Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

MAINTENANCE OF PUMPING SYSTEM

WIRMP301

Maintain pumping system

Competence

RQF Level: 3

Learning Hours 60

Credits: 6

Sector: Agriculture and food processing

Trade: Water and Irrigation

Module Type: Specific

Curriculum: AFPWIR3002- TVET Certificate III in water and irrigation

Issue Date: May, 2022

<table>
<tr><td>Purpose statement</td><td colspan="5">This module describes the skills, knowledge and attitude required to perform maintenance of pumping system. It is intended for learners who have successfully completed nine years basic education, TVET level II in water and irrigation or its equivalent and pursuing TVET levelIII in water and irrigation. At the end of this module, learners will be able to prepare for pump maintenance, carry out pump maintenance, carry out of routine maintenance of pumping and ancillary systems, and conclude the pump maintenance activities. Qualified learners deemed competent to this competency may work alone or with other on routine tasks in marshland, hillside, small scale irrigation, garden, greenhouses, agricultural land, rain water harvesting, and the related under minimum supervision.</td></tr>
<tr><td rowspan="6">Delivery modality</td><td colspan="2">Training delivery</td><td>100%</td><td colspan="2">Assessment</td><td>Total 100%</td></tr>
<tr><td colspan="2">Theoretical content</td><td>30%</td><td rowspan="4">Formative assessment</td><td>30%</td><td rowspan="4">50%</td></tr>
<tr><td colspan="2">Practical work:</td><td rowspan="3">70%</td><td rowspan="3">70%</td></tr>
<tr><td>• Group project and presentation</td><td>20%</td></tr>
<tr><td>• Individual project /Work</td><td>50%</td></tr>
<tr><td colspan="2"></td><td colspan="2">Summative Assessment</td><td>50%</td></tr>
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Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1. Prepare for pump maintenance	1.1. Instructions from supervisor are timely received and work requirements is interpreted for the satisfactory completion of pump maintenance
	1.2. Items and tools required are properly identified for the safe, effective and efficient conduct of servicing and maintenance tasks
	1.3 Support required is appropriately identified for the safe completion of maintenance tasks
2. Carry out pump	2.1. Pumps defaults are regularly inspected and timely

maintenance	reported in accordance with site and manufacturer's requirements and procedure
	2.2. hazardous and emergency situations are properly identified **in** accordance with legislative, site and manufacturer's requirements and procedures
	2.3. Used oil, lubricant and other waste are appropriately disposed of in accordance with legislative and site requirements
	2.4 pump engine is adequately and regularly greased, oiled and lubricatedin accordance with the specifications
3. Carry out of routine maintenance of pumping and ancillary systems	3.1. Flanges, gaskets and seals are regularly checked and maintainedwithin stated operational tolerances to avoid any environmental damage
	3.2. Pump pressure and flow are accurately monitored to satisfy the designed specifications
	3.3. Pumping components are regularly monitored and checked to identify any signs of excessive wear and low performance
	3.4. Operational valves and valve joints are regularly checked to detect possible leakages and perform maintenance
	3.5. Suction screens are periodically checked and cleaned for removal of any blockages or impurities entering the pumping system and causing any malfunction during pumping operation
4. Conclude the pump maintenance activities	4.1. The pump is properly shut down according to workplace procedures
	4.2. Pumping equipments are regularly cleaned according to workplace procedures
	4.3. The generated waste from both the pumping process

	and cleaning procedures are systematically collected and disposed of according to workplace procedures

Course content

Learning outcomes	At the end of the module the learner will be able to:
	1. Prepare for pump maintenance 2. Carry out pump maintenance 3. Carry out of routine maintenance of pumping and ancillary systems 4. Conclude the pump maintenance activities

Learning outcome 1: Prepare for pump maintenance	Learning hours: 10
Indicative content	

- Receiving instructions from supervisor and interpret work requirements
  - ✓ Pump components
  - ✓ Functions of pump components
  - ✓ Types of maintenance
  - ✓ Symptoms of malfunction of pump component
    - Pump does not start, Pump does not prime, Pump outputs insufficient product, Pump requires excessive power, Pump vibrates or overheats
- Identify items and tools required for the safe, effective and efficient conduct of maintenance tasks
  - ✓ Causes of pump failures
    - Suction troubles, Pump system troubles, Mechanical troubles
  - ✓ Common maintenance tasks on centrifugal pumps
    - Bearing lubrication and replacement, mechanical seal replacement, packing tightening and replacement, wear ring adjustment or replacement, impeller replacement, pump/motor alignment, Motor repair or replacement
  - ✓ Types of pump maintenance tools:
    - Hydraulic tools for mounting and dismounting
    - Mechanical tools for mounting and dismounting
    - Bearing heaters
    - Alignment tools

