

[KEY TO UNIT CODE iv](#_Toc195529922)

[OVERVIEW vi](#_Toc195529923)

[CORE UNITS OF COMPETENCY 1](#_Toc195529924)

[PERFORM GENERAL FITTING OPERATIONS 24](#_Toc195529925)

[JOIN PARTS BY WELDING 35](#_Toc195529926)

[PERFORM LATHE OPERATIONS 44](#_Toc195529927)

# OVERVIEW

This course is designed to equip a Mechanical Production Technician with the competencies required to perform general fitting operations, join parts by welding, and perform lathe operations and Milling Operations.

The course consists of core units of learning as indicated hereafter:

**SUMMARY OF UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **UNIT CODE** | **UNIT TITLE** |
| 0715 351 01A | Produce General Fitting Operations |
| 0715 351 02A | Join Parts by Welding |
| 0715 351 03A | Perform Lathe Operations |
| 0715 351 04A | Perform Milling Operations |

# CORE UNITS OF COMPETENCY

## PERFORM GENERAL FITTING OPERATIONS

**UNIT CODE** : 0715 351 01A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Production Technician in order to perform general fitting operations. It includes carrying out general bench work operations, performing drilling operations, performing grinding operations, performing sawing operations, assembling parts, carrying out maintenance and housekeeping operations.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Carry out general bench work operations | * 1. Safety is observed as per OSHA standards   2. Working drawing is interpreted as per drawing standards   3. Work plan is prepared as per working drawing   4. Fitting tools are identified as per task requirements   5. Measuring and marking out are carried out as per task requirements   6. *Fitting operations* are performed as per task requirements |
| 2. Perform drilling operations | * 1. Safety is observed as per OSHA standards   2. Working drawing is interpreted as per drawing standards   3. Drilling tools are identified as per task requirements   4. Cutting fluid is identified as per task requirements   5. Measuring and marking out are carried out as per task requirements   6. *Drilling operations* are performed as per task requirements |
| 3. Perform grinding operations | * 1. Safety is observed as per OSHA standards   2. Grinding methods are determined as per task requirements   3. Cutting fluid is identified as per task requirements   4. *Grinding machines* and tools are identified as per task requirements   5. Grinding operations are performed as per task requirements   6. Quality of surface finish is checked as per product requirements |
| 4. Perform sawing operations | * 1. Safety is observed as per OSHA standards   2. Sawing methods are determined as per task requirements   3. Cutting fluid is identified as per task requirements   4. *Sawing machines* and tools are identified as per task requirements   5. Sawing operations are performed as per task requirements |
| 5. Assemble parts | * 1. Safety is observed as per OSHA standards   2. Parts are assembled as per working drawings   3. Functionality of assembly is checked as per product requirements |
| 6 Carry out maintenance and housekeeping operations | * 1. Machine is cleaned and oiled as per workplace procedures   2. Tools and accessories are cleaned and properly stored as per workplace procedures   3. Bench and floor cleaned and waste segregated as per workplace procedures |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Fitting operations | May include but not limited to;   * 1. Filing   2. Threading (taps and dies)   3. Scrapping   4. Riveting   5. Reaming |
| 1. Drilling operations | May include but not limited to;   * 1. Countersinking   2. Boring   3. Counter boring   4. Drilling   5. Reaming   6. Tapping   7. Step drilling |
| 1. Grinding machines | May include but not limited to;   * 1. Pedestal grinder   2. Bench grinder   3. Hand grinder   4. Speed cutter   5. Surface grinder |
| 1. Sawing machines | May include but not limited to;   * 1. Hack saw   2. Slitting saw   3. Band saw   4. Reciprocating saw   5. Circular saw |
| 1. Maintenance | May include but not limited to;   * 1. Corrective maintenance   2. Troubleshooting   3. Problem diagnosing   4. Replacement and repair of faulty parts   5. Routine maintenance |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* OSHA 2007
* WIBA 2007
* Hand tools
* Marking out tools
* Measuring tools
* Power tools
* Repair and maintenance
* Drawing Interpretation
* Job card interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing skills
* Communication skills
* Problem solving skills
* Time management
* Numeracy skills
* Creativity
* Organizational skills

