RQF LEVEL 3

MATRO301

MANUFACTURING TECHNOLOGY

Rolling Operation

TRAINER'S MANUAL

October 2024

ROLLING OPERATION

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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Copies available from:

- *HQs: Rwanda TVET Board-RTB*
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Original published version: October 2024

ACKNOWLEDGEMENTS

The publisher would like to thank the following for their assistance in the elaboration of this training manual:

Rwanda TVET Board (RTB) extends its appreciation to all parties who contributed to the development of the trainer's and trainee's manuals for the TVET Certificate III in Manufacturing Technology, specifically for the module **" MATRO301: Rolling Operation."**

We extend our gratitude to KOICA Rwanda for its contribution to the development of this training manual and for its ongoing support of the TVET system in Rwanda.

We extend our gratitude to the TQUM Project for its financial and technical support in the development of this training manual.

We would also like to acknowledge the valuable contributions of all TVET trainers and industry practitioners in the development of this training manual.

The management of Rwanda TVET Board extends its appreciation to both its staff and the staff of the TQUM Project for their efforts in coordinating these activities.

This training manual was developed:

Under Rwanda TVET Board (RTB) guiding policies and directives

Under Financial and Technical support

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CBA: Competency Based Assessment

CBT: Competency Based Training

PPE: Personal Protective Equipment

RP: Rwanda Polytechnic

RQF: Rwanda Qualification Framework

RTB: Rwanda TVET Board

TQUM Project: TVET Quality Management Project

TVET: Technical and Vocational Education and Training

INTRODUCTION

This trainer's manual includes all the methodologies required to effectively deliver the module titled **"Rolling Operation."** Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies.

The development of this training manual followed the Competency-Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainer's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainer, you will begin by asking questions related to the activities to encourage critical thinking and guide trainees toward real-world applications in the labor market. The manual also outlines essential information such as learning hours, didactic materials, and suggested methodologies.

This manual outlines the procedures and methodologies for guiding trainees through various activities as detailed in their respective trainee manuals. The activities included in this training manual are designed to offer trainees opportunities for both individual and group work. Upon completing all activities, you will assist trainees in conducting a formative assessment known as the end learning outcome assessment. Ensure that trainees review the key reading and the points to remember section.

MODULE CODE AND TITLE: MATRO301 ROLLING OPERATION

Learning Outcome 1: Prepare for rolling operation
Learning Outcome 2: Carry out rolling operation
Learning Outcome 3: Perform post-rolling operation activities


FIRE

Indicative contents
1.1 Introduction to rolling operation
1.2 Safety rules and regulations
1.3 Selection of materials, tools and equipment
1.4 Identification of rolling process
1.5 Identification of rolling defects

Key Competencies for Learning Outcome 1: Prepare for Rolling Operation

Knowledge	Skills	Attitudes
• Description of rolling operation • Identification of Safety and security measure required in rolling operation • Description of materials, tools, and equipment used in rolling operation • Description of rolling process Description of rolling defects	• Applying safety precautions required in rolling operation • Selecting, materials, tools and equipment used rolling operation	• Being a good communicator with team members, supervisors, and other departments while selecting rolling tools and equipment. • Being adaptable to new techniques of maintaining rolling tools and equipment.

Duration: 8 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Define correctly key terms used in a manufacturing rolling operation
2. Explain clearly Working principle of rolling machine used in manufacturing
3. Identify correctly application of rolling operation used in manufacturing
4. Identify effectively advantages and disadvantages of rolling operation in manufacturing
5. Identify properly safety and regulations measures rolling operation applied in manufacturing
6. Describe correctly tools, materials and equipment for rolling operation used in manufacturing
7. Apply appropriately maintenance technics for rolling equipment used in manufacturing

Resources

Equipment	Tools	Materials
● PPE ● Fire extinguishers ● First aid kit ● Rolling machine ● Angle grinder ● Shear machine ● Cut-off machine	● Micrometre ● Taper measure ● Callipers ● Ruler ● Gauges ● Shears ● Cut-off saws ● Plasma cutter ● Marking pens and pencils ● Scribers	● Oil ● Grease ● Sheet metals ● Steel bar

	• Stencils and templates • Wire brushes • Abrasive pad • Solvents and degreasers • Wrenches • Screwdriver • Impact driver • Grease gun • Oil cans • Lubrication pumps • Inspections mirrors • Magnifying glasses •	

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have safety signs and symbols related to rolling operation
- Avail rolling machine in the workshop in good condition
- Avail sample video and picture for rolling operation
- Make sure there is workplace to be arranged.

Indicative content 1.1: Introduction to Rolling Operation

Duration: 2 hrs

Theoretical Activity 1.1.1: Introduction to rolling operation

Notes to the trainer:

- While delivering this content, Trainer may form small groups which can be used for describing the key terms used in rolling operation.
- Trainer may use images, videos, and illustrations as didactic materials.

Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the session, engage trainees in group forming and request them to answer the following questions:

i. What do you understand by the following terms?

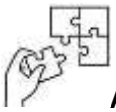
a) Rolling process
b) Ingot
c) Billet
d) Slab
e) Bloom
f) Strip
g) Foil
h) Bar
i) Wire

ii. Describe the working principle of rolling.
iii. Explain the application of rolling.
iv. Explain the advantages and disadvantages of rolling.

Step2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 1.1.1, in trainee manual

Points to Remember

- Always keep in mind these key terms related to rolling operation: ingot, bloom, billet, slab, plate, sheet, strip and wire.
- Rolling is widely used in the following main applications: structural shapes, wire and wire products, tubes and pipes sheet metal, plates, bars and rods.
- Even if rolling has different advantages, it has also disadvantages like: high initial equipment cost, material wastage and limited to metals.



Application of learning 1.1.

