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**THE REPUBLIC OF KENYA**

**COMPETENCY BASED MODULAR CURRICULUM**

**FOR**

**MECHANICAL PIPING FABRICATION**

**KNQF LEVEL 4**

**PROGRAMME CODE: 0715 354A**

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**FOREWORD**

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

Reforms in the education sector are necessary to achieve Kenya Vision 2030 and meet the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution, and this resulted in the formulation of the Policy Framework for Reforming Education and Training in Kenya (Sessional Paper No. 14 of 2012). A key feature of this policy is the radical change in the design and delivery of TVET training. This policy document requires that training in TVET be competency-based, curriculum development be industry-led, certification be based on demonstration of competence, and the mode of delivery allow for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this curriculum has been developed. For trainees to build their skills on foundational hands-on activities of the occupation, units of learning are grouped in modules. This has eliminated duplication of content and streamlined exemptions based on skills acquired as a trainee progresses in the up-skilling process, while at the same time allowing trainees to be employable in the shortest time possible through the acquisition of part qualifications.

It is my conviction that this curriculum will play a great role in developing competent human resources for the Mechanical Engineering Production Sector’s growth and development.

**PRINCIPAL SECRETARY**

**STATE DEPARTMENT FOR TVET**

**MINISTRY OF EDUCATION**

**PREFACE**

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

TVET Act, CAP 210A and Sessional Paper No. 1 of 2019 on Reforming Education and Training in Kenya for Sustainable Development emphasized the need to reform curriculum development, assessment, and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry, as well as increase the global competitiveness of the Kenyan labour force.

This curriculum has been developed in adherence to the Kenya National Qualifications Framework and CBETA standards and guidelines. The curriculum is designed and organized into Units of Learning with Learning Outcomes, suggested delivery methods, learning resources, and methods of assessing the trainee’s achievement. In addition, the units of learning have been grouped in modules to concretize the skills acquisition process and streamline upskilling.

I am grateful to all expert trainers and everyone who played a role in translating the Occupational Standards into this competency-based modular curriculum.

# ACKNOWLEDGEMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support were received from expert trainers, institutions and organizations.

I recognize with appreciation the role of the Engineering and Manufacturing National Sector Skills Committee (NSSC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the Mechanical Engineering Production sector for their valuable input and everyone who participated in developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that individuals aspiring to work in the Mechanical Engineering Production Sector Sector acquire competencies to perform their work more efficiently and effectively.

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# ACRONYMS AND ABBREVIATIONS

CBET Competency Based Education and Training

KCSE Kenya Certificate of Secondary Education

KNQF Kenya National Qualification Framework

OS Occupational Standards

TVET Technical and Vocational Education and Training

TVETA Technical and Vocational Education and Training Authority

# KEY TO ISCED UNIT CODE

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# OURSE OVERVIEW

Mechanical Piping Fabrication level 4 qualification consists of competencies that an individual must have to fabricate pipes. It involves pipe fabrication, pipe welding, pipes installation and piping maintenance.

The units of learning comprising Mechanical Piping Fabrication level 4 qualification include the following competencies

# SUMMARY OF UNITS OF LEARNING

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Unit Duration (Hours)** | **Credit** |
| **MODULE I** | | |  |
| 0715 351 01A | Pipe Fabrication | 100 | **10** |
| 0715 351 02A | Pipe Welding | 200 | **20** |
| **MODULE II** | | |  |
| 0715 351 03A | Pipes Installation | 200 | **20** |
| 0715 351 04A | Piping Maintenance | 100 | **10** |
|  | Industrial Training | 320 | 32 |
| **GRAND TOTAL** | | **920** | **92** |

**Entry Requirements**

An individual entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (KCSE)

**Or**

1. Equivalent qualifications as determined by TVETA.

**Trainer qualification**

Qualifications of a trainer for this course include:

1. Possession of at least level 5 qualification or its equivalent in related trade area; and
2. License by TVETA
3. Registered by Engineer Board of Kenya (E.B.K) or Kenya Engineering Technology Registration Board (KETRB).

**Industry Training**

An individual enrolled in this course will be required to undergo Industry training for a minimum period of 320 hours in mechanical engineering Production sector. The industrial training may be taken after completion of all units for those pursuing the full qualification or be distributed equally in each unit for those pursuing part qualification. In the case of dual training model, industrial training shall be as guided by the dual training policy.

**Competence Assessment**

1. An individual enrolled in this course shall be assessed for competence through formative and summative assessments.
2. During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
3. Number of formative assessments shall minimally be equal to the number of elements in a unit of competency.
4. During summative assessment basic and common units may be integrated in the core units or assessed as discrete units.
5. Theoretical and practical weighting for each unit of learning shall be as follows:
   1. 10:90 for the units in modules I and Module II
6. Formative and summative assessments shall be weighted at 60% and 40% respectively in the overall unit of learning score
7. For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:
8. Obtained at least 40% in theory assessment in formative and summative assessments.
9. Obtained at least 60% in practical assessment in formative and summative assessment where applicable.
10. Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
11. Assessment performance rating for each unit of competency shall be as follows:

|  |  |
| --- | --- |
| **MARKS** | **COMPETENCE RATING** |
| 80 -100 | Attained Mastery |
| 65 - 79 | Proficient |
| 50 - 64 | Competent |
| 49 and below | Not Yet Competent |
| Y | Assessment Malpractice/irregularities |

1. Assessment for Recognition of Prior Learning (RPL) may lead to award of part and/or full qualification.

**Certification**

A candidate will be issued with a Certificate of Competency upon demonstration of competence in a core Unit of Competency. To be issued with KenyaNational TVET Certificate in Mechanical Pipe Fabrication Level 4, the candidate must demonstrate competence in all the Units of Competency as given in the qualification pack. A Statement of Attainment certificate may be issued upon demonstration of competence in a certifiable element within a unit.

