



RQF LEVEL 4



MATSA401
**MANUFACTURING
TECHNOLOGY**

**SMAW on
Aluminium,
Stainless Steel
and Cast Iron**

TRAINER'S MANUAL

October, 2024



SMAW ON ALUMINIUM, STAINLESS STEEL AND CAST IRON



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ACRONYMS

CBT/A: Competency-Based Training and Assessment

MIG: Metal Inert Gas

PPE: Personal Protective Equipment

RTB: Rwanda TVET Board

SMAW: Shielded Metal Arc Welding

TIG: Tungsten Inert Gas

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 " **SMAW on Aluminium, Stainless Steel and Cast Iron** ". 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: MATSA401 SMAW ON ALUMINIUM, STAINLESS STEEL AND CAST IRON

Learning Outcome 1: Prepare the workplace for SMAW on aluminium, stainless and cast-iron

Learning Outcome 2: Weld the workpiece

Learning Outcome 3: Carry out finishing activities

Learning Outcome 1: Prepare the Workplace for SMAW on Aluminium, Stainless and Cast Iron



Indicative contents

1.1 Introduction to SMAW on Aluminium, Stainless steel and Cast iron

1.2 Organizing Workplace

1.3 Selecting materials

1.4 Selecting tools

1.5 Selecting SMAW equipment

1.6 Applying safety measures

Key Competencies for Learning Outcome 1: Prepare the Workplace for SMAW on Aluminium, Stainless and Cast Iron

Knowledge	Skills	Attitudes
• Explanation of key terms use in SMAW on Aluminium, Stainless steel and Cast iron • Classification of metals • Description of SMAW • Description of workplace organization • Description of selection criteria of materials, tools and equipment's used in SMAW on Aluminium, Stainless steel and Cast iron • explanation of Safety measures, signs and symbols	• Applying 5S in SMAW workplace • Selecting materials, tools, equipment and accessories for SMAW on Aluminium, Stainless steel and Cast iron • Applying Safety measures in SMAW on Aluminium, Stainless steel and Cast iron	• Being task oriented while applying 5S at workplace • Being carefully while handling heavy machine • Being attentive while selecting materials, tools and equipment



Duration: 20 hrs

1. Explain clearly the key terms used in SMAW on Aluminium, Stainless steel and Cast iron
2. Classify correctly metals used in SMAW on Aluminium, Stainless steel and Cast iron
3. Describe clearly the mode of operation of SMAW on Aluminium, Stainless steel and Cast iron.
4. Identify clearly area of application of SMAW on Aluminium, Stainless steel and Cast Iron Identify clearly importance of organizing workplace in SMAW process
5. Identify clearly the advantages and disadvantages of SMAW on Aluminium, Stainless steel and Cast iron
6. Organize properly workplace as required in SMAW on Aluminium, Stainless steel and Cast iron
7. Identify properly materials, tools and equipment used in SMAW on Aluminium, Stainless steel and Cast iron
8. Select correctly materials, tools and equipment's required in SMAW on Aluminium, Stainless steel and Cast iron
9. Describe properly the types of hazards in SMAW on Aluminium, Stainless steel and Cast iron
10. Apply effectively safety measures required in SMAW on Aluminium, Stainless steel and Cast iron



Resources

Equipment	Tools	Materials
• Air compressor • Blower • extinguisher • AC/DC welding machine • AC welding machine • DC welding machine • Welding generator • Work bench • Fume extractor • Electrode dryer/oven • Extension cable	• Sign Board • Walkway • Tape Measure • Try Square • Vernier • Calliper • Steel Scriber • Steel Punch • Hacksaw • Chisel • Angle Grinder • Plier • Screw Driver • Phase Tester	• Mop • Sponges • Cloths • Buckets • Glass Polishing Cloths • Dustpans • Protective Gloves • Brushes • Brooms • Water • Soap • Sand • Saw Dust



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail materials, tools and equipment required in SMAW on aluminium, stainless and cast iron.
- Avail of video and/or photo showing preparation of workplace for SMAW on aluminium, stainless steel and cast iron.
- Have workshop to be organized.



Indicative content 1.1: Introduction to SMAW on Aluminium, Stainless steel and Cast iron



Duration: 3hrs



Theoretical Activity 1.1.1: Description of SMAW on Aluminium, Stainless steel and cast iron



Notes to the trainer:

- While describing this content, small groups may be used to describe SMAW on Aluminium, stainless and cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- What do you understand by the following key terms used in SMAW on Aluminium, Stainless steel and Cast iron:
 - Arc welding
 - SMAW
 - MMAW
 - Flux
 - Polarity
- What could be the metal classifications in SMAW on Aluminium, Stainless steel and Cast iron
- What do you understand by the mode of operation of SMAW on Aluminium, Stainless steel and Cast iron
- What should be the applications of SMAW on Aluminium, Stainless steel and Cast iron?
- According to you, what should be the advantages and disadvantages of SMAW on Aluminium, Stainless steel and Cast iron?

Step 2: Ask trainees to write answers provided on flipchart/papers.

Step 3: Facilitate trainees to present their findings.

Step 4: Provide expert view and clarifies ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 1.1.1. in trainee manual and address any questions or concerns.



Points to Remember

- Machine polarities can be changed according to the characteristic of weld required (penetration and deposition rate)
- Nonferrous metal has good properties compared to the ferrous metal but are more expensive



Application of learning 1.1.

In your school manufacturing workshop there are welding activities of assembling aluminium doors, stainless steel water tank and cast-iron stove by using SMAW. Ask trainees to visit the workshop and elaborate a report after observing the welding process on.

- i. Metal classification
- ii. Mode of operation of SMAW process on aluminium, stainless steel and cast iron
- iii. Areas of applications of SMAW process on aluminium, stainless steel and cast iron
- iv. SMAW advantages and disadvantages of SMAW on aluminium, stainless steel and cast iron

Checklist

SN	Criteria	Indicators	Yes	No
1	1. SMAW on aluminium, cast iron and stainless steel is properly described	Ind1. Metals are identified		
		Ind2. Advantages and disadvantages of SMAW are identified		
		Ind3. Areas of applications of SMAW are identified		
		Ind4. Mode of operation of SMAW are identified		
	Total marks:			/4
	Passing line			70%



Indicative content 1.2: Organizing Workplace



Duration: 1 hr



Theoretical Activity 1.2.1: Description of workplace organization



Notes to the trainer:

- While delivering this content, small groups can be used to describe workplace organization in SMAW on Aluminium, stainless and cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- i. What could be the importance of organizing workplace in SMAW process?
 - ii. Explain the job hazard in SMAW process on aluminium, cast-iron and stainless steel?
 - iii. What do you understand by the 5S principle in workplace organization?
- Step 2:** Ask trainees to write provided answers on flipcharts/papers.
- Step 3:** Ask trainees to present their findings.
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 1.2.1. in trainee manual and address any questions or concerns.



Points to Remember

- Use checklists or flowcharts to map out each task and its associated risks.
- Application of 5S effectively increases the productivity and safe conditions in workplace



Practical Activity 1.2.2: Applying 5S in workplace organization



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to apply 5S, as required for SMAW on aluminium, stainless steel and cast iron. Remember you must ask them to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail tools, materials and equipment at workplace to be used in workplace organization for SMAW on aluminium, stainless steel and cast iron.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the task described below:

Suppose that you are going to fabricate aluminium windows by applying SMAW, as a welder you are requested to go in manufacturing workshop and organize it by applying 5S as required for SMAW on aluminium, stainless steel and cast iron.

Step 2: Explain the task and provide clear work instruction.

Step 3: Demonstrate how to apply 5S in SMAW on aluminium, stainless steel and cast iron

Step 4: Ask trainees to apply 5S in workplace preparation as required in SMAW on aluminium, stainless steel and cast iron and monitor application procedures.

Step 5: Verify whether 5S required in SMAW on aluminium, stainless steel and cast iron are correctly applied and provide support where necessary.

Step 6: Ask trainees to read key reading 1.2.2.

Step 7: Ask trainees to perform the task provided in application of learning 1.2



Points to Remember

- Employees can concentrate better on their tasks when distractions and clutter are minimized, boosting productivity.
- Remember to categorise the waste when you are disposing it (metal to non-metal).
- Remember to wear PPEs before apply 5S in workplace organization.