Organise a study visit to any manufacturing workshop/workplace located in your surroundings. The workshop/workplace should be specialized in production of rolled products using metallic materials. Observe how they produce different shapes by using rolling machines. By referring to the key readings 1.1 .1, Ask your trainees to prepare a report about:

i. The working principle of rolling machines
ii. Applications of rolling
iii. Advantages and disadvantages of rolling

Checklist:

SN	Criteria	Indicators	Yes	No
1	Rolling operation is well introduced	Rolling principle is described		
		Advantages of rolling are described		
		Disadvantages of rolling are described		
		Application of rolling are identified		
	Total marks:			**……/4**
	Passing line			**70%**

Indicative content 1.2: Safety Rules and Regulations

Duration: 1 hr

Theoretical Activity 1.2.1: Description of safety rules and regulations applied in rolling operation

Notes to the trainer:

- Trainer may engage trainees to form small groups to discuss about types of hazards, safety precautions, safety signs and symbols during rolling operation
- You are recommended to use pictures/photo, video, and /or illustrations as didactic materials.
- Take trainees to the working place to show them safety signs

Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the session, engage trainees in group forming and request them to answer the following questions:

i. What do you understand about the term “hazard”?

ii. Describe the types of potential hazards in the rolling workplace.

iii. Identify safety signs and symbols applied in the workshops.

Step 2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 1.2.1. in the trainee manual

Points to Remember

- While describing safety rules and regulations applied in rolling operation you must consider mainly types of hazards and safety signs and symbols used in rolling operation.

Practical Activity 1.2.2: Applying safety rules and regulations in rolling operation

Notes to the trainer

- The trainer may facilitate this activity using individual-based practices
- You are recommended to demonstrate how safety rules and regulations should be applied at workplace during rolling operation.
- You are recommended to:
  - ✓ Avail a manufacturing workshop which is not arranged
  - ✓ Avail safety signs, mandatory signs, prohibition signs, warning signs in rolling

Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the topic and ask trainees to go at manufacturing workplace and apply safety rules and regulations by positioning hazard symbols, fire safety signs, Mandatory Signs, Prohibition Signs, Warning Signs.

Step2: Explain the task and provide clear work instruction (Task, Time allocated)

Step3: Demonstrate how hazard symbols, fire safety signs, mandatory signs, prohibition signs, warning signs are demarcated in rolling.

Step4: Ask trainees to fix hazard symbols, fire safety signs, mandatory signs, prohibition signs, warning signs in rolling workplace.

Step5: Checks whether hazard symbols, fire safety signs, mandatory signs, prohibition signs, warning signs are demonstrated and provide clarifications if any.

Step6: Ask Trainees to read key reading 1.2.2 and 1.1.2 in the Trainee's manual.

Step7: Ask trainees to perform the task provided in application of learning 1.2

Points to Remember

- While applying safety precautions in rolling operation you should focus mainly on the following elements: install emergency control devices, skilled and experienced

operator, carry out regular maintenance and repair, use personal protective equipment, safe working distance, environmental safety.

- While preventing hazards at a rolling workplace you should consider risk assessment, safety training, safety equipment, emergency plans, and regular inspections.

Application of learning 1.2.

Suppose there is a manufacturing workshop that is requesting your school a support of training its workers about the appropriate application of safety and security measures in the manufacturing workshop. Ask your learners to train workers how to perform the following tasks:

a) Use PPEs for metal cutting
b) Allocate and use fire extinguisher
c) Allocate safety signs and symbols in the workshop
d) Identify first aid kit
e) Control hazards

Checklist:

SN	Criteria	Indicators	Yes	No
1	Safety practices are properly applied	PPEs are identified		
		First aid kit is identified		
		Fire extinguisher is allocated		
		Safety signs and symbols are allocated		
		Hazards are controlled		
	Total marks:			**……/5**
	Passing line			**70%**

Indicative content 1.3: Selection of Materials, Tools and Equipment.

Duration: 3 hrs

Theoretical Activity 1.3.1: Description of materials, tools and equipment used in rolling

Notes to the trainer:

- Trainer may use small groups to discuss about tools materials and equipment used in rolling operation.
- Use pictures or photo of different types of tools, materials and equipment to provide more understanding.

Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the session, engage trainees in group forming and request them to answer the following questions:

i. What do you understand by?

a. Materials
b. Tools
c. Equipment

ii. Identify (with examples) the types of materials, tools, and equipment used in rolling operations

Step2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 1.3.1. in the trainee manual

Points to Remember

- While describing types of materials used rolling ng operation you must consider focus mainly on: Ferrous and Nonferrous

- For describing tools used in rolling operation you must consider mainly on their uses

Practical Activity 1.3.2: Selecting materials, tools and equipment for rolling operation

Notes to the trainer

- The trainer may allow trainee to go to the workplace and select tools, material and equipment to be used in rolling operation.
- You need to have store of tools, materials, and equipment.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to go in manufacturing workplace to Select the right tools, material and equipment to be used while performing rolling operation.

Step 2: Demonstrate how to select tools, materials and equipment used in rolling operation and explain selection criteria.

Step 3: Ask trainees to select tools, materials and equipment used in rolling operation and monitor the procedures.

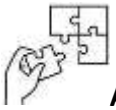
Step 4: Verify whether tools, materials and equipment used in rolling operation are correctly selected and provide support where necessary.

Step 5: Ask trainees to read key reading 1.3.2.

Step 6: Ask trainees to perform the task provided in application of learning 1.3

Points to Remember

- While describing types of materials used rolling ng operation you must consider focus mainly on: Ferrous and Nonferrous
- While selecting tools materials, and equipment to be used in rolling operation, you should consider their functionality, life span, ease use, and cost.



Application of learning 1.3.