The certificates will be issued by the Qualification Awarding Institution

# MODULE I

## PIPE FABRICATION

**Unit Code:** 0715 351 01A

**Unit Duration: 100** Hours

**Relationship to Occupational Standards**

**This unit addresses the Unit of Competency:** Perform Pipe Fabrication

**Unit Description**

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train pipe fabrication. The learning outcomes involve carrying out pipe cutting, shaping and edge preparation.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee will be able to:

|  |  |  |
| --- | --- | --- |
| **S/No.** | **Learning Outcome** | **Duration (Hours)** |
|  | Carry out pipe cutting | 40 |
|  | Carry out pipe shaping | 40 |
|  | Carry out pipe edge preparation | 20 |
| **Total** | | **100** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Carry out pipe cutting | * 1. Pipe fabrication safety      1. Workshop rules and regulations      2. Pipe fabrication hazards         1. Physical         2. Chemical         3. Environmental         4. Psychological      3. Pipe fabrication hazard control         1. Personal Protective Equipment (PPE)         2. Administrative control         3. Engineering design   2. Fabrication drawing      1. Interpretation         1. Symbols and notations         2. Abbreviations         3. Parts list   3. Pipe cutting      1. Methods         1. Manual Methods         + Hack saws         + Pipe cutters         1. Thermal Methods         + Gas cutting         + Gouging         1. Mechanical Methods         + Grinders         + Bandsaws      2. Pipe cutting tools         1. Hand tools         2. Power tools         3. Thermal Cutting Tools         4. Abrasive Tools         5. Plastic-Specific Tools      3. Pipe cutting activities         1. Manual Cutting         2. Power Tool Cutting         3. Thermal Cutting      4. Post cutting operations         1. Deburring         + Purpose         + Methods         1. Cleaning         + Purpose         + Methods   4. Pipe fabrication housekeeping      1. Work area organization         1. Clear clutter         2. Designated storage         3. Maintain pathways      2. Cleaning         1. Work area cleaning         2. Pipe cleaning         3. Tool cleaning      3. Waste management         1. Segregation         2. Disposal   **Practice**   * Cut metal and plastic pipes of different sizes | * Practical test * Project work * Portfolio of evidence * Written tests |
| 1. Carry out pipe shaping | * 1. Pipe shaping      1. Definition of terms         1. Pipe shaping         2. Bending         3. Swaging         4. Threading         5. Spinning         6. Grooving         7. Notching         8. Coiling         9. Flattening         10. Piercing         11. Beading      2. Methods of pipe shaping         1. Bending         + Mandrel bending         + Roll bending         + Compression bending         + Heat bending         1. Swaging         2. Threading         + Internal         + External         1. Flanging         + Manual flanging         1. Spinning         + Manual spinning         1. Grooving         + Manual grooving         1. Notching         + Manual notching         1. Cutting         2. Coiling         3. Flattening         4. Piercing         5. Beading      3. Applications and procedure of pipe shaping      4. Pipe shaping tools         1. Pipe bending tools         + Hand benders         + Hydraulic pipe benders         + Mandrel benders         + Roll benders         1. Cutting and notching tools         + Pipe cutters         + Hole saws         1. Swaging and expanding tools         2. Bevelling tools         + Handheld         1. Threading tools         + Manual pipe threaders         + Die heads         1. Deburring tools         + Internal deburring tools         + External deburring tools         + Rotary deburring tools         + Hand files         1. Flanging tools         + Portable flange spreaders         1. Coiling tools         + Pipe coilers         1. Grooving tools         + Manual groovers   **Practice**  Carry out:   * + - * Bending       * Grooving       * Cutting | * Practical test * Project work * Portfolio of evidence * Written tests |
| 1. Carry out pipe edge preparation | * 1. Pipe edge preparation      1. Definition of terms         1. Bevelling         2. Chamfering         3. Squaring         4. Tapping         5. Deburring         6. Flanging         7. Coping Notching         8. Tapering         9. Heat treatment      2. Purpose of pipe edge preparation      3. Pipe edge preparation methods         1. Bevelling         + Manual bevelling         1. Squaring         + Manual squaring         1. Chamfering         + Hand chamfering         1. Deburring         + Internal deburring         + External deburring         1. Flanging         + Manual flanging         1. Grinding         + Hand grinding         1. Coping         + Manual coping         1. Cutting         + Manual cutting         1. Heat treatment         + Furnace         + Oxy-fuel heating         1. Notching         2. Tapering         + Manual tapering         1. Tapping         + Manual tapping         1. Welding         + Oxy-fuel gas welding         1. Scarfing         + Manual scarfing      4. Pipe edge preparation tools         1. Pipe bending tools         2. Cutting tools         + Hack saws         + Tube cutters         + Band saws         1. Swaging and expanding tools         2. Bevelling tools         + Hand held grinders         + Pipe bevelling dies         + File set         1. Threading tools         2. Deburring tools         + Hand deburring blades         + Deburring brushes         1. Flanging tools         + Flange spreader tools         + Handheld flange dies         1. Coiling tools         2. Grooving tools         3. Chamfering tools         + Hand grinders         + Files and rasps         1. Pipe end squaring tools         + Hand files         + Square jigs         1. Pipe threading tools         + Taps and dies         + Pipe threader sets         1. Pipe marking out tools         + Scriber         + Surface plate         + Vernier height gauge         + Dot punch         1. Pipe securing tools         + Vices         + Clamps         + Pipe fixtures         + Tack welds      5. Pipe edge preparation procedure   **Practice**  Carry out:   * Chamfering * Deburring * Grinding * Tapering * Tapping | * Practical test * Project work * Portfolio of evidence * Written tests |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* Practical work.
* Exercises
* Industrial visits
* Online materials
* Direct instructions
* Simulation