- ✓ Pump performance indicators (Pump energy efficiency)

- Identify the support required for the safe completion of maintenance tasks

Resources required for the learning outcome	
Equipment	Pump and its accessories, source of power, pump engine, Pump ancillary equipments
Materials	Technical manual ,Flip chart, Markers, Pipes, Fittings, book, Lubricants, Fuels, Water
Tools	Tool kit
Facilitation techniques	• Demonstration and simulation • Individual and • group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Project based assessment

Learning outcome 2: Carry out pump maintenance	Learning hours: 10
Indicative content	

- Inspection of pumps and report any default
  - ✓ Troubleshooting procedures:
  - ✓ Follow the system checklist.
  - ✓ Analyze symptoms and factors.
  - ✓ Check to see if the problem is a common issue.
  - ✓ Isolate the source of the problem.
  - ✓ Define an action plan.
  - ✓ Consult technical support resources.
  - ✓ Pump troubleshooting field guide

- Identification of hazardous and emergency situations

- Disposing used oil, lubricant and other waste
  - ✓ Types of fuels
  - ✓ Types of pump waste

- Greasing, oil and lubricate pump engine
  - ✓ Pump lubricating process
  - ✓ Types of lubricants

Resources required for the indicative content	
Equipment	Pump and its accessories, Pump engine/source of power, Flow meter, Computer
Materials	Fuel, Book, Technical manual, Disposal site, Flip chart, Handbook, Pens ,Water
Tools	Tool kit, Screwdriver, Electrical tester
Facilitation techniques	• Demonstration and simulation • Individual and • group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Project based assessment

Learning outcome 3: Carry out routine maintenance of pumping and ancillary systems	Learning hours: 10

Indicative content

- Checking and maintain flanges, gaskets and seals within stated operational tolerances

✓ Flanges/gaskets system overview

✓ Flange/gaskets arrangement

✓ Types of Flanges/gaskets damages

- Monitoring pump pressure and flow

✓ Parameters of pump performance monitoring:

- Suction pressure, discharge pressure, flow, pump speed, power

- Monitoring and checking pump components in order to identify any signs of excessive wear and tear for low performance

✓ Main types of pumps:

- Displacement pump
- Centrifugal pump

✓ Cavitation in pumps:

- Causes of cavitation, effects of cavitation, precautions against cavitation

✓ Water hammer phenomenon

- Causes
- Remedies

- Checking the operational valves and valve joints to detect possible leakages

✓ Types of valves

✓ Stopping and starting flow

✓ Reduce or increase a flow

✓ Controlling the direction of flow

✓ Regulating a flow or process pressure

✓ Relieve a pipe system of a certain pressure

- Checking and clean the suction screens for removal of any blockages or impurities

entering the pumping system and causing any malfunction during pumping operation ✓ Advantages of suction screen cleaning ✓ Self-cleaning of pump suction screens	
Resources required for the indicative content	
Equipment	Pump and its accessories, source of power,pump engine, Pump ancillary equipments, phones, printer, screen
Materials	Fuel, Book, Technical manual, Disposal site, Flip chart, Handbook, Pens ,Water , pen, pencil, delivery pipe, valves
Tools	Tool kit, Screwdriver, Electrical tester
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Project based assessment

Learning outcome 4: Conclude the pump maintenance activities	**Learning hours: 10**
Indicative content	
• Shutdown the pump ✓ Processes of pump shutting down • Cleaning the pumping equipment ✓ Pump cleaning procedures ✓ Storing a pump • Collecting and disposing of waste generated by both the pumping process and cleaning procedures	
Resources required for the indicative content	
Equipment	Pump and its accessories, source of power/ pump engine

Materials	Fuel, Book, Technical manual, Disposal site, Flip chart, Handbook, Pens ,Water
Tools	Tool kit
Facilitation techniques	• Demonstration and simulation • Individual and group work • Practical exercise • Individualized • Trainer guided • Group discussion
Formative assessment methods	• Written assessment • Oral presentation • Performance assessment • Project based assessment

Integrated/Summative assessment

Integrated situation

KANAMUGIRE live in GATSIBO District, KABARORE Sector**,** NYARUBUYE Cell and NYIRAMAHWERA Village. He grows tomatoes under 4 hectares and has a sprinkler irrigation kit composed by Diesel water pump, quick coupling high pressure hose pipes and accessories.