Application of learning 1.2.

In your school manufacturing workshop, there are welding technician who are going to assemble cylindrical stainless-steel tank of 5 m³ by SMAW process. Ask trainees to:

- Sort materials, tools and equipment required for the work
- Set in order materials, tools and equipment required for the work
- Clean workplace

Checklist

SN	Criteria	Indicators	Yes	No
1	1. workplace are properly organized	Ind1. Materials, tools and equipment are sorted		
		Ind2. Materials, tools and equipment are set in order		
		Ind3. Workplace are shine/cleaned		
	Total marks:		/3	
	Passing line		70%	



Indicative content 1.3: Selecting Materials



Duration: 5hrs



Theoretical Activity 1.3.1: Explanation of cleaning materials used in SMAW on Aluminium, stainless steel and cast iron



Notes to the trainer:

While delivering this content, small groups can be used for describing cleaning materials used in SMAW on Aluminium, stainless steel and cast iron.

- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following question:

- What could be the cleaning materials required in SMAW on Aluminium, stainless steel and cast iron.

Step 2: Ask trainees to write provided answers on flipcharts/papers

Step 3: Ask trainees to present their findings.

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 1.3.1. in trainee manual and address any questions or concerns.



Points to Remember

- Remember to clean metal for removing dust, oil or paint before welding to ensure proper weld formation and prevention of defects.



Practical Activity 1.3.2: Selecting cleaning materials



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to select cleaning materials used for SMAW on Aluminium, stainless steel and cast iron.
- Remember to ask trainees to perform this activity and facilitate them individually.

You are recommended to:

- ✓ Avail materials, tools, and equipment required for selecting cleaning materials in SMAW on Aluminium, stainless steel and cast iron.
- ✓ Have a well-organized workplace.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
Suppose you are going to weld cast iron cooking stove, as a manufacture you are requested to go to the manufacturing workshop and select cleaning material to be used in SMAW on Aluminium, stainless steel and cast iron.
- Step 2:** Explain the task and provide clear work instruction.
- Step 3:** Demonstrate how to select cleaning materials used in SMAW on Aluminium, stainless steel and cast iron.
- Step 4:** Ask trainees to select cleaning materials used in SMAW on Aluminium, stainless steel and cast iron and monitor selection procedures.
- Step 5:** Verify whether cleaning materials used in SMAW on Aluminium, stainless steel and cast iron are correctly selected and provide support where necessary.
- Step 6:** Ask trainees to read key reading 1.3.2.
- Step 7:** Ask trainees to perform the task provided in application of learning 1.3.



Points to Remember

- Don't use mild steel wire brush to clean aluminum and stainless steel because it can cause the rust spots on stainless steel or aluminum, compromising corrosion resistance and the material clean appearance



Theoretical Activity 1.3.3: Description of aluminium selection criteria



Notes to the trainer:

- While delivering this content, small groups can be used for Identifying of selection criteria of Aluminium.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following question:

- i. What could be the types of aluminium?
- ii. What could be the properties of aluminium?
- iii. What could be the common forms of aluminium
- iv. What could be the applications area of aluminium?

Step 2: Ask trainees to write provided answers on flipcharts/papers

Step 3: Ask trainees to present their findings.

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 1.3.3. in trainee manual and address any questions or concerns.



Points to Remember

- While selecting aluminium ensure that it has better properties compare to mild steel like corrosion resistance and lightweight, but it is more costly than mild steel.



Theoretical Activity 1.3.4: Description of Stainless-steel selection criteria



Notes to the trainer:

- While delivering this contents, small groups can be used to identify selection criteria of Stainless steel.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following question:

- i. What should be the types of stainless steel
- ii. What should be the properties of stainless steel
- iii. What could be the Shapes and sizes of stainless steel
- iv. Where do you think are the stainless-steel applications?

Step 2: Ask trainees to write provided answers on flipcharts/papers

Step 3: Ask trainees to present their findings.

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 1.3.4. in trainee manual and address any questions or concerns



Points to Remember

- While selecting stainless steel materials consider their types according to their specific application.



Theoretical Activity 1.3.5: Description of cast iron selection criteria



Notes to the trainer:

- While delivering this contents, small groups can be used to describe the selection criteria of Cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following question:

- i. What could be the types of cast iron
- ii. what could be the properties of cast iron
- iii. explain the Shapes and sizes of cast iron
- iv. What should be the area of applications of cast iron

Step 2: Ask trainees to write provided answers on flipcharts/papers

Step 3: Ask trainees to present their findings.

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 1.3.5. in trainee manual and address any questions or concerns.



Points to Remember

- While selecting cast iron remember that it has less ductility compare to aluminium and stainless steel but cast iron are harder than aluminium and stainless steel.



Theoretical Activity 1.3.6: Description of finishing materials used in SMAW on aluminium, stainless steel and cast iron.



Notes to the trainer:

- Trainer may use small groups for identifying finishing materials required in SMAW on Aluminium, stainless and cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
- i. What could be finishing materials used in SMAW on aluminium, cast-iron and stainless steel.
- Step 2:** Ask trainees to write provided answers on flipcharts/papers
- Step 3:** Ask trainees to present their findings.
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 1.3.6. in trainee manual and address any questions or concerns.



Points to Remember

- For specialized coatings, liquid paraffin can be used to adjust the viscosity of various coating materials.
- Before applying any finishing material (powder coating, painting, or varnishing), ensure the surfaces are properly cleaned, degreased, and free from oxidation.



Practical Activity 1.3.7: Selecting materials required in SMAW on Aluminium, Stainless and Cast iron.



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to select materials required in SMAW on Aluminium, Stainless and Cast iron. Remember to ask trainees to perform this activity and facilitate them individually. You are recommended to:
 - ✓ Avail of tools, materials and equipment required for selecting materials in SMAW on Aluminium, Stainless and Cast iron.
 - ✓ Have a well-organized workplace.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
You are requested to go to the workshop and select aluminium materials required for fabricating a window of 100*120 cm and stainless-steel materials required for fabricating a dining table of 70cm width,120cm length and 100cm height by using SMAW process.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to select materials used in SMAW on Aluminium, Stainless steel and Cast iron and explain selection criteria.
- Step 4:** Ask trainees to select materials used in SMAW on Aluminium, Stainless and Cast iron and monitor selection procedures.
- Step 5:** Verify whether materials used in SMAW on Aluminium, Stainless and Cast iron are correctly selected and provide support where necessary.
- Step 6:** Ask trainees to read key reading 1.3.7.
- Step 7:** Ask trainees to perform the task provided in application of learning 1.3.2



Points to Remember

- While selecting aluminium ensure that it has better properties compare to mild steel like corrosion resistance and lightweight, but it is costlier than mild steel.
- Remember cast iron is limited to humidity, aluminium and stainless steel can be used instead of using cast iron.
- Aluminium and stainless steel are recommended to kitchen and medical materials due to their high corrosion resistance.



Application of learning 1.3

In you school manufacturing workshop, there are materials for fabricating aluminium doors, stainless steel water tank and cast-iron stove. Ask trainees to:

- Select aluminium material required for fabricating the doors
- Select stainless steel material required for fabricating water tank
- Select cast-iron material for fabricating a stove

Checklist

SN	Criteria	Indicators	Yes	No
1	1. Materials are properly selected	Ind1. Aluminium materials are selected		
		Ind2. Stainless steel materials are selected		
		Ind3. Cast-iron materials are selected		
	Total marks:		/3	
	Passing line		70%	



Indicative content 1.4: Selecting Tools



Duration: 5hrs



Practical Activity 1.4.1: Selecting tools used in SMAW on Aluminium, Stainless steel and Cast iron



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to select tools required in SMAW on Aluminium, Stainless and Cast iron. Remember to ask trainees to perform this activity and facilitate them individually. You are recommended to:
 - ✓ Avail tools, materials and equipment required for selecting tools in SMAW on Aluminium, Stainless and Cast iron.
 - ✓ Have a well-organized workplace



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
You are requested to go to the workshop and select tools required for fabricating an aluminium window of 100*120 cm, stainless-steel dining table of 70cm width, 120cm length and 100cm height and cast-iron stove by using SMAW process.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to select tools used in SMAW on Aluminium, Stainless steel and Cast iron and explain selection criteria.
- Step 4:** Ask trainees to select tools used in SMAW on Aluminium, Stainless and Cast iron and monitor selection procedures.
- Step 5:** Verify whether tools used in SMAW on Aluminium, Stainless and Cast iron are correctly selected and provide support where necessary.
- Step 6:** Ask trainees to read key reading 1.4.1.
- Step 7:** Ask trainees to perform the task provided in application of learning 1.4.