**List of Recommended Resources**

**Recommended Resources for 25 trainees**

| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| --- | --- | --- | --- | --- |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Textbooks on Pipe Fabrication | 25 | 1:1 |
|  | Drawing papers | A4, A3 and A2 size drawing papers for drafting of sketches and working drawings | 1 ream |  |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:25 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:25 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:25 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Standard workshop with bench/fitting area approximately 80 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Dust coat/ overall | Shields skin and regular clothes from sparks | 25 | 1: |
|  | Gloves | Shields hands from sharp edges, heat, and chemical exposure | 25 | 1:1 |
|  | Safety boots | Protects feet from heavy objects, sharp materials, and impact. | 25 | 1:1 |
|  | Ear muffs/ ear plugs | Shields against prolonged exposure to high noise levels from machinery | 25 | 1:1 |
|  | Safety goggles | Protects eyes from flying metal particles, sparks, and dust | 25 | 1:1 |
|  | Raw materials | Steel, Copper and Aluminium Pipes   * 4 mm thickness * 6 mm thickness * 9 mm thickness   Assorted plastic pipes | Enough |  |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:25 |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
|  | Cotton waste | Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment |  |  |
|  | Cleaning detergents | General degreasers | 10 liters |  |
| Floor detergents | 10 liters |
| Hand detergents | 10 liters |
| **D** | **Tools and Equipment** | | | |
| **Measuring tools** | | | | |
|  | Steel rules | Calibrated steel rules for linear measurements | 20 | 4:5 |
|  | Vernier calipers | Calibrated vernier calipers for linear measurements | 20 | 4:5 |
|  | Tri squares | Properly aligned steel Tri-square for checking perpendicular edges | 5 | 1:5 |
|  | Vernier height gauge and surface plates | Calibrated vernier height gauges and surface plates for measurement of heights | 5 | 1:5 |
|  | Measuring tapes | Calibrated measuring tapes for linear measurements | 20 | 4:5 |
|  | Angle gauges | Calibrated steel rules for linear measurements | 5 | 1:5 |
| **Marking out tools** | | | | |
|  | Scribers | Quality steel pencil scribers for marking out lines on metal surfaces | 20 | 4:5 |
|  | Dot punches | Quality steel dot punches for marking out centres | 20 | 4:5 |
|  | Calipers | Quality steel calipers for marking out arcs on metal surfaces | 5 | 1:5 |
| **Cutting Tools** | | | | |
|  | Assorted hand files | Flat and round hand files for material preparation and finishing | 20 | 4:5 |
|  | Hacksaws | Hack saws with functional frames and blades for cutting metal plates and pipes | 20 | 4:5 |
|  | Angle grinders | Portable angle grinders with cutting and grinding disks for cutting and grinding and pipes | 5 | 1:5 |
|  | Tube cutters | Manual/handheld | 5 | 1:5 |
|  | Band saw | Electricity powered | 1 | 1:25 |
| **Pipe shaping tools** | | | | |
|  | Hand benders | Assorted manual set of bending tools | 1 | 1:25 |
|  | Pipe cutters | Hand held cutters | 5 | 1:5 |
|  | Pipe threaders | Manual | 5 | 1:5 |
|  | Die heads | For threading | 5 | 1:5 |
| **Edge preparation tools** | | | | |
|  | Pipe beveling dies | For edge preparation | 5 | 1:5 |
|  | Hand deburring blades | Assorted | 5 | 1:5 |
|  | Deburring brushes | Assorted | 5 | 1:5 |
|  | Hand held flange dies | Assorted | 5 | 1:5 |
|  | Files and rasps | Assorted hand files and rasps | 5 | 1:5 |
|  | Taps and dies | Assorted | 5 | 1:5 |
| **Work holding tools** | | | | |
|  | Work benches | Stable work benches for carrying out bench work | 5 | 1:5 |
|  | Bench vices | Functional bench vices/clamps for holding work pieces during bench work | 20 | 4:5 |
|  | Pipe fixtures | For securing pipes into position during cutting, shaping and edge preparation | 5 | 1:5 |
| **E** | **Machines and Equipment** | | | |
|  | Firefighting equipment | for ensuring safety in fabrication workshops where fire hazards are present, such as sparks | 3 |  |
|  | Rolling machines | used to bend and shape pipes into curved shapes, cylinders, or tubes | 1 | 1:25 |
|  | Bending machine | Used to pipes into angles and specific shapes. | 1 | 1:25 |
| **F** | **Reference Materials** | | | |
|  | Working drawings | Technical welding drawings giving the specifications of the welding to be carried out | 25 | 1:1 |
|  | Operation sheets | Operation sheets describing the procedures to be followed in carrying out welding | 25 | 1:1 |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
|  | Practical Assessment Guides | Worksheets for practical assessments | 25 | 1:1 |

## PIPE WELDING

**Unit Code:** 0715 351 02A

**Unit Duration:** 200 Hours

**Relationship to Occupational Standards**

**This unit addresses the Unit of Competency:** Perform Pipe Welding

**Unit Description**

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train pipe welding. The learning outcomes involve carrying out Manual Metal Arc Welding (MMAW), Oxy-fuel gas welding, Metal Inert Gas (MIG) welding and Tungsten Inert Gas (TIG) welding.