Suppose that your school has organised a study visit to one of the manufacturing workshops located in your home district. The workshop wishes to produce metallic doors and windows. By referring to the key readings 1.3.1, Ask your trainees to accomplish the following tasks:

i. Select tools
ii. Select materials
iii. Select equipment

Checklist/Solution for application:

SN	Criteria	Indicators	Yes	No
1	Equipment, tools and materials are properly selected	PPEs are worn		
		Tools are selected		
		Materials are selected		
		Equipment are selected		
	Total marks		**……/ 4**	
	Passing line		**70%**	

Indicative content 1.4: Identification of Rolling Process

Duration: 1hr

Theoretical Activity 1.4.1: Description of rolling process.

Notes to the trainer:

- While delivering this content small groups can be used for discussing about rolling process, this content should be delivered in classroom or other learning place.
- Pictures or video can be used as didactic material while describing rolling process

Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the session, engage trainees in group forming and request them to answer the following questions:

i. Describe the rolling process?

Step 2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 1.4.1. in the trainee manual.

Points to Remember

- While describing rolling process you must consider the following elements: Material preparation, rolling mill setup, passing through rolls, reduction in thickness, cooling and lubrication, shape and dimensional changes, final inspection, coiling or cutting.

Indicative content 1.5: Identification of Rolling Defects

Duration: 1 hr

Theoretical Activity 1.5.1: Identification rolling defects

Notes to the trainer:

- While delivering this content small groups can be used to identify rolling defects these contents should be delivered in classroom or other learning place.
- Pictures or video can be used as didactic material while describing rolling defects.

Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the session, engage trainees in group forming and request them to answer the following questions:

i. What do you understand about "defect" in rolling operation?
ii. State the types of rolling defect
iii. Explain the causes and prevention of rolling defect

Step2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 1.5.1. in the trainee manual

Points to Remember

- While describing rolling defects, you should consider edge cracking, alligator, and wavy edge.

Learning outcome 1 end assessment

Theoretical assessment

Question 1. Define the following terms: (5 marks)

Answer:

a) Rolling process

is a deformation process in which Metal(s) in its semi-finished or finished form is passed between the two opposing rollers, which reduces the metal's thickness through the compression process or

Rolling is a metal forming process in which the deformation takes place under the application of Compressive forces between the rollers.

b) Sheet is a Mill product, with thickness less than 6 mm, and width greater than 600 mm

C) A lubricant: is a substance which you put on the surfaces or parts of something, especially something mechanical, to make the parts move smoothly.

Question 2. Where rolling operation is applicable? (at least six). (3 marks)

Answer:

a) Rolling operation used in various industries such as

b) Steel sheets and plates are made by the rolling

c) Rods, seamless hallow tube are made by rolling.

d) Rolling is used to producing cross-section of large section.

e) Rolling is used to cutting the gear on the gear blank

f) the threaded parts, bolt, screw etc. which have mass production is made by rolling.

g) Automotive industries, various part, are manufactured by rolling

h) the rolling process is used to make a plate.

i) bearing, turbines' ring is rolling product

Question 3. State at least five advantages of rolling operation. **(5marks)**

Answer:

The advantages of Rolling process are as follows:

A) By rolling, uniform dimensions of the components can be obtained.

b) It uses the same tool in the sense, the same rollers are responsible for the production of various components.

C)Close tolerance is possible for the components in the rolling.

d)high-speed production takes place in the rolling.

e) Highly efficient

f) High speed production take place to make rolling.

g) Fast and less time consuming in manufacturing process.

Question 4. Differentiate ferrous metals and non- ferrous metals and state two examples for each**. (4) marks**

Answer: Ferrous metals are metals that contain iron.

Ex: irons, carbon steel.

While

Nonferrous metals are the metal that are not contain iron.

Ex: aluminium, copper, magnesium, nickel, titanium.

Question 5. What is the principal aims of rolling operation ¬? (2marks)

Answer: is to reduce the thickness and increase the length of metals.

Question 6. Choose the letter corresponding to the right answer. Measuring instrument are **(2marks)**

a) Tape measure, Steel rule, Square, Protractor., Vernier caliper.

b) Tape measure, chisel, Square, Vernier caliper, Protractor.

c) Vernier caliper, Tape measure, Steel rule, Square, Scriber.

d) a, b and c are measuring instrument.

Answer: A

Question 7. Read the following statement and answer by True if the statement is correct or False if it is wrong:

Surface defects, such as scale and cracks, are common rolling defects. **(2marks)**

Answer: True.

Question 8. Match the stimuli of column A with their corresponding response in column B in the provided place for column of response using the letter corresponding to the correct answer**/(4marks)**

Column A	Column B
1. Primary function of a rolling mill in the rolling operation	a. Material Properties
2.Is crucial in determining the success of a rolling operation	b. Heat Treatment (Annealing)
3.Metalworking process that uses a rolling mill to reduce thickness and change shape	c. Rolling Mill
4.used to remove internal stresses and improve the material's ductility	d. Rolling
	e. Drawing

Answer

Answer	Column A	Column B
1….c	1. Primary function of a rolling mill in the rolling operation	a. Material Properties
2…a	2.Is crucial in determining the success of a rolling operation	b. Heat Treatment (Annealing)
3…d	3.Metalworking process that uses a rolling mill to reduce thickness and change shape	c. Rolling Mill
4..b	4.used to remove internal stresses and improve the material's ductility	d. Rolling
		e. Drawing

Practical assessment

DUFATANYE company located in Nyamasheke District needs to replace the damaged gutter which is fixed on their store house. The manager of the company wants to hire a technician to roll another gutter made in mild steel sheet metal with the following dimensions 1.5mm thick, the width of 18mm, front side of 18mm, length of 4m and the back side of 14mm respectively. Ask trainees to perform the following tasks to make that gutter in 4 hours:

a) Apply safety rules and regulations
b) Select materials, tools and equipment

all resources are available DUFATANYE store.