He supplies the produce to NYABUGOGO Vegetable market, the total seasonal outcome of his production is about 15,000,000 Rwandan francs. During the last agricultural season A, his production has reduced to 8,000,000 due to the lack of Water pump maintenance. In fact, Mr. KANAMUGIRE Louis is no longer getting solution to the pump maintenance required, that why, he would like to recruit an experienced technician to handle the pump problem.

The task should meet the following specifications

- Cleaning of pumping equipments according to workplace procedures
- Monitoring and checking of pumping components in order to identify any signs of excessive wear and low performance
- Checking and cleaning of suction screens for removal of any blockages or impurities entering the pumping system and causing any malfunction during pumping operation

Task must be completed within 5 hours

Resources

Tools	Tool box
Equipment	water pump and its accessories, source of energy/ engine, control panel, irrigation kit
Materials/ Consumables	Work clothes with long pants and long-sleeve shirts, boots,pipes, connectors, water , field

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
Learning outcome 1: Prepare for pump maintenance **(20%)**	1.1. Instructions from supervisor are timely received and work requirements is interpreted for the satisfactory completion of pump maintenance	Ind.1 Check the cause of malfunction			1
		Ind.2 Daily checks			1
		Ind.3All leakages are checked			3
	1.2. Items and tools required are properly identified for the safe, effective and efficient conduct of servicing and maintenance tasks	Ind.1identification of the pump maintenance required			3
		Ind.2 identification of pump maintenance tools			3
		Ind.3 Perform maintenance task.			2
		ind 4. Tools for mounting and			1

		dismounting			
	1.3. Support required is appropriately identified for the safe completion of maintenance tasks	Ind.1Cause pump failure			2
		Ind.2Bearing lubrication and replacement			2
		Ind.3Motor repair or replacement			2
Learning outcome 2: Carry out pump **maintenance** **(30%)**	2.1. Pumps defaults are regularly inspected and timely reported in accordance with site and manufacturer's requirements and procedure	Ind.1 system checklist			2
		Ind.2 Isolate the source of the problem			3
		Ind.3 Consult technical support resources/ troubleshooting			3
	2.2. Hazardous and emergency situations are properly identified in accordance with legislative, site and manufacturer's requirements and procedures	Ind.1possible safety hazards			2
		Ind.2 water leaks on valves and air relief port			3
		Ind.3 Selection and wear PPE			4
	2.3. Used oil, lubricant and other waste are appropriately disposed of in accordance with legislative and site requirements	Ind.1 Check the quality of lubricants			3
		Ind.2 oil disposal of method			5
		Ind.3 Categories of Lubricant used			3

		ind4: methods of lubrication			4
		ind5: causes of oil degradation			3
		ind6 functions of the lubricant in pump engine			3
	2.4. pump engine is adequately and regularly greased, oiled and lubricatedin accordance with the specifications				
Learning outcome 3: Carry out of routine maintenance of pumping and ancillary systems **(35%)**	3.1. Flanges, gaskets and seals are regularly checked and maintained within stated operational tolerances to avoid any environmental damage	Ind.1 Types of gaskets used			1
		Ind.2 Types of flanges used			1
		Ind.3Flange/gaskets arrangement			3
		ind4:Careful preparation ,cleaning ,assemble and installation			4
	3.2. Pump pressure and flow are accurately monitored to satisfy the designed specifications	Ind.1Suction pressure			2
		Ind.2 Discharge pressure,			2
		Ind.3 Flow			2
		ind 4 Pump speed			2
	3.3. Pumping components are regularly monitored and checked to identify any signs of excessive wear and low performance	Ind.1types of pumps			1
		Ind.2 Types of pump cavitations			1

		Ind.3 Causes of cavitations			2
		ind 4 Best practices to avoid water hammer			2
	3.4 Operational valves and valve joints are regularly checked to detect possible leakages and perform maintenance	ind1 Types of valves			1
		ind2 Functions of valve			1
		ind3 Method for cleaning of suction screens			2
		ind4Shutting down procedures of the pump			2
	3.5 Suction screens are periodically checked and cleaned for removal of any blockages or impurities entering the pumping system and causing any malfunction during pumping operation	ind1 Cleaning of pumping equipments			2
		ind2suction screen cleaning			3
		ind3 Self-cleaning of pump suction screens			1
Learning outcome 4:