**Summary of Learning Outcomes**

By the end of this unit of learning, the trainee should be able to:

|  |  |  |
| --- | --- | --- |
| **S/NO** | **Learning Outcomes** | **Hours** |
|  | Carry out Manual Metal Arc Welding (MMAW) | **40** |
|  | Carry out oxy-fuel gas welding | **60** |
|  | Carry out Metal Inert Gas (MIG) Welding | **40** |
|  | Carry out Tungsten Inert Gas (TIG) Welding | **60** |
| **TOTAL** | | **200** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Carry out Manual Metal Arc Welding (MMAW) | * 1. Pipe welding safety      1. Workshop rules and regulations      2. Pipe welding hazards         1. Physical         2. Chemical         3. Environmental         4. Psychological      3. Pipe welding hazard control         1. Personal Protective Equipment (PPE)         2. Administrative control         3. Engineering design   2. Pipe welding (MMAW)      1. Types of pipes         1. Steel         2. Aluminium         3. Copper      2. Drawings         1. Drawing dimension         2. Welding symbols and notations      3. Operation procedure         1. Development of operation procedure         2. Use of operation procedure      4. Welding joints         1. Butt         2. Cornet         3. Tee         4. Lap      5. Welding positions         1. Flat         2. Horizontal         3. Vertical         4. Overhead      6. Arc welding machines, tools and equipment         1. Machines and equipment         + Transformer based         + AC/DC machines         + Inverter welding machine         + Shields and helmets         + Aprons         + Welding curtains         + Fume extractors         1. Welding tools         + Chipping hammers         + Wire brushes         + Welding positioners         + Tongs      7. Welding material preparation         1. Pipe cleaning         2. Pipe cutting         3. Pipe edge preparation         4. Preheating         5. Back gouging      8. Arc welding parameters         1. Current         2. Arc length         3. Travel speed         4. Arc force         5. Electrode size and type         6. Welding position      9. MMAW process      10. Advantages of MMAW in pipes      11. Disadvantages of MMAW in pipes      12. Applications of MMAW in pipes      13. Finishing processes in pipe welding          1. Chipping          2. Grinding          3. Polishing          4. Surface cleaning          5. Heat treatment          6. Coating/painting   **Practice**   * Carry out MMAW on steel pipes of different sizes | * Practical test * Project work Portfolio of evidence * Written tests |
| 1. Carry out oxy-fuel gas welding | * 1. Oxyfuel gas pipe welding      1. Definition of terms         1. Oxyfuel welding         2. Spelter         3. Brazing         4. Soldering      2. Oxyfuel welding flames         1. Neutral         2. Carburizing         3. Oxidizing      3. Oxy-fuel gas welding machines, tools and equipment         1. Machines and equipment         + Gas cylinders         + Welding torch         + Regulators         + Flashback arrestors         + Welding hoses         + Lighter         + Googles         + Aprons         1. Tools         + Tongs         + Tip cleaner         + Clamps      4. Oxy-fuel welding parameters         1. Pressure         2. Flame type         3. Torch travel speed         4. Filler material size and type         5. Welding position      5. Oxyfuel welding process      6. Advantages of oxyfuel pipe welding      7. Disadvantages of oxyfuel pipe welding      8. Applications of oxyfuel pipe welding   **Practice**   * Carry out oxyfuel welding of aluminium and copper pipes | * Practical test * Project work Portfolio of evidence * Written tests |
| 1. Carry out Metal Inert Gas (MIG) Welding | * 1. MIG pipe welding      1. Definition of terms         1. MIG welding         2. Pulse MIG welding         3. Wire speed      2. MIG welding machines, tools and equipment         1. MIG welding machine         + MIG torch         + Gas cylinders         + Cables         + Helmets and shields         1. Tools         + Tongs         + Clamps      3. MIG welding parameters         1. Current         2. Wire speed         3. Shielding gas         4. Wire size         5. Gun angle         6. Arc length         7. Pulse settings      4. MIG pipe welding process      5. Advantages of MIG pipe welding      6. Disadvantages of MIG pipe welding      7. Application of MIG pipe welding   **Practice**   * Carry out MIG welding of aluminium and copper pipes | * Practical test * Project work Portfolio of evidence * Written tests |
| 1. Carry out Tungsten Inert Gas (TIG) Welding | * 1. TIG pipe welding      1. Definition of terms         1. TIG welding         2. TIG torch         3. Pulsed TIG welding      2. TIG welding machines, tools and equipment         1. TIG welding machine         + TIG torch         + Gas cylinders         + Cables         + Helmets and shields         1. Tools         + Tongs         + Clamps      3. TIG welding parameters         1. Current         2. Electrode type and size         3. Shielding gas         4. Filler material         5. Torch angle         6. Travel speed         7. Pulse setting         8. Arc length      4. TIG pipe welding process      5. Advantages of TIG pipe welding      6. Disadvantages of TIG pipe welding      7. Applications of TIG pipe welding   **Practice**   * Carry out TIG welding of aluminium and copper pipes |  |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* Practical work.
* Exercises
* Industrial visits
* Online materials
* Direct instructions
* Simulation