Checklist:

SN	Assessment criteria (Based on performance criteria)	Indicators	Score		Comments
			Yes	No	
1	1.1. Safety and security measures are effectively applied as per workplace policy	**Ind1**. PPE are worn			
		Ind2. Safety signs and hazards are applied			
		Ind3. safety precautions are applied			
	1.2. Equipment, tools and materials are properly selected according to the work to be done.	**Ind1.** Equipment is selected			
		Ind2. Tools are selected			
		Ind3. Materials are selected			
	1.3. Rolling operations are correctly conducted refer to the machine manual	**Ind1**. Working principles of rolling machine are observed			
		Ind2. Pre-operation maintenance of machine, tools and equipment are performed			
		Ind3. Finishing operations are well performed			
Total marks:					**……/9**
Passing line:					**70%**
Decision:					

Further information to the trainer

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Indicative contents
2.1 Interpretation of drawing
2.2 Setting rolling machine
2.3 Application of rolling operations
2.4 Checking rolled products

Key Competencies for Learning Outcome 2: Carry out Rolling Operation

Knowledge	Skills	Attitudes
• Description cutting list elements • Description of procedures for setting up rolling machine • Description of rolling operation application • Identification of criteria for checking rolled product	• Interpreting drawing • Setting up machine • Mounting work piece • Performing rolling operation • Checking the rolled product	• Being able to identify and troubleshoot issues related to rolling operations • Having a deep understanding of rolling principles and techniques • Committing to maintaining high standards of quality throughout the rolling process

Duration: 15 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly elements of cutting list used on Interpretation of drawing
2. Interpret correctly the drawing according to the work specifications
3. Set correctly rolling machine according to the distance between rollers to be used.
4. Set properly rolling machine according to Guides, meters and stops required
5. Set properly rolling machine according to the speed of roller required
6. Differentiate correctly rolling operations according to their application
7. Perform properly rolling operation according to the shape and application required.
8. Checking out clearly of rolled products on rolling operation

Resources

Equipment	Tools	Materials
• PPE • Fire extinguishers • First aid kit • Bench • Anvil • Shear machine • Cut-off machine • Bending machine • Material handling equipment	• Micrometre • Taper measure • Callipers • Ruler • Gauges • Shearing • Cut-off saws • Plasma cutter • Marking pens and pencils • Scribers • Stencils and templates	• Metals • Oil • Grease

• Rolling machine • Air compressor • Printer	• Wire brushes • Abrasive pad • Rulers • Files • Reamers • Hummers • Screwdriver • Pliers • Spanners • Wrench • Allen • Key cloths rugs • Wire brushes • Spray gun	

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Use personal protective equipment, safety signs and symbol.
- Avail rolling equipment and tools in good condition.
- Access materials.

Indicative content 2.1: Interpretation of Drawing

Duration: 2 hrs

Theoretical Activity 2.1.1: Description of cutting list elements

Notes to the trainer:

- Trainer may use small groups to identify cutting list elements such as serial number, material, specifications, unit and quantity.
- Use pictures or photo to provide more understanding about cutting list elements.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the session, engage trainees in groups forming and ask them to answer the following questions:

i. What do you understand "cutting list"?
ii. State elements of cutting list

Step2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 2.1.1. in trainee manual

Points to Remember

- While interpreting a drawing, take into consideration cutting list elements mainly material and specification.

Indicative content 2.2: Setting up Rolling Machine

Duration: 3 hrs

Theoretical Activity 2.2.1: Description of setting up rolling machines

Notes to the trainer:

- Trainer may use small groups to discuss on the setting the distance between rollers, guide, meter, stop and the speed of roller on rolling machines.
- Use some videos or pictures to explain more about setting the distance between rollers, guide, meter, stop and the speed of roller on rolling machines.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the session, engage trainees in group forming and ask them to answer the following questions:

i. What do you think about distance between rollers?
ii. Differentiate guide and meter.
iii. How the speed of rolling machine can be controlled?

Step2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 2.2.1. in trainee manual

Points to Remember

- While setting up a rolling machine you should consider the following steps: read the manual, choose the right rolling machine, select the proper dies and rollers, inspect the machine, prepare the material, adjust the machine settings, install the material, test run and adjust.

Practical Activity 2.2.2: Setting up rolling machine

Notes to the trainer

- Facilitation of this activity can be individually based; you are requested to go in rolling workshop to guide trainees how to set up rolling machine. For the effective delivery, it is recommended to:
- Avail rolling equipment in good condition
- Avail organized workshop

Key steps:

While delivering this activity, pass through the following steps:

Step 1. Introduce the topic and ask trainees to go in the rolling workshop to set rolling machine based on trainer's instructions.
Step 2. Explain the task and provide clear work instruction (Task, PPE, Time allocated)
Step 3. Demonstrate and explain step by step how to set rolling machine,
Step 4. Ask trainees to set up rolling machine
Step 5. Verify whether rolling machine is well set.
Step 6. Ask trainees to read key reading 2.2.2.
Step 7. Ask trainees to perform the task provided in application of learning 2.2

Points to Remember

- While setting up the speed of the roller of rolling machine, you must mainly read the manual, check the safety, do calibration, and make the final adjustments.

Application of learning 2.2.