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Observed safety as per OSHA standards  1.2 Interpreted working drawing as per drawing standards  1.3 Identified fitting tools as per task requirements  1.4 Carried out measuring and marking out as per task requirements  1.5 Performed fitting operations as per task requirements  1.6 Performed drilling operations as per task requirements  1.7 Performed grinding operations as per task requirements  1.8 Checked quality of surface finish as per product requirements  1.9 Performed sawing operations as per task requirements  1.10 Assembled parts as per working drawings  1.11 Checked functionality of assembly as per product requirements  1.12 Cleaned and oiled machine as per workplace procedures  1.13 Cleaned and properly stored tools and accessories as per workplace procedures  1.14 Cleaned floor and bench and segregated waste as per workplace procedures |
| 2. Resource implications | The following resources should be provided:  2.1 Appropriate working environment where assessment can take place   * 1. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project work   2. Observation   3. Oral questioning   4. Portfolio of evidence   5. Third party report   6. Written tests |
| 1. Context of assessment | Competency may be assessed in workplace or a simulated workplace environment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |

## JOIN PARTS BY WELDING

**UNIT CODE:** 0715 351 02A

**UNIT DESCRIPTION**

This unit covers the competencies required in joining parts by welding. It involves carrying out manual metal arc welding, gas welding, brazing and soldering, MIG welding, TIG welding and maintaining welding equipment.

**ELEMENT AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| --- | --- |
| 1. Carry out manual metal arc welding | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. ***Electrodes*** are stored in an air tight container   5. Workpiece is prepared as per the job requirement   6. Manual metal arc welding is performed on steel and copper workpiece up to 6mm thickness as per welding symbols and ***weld positions***   7. Arc welded ***product finishing*** is performed as per job requirement   8. MMAWinspectionis carried out as per job requirement   Housekeeping is carried out as per work procedure |
| 1. Carry out gas welding, brazing and soldering | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. Workpiece is prepared as per the job requirement   5. Gas welding equipment are set up as per machine manual.   6. Gas welding is performed on steel and copper up to 4mm thickness is performed as per job requirement.   7. Gas cutting is performed on steel and copper up to 4mm thickness is performed as per job requirement.   8. Brazing is performed on steel and copper up to 4mm thickness is performed as per job requirement.   9. Soldering is performed on steel and copper up to 4mm thickness is performed as per job requirement.   10. Welded product finishing is performed as per job requirement   11. Gas welding inspectionis carried out as per job requirement   Housekeeping is carried out as per work procedure |
| 1. Carry out metal inert gas welding (MIG) | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. Workpiece is prepared as per the job requirement   5. MIG welding is performed on steel up to 12mm thickness is performed as per job requirement.   6. MIG welding product finishing is performed as per job requirement   7. MIG weldinginspectionis carried out as per job requirement   Housekeeping is carried out as per work procedure |
| 1. Carry out tungsten inert gas welding (TIG) | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. Workpiece is prepared as per the job requirement   5. TIG welding is performed on stainless steel up to 4mm thickness is performed as per job requirement.   6. TIG welding product finishing is performed as per job requirement   7. TIG weldinginspectionis carried out as per job requirement   Housekeeping is carried out as per work procedure |
| 1. Maintain welding tools and equipment | 1. Maintenance schedule is prepared as per manufacturers manual. 2. Welding Machines, tools and equipment are cleaned and lubricated as per the Manual. 3. Welding Machines, tools and equipment are inspected as per the Manual. 4. Faults on welding Machines, tools and equipment are identified and reported/rectified and as per sops. Maintenance report is prepared as per the organization policy. |