Points to Remember

- Ensure that during selecting tools, consider their applications and task to be done
- Each tool has their specific application, do not use tool differ to its indented use.



Application of learning 1.4.

In you school manufacturing workshop, there are a collection of SMAW tools to be used for fabricating aluminium doors, stainless steel water tank and cast-iron stove. Ask trainees to:

- Select cleaning tools
- Select handling tools
- Select measuring tools
- Select marking tools
- Select cutting tools
- Select miscellaneous/common tools

Checklist

SN	Assessed Criteria	Indicators	Yes	No
1	1. tools are properly selected	Ind1. safety tools are selected		
		Ind2. cleaning tools are selected		
		Ind3. handling tools are selected		
		Ind4. Measuring tools are selected		
		Ind5. Marking tools are selected		
		Ind6. Cutting tools are selected		
		Ind7. Miscellaneous/common tools are selected		
	Total marks:		/7	
	Passing line		70%	



Indicative content 1.5: Selecting SMAW Equipment



Duration: 5hrs



Theoretical Activity 1.5.1: Description of equipment and accessories used in SMAW on aluminium, Stainless steel and Cast iron



Notes to the trainer:

- While delivering this content, small groups can be used for describing equipment used in SMAW on Aluminium, Stainless steel and cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following question:
- What types of safety equipment are used in SMAW on aluminium, cast iron and stainless steel?
 - Why is safety equipment important in the workplace in SMAW on aluminium, cast iron and stainless steel?
 - What cleaning equipment is typically required for Shielded Metal Arc Welding (SMAW) on aluminium, cast iron and stainless steel?
 - Can you describe the handling equipment used in SMAW on aluminium, cast iron and stainless steel?
 - What could be SMAW equipment for welding aluminium, stainless steel, and cast iron?
 - What should be the accessories for SMAW when working with aluminium, stainless steel, and cast iron?
- Step 2:** Ask trainees to write provided answers on flipcharts/papers
- Step 3:** Ask trainees to present their findings.
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 1.5.1. in trainee manual and address any questions or concerns.



Points to Remember

- Aluminium welding requires high current it is better to use AC machine to achieve a strong weld.



Practical Activity 1.5.2: Selecting equipment for SMAW on Aluminium, stainless and cast iron



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to select equipment required in SMAW on Aluminium, Stainless and Cast iron. Remember to ask trainees to perform this activity and facilitate them individually. You are recommended to:
 - ✓ Avail of tools, materials and equipment required for selecting equipment in SMAW on Aluminium, Stainless and Cast iron.
 - ✓ Have a well-organized workplace.



Key steps:

While delivering this activity, pass through the following steps:

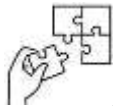
- Step 1:** Introduce the activity and ask trainees to do the task described below:
You are requested to go to the workshop and select equipment required for fabricating an aluminium window of 100*120 cm, stainless-steel dining table of 70cm width,120cm length and 100cm height and cast-iron stove by using SMAW process.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to select equipment to be used in SMAW on Aluminium, Stainless and Cast iron and explain selection criteria.
- Step 4:** Ask trainees to select equipment to be used in SMAW on Aluminium, Stainless and Cast iron and monitor selection procedures.

- Step 5:** Verify whether equipment to be used in SMAW on Aluminium, Stainless and Cast iron are correctly selected and provide support where necessary.
- Step 6:** Ask trainees to read key reading 1.5.2
- Step 7:** Ask trainees to perform the task provided in application of learning 1.5.



Points to Remember

- It is difficult to weld aluminium with SMAW rather than using other welding process like TIG or MAG.
- While lifting product with handling equipment, make sure the chain is tight and can support this product.



Application of learning 1.5.

In your school's manufacturing workshop, there are a collection of SMAW equipment to be used for welding aluminium, stainless steel and cast-iron. Ask trainees to:

- i. Select safety equipment for SMAW
- ii. Select cleaning equipment
- iii. Select handling equipment
- iv. Select SMAW equipment
- v. Select SMAW accessories

Checklist

SN	Assessed criteria	Indicators	Yes	No
1	1. Equipment are properly selected	Ind1. safety equipment are selected		
		Ind2. cleaning equipment are selected		
		Ind3. handling equipment are selected		
		Ind4. SMAW equipment are selected		
		Ind5. SMAW accessories are selected		
	Total marks:		/5	
	Passing line		70%	



Indicative content 1.6: Applying Safety Measures



Duration: 1hr



Theoretical Activity 1.6.1: Description of safety measures in SMAW on aluminium, stainless steel and cast iron



Notes to the trainer:

- While delivering this content, short questions can be used for describing the safety measures in SMAW on Aluminium, stainless and cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions
- i. What could be the PPE required in SMAW for Aluminium, stainless steel and cast iron?
 - ii. What do you understand by term hazard?
 - iii. What should be the types of hazard in SMAW for Aluminium, stainless steel and cast iron
 - iv. Explain the ways of controlling the hazards at workplace
- Step 2:** Ask trainees to write provided answers on flipcharts/papers
- Step 3:** Ask trainees to present their findings.
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 1.5.1. in trainee manual and address any questions or concerns.



Points to Remember

- Remember that safety is first, welding without safety can cause an injury or death to employees.
- Select fire extinguisher refer to the source of fire.



Practical Activity 1.6.2: Applying safety measures in SMAW on aluminium, stainless steel and cast iron



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to apply safety measures, required for SMAW on Aluminium, stainless steel and cast iron. Remember you must ask them to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail tools, materials and equipment required for apply safety measures in SMAW on Aluminium, stainless steel and cast iron.
 - ✓ Have a well-organized workplace.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the task described below:
You are requested to go to the manufacturing workshop and apply safety measures required for fabricating an aluminium window of 100*120 cm, stainless-steel dining table of 70cm width,120cm length and 100cm height and cast-iron stove by using SMAW process.

As welder you are requested to go to the workshop and perform the following task:

- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to apply safety measures in SMAW on Aluminium, stainless steel and cast iron and explain application criteria.
- Step 4:** Ask trainees to apply safety measures as required in SMAW on Aluminium, stainless steel and cast iron and monitor application procedures.
- Step 5:** Verify whether safety measures required in SMAW on Aluminium, stainless steel and cast iron are correctly applied and provide support where necessary.

Step 6: Ask trainees to read key reading 1.6.2.

Step 7: Ask trainees to perform the task provided in application of learning 1.6.



Points to Remember

- Applying Safety measures in workshop is essential for being safe and more productive
- When safety equipment used in improper way it can cause or increase hazards



Application of learning 1.6.

Suppose that you are assigned to apply safety measures required for welding aluminium doors, stainless steel water tank and cast-iron stove by using SMAW. Ask trainees to:

- Wear PPEs
- Install firefighting equipment in workshop
- Select first aid kits
- Allocate safety sign and symbols

Checklist

SN	Assessed criteria	Indicators	Yes	No
1	1. Safety measures are properly applied	Ind1. PPEs are worn		
		Ind2. Firefighting equipment are installed		
		Ind3. First aid kits are selected		
		Ind4. Safety signs and symbols are allocated		
	Total marks:		/4	
	Passing line		70%	



Learning outcome 1 end assessment

Written assessment

Q1. Read the following statement concern with key terms and equipment used in SMAW and answer by **TRUE** if it is correct or **FALSE** if it is incorrect.