Suppose that your trainees are tasked by one of the manufacturing workshops located in your district to make 20 cylindrical tanks within specification of 2m of diameter ,3m of length and 3mm of sheet metal thickness. Ask your trainees to perform the following tasks:

i. Set the distance between rollers

ii. Set guides, meters and stops
iii. Set the speed of rollers
iv. Check working of rolling machine

Checklist:

SN	Criteria	Indicators	Yes	No
1	Rolling machine is accurately set	PPE are worn		
		Distance between roller is set		
		Guides, meters and stops		
		The speed of roller		
		Rolling machine setting is checked		
	Total marks			**……/5**
	Passing line			**70%**

Indicative content 2.3: Application of Rolling Operation

Duration: 8 hrs

Practical Activity 2.3.1: Performing Rolling Operation

Notes to the trainer

- Facilitation of this activity can be individual based; you are requested to guide trainee how to perform rolling operation. For the effective delivery; it is recommended to:
- Avail safety symbols and signs related to metal cutting process.
- Avail rolling equipment in good condition.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to go in manufacturing workshop for performing rolling operations

Step 2: Explain the task and provide clear work instruction (Task, PPE, Time allocated)

Step 3: Demonstrate and explain procedures of rolling operations,

Step 4: Ask trainees to perform rolling operations.

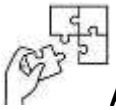
Step 5: Verify whether rolling operation are properly performed.

Step 6: Ask trainees to read key reading 2.3.1.

Step 7: Ask trainees to perform the task provided in application of learning 2.3

Points to Remember

- While performing rolling operation, you should consider required product specifications



Application of learning 2.3.

Organise a study visit to one of the manufacturing companies located in your surroundings. The company should be performing different rolling operations required for making rolling products. Ask your trainees to help the company perform the following rolling operations:

a) Thread rolling
b) Gear rolling
c) Shape rolling
d) Ring rolling
e) Tube piercing
f) Skew rolling
g) Transverse rolling
h) Roll bending process
i) Flat rolling
j) Controlled rolling

Checklist:

SN	Criteria	Indicators	Yes	No
1	Rolling machine is accurately set	PPE are worn		
		Thread rolling is performed		
		Gear rolling is performed		
		Shape rolling is performed		
		Ring Rolling is performed		
		Tube piercing is performed		
		Skew rolling is performed		
		Transverse rolling is performed		
		Roll bending process is performed		
		Flat rolling is performed		

		Controlled rolling is performed		
	Total marks			**……../11**
	Passing line			**70%**

Indicative content 2.4: Checking Rolled Products

Duration: 2 hrs

Practical Activity 2.4.1. Checking rolling products

Notes to the trainer

- Facilitation of this activity can be individual based; you are requested to guide trainee how to check rolling defect. For the effective delivery, it is recommended to:
- Avail rolling equipment in good condition.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to go in manufacturing workshop for checking rolling defects

Step 2: Explain the task and provide clear work instruction (Task, PPE, Time allocated)

Step 3: Demonstrate and explain how to check rolling defect

Step 4: Ask trainees to check rolling defect individually.

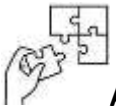
Step 5: Verify whether rolling defects are effectively checked.

Step 6: Ask trainees to read key reading 2.4.1.

Step 7: Ask trainees to perform the task provided in application of learning 2.4

Points to Remember

- While checking rolling defects, you should remember that all rolling defects must be corrected with its proper correcting methods.



Application of learning 2.4.

Suppose that your trainees are conducting an Industrial Attachment Program in one of the manufacturing workshops located in your district. The main tasks to do include checking rolled products after their production. Request your trainees to perform the following tasks:

i. Check rolling defects

ii. Check measurements**:**

Checklist:

SN	Criteria	Indicators	Yes	No
2	Surface defects in rolling are properly checked	PPE are worn		
		Rolling defects are checked		
		Measurements are checked		
	Total marks			**……../3**
	Passing line			**70%**

Learning outcome 2 end assessment

Theoretical assessment

Q1. Define the following terms

i. Part list
ii. Item description.
iii. Non-destructive rolled test

Answer

i. Part list: This is a tabulation of the items necessary for fabricating or assembling the end item(s) to which the list applies
ii. Item description Enter the noun or noun phrase describing the item whose part or identifying number appears on assembly drawing.
iii. Non-destructive rolled test is test carried out on specimen without damaging it for the evaluation of materials and rolls will be outlined here

Q2. Read the following statement and answer by True if it is right Answer by true or false

i. Visual inspection (VT) relies upon the detection of surface imperfections using the eye
ii. In rolling operation, the upper roller and lower roller always move in the same direction
iii. Non-destructive testing is a one method of testing rolled product
iv. During rolling operation, hands and feet are allowed to enter between roller and transmission parts.

Answer

i. True
ii. False
iii. True
iv. False

Q4. List the main elements of

i. Upper roller
ii. Supporting roller

Answer

i. The upper roller device is mainly composed of the main oil cylinder, bearings, and upper roll supporting roll, wedge mechanism and adjusting hand wheel
ii. The supporting roller device is composed of supporting roll, wedge mechanism and adjusting hand wheel

Q5. In work mounting for rolling operation. Explain what will happen when higher roller gap is too high.

Answer

once the roller gap is too tight machine will face several problems such as material marking, roller worn, and the final profile has wrinkle, twisting bow as well

Q6. Identify 6 steps of plate rolling process of 4-roll steel plate rolling machine

Answers

i. Metal sheet centering
ii. Pre-bending beginning-sheet
iii. Partially Rolled
iv. Continuous rolling
v. Pre-bending end-sheet
vi. Close the circle

Q7. Read the following questions and choose the correct answer by writing it .

a. What is the primary purpose of metal rolling?

i. To heat treat the metal
ii. To reduce thickness and make thickness uniform
iii. To weld pieces together
iv. To paint the metal surface

Answer: ii) To reduce thickness and make thickness uniform

b. Which type of rolling is typically performed at elevated temperatures?

i. Cold Rolling
ii. Thread Rolling
iii. Hot Rolling
iv. Shape Rolling

Answer: iii) Hot Rolling

c. What is the main function of the upper roller in the rolling machine?