**RANGE**

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| * 1. Personal growth may include but not limited to: | * Growth in the job * Career mobility * Gains and exposure the job gives * Net workings * Benefits that accrue to the individual as a result of noteworthy performance |
| 1. Welding equipment | * MMAW welding machine * Gas welding machine * MIG welding machine * TIG welding machine |
| 1. Materials | * Stainless Steel * Plain carbon steel |
| 1. Welded joints | * Lap joint * Butt joint * Corner joint * T-joint * Edge joint |
| 1. Welding positions | * Flat position * Horizontal position * Vertical position * Overhead position |
| 1. Product finishing. | * Buffing * Grinding * Polishing * Plating. * Electro-Coating. * Blasting * Brushing |
| 1. Welding electrodes | * Metal electrodes * Carbon electrodes * Graphite electrodes * Platinum electrodes * Glass electrodes * Tungsten electrode * Aluminum electrode |
| 1. Destructive testing | * Tensile Test * Bend test |
| 1. Non-Destructive testing | * Dye-penetrant |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Design of working drawing
* Interpreting working drawings
* Preparing joints
* welding
* Cutting
* Manipulation of electrodes
* Product assessment
* Observation of safety

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Workplace procedures and OSHA
* Welding equipment
* Joint preparation
* Types of electrodes
* Welding techniques and specification procedure
* Setting current on welding equipment
* BS and ISO welded joint standards
* Applications of MMAW, gas welding, brazing and soldering, MIG welding and TIG welding
* Welding and gas cutting techniques
* welding safety procedures
* Workplace housekeeping procedures

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Observed safety and health as per Workplace procedures and OSHA   2. Produced detail design of manual metal arc welding component as per drawing standards.   3. Selected materials, tools and equipment   4. Prepared joints as per working drawing   5. Set up welding equipment in accordance with job specifications   6. Welded work piece using welding equipment process as per job specifications and ISO 9606-1   7. Examined welded Work pieces as per   ISO 17637   * 1. Dressed welded joint as per standard operating procedures   2. Maintained welding equipment as per manufacturers manual.   3. Carried out housekeeping as per organization requirement. |
| 1. Resource Implications | The following resources must be provided:   * 1. Welding workshop equipped with:      1. Welding Machines      2. welding consumables and equipment      3. welding Personal Protective Equipment      4. weld testing equipment |
| 1. Methods of Assessment | 3.1 Observation  3.2 Oral questioning  3.3 Written tests  3.4 Projects |
| 1. Context of Assessment | 4.1 On-job  4.2 Simulated workplace environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM LATHE OPERATIONS

**UNIT CODE :** 0715 351 03A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Production Technician in order to perform lathe operations. It includes interpreting working drawings, setting work piece and tool(s) on lathe machine, setting up lathe machine, performing lathe machine operations and carrying out lathe maintenance.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Interpret working drawings | * 1. Job card is signed for and interpreted   2. Working drawing is interpreted as per drawing standards   3. Work plan is prepared as per the working drawing   4. Materials are selected as per work plan   5. Tools are identified and selected as per work plan   6. Accessories are identified and selected as per work plan |
| 1. Set work piece and tool(s) on lathe machine | 1. Work piece is mounted as per task requirements 2. Tools are prepared as per set standards 3. Tools and accessories are mounted as per task requirements 4. True running of work piece is checked |
| 1. Set up lathe machine | * 1. Speeds and feeds are selected as per manufacturer’s specifications   2. Cutting fluid is identified as per task requirements   3. *Mode* *of operation* is identified as per task requirements |
| 1. Perform *lathe machine operations* | * 1. Safety is observed as per OSHA standards   2. Housekeeping is observed as per workplace regulations   3. Trial test is performed   4. Machining is carried out as per task requirements   5. Dimensions are checked and adjusted as per task specifications   6. Quality of surface finish is checked as per product specifications |
| 1. Carry out lathe maintenance | * 1. Maintenance requirements are identified as per workplace procedures   2. Preventive maintenance is carried out as per machine manual   3. Corrective maintenance is carried out as per machine manual |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. *Mode* *of operation* | * Semi-Automatic * Manual |
| 1. *Lathe machine operations* | May include but not limited to;   * Turning * Drilling * Facing * Chamfering * Threading * Parting * Knurling * Boring * Forming |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* OSHA and WIBA 2007
* Hand tools
* Marking out, measuring and cutting tools
* Repair and maintenance
* Job card and drawing Interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing skills
* Communication skills
* Problem solving skills
* Time management
* Numeracy skills
* Creativity
* Organizational skills