- i. Arc welding is welding using the heat of an arc as a heat source.
- ii. SMAW It is a welding process that involves joining metals together by melting and fusing them using an electric arc between an electrode (also known as a welding rod) and the workpiece.
- iii. Polarity refers to the material that is used to shield the weld pool and electrode from atmospheric contamination
- iv. Flux refers to the direction of electrical current flow in the welding circuit
- v. a blower is an equipment provides air with pressure in order to clean equipment, tools and working place.
- vi. AC welding is often used for welding aluminium and magnesium alloys, while DC welding is suitable for a broader range of materials, including steel and stainless steel.
- vii. Tong is an accessory used to remove rust, paint and other contaminants from the surface of material.

Answer:

- i. **True**
- ii. **True**
- iii. **False**
- iv. **False**
- v. **True**
- vi. **True**
- vii. **False**

Q2. Read the following sentence and complete the blank space with (**Ferrous metal, Non-metal, Prohibition sign, Warning sign, Mandatory sign or Non-ferrous metal**)

- i. are those metal which cannot contain iron atom
- ii. are those metal which contain iron atom
- iii.is a sign that orders a specific action to help comply with statutory requirements involving a business or industry.
- iv. is a type of sign that indicates an instruction of unfriendly activity.

Answer:

- i. Non-ferrous metal
- ii. Ferrous metal
- iii. Mandatory
- iv. Prohibition

Q3. Table below shows advantages and disadvantages of SMAW. Use tick to show if it is advantages or disadvantages

No	advantages and disadvantages of SMAW	Advantages	Disadvantages
1.	SMAW can be used on a wide range of metals and alloys, making it a versatile welding process for various applications.		
2.	the electrode is consumed during the welding process, it must be replaced periodically.		
3.	SMAW is capable of providing deep penetration into the workpiece, allowing for strong and durable welds.		
4.	Achieving high-quality welds with SMAW requires a skilled and experienced operator.		
5.	The equipment for SMAW tends to be more affordable compared to some other welding processes, which can make it a cost-effective choice for certain applications.		

Answer:

No	advantages and disadvantages of SMAW	Advantages	Disadvantages
1.	SMAW can be used on a wide range of metals and alloys, making it a versatile welding process for various applications.	✓	
2.	the electrode is consumed during the welding process, it must be replaced periodically.		✓
3.	SMAW is capable of providing deep penetration into the workpiece, allowing for strong and durable welds.	✓	
4.	Achieving high-quality welds with SMAW requires a skilled and experienced operator.		✓
5.	The equipment for SMAW tends to be more affordable compared to some other welding processes, which can make it a cost-effective choice for certain applications.	✓	

Q4. Table below contain materials, tools and equipment used in **SMAW (column A)** and their categories (**column B**), match column **A** to column **B** and provide the answer in column **C**.

Answer C	Column A	Column B
1.....	1. Screwdriver	i) Finishing tool
2.....	2. AC welding machine	ii) Common /miscellaneous tool
3.....	3. Centre punch	iii) SMAW equipment
4.....	4. Thinner	iv) Marking tool
		v) Handling equipment

Answer:

Answer	Column A	Column B
1. =ii	1. Screwdriver	i) Finishing material
2. =iii	2. AC welding machine	ii) Common /miscellaneous tool
3. =iv	3. Centre punch	iii) SMAW equipment
4. =i	4. Thinner	iv) Marking tool
		v) Handling equipment

Q5. Read the following statement and re-write the letter corresponding to the correct answer

- i. Term 5S in workshop organization stand for:
 - a) Sort, Straighten/Set-in order, Shine, Standardize, Sustain
 - b) Sort, Straighten/Set-in order, Shy, Standardize, Sustain
 - c) Sort, Straighten/Set-in order, Shine, Standardize, Sky
- ii. The following are the types of aluminium except
 - a) Cast aluminium
 - b) Wrought aluminium
 - c) Impure aluminium
- iii. The following are not a property of stainless steel except
 - a) Low corrosion resistance
 - b) High strength
 - c) Brittleness
- iv. the following are the application of cast iron except
 - a) Aircraft frames and structural components
 - b) Agricultural machinery components
 - c) Automotive and railroad components
 - d) Brake discs, hubs, and other automotive components
- v. All those are area of application of SMAW except:
 - a) Fabricating components for heavy equipment used in mining, Manufacturing of industrial machinery, agriculture and construction.
 - b) Cutting ferrous and non-ferrous metal
 - c) Fabrication and repair of ship hulls, decks, and other components.
- vi. All those are not importance of organizing workplace except:
 - a) Maximization of Health Risks
 - b) Prevention of Injuries
 - c) Increases of Workplace Accidents

Answer:

- i. a
- ii. c
- iii. b
- iv. a
- v. b
- vi. b

Practical assessment

XWZ welding company is located at GAHANGA industrial zone, this company fabricating different products made in aluminium, stainless steel or cast iron, this company worn a job of fabricating staff table made in stainless steel, simple doors and windows made in aluminium of building house of bank, suppose you are a welder in this company, you are requested to:

- i. Apply safety measures required for making a door, table and window
- ii. Apply 5S required for making a door, table and window
- iii. Select materials, tools and equipment required for making a door, table and window

Checklist

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicators	Observations	
			Yes	No
1. Prepare the workplace	1. Safety measures are effectively applied	1. PPE are worn		
		2. Safety symbols and signs are respected		
		3. Hazards are controlled		
		4. Firefighting equipment is prepared		
	2. Workplace is properly organized	1. Materials, tools and equipment are sorted		
		2. Materials, tools and equipment are set in order		
		3. Workplace is ventilated		
		4. workplace is cleaned		
	3. Material, tools and equipment are properly selected	1. Aluminum materials are selected		
		2. Stainless steel materials are selected		

		3. Cast iron materials are selected		
		4. Safety tools are selected		
		5. Measuring tools are selected		
		6. Marking tool are selected		
		7. Cutting tool are selected		
		8. Safety equipment are selected		
		9. Cleaning equipment are selected		
		10. Handling equipment are selected		
		11. SMAW equipment are selected		
		12. SMAW accessory are selected		
Total score	/100			
Passing line	70%			



Further information to the trainer

American Welding Society. (2017). AWS Welding Handbook: Volume 1 - Welding Science and Technology (9th ed.).

Callister, W. D., & Rethwisch, D. G. (2018). Materials Science and Engineering: An Introduction (10th ed.). Wiley.

Cary, H. B., & Helzer, S. (2005). Modern Welding Technology (6th ed.).

Davis, J. R. (1994). ASM specialty handbook: Stainless steels. ASM International

Jeffus, L. (2020). Welding: Principles and Applications (9th ed.).

Miller, R. T., & Allen, H. E. (2014). Welding: Principles and applications (8th ed.). Cengage Learning.

Learning Outcome 2: Weld the Workpiece



Indicative contents

2.1 Preparing work piece

2.2 Applying cutting techniques

2.3 Applying SMAW process on welding aluminium

2.4 Applying SMAW techniques on welding Stainless steel

2.5 Applying SMAW techniques on welding Cast iron

2.6 Checking and correcting SMAW defects

Key Competencies for Learning Outcome 2: Weld the Workpiece

Knowledge	Skills	Attitudes
• Description of SMAW defects on aluminium, stainless steel and cast iron.	• Preparing work piece • Applying cutting techniques • Applying SMAW techniques on aluminium, stainless steel and cast iron • Checking SMAW weld defects • Applying testing techniques of SMAW weld defects • Correcting SMAW weld defects	• Being attentive while preparing workpiece • Have self-confidence while applying cutting techniques • Having ability to applying SMAW techniques • Being task oriented while checking and correcting SMAW defects



Duration: 60 hrs

Learning outcome 2 objectives:



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

1. Prepare properly the work piece required for SMAW welding process of aluminium, stainless steel and cast iron
2. Apply correctly the cutting techniques as required for SMAW welding process of aluminium, stainless steel and cast iron
3. Apply effectively SMAW welding techniques on aluminium, stainless steel and cast iron in SMAW process
4. Describe properly SMAW welding defects found in SMAW welding process of aluminium, stainless steel and cast iron
5. Check correctly the SMAW welding defects according to product requirement
6. Apply properly weld defects testing techniques as required in SMAW process
7. Correct properly SMAW weld defects according to product requirement



Resources

Equipment	Tools	Materials
• AC/DC welding machine • AC welding machine • DC welding machine	• Tape Measure • Vernier Calliper • Steel Try Square • Steel Scriber • Steel Punch • Hack Saw	• Stainless steel • Aluminium • Cast iron • Aluminium electrode • Cast iron electrode

• Welding generator • Work bench • Fume extractor • Electrode dryer/oven • Extension cable • Vice • Clamps • Anvil	• Angle Grinder • Plier • Screw Driver • Phase Tester • Chipping hammer	• Stainless steel electrode
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Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail materials, tools and equipment required for weld the workpiece in SMAW process on aluminium, stainless steel and cast iron.
- Have video/images illustrating SMAW process on aluminium, stainless steel and cast iron.
- Have a well-organized workshop.



Indicative content 2.1: Preparing WorkPiece



Duration: 5 hrs



Practical Activity 2.1.1: Preparing workpiece



Notes to the trainer

- Facilitation of this activity can be individual based, and should take place in workshop where you are supposed to demonstrate trainees how to prepare work piece required for SMAW welding process of aluminium, stainless steel and cast iron, for the effective delivery; it is recommended to:
 - ✓ Have materials, tools and equipment to be used in preparing workpiece.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
As a welder, you are requested to go to the manufacturing workshop to prepare work pieces required for fabricating aluminium table in SMAW welding of aluminium, stainless steel and cast iron by performing different operations based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to prepare work pieces through difference operations.
While demonstrating, explain the preparing procedures.
- Step 4:** Ask trainees to prepare work pieces through difference operations and monitor the procedures.
- Step 5:** Verify whether the work pieces are properly prepared and provide support.
- Step 6:** Ask trainees to read key reading 2.1.1.
- Step 7:** Ask trainees to perform the task provided in application of learning 2.1.



Points to Remember

- While preparing the workpiece ensure that correct tools and equipment are used for safety and quality of product.
- It is crucial to apply safety and security measures while preparing work pieces.



Application of learning 2.1.

Suppose there are materials in your schools' workshop need to be prepared for fabricating stainless steel table of 1*2*1.5m (height*length*width respectively). Ask trainees to:

- Clean work piece
- Measure the work piece
- Mark the work piece
- Clamp work piece

Checklist:

SN	Criteria	Indicators	Yes	No
1	1. Work pieces are properly prepared	Ind1. Work piece is cleaned		
		Ind2. Work piece is measured		
		Ind3. Work piece is marked		
		Ind4. Work piece is clamped		
	Total marks:		/4	
	Passing line		70%	



Indicative content 2.2: Applying Cutting Techniques



Duration : 7 hrs



Practical Activity 2.2.1: Applying cutting techniques



Notes to the trainer

- Facilitation of this activity can be individual based and should take place in workshop, where you are supposed to demonstrate trainees how to apply cutting technique in SMAW welding on aluminium, stainless steel and cast iron, for the effective delivery. You are recommended to:
 - ✓ Have materials, tools and equipment to be used in SMAW welding on aluminium, stainless steel and cast iron



Key steps:

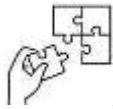
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below
As a welder, you are requested to go to the manufacturing workshop to apply cutting technique while preparing workpieces required make aluminum window frame.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to cut work pieces by applying different cutting techniques.
While demonstrating, explain the cutting procedures.
- Step 4:** Ask trainees to cut work pieces by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the work pieces are properly cut and provide support.
- Step 6:** Ask trainees to read key reading 2.2.1.
- Step 7:** Ask trainees to perform the task provided in application of learning 2.2.



Points to Remember

- While selecting cutting technique have to consider the material type and thickness for optimal results.
- Measure and mark materials accurately before cutting to achieve the desired results.
- Maintain consistent cutting speed to avoid overheating and blade damage.
- Choose snips that are suitable for the thickness and type of material being worked on.
- Regularly lubricate the shearing machine to ensure smooth operation and reduce wear on components.
- Lubricate the punch and die to extend their lifespan and prevent overheating.
- Ensure a steady hand and correct torch distance from the material to avoid uneven cuts or excessive dross formation.
- Ensure proper ventilation or dust extraction systems are in place to prevent inhalation of particles.



Application of learning 2.2.

Near our school there is a person who has selected a stainless-steel tubes material need to be cut 200 pieces of 50cm length. Ask trainees to:

- i. Identifying appropriate cutting methods
- ii. Setting up cutting equipment
- iii. Cut the workpieces

Checklist

SN	Criteria	Indicators	Yes	No
1	1. Work pieces are properly cut	Ind1. Cutting techniques are identified		
		Ind2. Cutting equipment are selected		
		Ind3. Work pieces are cut		
	Total marks:		 /3	
	Passing line		70%	



Indicative content 2.3: Applying SMAW Process on Welding Aluminium



Duration: 15 hrs



Practical Activity 2.3.1: Applying SMAW process on welding aluminium



Notes to the trainer

- Facilitation of this activity can be individual based, and should take place in workshop where you are supposed to demonstrate trainees how to apply SMAW technique on aluminium, for the effective delivery. You are recommended to:
 - ✓ Avail materials, tools and equipment to be used in SMAW welding on aluminium.



Key steps:

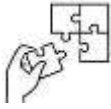
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
As a welder, you are requested to go to manufacturing workshop to fabricate aluminium kitchen rake based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to weld aluminium by applying different SMAW welding techniques. While demonstrating, explain the welding procedures.
- Step 4:** Ask trainees to weld aluminium by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the work pieces are properly cut and provide support.
- 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

- When applying the Shielded Metal Arc Welding (SMAW) process to weld aluminium, several important steps and precautions need to be followed to ensure a high-quality weld and maintain safety.



Application of learning 2.3.

Suppose in your school manufacturing workshop there are prepared workpieces for assembling aluminium window. Ask trainees to:

- Wear PPE required
- Clean aluminium piece
- Prepare aluminium joint
- Set welding machine for aluminium
- Join aluminium pieces

Checklist:

SN	Criteria	Indicators	Yes	No
1	1. Aluminium pieces are correctly welded	Ind1. PPE are used		
		Ind2. Aluminium work pieces are cleaned		
		Ind3. Joints are prepared		
		Ind4. Welding machine are set		
		Ind5. Aluminium work pieces are joined		
	Total marks:		/5	
	Passing line		70%	



Indicative content 2.4: Applying SMAW Techniques on Welding Stainless Steel



Duration: 15 hrs



Practical Activity 2.4.1: Applying SMAW techniques on welding Stainless steel



Notes to the trainer

- This activity should take place in workshop where you are supposed to demonstrate trainees how to apply SMAW technique on stainless steel. Remember to ask trainees to perform this activity and facilitate them individually. You are recommended to:
 - ✓ Avail materials, tools and equipment to be used in SMAW welding on stainless steel.
 - ✓ Have a well-organized workplace.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
As a welder, you are requested to go to manufacturing workshop to weld stainless steel tank based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to weld stainless steel by applying different SMAW welding techniques. While demonstrating, explain the welding procedures.
- Step 4:** Ask trainees to weld stainless steel by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the work pieces are properly cut and provide support.
- 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

- Achieving high-quality welds with controlled heat input and optimal performance.
- It is essential to identify the appropriate SMAW electrodes used specifically for welding stainless steel.



Application of learning 2.4.

Suppose that, the manager of our district hospital requests your school manager to maintain a broken stainless-steel tank and this activity will take place in your school manufacturing workshop. Ask your trainees to:

- Set welding machine
- Maintain the tank by Perform string bead weld

Checklist:

SN	Criteria	Indicators	Yes	No
	1.	Ind1. Current is set		
		Ind2. Polarity is set		
		Ind3. String bead weld is performed		
		Ind4. Weld is strong		
	Total marks:		/4	
	Passing line		70%	



Indicative content 2.5: Applying SMAW Techniques on Welding Cast Iron



Duration: 15 hrs



Practical Activity 2.5.1: Applying SMAW techniques on welding cast iron



Notes to the trainer

- Facilitation of this activity can be individual based, you are supposed to demonstrate trainees how to apply SMAW techniques on cast iron, for the effective delivery. You are recommended to:
 - ✓ Avail materials, tools and equipment to be used in SMAW welding on cast iron.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
As a welder, you are requested to go to the manufacturing workshop to weld cast iron stove by using different welding techniques based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to weld cast iron by applying different SMAW welding techniques. While demonstrating, explain the welding procedures.
- Step 4:** Ask trainees to weld cast iron by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the work pieces are properly cut and provide support where necessary
- Step 6:** Ask trainees to read key reading 2.5.1.
- Step 7:** Ask trainees to perform the task provided in application of learning 2.5.