i. To support the material
ii. To provide rotational force
iii. To be fixed while the lower roller moves
iv. To gauge the thickness

Answer: iii) To be fixed while the lower roller moves

d. In which rolling operation are threads formed on a workpiece?

i. Shape Rolling
ii. Gear Rolling
iii. Thread Rolling
iv. Controlled Rolling

Answer: iii) Thread Rolling

e. What is the purpose of pre-bending in the rolling process?

i. To start the cooling process
ii. To align the workpiece with the rollers
iii. To ensure the rolled piece has a proper contour
iv. To increase the thickness of the material

Answer: iii) To ensure the rolled piece has a proper contour

f. Which rolling process is used to produce seamless tubes?

i. Flat Rolling
ii. Ring Rolling
iii. Tube Piercing
iv. Skew Rolling

Answer: iii) Tube Piercing

g. What safety precautions should be taken during the rolling operation?

i. Only one person can operate the machine
ii. Hands should be placed on rolled steel plates
iii. The rolling machine can be operated without supervision
iv. The area should be cluttered for easy access

Answer: i. Only one person can operate the machine

h. What happens if the roller gap is set too tight?

i. It improves the final profile
ii. The material moves forward smoothly
iii. It may cause material marking and roller wear
iv. It ensures a precise result in thickness

Answer: iii) It may cause material marking and roller wear

Practical assessment

EDK manufacturing workshop Located in Nyabihu District won a tender of producing chimney made of alloyed steel metal of 2mm thick for Nyabihu TSS. The chimney should have cylinder of 18cm diameter and 3.5m height with cap cone shaped of 15 cm height and 22 cm radius. Assign trainees to perform rolling operation by:

i. Interpreting drawing,
ii. Setting rolling machine
iii. Execute rolling operation
iv. Checking rolled products both defect and measurement

Checklist:

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicators	Score		Comments
			Yes	No	
Learning outcome 2: Carry out rolling operation **(40%)**	2.1. Part list of rolling work is properly produced based on technical drawing	**Ind1.** Dimensions are respected			
		Ind2. Part list is observed			
		Ind3 Sketch is done			
	2.2. Rolling machine is accurately set according to the work to be done	**Ind1** Rollers are set			
		Ind2 The speed of roller is set			
	2.3. Work piece is properly fixed according to the size of dies and machine positions	**Ind1** Work piece is positioned			
		Ind2 Work piece is tightened			
	2.4. Work piece is properly rolled according to the shape required	**Ind1.** The conical shape is obtained			
		Ind2 The cylindrical shape is produced			
	2.5. Rolled product is properly checked according to the shape required.	**Ind1** Shape respected			
		Ind2 Dimensions respected.			
Total marks:					**……/11**
Passing line:					**70%**
Decision:					

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END

Indicative contents
3.1 Finishing the product
3.2 Routine maintenance of rolling machine
3.3 Site clearance
3.4 Reporting

Key Competencies for Learning Outcome 3: Perform Post-operation Activities

Knowledge	Skills	Attitudes
• Description of • finishing operations • Description of routine maintenance on rolling machine • Identification of methods of storage • Identification of types of wastes • Identification of methods of waste disposal • Identification of reporting methods	• Polishing edge of rolled products • Coating rolled products • Painting rolled products • Cleaning rolling machine • Lubricating rolling machine • Adjusting rolling machine • Disposing wastes • Reporting work done	• Being consistent and reliable in performing post-operations of rolling activities

Duration: 7 hrs

Learning outcome 3 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Identify correctly products to be finished in rolling operation
2. Identify clearly methods of finishing rolled products
3. Apply correctly methods of finishing rolled products
4. Identify effectively operations of preventive maintenance for rolling machine
5. Perform appropriately preventive maintenance operations of rolling machine
6. Identify effectively storing methods of materials, tools and equipment used on rolling machine
7. Manage properly storage of materials, tools and equipment for rolling
8. Identify correctly reporting methods on rolling operation
9. Report correctly the work on rolling

Resources

Equipment	Tools	Materials
• PPE • Fire extinguishers • First aid kit • Benches • Anvil • Shear machine • Cut-off machine • Material handling • Equipment	• Micrometre • Taper Measure • Callipers • Ruler • Gauges • Marking pens and pencils • Wire brushes • Abrasive pad • Solvents and degreasers	• Fire extinguishers • First aid kit • Benches • Anvil • Shear machine • Cut-off machine • Material handling • Bending machine • Rolling machine • Air compressor • Metal scrap yard

• Rending machine • Rolling machine • Air compressor • Metal scrap yard	• Screwdriver • Grease gun • Oil cans • Lubrication Pumps • Files • Reamers • Paint • Brush • Wire brushes • Bloom and • Spray gun.	

Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail personal protective equipment, safety signs and symbols
- Have rolling machine equipment and tools in good condition
- Avail finishing tools and equipment in good condition at work place
- Have waste disposal and storage place
- Avail Pens, pencils and paper for making report

Indicative content 3.1: Finishing the Product

Duration: 3 hrs

Practical Activity 3.1.1: Performing finishing operations

Notes to the trainer

- Facilitation of this activity can be individual based; you are requested to demonstrate trainees how to perform finishing operations on products rolled. For the effective delivery, it is recommended to:
- Avail finishing tools, materials and equipment in good condition.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to go in manufacturing workshop for finishing rolled product.

Step 2: Explain the task and provide clear work instruction (Task, PPE, Time allocated)

Step 3: Demonstrate and explain how to perform finishing operations on rolled products

Step 4: Ask trainees to perform finishing operation on rolled products.

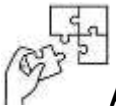
Step 5: Verify whether finishing operation are correctly performed.