**List of Recommended Resources**

**Recommended Resources for 25 trainees**

| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| --- | --- | --- | --- | --- |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Textbooks on Welding and Fabrication | 25 | 1:1 |
|  | Drawing papers | A4, A3 and A2 size drawing papers for drafting of sketches and working drawings | 1 ream for each size |  |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:25 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:25 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:25 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Standard workshop with bench/fitting area and welding booths approximately 80 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Dust coat/ overall | Shields skin and regular clothes from sparks | 25 | 1: |
|  | Gloves | Shields hands from sharp edges, heat, and chemical exposure | 25 | 1:1 |
|  | Safety boots | Protects feet from heavy objects, sharp materials, and impact. | 25 | 1:1 |
|  | Welding helmets | Protecting the eyes while providing a clear view of the weld. | 25 | 1:1 |
|  | Ear muffs/ ear plugs | Shields against prolonged exposure to high noise levels from machinery | 25 | 1:1 |
|  | Safety goggles | Protects eyes from flying metal particles, sparks, and dust | 25 | 1:1 |
|  | Raw materials | Assorted steel, copper and aluminum pipes | Enough |  |
|  | MMAW rods | For use in MMAW | Enough |  |
|  | TIG filler rods | Electrodes used in TIG welding | Enough |  |
|  | Spelter | Filler for oxyfuel gas welder | Enough |  |
|  | MIG wire | Copper wire of assorted gauges | Enough |  |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:25 |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
|  | Cotton waste | Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment | Enough |  |
|  | Cleaning detergents | General degreasers | 10 liters |  |
| Floor detergents | 10 liters |
| Hand detergents | 10 liters |
| **D** | **Tools and Equipment** | | | |
| **Measuring tools** | | | | |
|  | Steel rules | Calibrated steel rules for linear measurements | 20 | 4:5 |
|  | Vernier calipers | Calibrated vernier calipers for linear measurements | 20 | 4:5 |
|  | Tri squares | Properly aligned steel Tri-square for checking perpendicular edges | 5 | 1:5 |
|  | Vernier height gauge and surface plates | Calibrated vernier height gauges and surface plates for measurement of heights | 5 | 1:5 |
|  | Measuring tapes | Calibrated measuring tapes for linear measurements | 20 | 4:5 |
|  | Angle gauges | Calibrated steel rules for linear measurements | 5 | 1:5 |
| **Marking out tools** | | | | |
|  | Scribers | Quality steel pencil scribers for marking out lines on metal surfaces | 20 | 4:5 |
|  | Dot punches | Quality steel dot punches for marking out centres | 20 | 4:5 |
|  | Calipers | Quality steel calipers for marking out arcs on metal surfaces | 5 | 1:5 |
| **Cutting Tools** | | | | |
|  | Assorted hand files | Flat and round hand files for material preparation and finishing | 20 | 4:5 |
|  | Hacksaws | Hack saws with functional frames and blades for cutting metal plates and pipes | 20 | 4:5 |
|  | Angle grinders | Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes | 5 | 1:5 |
| **Work holding tools** | | | | |
|  | Work benches | Stable work benches for carrying out bench work | 5 | 1:5 |
|  | Collet | Hold the tungsten electrode in place | 5 | 1:5 |
|  | Bench vices | Functional bench vices/clamps for holding work pieces during bench work | 20 | 4:5 |
|  | Tongs | Functional pairs of tongs for holding hot pieces of metal during welding | 10 | 2:5 |
| **Finishing tools** | | | | |
|  | Wire brushes | To clean metal surfaces | 20 | 4:5 |
|  | MIG welding wire | Acts as both the electrode and the filler material | 2000kg | 80:1 |
|  | File cards | Cleaning tool used to maintain files | 5 | 1:5 |
| **E** | **Machines and Equipment** | | | |
|  | MIG welding machine | Uses a continuous wire feed as an electrode | 1 | 1:25 |
|  | TIG welding machine | Functional machine for practice | 1 | 1:25 |
|  | MMAW machine | Functional machine for practice | 1 | 1:25 |
|  | Oxyfuel welding machine | Functional machine for practice | 1 | 1:25 |
|  | Firefighting equipment | For ensuring safety in fabrication workshops where fire hazards are present, such as sparks | 3 |  |
| **F** | **Reference Materials** | | | |
|  | Working drawings | Technical welding drawings giving the specifications of the welding to be carried out | 25 | 1:1 |
|  | Operation sheets | Operation sheets describing the procedures to be followed in carrying out welding | 25 | 1:1 |
|  | Welding Procedure Specifications (WPS) | WPS to guide on the procedure and standards to be used to achieve specific types of welds | 25 | 1:1 |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
|  | Practical Assessment Guides | Worksheets for practical assessments | 25 | 1:1 |

# MODULE II

## PIPES INSTALLATION

**Unit Code:** 0715 351 03A

**Unit Duration:** 200 Hours

**Relationship to Occupational Standards**

**This unit addresses the Unit of Competency:** Perform Pipes Installation

**Unit Description**

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train pipes installation. The learning outcomes involve carrying out pipe fitting, assembly and surface treatment.

**Summary of Learning Outcomes**

By the end of this learning unit, the trainee should be able to:

|  |  |  |
| --- | --- | --- |
| S/NO | **Learning Outcomes** | **Duration (hours)** |
|  | Carry out pipe fitting | 100 |
|  | Carry out pipe assembly | 60 |
|  | Carry out surface treatment | 40 |
| **TOTAL** | | **200** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Carry out pipe fitting | * 1. Pipe installation safety      1. Workshop rules and regulations      2. Pipe installation hazards         1. Physical         2. Chemical         3. Environmental         4. Psychological      3. Pipe installation hazard control         1. Personal Protective Equipment (PPE)         2. Administrative control         3. Engineering design   2. Pipe installation drawing      1. Interpretation         1. Symbols and notations         2. Abbreviations         3. Parts list   3. Pipe fitting      1. Definition of terms         1. Pipes         2. Pipi fitting         3. Pipe alignment      2. Pipe fitting methods         1. Threaded pipe fitting         2. Welded pipe fitting         3. Flanged pipe fitting         4. Compression pipe fitting         5. Soldered pipe fitting         6. Push-Fit pipe fitting         7. Butt fusion pipe fitting         8. Clamped pipe fitting      3. Applications      4. Pipe fitting tools         1. Pipe cutters         2. Pipe benders         3. Pipe threading tools         4. Pipe reamers         5. Pipe flaring tools         6. Pipe wrenches         7. Tube expander         8. Pipe vices         9. Pipe boring tools         10. Pipe support tools         11. Pipe jointing machines      5. Pipe alignment      6. Housekeeping   **Practice**   * Carry out pipe fitting | * Practical test * Project work Portfolio of evidence * Written tests |
| 1. Carry out pipe assembly | * 1. Pipe assembly      1. Definition of terms         1. Pipe assembly      2. Pipe assembly methods         1. Threaded pipe         2. Welded pipe         3. Flanged pipe         4. Compression pipe         5. Soldered pipe         6. Push-Fit pipe         7. Butt fusion pipe         8. Clamped pipe      3. Applications of pipe assembly methods      4. Pipe assembly tools         1. Pipe cutters         2. Pipe benders         3. Pipe threading tools         4. Pipe reamers         5. Pipe flaring tools         6. Pipe wrenches         7. Tube expander         8. Pipe vices         9. Pipe boring tools         10. Pipe support tools         11. Pipe jointing machines      5. Piping assembly accessories         1. Pipe connectors         + Couplings         + Adapters         + Reducers         + Bushings         + Nipples         1. Directional fittings         + Elbows         + Tees         + Cross         + Wyes         1. Pipe end fittings         + Caps         + Plugs         + Flanges         + Blind flanges         1. Valves and control accessories         + Gate valves         + Ball valves         + Globe valves         + Check valves         + Butterfly valves         + Pressure relief valves         1. Threaded and compression fittings         + Union fittings         + Compression fittings         + Swivel fitting         1. Specialized fittings         + Flexible connectors         + Quick connect fittings         + Barbed fittings         + Expansion Joints         1. Pipe hangers and supports         + Clamps         + Straps         + Saddles         1. Gaskets and seals         + Rubber gaskets         + O-rings         1. Welding and soldering accessories         + Welded fittings         + Sweat fittings         1. Flare and groove fittings         + Flare fittings         + Grooved couplings      6. Piping assembly functional assessment         1. Visual inspection         2. Leak test   **Practice**   * Carry out piping assembly | * Written tests * Practical test * Project work * Portfolio of evidence |
| 1. Carry out surface treatment | * 1. Pipe surface treatment      1. Definition of terms         1. Surface treatment         2. Coating         3. Lining      2. Methods of pipe surface treatment         1. Coating and lining         2. Heat treatment      3. Tools and materials         1. Heat treatment furnace         2. Chemical sprayers      4. Applications of pipe surface treatment   **Practice**   * Apply galvanizing coat on welded pipe joint | * Practical test * Project work Portfolio of evidence * Written tests |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* Practical work.
* Exercises
* Industrial visits
* Online materials
* Direct instructions
* Simulation

**List of Recommended Resources**

**Recommended Resources for 25 trainees**

| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| --- | --- | --- | --- | --- |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Textbooks on Pipe Fitting | 25 | 1:1 |
|  | Drawing papers | A4, A3 and A2 size drawing papers for drafting of sketches and working drawings | 1 ream for each size |  |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:25 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:25 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:25 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Standard workshop with bench/fitting area and welding booths approximately 80 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Dust coat/ overall | Shields skin and regular clothes from sparks | 25 | 1: |
|  | Gloves | Shields hands from sharp edges, heat, and chemical exposure | 25 | 1:1 |
|  | Safety boots | Protects feet from heavy objects, sharp materials, and impact. | 25 | 1:1 |
|  | Welding helmets | Protecting the eyes while providing a clear view of the weld. | 5 |  |
|  | Ear muffs/ ear plugs | Shields against prolonged exposure to high noise levels from machinery | 25 | 1:1 |
|  | Safety goggles | Protects eyes from flying metal particles, sparks, and dust | 25 | 1:1 |
|  | Raw materials | Steel, copper and aluminum pipes  Assorted plastic pipes | Enough |  |
|  | MMAW electrodes | Electrodes used in pipe welding | Enough |  |
|  | Spelter rods | Filler material for oxyacetylene pipe welding | Enough |  |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 |  |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
|  | Cotton waste | Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment | Enough |  |
|  | Cleaning detergents | General degreasers | 10 liters |  |
| Floor detergents | 10 liters |
| Hand detergents | 10 liters |
| **D** | **Tools and Equipment** | | | |
| **Measuring tools** | | | | |
|  | Steel rules | Calibrated steel rules for linear measurements | 5 | 1:5 |
|  | Vernier calipers | Calibrated vernier calipers for linear measurements | 5 | 1:5 |
|  | Tri squares | Properly aligned steel Tri-square for checking perpendicular edges | 5 | 1:5 |
|  | Vernier height gauge and surface plates | Calibrated vernier height gauges and surface plates for measurement of heights | 5 | 1:5 |
|  | Measuring tapes | Calibrated measuring tapes for linear measurements | 5 | 1:5 |
|  | Angle gauges | Calibrated steel rules for linear measurements | 5 | 1:5 |
| **Marking out tools** | | | | |
|  | Scribers | Quality steel pencil scribers for marking out lines on metal surfaces | 5 | 1:5 |
|  | Dot punches | Quality steel dot punches for marking out centres | 5 | 1:5 |
|  | Calipers | Quality steel calipers for marking out arcs on metal surfaces | 5 | 1:5 |
| **Cutting Tools** | | | | |
|  | Assorted hand files | Flat and round hand files for material preparation and finishing | 5 | 1:5 |
|  | Hacksaws | Hack saws with functional frames and blades for cutting metal plates and pipes | 5 | 1:5 |
|  | Tinsnips | Cutting sheet metal components | 5 | 1:5 |
|  | Angle grinders | Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes | 5 | 1:5 |
|  | Pipe cutters |  | 5 | 1:5 |
|  | Pipe threaders | Assorted | 5 | 1:5 |
| **Work holding tools** | | | | |
|  | Work benches | Stable work benches for carrying out bench work | 5 | 1:5 |
|  | Collet | Hold the tungsten electrode in place | 5 | 1:5 |
|  | Pipe vices | Functional vices/clamps for holding pipes during installation | 5 | 1:5 |
|  | Tongs | Functional pairs of tongs for holding hot pieces of metal during welding | 5 | 1:5 |
|  | Pipe wrenches |  | 5 | 1:5 |
|  | Piping accessories | Sleeves, elbows, nuts, bolts, Teflon tapes etc. | Enough |  |
| **Finishing tools** | | | | |
|  | Wire brushes | To clean metal surfaces | 5 | 1:5 |
|  | File cards | Cleaning tool used to maintain files | 5 | 1:5 |
| **E** | **Machines and Equipment** | | | |
|  | MMAW welding machine | Uses a non-consumable tungsten electrode | 1 | 1:25 |
|  | Oxyfuel welding machine | For welding and heat treatment | 1 | 1:25 |
|  | Firefighting equipment | for ensuring safety in fabrication workshops where fire hazards are present, such as sparks | 3 |  |
|  | Welding gun | Feeds the filler wire into the weld pool | 5 | 1:5 |
| **F** | **Reference Materials** | | | |
|  | Working drawings | Technical drawings giving the specifications of the installation to be carried out | 25 | 1:1 |
|  | Operation sheets | Operation sheets describing the procedures to be followed in carrying out pipe installation | 25 | 1:1 |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
|  | Practical Assessment Guides | Worksheets for practical assessments | 25 | 1:1 |