Points to Remember

- After welding process, allow the weld to cool slowly to avoid cracking



Application of learning 2.5.

The garage located near your school wishes to maintain the broken engine housing made from cast iron of customer's car by using SMAW welding. Ask trainee to:

- Set SMAW welding machine
- Maintain broken engine housing Weld cast iron product

Checklist:

SN	Criteria	Indicators	Yes	No
1	1. Cast iron pieces are correctly welded	Ind1. SMAW welding machine is set		
		Ind2. Broken engine is maintained		
		Ind3. Weld is strong		
	Total marks:		/3	
	Passing line		70%	



Indicative content 2.6: Checking and Correcting SMAW Defects



Duration: 3 hrs



Theoretical Activity 2.6.1: Description of SMAW defects on aluminium, cast-iron and stainless steel



Notes to the trainer:

- During delivering this content, short questions can be used to describe SMAW defects in SMAW process of aluminium, stainless steel and cast iron.
- Use some videos or pictures and illustrations to describe SMAW defects in SMAW process of aluminium, stainless steel and cast iron.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following question.

- What do you think are the SMAW welding defects when you are welding aluminium, cast-iron and stainless steel?
- What do you understand by the following Testing techniques of SMAW welding defects:
 - Destructive
 - Non-destructive
- What could be the cause and remedies of SMAW welding defects on aluminium, stainless steel and cast-iron

Step 2: Ask any trainee to write answers provided on flipchart/papers.

Step 3: Facilitate trainees to present their findings.

Step 4: Provide expert view and clarifies ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 2.6.1. in trainee manual and address any questions or concerns.



Points to Remember

- Conduct visual inspections of SMAW welds to identify common defects such as cracks, porosity, and inconsistent bead appearance.



Practical Activity 2.6.2: Checking and correcting SMAW defects



Notes to the trainer

- This activity should take place in workshop where, you are supposed to demonstrate trainees how to check and correct SMAW defect as required for SMAW process on aluminium, stainless steel and cast iron. Remember you must ask them to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail materials, tools, and equipment required for checking and correcting SMAW defects in SMAW process on aluminium, stainless steel and cast iron
 - ✓ Avail of product to be checked
 - ✓ Have a well-organized workplace.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the topic and ask trainees to do the task described below:
As a welder, you are requested to go to the workshop to check and correct defects on the produced products.
- Step 2:** Explain the task and provide clear work instruction.
- Step 3:** Demonstrate how to check and correct SMAW defects in SMAW process on aluminium, stainless steel and cast iron and explain checking and correcting criteria.

Step 4: Ask trainees to check and correct SMAW defects as required for SMAW process on aluminium, stainless steel and cast iron and monitor checking and correcting procedures.

Step 5: Verify whether SMAW defects identified SMAW process on aluminium, stainless steel and cast iron are correctly checked and corrected and provide support where necessary.

Step 6: Ask trainees to read key reading 2.6.2.

Step 7: Ask trainees to perform the task provided in application of learning 2.6.



Points to Remember

- Ensure regular maintenance and calibration of welding and testing equipment to maintain accuracy and reliability.



Application of learning 2.6.

There are ten (10) welded stainless-steel tables for KBS schools, in your school workshop require checking and correcting defects before painting. Ask trainees to:

- i. Check SMAW weld defects
- ii. Correct SMAW weld defects

Checklist:

SN	Criteria	Indicators	Yes	No
1	2. SMAW defects are properly checked and corrected	Ind1. SMAW defects checking instrument is used		
		Ind2. SMAW weld defects is tested		
		Ind3. SMAW weld defects is corrected		
	Total marks:		/3	
	Passing line		70%	



Learning outcome 2 end assessment

Written assessment

Q1. Read and answer the following sentence by **TRUE** if the statement is correct or **FALSE** if the statement is not correct

- a) Cleaning is an essential step before welding to remove contaminants.
- b) Cleaning the workpiece is only necessary for stainless steel.
- c) Accurate measuring ensures proper fit and alignment of workpieces.
- d) Measuring is not necessary if the workpieces are already cut.
- e) Marking helps guide the cutting and welding processes by indicating precise locations.
- f) Marking is only useful for aesthetic purposes in welding.
- g) Proper personal protective equipment (PPE) is essential when welding aluminium.

Answer:

- a) true,
- b) false
- c) true
- d) false
- e) true
- f) false
- g) true

Q2. Read carefully the following sentence, then select the correct answer by re-writing the corresponding letter.

- i. Which marking tool is used to create a line that is perpendicular to a surface?
 - a) Divider
 - b) Try square
 - c) Steel ruler
 - d) Centre punch

Answer. B, Try square

- ii. What is the primary goal of polishing a workpiece?
- a) To clean the surface
 - b) To prepare the surface for welding
 - c) To improve the appearance and smoothness of the surface
 - d) To measure dimensions

Answer: C. To improve the appearance and smoothness of the surface

- iii. Which tool is best suited for brushing the surface of a workpiece?
- a) Grinding wheel
 - b) Wire brush
 - c) Plasma cutter
 - d) Saw blade

Answer: B. Wire brush

- iv. Which tool is typically used for shearing metal sheets?
- a) Band saw
 - b) Plasma cutter
 - c) Shearing machine
 - d) Hammer

Answer: C) Shearing machine

- v. Which tool is used for grinding?
- a) Plasma cutter
 - b) Grinding wheel
 - c) Snips
 - d) Shearing machine

Answer: B) Grinding wheel

- vi. Plasma cutting is best suited for:
- a) Cutting wood
 - b) Cutting metal
 - c) Grinding surfaces
 - d) Polishing surfaces

Answer: B) Cutting metal

vii. What is the primary purpose of punching?

- a) To cut large sections of metal
- b) To create holes in materials
- c) To polish surfaces
- d) To measure dimensions

Answer: B) To create holes in materials

Q4. Read the following sentence and complete with “shift”, “fixed” “body”, “gear”

- a. Ensures that the workpieces do not _____ during the cutting or welding process.
- b. Ensures that the workpieces are _____ during the cutting or welding process.

Answer:

- a. Shift
- b. Fixed

Q5. Table below contain welding defects (**column B**) and remedies in (**column A**), match column B to column A to the provided place.

Answer	Column A	Column B
i).....	i) Incorrect electrode angle or too fast travel speed	1. Porosity
ii).....	ii) Moisture in the welding material or gas entrapment	2. Cracks
iii).....	iii) Using incorrect shielding gas or current settings	3. Undercut
iv).....	iv) Excessive heat input during welding	4. Spatter
		5. Lack of fusion

Answer	Column A	Column B
i. 3	i) Incorrect electrode angle or too fast travel speed	1. Porosity
ii. 1	ii) Moisture in the welding material or gas entrapment	2. Cracks
iii. 2	iii) Using incorrect shielding gas or current settings	3. Undercut
iv. 4	iv) Excessive heat input during welding	4. Spatter
		5. Lack of fusion

Practical assessment

KAMANA metal company ltd is a manufacturing company located IN HUYE District, won a tender from UMUCYO restaurant for fabricating aluminium tank for pure water, with cast iron tank support structure and connect stainless steel pipe by applying SMAW techniques.

Ask trainees to:

- i. Prepare required workpieces
- ii. Fabricate aluminium tank, cast iron support structure and connect stainless steel pipes to the tank.
- iii. Check and correct the defects.

Checklist:

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicators	Observations	
			Yes	No
2, Weld the workpiece	1.&2 Preparing work piece	Ind1. Work piece is cleaned		
		Ind2. Workpiece is measured		
		Ind3. Workpiece is marked		
		Ind4. Workpiece is clamped		
		Ind5. Workpiece is cut		
		Ind6. Workpiece is cleaned		
	2. Applying SMAW process on welding aluminium	Ind1. PPE are worn		
		Ind2. Aluminum piece is cleaned		
		Ind3. aluminium joints are prepared		
		Ind4. Machine is set		
		Ind 5. Product is produced		
	3. Applying SMAW techniques on welding Stainless steel	Ind1. SMAW machine is set		
		Ind2. String beads is produced		
		Ind 3. Weld is attractive		
	5. Applying SMAW techniques on welding Cast iron	Ind1. SMAW machine is set		
		Ind 2. Welding bead is welded		
		Ind3. Welding bead is clear		
	6. Checking and correcting SMAW defects	Ind1. SMAW defects are checked		
		Ind2. SMAW weld defects are corrected		
Total score	/100			
Passing line	70%			



Further information to the trainer

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Learning Outcome 3: Carry out Finishing Activities



Indicative contents

3.1 Applying finishing techniques

3.2 Applying protective techniques

3.3 Storing techniques of product

3.4 Performing workplace cleaning activities

3.5 Reporting the work done

Key Competencies for Learning Outcome 3: Carry out Finishing Activities

Knowledge	Skills	Attitudes
• Description of welding wastes management • Description of work report.	• Applying finishing techniques on product in SMAW on aluminium, stainless steel and cast iron • Applying protective techniques on product • Storing produced product • Performing workplace cleaning activities	• Being organizer in storing product • Having critical thinking while reporting the work done • Being attentive in cleaning activities • Having precision while applying finishing techniques



Duration: 20 hrs

Learning outcome 3 objectives:



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

1. Apply effectively finishing techniques on product in SMAW on aluminium, stainless steel and cast iron
2. Apply correctly protective techniques on product in SMAW on aluminium, stainless steel and cast iron
3. Store properly product produced in SMAW on aluminium, stainless steel and cast iron
4. Describe properly the welding wastes management in SMAW on aluminium, stainless steel and cast iron
5. Clean effectively workplace after SMAW activities in SMAW on aluminium, stainless steel and cast iron
6. Fill perfectly report template as required in SMAW on aluminium, stainless steel and cast-iron process.



Resources

Equipment	Tools	Materials
• Trolley • Wheelbarrow • Hydraulic Pallet Jack • Hydraulic Floor Crane • Air compressor • Air blower	• Sandpaper • Files • Paint Gun • Cutting Tools • Grinding Disc • Sanding Disc • Paint Brush • Paint roller	• Papers • Scotch • Pencils, Paints • Thinner • Paraffin • Varnish • Under Coats • Filler Paint • Oil • Lubricant

**Advance Preparation:**

Before delivering this learning outcome, you are recommended to:

- Avail of products to be finished
- Avail of materials, tools and equipment required in finishing
- Avail of photo or pictures related to finishing activities in SMAW on aluminium, stainless steel and cast iron



Indicative content 3.1: Applying Finishing Techniques



Duration: 7hrs



Practical Activity 3.1.1: Applying finishing techniques on product in SMAW on aluminium, stainless steel and cast iron



Notes to the trainer

- This activity should take place in workshop where, you are supposed to demonstrate trainees how to apply finishing techniques as required for SMAW process on aluminium, stainless steel and cast iron. Remember to ask trainees to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail materials, tools, and equipment required for finishing the welded product in SMAW process on aluminium, stainless steel and cast iron
 - ✓ Have a well-organized workplace.
 - ✓ Avail of product to be finished



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to perform the following task:
Suppose you are requested to go in manufacturing workshop, and apply finishing techniques on welded product based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to apply finishing techniques by applying different finishing techniques. While demonstrating, explain the finishing procedures.
- Step 4:** Ask trainees to apply finishing techniques by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the work pieces are properly finished and provide support.

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

- Regularly check tool wear to maintain precision while in honing and grinding operation.
- Always monitor the temperature to prevent distortion of product while in polishing.
- Ensure proper ventilation during sand blasting for safety.



Application of learning 3.1.

In manufacturing workshop there are a fabricated aluminium door, stainless steel water tank and cast-iron stove needs to be finished before used in new school kitchen. Ask trainees to finish this product by performing the following task:

- i. Grinding
- ii. Polishing
- iii. Sand blasting

Checklist

SN	Assessed criteria	Indicators	Yes	No
1	1. Product is properly finished	Ind1. Product is grinded		
		Ind2. Product is polished		
		Ind3. Product is blasted		
	Total marks:	/3		
	Passing line	70%		



Indicative content 3.2: Applying Protective Techniques



Duration: 7 hrs



Practical Activity 3.2.1: Applying protecting techniques on product in SMAW on aluminium, stainless steel and cast iron



Notes to the trainer

- This activity should take place in workshop where, you are supposed to demonstrate trainees how to apply protection techniques as required for SMAW process on aluminium, stainless steel and cast iron. Remember to ask trainees to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail materials, tools, and equipment required for protecting the welded product in SMAW process on aluminium, stainless steel and cast iron
 - ✓ Have a well-organized workplace.
 - ✓ Avail of product to be protected.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to perform the following task:
You are requested to go in manufacturing workshop, and apply protecting techniques on welded stainless-steel tank, aluminium windows and cast-iron stove by using different techniques based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to apply protecting techniques by applying different finishing techniques. While demonstrating, explain the protecting procedures.
- Step 4:** Ask trainees to apply protecting techniques by applying different techniques and monitor the procedures.

Step 5: Verify whether the work pieces are properly protected and provide support.

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

- Rust is harmful to metal product, the lifespan of product depends on their ways are protected, without protection the product destroyed at a short time



Application of learning 3.2.

In manufacturing workshop there are a fabricated aluminium door, stainless steel water tank and cast-iron stove needs to be finished before used in new school kitchen. ask trainees to finish this product by performing the following tasks:

- Waxing
- Painting
- Lubricating

Checklist

SN	Assessed criteria	Indicators	yes	No
1	1. Product is properly protected	Ind1. Product is waxed		
		Ind2. Product is painted		
		Ind3. Product is lubricated		
		Ind4. Good appearance of product is created		
	Total marks:			/4
	Passing line			70%



Indicative content 3.3: Storing Techniques of Product



Duration: 2hrs



Practical Activity 3.3.1: Storing the welded product



Notes to the trainer

- This activity should take place in workshop where, you are supposed to demonstrate trainees how to store the welded products as required for the welded product in SMAW process on aluminium, stainless steel and cast iron. Remember to ask trainees to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail materials, tools, and equipment required for storing the welded product in SMAW process on aluminium, stainless steel and cast iron
 - ✓ Avail of products to be stored



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to perform the following task:
You are requested to go in manufacturing workshop, and store a welded products by applying difference storing techniques based on trainer's instructions.
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to store product by applying different storing techniques. While demonstrating, explain the storing procedures.
- Step 4:** Ask trainees to store the product by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the products are properly stored and provide support.
- Step 6:** Ask trainees to read key reading 3.3.1.
- Step 7:** Ask trainees to perform the task provided in application of learning 3.3.



Points to Remember

- For hanging a product ensure the hardware (hooks, brackets, anchors) can support the full weight of the product. Check the manufacturer's specifications for load limits



Application of learning 3.3.

In your school manufacturing workshop there are fabricated products like doors, water tank and stoves require to be stored, ask trainees to:

- Use handling tools
- Use handling equipment
- Store the products

Check list

SN	Accessed criteria	Indicators	yes	No
1	1. Products are properly stored	Ind1. Handling tools are used		
		Ind2. Handling equipment are used		
		Ind3. Products are stored		
	Total mark	/3		
	Passing line	70%		



Indicative content 3.4: Performing Workplace Cleaning Activities



Duration: 2hrs



Theoretical Activity 3.4.1: Description of welding waste management



Notes to the trainer:

- While delivering this content, small groups may be used to describe welding waste management in SMAW on Aluminium, stainless and cast iron.
- The use of images or videos as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to answer the following questions:
- What are the categories of welding wastes
 - What is the meaning of 4Rs principles
 - According to you, how to dispose the welding wastes
- Step 2:** Ask trainees to write provided answers on flipcharts/papers
- Step 3:** Ask trainees to present their findings and choose the correct answers.
- Step 4:** Provide expert view and clarify ideas by using didactic materials.
- Step 5:** Ask trainees to read the key reading 3.4.1. in trainee manual and address any questions or concerns.