Step 6: Ask trainees to read key reading 3.1.1.

Step 7: Ask trainees to perform the task provided in application of learning 3.1.

Points to Remember

- While performing finishing operations, you should remember that after coating a product it must be stored in good conditions.



Application of learning 3.1.

Suppose that there is a manufacturing workshop located in your district that wants to perform finishing on their rolled products. Invite your trainees to perform the following tasks:

a) Edge polishing of the rolled products
b) Coating the products
c) Painting products

Checklist:

SN	Criteria	Indicators	Yes	No
2	The rolled product is correctly finished	PPE are worn		
		Edges are polished		
		Products are coated		
		Painting is done		
	Total marks			**……/4**
	Passing line			**70%**

Indicative content 3.2: Routine Maintenance of Rolling Machine

Duration: 2 hrs

Theoretical Activity 3.2.1: Describing routine maintenance of a rolling machine

Notes to the trainer:

- Trainer may engage trainees in groups to discuss about routine maintenance conducted on rolling machine like cleaning, lubrication and adjustment as well as objectives of routine maintenance.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the session, engage trainees in group forming and ask them to answer the following questions

i. What do you understand about routine maintenance?
ii. Differentiate cleaning, lubrication and adjustment as techniques of routine maintenance?
iii. What do you think should be the objectives of routine maintenance for rolling machine?

Step 2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 3.2.1 in the trainee manual

Points to Remember

- While describing types of routine maintenance of the rolled products, you should consider cleaning, lubrication and adjustment.

Practical Activity 3.2.2: Performing routine maintenance on rolling machine

Notes to the trainer

- Facilitation of this activity can be individual based; you are requested to demonstrate trainees how to perform routine maintenance on rolling equipment. For the effective delivery, it is recommended to:
- Avail required tools, materials and equipment in good condition.

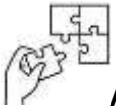
Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to go in manufacturing workshop for performing routine maintenance on rolling equipment.
Step 2: Explain the task and provide clear work instruction (Task, PPE, Time allocated)
Step 3: Demonstrate and explain how to Clean, lubricate, adjusting rolling equipment.
Step 4: Ask trainees to perform finishing operation on rolled products.
Step 5: Verify whether rolling equipment are correctly cleaned, lubricated and adjusted are correctly performed.
Step 6: Ask trainees to read key reading 3.2.1.
Step 7: Ask trainees to perform the task provided in application of learning 3.2.

Points to Remember

- While performing routine maintenance, you must remember that equipment should be turned off



Application of learning 3.2.

Suppose that your trainees are conducting an Industrial Attachment Program in one of the manufacturing workshops located in your district. Their tasks include performing routine maintenance of rolling machines. Visit them and check how they are performing the following tasks:

i. Cleaning of rolling equipment
ii. Lubricating rolling equipment
iii. Adjusting rolling equipment

Checklist

SN	Criteria	Indicators	Yes	No
2	Rolled Product is correctly finished	PPE are worn		
		Rolling equipment are cleaned		
		Rolling equipment are lubricated		
		Adjustment are is doned		
	Total marks			**…/ 4**
	Passing line			**70%**

Indicative content 3.3: Site Clearance

Duration: 1hr

Theoretical Activity 3.3.1: Description of site clearance

Notes to the trainer:

- Trainer may engage trainees in group to discuss about site clearance machine.
- Avail videos or pictures illustrating a site clearance machine.

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the session, engage trainees in group forming and ask them to answer the following questions

i. What do you understand about site clearance and waste?
ii. How can you store tools, equipment and product?
iii. How can you dispose waste after carrying out rolling works?

Step 2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 3.3.1 in the trainee manual

Points to Remember

- While cleaning the rolling site, you should consider cleaning and storing techniques of tools and equipment.

Practical Activity 3.3.2: Cleaning site

Notes to the trainer

- Facilitation of this activity can be individual based; you are requested to guide trainees how to store and dispose waste site after work. For the effective delivery; it is recommended to:
- Avail required tools and equipment to be stored.
- Avail waste to be disposed

Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the topic and ask trainees to go in manufacturing workshop for guiding trainees how to store tools and equipment after work and disposal waste with respect to trainer's instructions.

Step 2: Explain the task and provide clear work instruction (Task, PPE, Time allocated)

Step 3: Guide trainees how to store tools and equipment after work and dispose waste

Step 4: Verify whether tools and equipment are properly stored and waste are correctly disposed.

Step 5: Ask trainees to read key reading 3.3.2

Step 6: Ask trainees to perform the task provided in application of learning 3.3

Points to Remember

- For best practices, remember to dispose rolling wastes in appropriate ways. This will make the working place more conducive.

Application of learning 3.3.

Suppose XN manufacturing workshop located in your home district has finished to produce 20 mild steel chimneys.

Referring to the activity 3.3.1 and 3.3.2. Ask your trainees to perform the following tasks:

i. Clean tools and equipment
ii. Store tools and equipment
iii. Dispose wastes

Checklist:

SN	Criteria	Indicators	Yes	No
1	Rolled Products are correctly cleaned and stored.	Rolling tools are cleaned		
		Rolling equipment are cleaned		
		Rolling tools are stored		
		Rolling equipment are stored		
		Waste are separated		
		Waste are disposed		
	Total marks			**5**
	Passing line			**70%**

Indicative content 3.4: Reporting

Duration: 1 hr

Theoretical Activity 3.4.1: Description of reporting

Notes to the trainer:

- Trainer must use small groups to discuss on technical report by defining technical report, describing types of report, parts of report, ways of reporting and format/template of report.
- Use pictures or videos and didactic material to provide more understanding about reporting.