## PIPING MAINTENANCE

**Unit Code:** 0715 351 04A

**Unit Duration:** 100 Hours

**Relationship to Occupational Standards**

**This unit addresses the Unit of Competency:** Perform Piping Maintenance

**Unit Description**

This unit of learning covers the learning outcomes, content, assessment methods, methods of delivery and resources required to train piping maintenance. The learning outcomes involve carrying out dimensional inspection, leak tests, non-destructive tests and performing piping repair work.

**Summary of Learning Outcomes**

By the end of this learning unit, the trainee should be able to:

|  |  |  |
| --- | --- | --- |
| S/NO | **Learning Outcomes** | Duration (Hours) |
|  | Carry out dimensional inspection | 20 |
|  | Carry out leak tests | 20 |
|  | Carry out non-destructive tests | 20 |
|  | Perform piping repair work | 40 |
| **TOTAL** | | **100** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Carry out dimensional inspection | * 1. Piping maintenance safety      1. Workshop rules and regulations      2. Piping maintenance hazards         1. Physical         2. Chemical         3. Environmental         4. Psychological      3. Piping maintenance hazard control         1. Personal Protective Equipment (PPE)         2. Administrative control         3. Engineering design   2. Working drawing      1. Interpretation         1. Symbols and notations         2. Abbreviations         3. Parts list   3. Dimensional inspection      1. Definition of terms         1. Inspection         2. Dimensional inspection      2. Parameters of dimensional inspection         1. Pipe length         2. Pipe diameter         3. Wall thickness         4. Pipe alignment         5. Angle and orientation         6. Flange alignment         7. Offsets and distances         8. Weld joints and edges      3. Procedure of dimensional inspection      4. Dimensional inspection tools         1. Tape measure         2. Vernier calipers         3. Micrometer screw gauges         4. Feeler gauges         5. Plumb bob         6. Spirit level         7. Straight edge         8. Protractor         9. Pipe alignment clamps      5. Pipe preparation         1. Cleaning         2. Polishing         3. Disassembly      6. Inspection checklist   4. Housekeeping      1. Work area organisation      2. Waste Management      3. Storage   **Practice**   * Carry out pipe dimensional inspection and record findings in a checklist | * Practical test * Project work Portfolio of evidence * Written tests |
| 1. Carry out leak tests | * 1. Leak tests      1. Definition of terms         1. Leakage         2. Leak test      2. Leak test parameters         1. Test medium         2. Test pressure         3. Test duration         4. Temperature      3. Types of leak tests         1. Pressure test         2. Vacuum test         3. Dye test         4. Bubble test      4. Procedure of leak tests      5. Applications of leak tests   **Practice**  Carry out:   * Dye test * Bubble test | * Written tests * Practical test * Project work * Portfolio of evidence |
| 1. Carry out non-destructive tests | * 1. Non-destructive testing      1. Definition of terms         1. Non-destructive tests         2. Visual inspection      2. Types of non-destructive tests         1. Visual inspection         2. Dye penetrant testing      3. Procedure of non-destructive testing      4. Applications of non-destructive tests   **Practice**  Carry out:   * Visual inspection of plastic pipes * Dye penetrant tests on metal pipes | * Practical test * Project work Portfolio of evidence * Written tests |
| 1. Perform piping repair work | * 1. Piping repair work      1. Definition of terms         1. Repair         2. Maintenance         3. Faults         4. Defects      2. Piping faults and defects         1. Corrosion         2. Cracks         3. Leaks         4. Misalignment         5. Blockages and clogs         6. Welding defects         7. Deformation      3. Types of piping repair works         1. Leak repairs         2. Corrosion repair         3. Cracked or broken pipe repair         4. Joint repair         5. Misalignment repair         6. Unblocking and unclogging         7. Pipe replacement      4. Piping repair work procedure   **Practice**  Carry out:   * Pipe replacement * Leak repairs |  |

**Suggested Delivery Methods**

* Demonstration
* Group discussions
* Practical work.
* Exercises
* Industrial visits
* Online materials
* Direct instructions
* Simulation