Points to Remember

- While disposing the waste materials, differentiate recyclable and non- recyclable waste
- Non-recyclable materials should be handled according to local waste disposal regulations.
- Prioritize waste reduction and recycling to minimize the environmental impact of welding operations



Practical Activity 3.4.2: Performing workplace cleaning activities



Notes to the trainer

- This activity should take place in workshop where, you are supposed to demonstrate trainees how to clean the workplace as required for SMAW process on aluminium, stainless steel and cast iron. Remember to ask trainees to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail materials, tools, and equipment required for cleaning workplace as required in SMAW process on aluminium, stainless steel and cast iron
 - ✓ Avail workplace to be cleaned



Key steps:

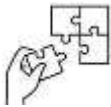
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to perform the task below:
You are requested to go in manufacturing workshop, to Arrange tools and equipment on appropriate place, Dispose the wastes according to its categories and clean workplace by using cleaning tools or equipment
- Step 2:** Explain the task and provide clear work instruction
- Step 3:** Demonstrate how to clean workplace by applying different cleaning techniques. While demonstrating, explain the cleaning procedures.
- Step 4:** Ask trainees to clean the workplace by applying different techniques and monitor the procedures.
- Step 5:** Verify whether the workplace is clearly cleaned and provide support.
- Step 6:** Ask trainees to read key reading 3.4.2.
- Step 7:** Ask trainees to perform the task provided in application of learning 3.4.



Points to Remember

- Waste materials can be sharpening, wear appropriate PPEs before handle them for avoid being cut.



Application of learning 3.4.

There is uncleaned work place where welding activities have been performed, ask trainees to:

- Arrange materials, tools and equipment
- Dispose waste materials
- Clean the workplace

Check list

SN	Accessed criteria	Indicators	yes	No
1	1. Workplace are properly cleaned	Ind1. Tools and materials are arranged		
		Ind2. Equipment are arranged		
		Ind3. Waste are disposed according to its categories		
		Ind4. Workplace is cleaned		
2	Total marks	/4		
3	Passing line	70%		



Indicative content 3.5: Reporting the Work Done



Duration: 2hrs



Theoretical Activity 3.5.1: Description of work report



Notes to the trainer:

- While delivering this content, small groups can be used for describing work report in SMAW on Aluminium, stainless steel and cast iron.
- The use of images, videos, and illustrations as didactic materials is required for more clarification.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following question:

- i. What do you understand by work report
- ii. What could be the difference between oral report and written report

Step 2: Ask trainees to write provided answers on flipcharts/papers

Step 3: Ask trainees to present their findings.

Step 4: Provide expert view and clarify ideas by using didactic materials.

Step 5: Ask trainees to read the key reading 3.5.1. in trainee manual and address any questions or concerns.



Points to Remember

- Report provides a structured way to document tasks, track progress, communicate achievements, and identify areas for improvement.
- Make sure to cover all relevant aspects such as objectives, methods, observations, and conclusions.



Practical Activity 3.5.2: Preparing work report



Notes to the trainer

- This activity should take place in workshop where, you are supposed to demonstrate trainees how to prepare work report as required for SMAW welding activity. Remember to ask trainees to perform this activity and facilitate them individually.
- You are recommended to:
 - ✓ Avail materials and tools, required for preparing work report as required in SMAW process on aluminium, stainless steel and cast iron.
 - ✓ Avail an organized workplace.



Key steps:

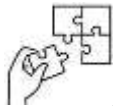
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
As manufacture, after fabricating 5 windows (150*120) cm and 2 doors (200*90) cm made from (40*40*1.5) mm aluminium tube, you are requested to prepare work done report.
- Step 2:** Guide trainees how to prepare work report, and explain preparing procedures.
- Step 3:** Check whether report is properly prepared and provide support if necessary.
- Step 4:** Ask trainees to read key reading 3.5.2
- Step 5:** Ask trainees to perform the task provided in application of learning 3.5



Points to Remember

- When you prepare work report, Fill the template and submit it (physical and electronic) as well as present the verbal report to the audience or supervisor.



Application of learning 3.5

Suppose there are 10 aluminium windows you have fabricated in your school workshop the supervisor requires a report. Ask trainees to:

- i. Fill the report template
- ii. Submit the work report

Checklist:

SN	Criteria	Indicators	Yes	No
1	1. Work done is properly reported	Ind1. Report templet is filled		
		Ind2. Report is submitted		
	Total marks:			2
	Passing line			70%



Learning outcome 3 end assessment

Written assessment

Q1. Read the following statement and answer by **TRUE** if it is correct or **FALSE** if it is incorrect

- i. Honing is a precision machining process used to improve the geometric form of a surface, as well as to produce a rough surface finish.
- ii. Grinding can create a uniform surface and is often following polishing for a shiny finish.
- iii. Buffing is similar to polishing except that buffing uses a soft cloth wheel instead of using an abrasive wheel
- iv. The right storage arrangement can help prevent damage, increases waste, and ensure that products are easily accessible
- v. Proper shelving not only maximizes space utilization but also enhances accessibility, organization, and inventory management.

Answer:

- i. **F**
- ii. **F**
- iii. **T**
- iv. **F**
- v. **T**

Q2. Table below contain the protective techniques in column B and their corresponding description in column A, match column A with column B in the column C

Answer C	A	B
i.	i) This is crucial for preventing corrosion and reducing friction in moving parts	1. Painting
ii.....	ii)is a process used to apply a protective zinc coating to steel or iron to prevent rust and corrosion.	2. Lubrication
iii.....	iii) is a process of applying a paint on product to enhance appearance and provide protection against corrosion	3. Alloying
		4. Galvanizing

Answer:

Answer	A	B
i. =2	i) This is crucial for preventing corrosion and reducing friction in moving parts	1. Painting
ii. =4	ii)is a process used to apply a protective zinc coating to steel or iron to prevent rust and corrosion.	2. Lubrication
iii. =1	iii) is a process of applying a paint on product to enhance appearance and provide protection against corrosion	3. Alloying
		4. Galvanizing

Q3. Read the following sentence and select the correct answer by re-write the corresponding letter.

- i. All those are the factors to consider for store tools and equipment except:
 - a) Sizes
 - b) Types
 - c) Colour
- ii. 4Rs stand for
 - a) Reduce, Reuse, Recycle, Reproduce
 - b) Reduce, Reuse, Recycle, Recover
 - c) Reduce, Reuse, Re-weld, Recover

Answer:

- i. **C**
- ii. **B**

Q4. Read the following sentence and complete blank space with (**oral report, electronic report or written report**)

- i. is a report transmitted to, or otherwise forwarded to, the Central Criminal Records Exchange in an electronic format approved by the Exchange
- ii. is a presentation in which you speak to someone or an audience about a topic? You will only have a certain amount of time to talk, so you'll have to pick and choose the most important points you want to make

Answer:

- i. **Electronic report**
- ii. **Oral report**

Practical assessment

KB welding company ltd is a welding company located at Kigali industrial zone, after welding a trolley of KEZA medical Hospital want to finish it, suppose you are a welder in

this company, ask trainees to perform finishing activities of this trolley by perform the following task:

- i. Grinding and polishing the product
- ii. Painting the product
- iii. store products
- iv. Clean the workplace

Checklist

Assessable outcomes	Assessed criteria (Based on performance criteria)	Indicators	Observations	
			Yes	No
1. carry out finishing activities	1. Apply properly finishing techniques	Ind1. Grinding is done		
		Ind2. Polishing is done		
		Ind3. Buffing is done		
	2. Apply correctly protective techniques	Ind1. Painting is done		
	3. Store properly product	Ind1. Products are stored		
	4. Clean effectively the workplace	Ind1. Workplace is cleaned		
		Ind2. Tools are arranged		
		Ind3. Equipment are arranged		
		Ind4. Waste are disposed		
	5. Report clearly Work done	Oral report is done		
		Written report are done		
Total score	/100			
Passing line	70%			

END



Further information to the trainer

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