Key steps:

While delivering this activity, pass through the following steps:

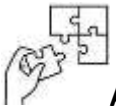
Step 1: Introduce the session, engage trainees in group forming and ask them to answer the following questions:

i. What do you understand reporting?
ii. Differentiate form of report?

Step 2: Ask trainees to write their findings on paper, flipchart, blackboard or whiteboard.
Step 3: Engage trainees in presentation of their findings.
Step 4: Provide an expert view on presentations of the groups.
Step 5: Address any questions or concerns from the trainees
Step 6: Ask trainees to read the key readings 3.4.1 in the trainee manual

Points to Remember

- While reporting the work done, remember to select use the appropriate template.



Application of learning 3.4.

Suppose XN manufacturing workshop have produced 200 mild steel chimneys for newly opened Technical Secondary Schools. Chef of technician at of XN manufacturing workshop need a technician for preparing report of the work done. Ask your trainees to perform the following tasks:

i. Prepare the report template
ii. Identify form of reporting to be used
iii. Fill in the report template.

Checklist:

SN	Criteria	Indicators	Yes	No
1	Performed work is correctly reported as per reporting templates	Report template is prepared		
		Report template is filled		
		Form of reporting is identified		
	Total marks			**……../3**
	Passing line			**70%**

Learning outcome 3 end assessment

Theoretical assessment

Q1. Read the following statement and choose the right by writing it.

a. What is the primary goal of proper waste disposal

i. To generate profit from waste
ii. To minimize environmental impact and protect public health
iii. To increase landfill space
iv. To create more waste products

Answer: ii) To minimize environmental impact and protect public healt

b. Which of the following is NOT a method of waste disposal mentioned in the text?

i. Landfilling
ii. Incineration
iii. E-waste dumping
iv. Composting

Answer: iii) E-waste dumping

c. What is the first step recommended for effective waste disposal?

i. Engage waste management companies
ii. Conduct a final site inspection
iii. Segregate and categorize waste
iv. Identify hazardous materials

Answer: iii) Segregate and categorize waste

d. Why is it important to identify hazardous waste separately?

i. It is more valuable than other waste types
ii. It requires different disposal guidelines and regulations to prevent contamination
iii. It reduces the overall volume of waste
It can be mixed with other recyclables

Answer: ii) It requires different disposal guidelines and regulations to prevent contamination

e. What should be documented during waste disposal activities?

i. The location of disposal sites only
ii. The type and quantity of waste removed and disposal methods used
iii. The cost of garbage bags
iv. The personal information of workers involved

Answer: ii) The type and quantity of waste removed and disposal methods used

Q2. Read the following statement and answer by True if the statement is right and False if it is wrong

a. Routine maintenance is performed only when equipment has already failed to identify problems.

Answer: False.

b. Cleaning is an essential type of routine maintenance that should be performed after every use of a machine.

Answer: True.

c. It is not necessary to inspect and clean hydraulic systems monthly as long as they are cleaned at the start of the operation.

Answer: False.

d. Using abrasive cleaners is recommended for cleaning metal surfaces to ensure they are free of grime and dirt.

Answer: False.

e. Routine lubrication is essential to minimize wear and tear on machinery and ensure efficient operation.

Answer: True.

f. Over-lubrication is generally harmless and will not affect machinery performance.

Answer: False.

g. True or False: Adjustments during routine maintenance should only be made if equipment is not functioning as expected.

Answer: False.

h. Finishing exclusively refers to polishing the surface of metallic parts.

Answer: False

i. choice of metal coating technique cannot differ based on the specific requirements of the application.

Answer: False

k. Edge polishing operations can either be polished wet or dry, and wet polishing results in a smoother finish.

Answer: True

l. Electroplating involves applying a layer of zinc to steel or iron for corrosion protection.

Answer: False

m. Anodizing can provide anodized aluminum with enhanced corrosion resistance and color options.

Answer: True

n. Painting rolled metal requires no specific preparation to ensure a good finish.

Answer: False

m. Physical Vapor Deposition (PVD) is a method that operates in a vacuum to deposit thin films of material onto a substrate.

Answer: True

p. The use of protective clear coats over paint can enhance durability against environmental factors.

Answer: True

Q3. Why is it important to define the purpose of a report before writing it?

Answer: Defining the purpose of a report is crucial because it sets the direction for the content. Knowing the purpose helps in determining what information to include, the level of detail, and how to structure the report to meet the needs of the audience.

Q4. What role does the audience play in report writing?

Answer: The audience is a key consideration in report writing. Understanding the audience helps in tailoring the language, tone, and level of detail to ensure that the report is relevant, accessible, and effectively communicates the intended message.

Practical assessment

Suppose XN manufacturing workshop have produced 200 mild steel chimneys for newly opened Technical Secondary Schools. Chief of technician in XN manufacturing workshop need a technician for performing post operation activities. Ask learners to perform the following tasks:

i. Finishing the product
ii. Routine maintenance of rolling machine
iii. Cleaning site
iv. Reporting the work done

Checklist:

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicators	Observation		Comments
			Yes	No	
Learning Outcome 3: Perform post operation activities	3.1. Rolled Product is correctly finished according to the finishing operations and storage conditions	**Ind1.** Defects are corrected			
		Ind2. Edge debarring is done			
	3.2. Rolling machine is properly maintained according to the maintenance manual	**Ind1.** Rolling machine is cleaned			
		Ind2. Rolling machine is lubricated			
		Ind3. Loose parts of rolling machine are tightened			
	3.3. Performed work is correctly reported as per reporting templates	**Ind1.** The workplace is cleaned			
		Ind2. The tools and equipment used are cleaned			
		Ind3. The tools and equipment used are stored			
		Ind4. The reporting templates is established			
Total marks:					……/9
Minimum Passing line % (Aggregate): 70%					
Decision:					

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END

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