**List of Recommended Resources**

**Recommended Resources for 25 trainees**

| **S/No.** | **Category/Item** | **Description/Specifications** | **Quantity** | **Recommended Ratio (Item: Trainee)** |
| --- | --- | --- | --- | --- |
| **A** | **Learning Materials** | | | |
|  | Textbooks | Textbooks on Piping Maintenance | 25 | 1:1 |
|  | Drawing papers | A4, A3 and A2 size drawing papers for drafting of sketches and working drawings | 1 ream for each size |  |
|  | Projector | Functional projector for displaying content during presentations | 1 | 1:25 |
|  | Computer | Functional desktop computer with online instructional content | 1 | 1:25 |
|  | White board | Quality whiteboard of approximately 6 ft by 3 ft for writing during theory instruction | 1 | 1:25 |
|  | Printer | An ink-jet, laser-jet or toner-cartridge printer for printing notes, instructions and working drawings | 1 | 1:25 |
| **B** | **Learning Facilities & Infrastructure** | | | |
|  | Lecture/Theory Room | Spacious room with seats for 25 trainees, approximately 60 sqm | 1 | 1:25 |
|  | Workshop | Standard workshop with bench/fitting area and welding booths approximately 80 sqm | 1 | 1:25 |
| **C** | **Materials and Supplies** | | | |
|  | Dust coat/ overall | Shields skin and regular clothes from sparks | 25 | 1: |
|  | Gloves | Shields hands from sharp edges, heat, and chemical exposure | 25 | 1:1 |
|  | Safety boots | Protects feet from heavy objects, sharp materials, and impact. | 25 | 1:1 |
|  | Welding helmets | Protecting the eyes while providing a clear view of the weld. | 25 | 1:1 |
|  | Ear muffs/ ear plugs | Shields against prolonged exposure to high noise levels from machinery | 25 | 1:1 |
|  | Safety goggles | Protects eyes from flying metal particles, sparks, and dust | 25 | 1:1 |
|  | Raw materials | * Assorted plastic pipes * Steel, copper and aluminum pipes | Enough |  |
|  | Welding electrodes and fillers | Assorted electrodes and filler rods used in MMAW, TIG and oxyfuel welding | Enough |  |
|  | First Aid kit | Fully equipped First Aid kit for use in case of accidents | 1 | 1:25 |
|  | Brooms and cleaning stuff | Hand brooms and mops for cleaning | 10 | 2:5 |
|  | Cotton waste | Absorbent cotton waste for cleaning of oils and other dirt on machines, tools and equipment | Enough |  |
|  | Cleaning detergents | General degreasers | 10 liters |  |
| Floor detergents | 10 liters |
| Hand detergents | 10 liters |
|  | Dye, developer and soapy detergent | For leak and bubble tests | Enough |  |
| **D** | **Tools and Equipment** | | | |
| **Measuring tools** | | | | |
|  | Steel rules | Calibrated steel rules for linear measurements | 20 | 4:5 |
|  | Vernier calipers | Calibrated vernier calipers for linear measurements | 20 | 4:5 |
|  | Tri squares | Properly aligned steel Tri-square for checking perpendicular edges | 5 | 1:5 |
|  | Vernier height gauge and surface plates | Calibrated vernier height gauges and surface plates for measurement of heights | 5 | 1:5 |
|  | Measuring tapes | Calibrated measuring tapes for linear measurements | 5 | 1:5 |
|  | Angle gauges | Calibrated steel rules for linear measurements | 5 | 1:5 |
|  | Plumb bobs | Checking vertical straightness | 5 | 1:5 |
|  | Spirit levels | Checking straightness | 5 | 1:5 |
| **Marking out tools** | | | | |
|  | Scribers | Quality steel pencil scribers for marking out lines on metal surfaces | 5 | 1:5 |
|  | Dot punches | Quality steel dot punches for marking out centres | 5 | 1:5 |
|  | Calipers | Quality steel calipers for marking out arcs on metal surfaces | 5 | 1:5 |
| **Cutting Tools** | | | | |
|  | Assorted hand files | Flat and round hand files for material preparation and finishing | 5 | 1:5 |
|  | Hacksaws | Hack saws with functional frames and blades for cutting metal plates and pipes | 5 | 1:5 |
|  | Tinsnips |  | 5 | 1:5 |
|  | Tube/Pipe cutters |  | 5 | 1:5 |
|  | Angle grinders | Portable angle grinders with cutting and grinding disks for cutting and grinding metal plates and pipes | 5 | 1:5 |
| **Work holding tools** | | | | |
|  | Work benches | Stable work benches for carrying out bench work | 5 | 1:5 |
|  | Bench vices | Functional bench vices/clamps for holding work pieces during bench work | 5 | 1:5 |
|  | Tongs | Functional pairs of tongs for holding hot pieces of metal during maintenance | 5 | 1:5 |
| **Finishing tools** | | | | |
|  | Wire brushes | To clean metal surfaces | 5 | 1:5 |
|  | File cards | Cleaning tool used to maintain files | 5 | 1:5 |
| **E** | **Machines and Equipment** | | | |
|  | Welding machine | MMAW/TIG/MIG/oxyfuel welding equipment | 1 | 1:25 |
|  | Firefighting equipment | for ensuring safety in fabrication workshops where fire hazards are present, such as sparks | 3 |  |
| **F** | **Reference Materials** | | | |
|  | Working drawings | Technical welding drawings giving the specifications of the maintenance to be carried out | 25 | 1:1 |
|  | Operation sheets | Operation sheets describing the procedures to be followed in carrying out maintenance | 25 | 1:1 |
|  | Welding Procedure Specifications (WPS) | WPS to guide on the procedure and standards to be used to achieve specific types of welds | 25 | 1:1 |
|  | Training Presentations/Slides | Digital format for shared access among trainees | 1 | 1:25 |
|  | Practical Assessment Guides | Worksheets for practical assessments | 25 | 1:1 |