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Interpreted working drawing as per drawing standards   2. Selected materials as per task requirements   3. Identified and selected tool as per the working drawing   4. Identified and selected accessories per working drawing   5. Mounted work piece as per task requirements   6. Selected speeds and feeds as per manufacturer’s specifications   7. Observed safety as per OSHA standards   8. Carried out machining as per task requirements   9. Checked and adjusted dimensions as per task requirements   10. Checked quality of surface finish as per products specifications |
| 2. Resource implications | The following resources should be provided:  2.1 Appropriate working environment where assessment can take place   * 1. Resources relevant to the proposed activities or tasks |
| 3. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project work   2. Observation   3. Oral questioning   4. Portfolio of evidence   5. Third party report   6. Written tests |
| 4. Context of assessment | Competency may be assessed in workplace or a simulated workplace environment. |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |

## PERFORM MILLING OPERATIONS

**UNIT CODE** : 0715 351 04A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Production Technician in order to perform milling operations. It includes interpreting working drawings, setting work piece and tool(s) on milling machine, setting up milling machine, performing milling machine operations and carrying out milling machine maintenance.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Interpret working drawings | * 1. Safety is observed as per OSHA standards   2. Housekeeping is observed as per workplace regulations   3. Working drawing is interpreted as per drawing standards   4. Work plan is prepared as per the working drawing   5. Materials are selected as per task requirements   6. Tools and accessories are identified as per task requirements |
| 2. Set work piece and tool(s) on milling machine | * 1. Work piece is marked out as per task requirements   2. Work piece is mounted and aligned as per task requirements   3. Tools and accessories are selected as per task requirements   4. Tools and accessories are mounted as per task requirements |
| 3. Set up milling machine | * 1. *Mode of milling operation* is identified a requirements   2. Speeds and feeds are selected as per manufacturer’s specifications   3. Cutting fluid is identified as per task requirements |
| 4. Perform milling machine operations | * 1. *Milling machine operations* are identified as per task requirements   2. Machining is carried out as per task requirements   3. Dimensions are checked and adjusted as per working drawing |
| 5. Carry out milling machine maintenance | * 1. Maintenance requirements are identified as per workplace procedures   2. *Preventive maintenance* is carried out as per machine manual   3. Corrective maintenance is carried out as per machine manual |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| ***1. Mode of milling operation*** | * Semi-Automatic * Manual * Conventional/Up milling * Climb/Down milling |
| ***2. Milling machine operations*** | Milling machine operations may include but not limited to;   * Face milling * Progressive milling * Profile milling * End milling * Form milling * Gang milling * Slitting * Slab milling * Straddle milling |
| ***3. Preventive maintenance*** | May include but not limited to;   * Troubleshooting * Problem diagnosing * Replacement and repair of faulty parts * Routine maintenance |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* OSHA 2007
* WIBA 2007
* Hand tools
* Marking out tools
* Measuring tools
* Power tools
* Repair and maintenance
* Drawing Interpretation
* Job card interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing skills
* Communication skills
* Problem solving skills
* Time management
* Numeracy skills
* Creativity
* Organizational skills

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Observed safety as per OSHA standards  1.2 Interpreted working drawing as per drawing standards  1.3 Selected materials, tools and accessories as per task requirements  1.4 Marked out work piece is as per task requirements  1.5 Mounted and aligned tools, accessories and work piece as per task requirements  1.6 Selected speeds and feeds as per manufacturer’s specifications  1.7 Carried out machining as per task requirements  1.8 Checked and adjusted dimensions as per working drawing  1.9 Cleaned and oiled machine as per manufacturer’s specifications  1.10 Cleaned work and segregated waste as per workplace procedures |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriate working environment where assessment can take place   2. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project work   2. Practical assessment   3. Observation   4. Oral questioning   5. Portfolio of evidence   6. Third party report   7. Written tests |
| 1. Context of assessment | Competency may be assessed in workplace or a simulated workplace environment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |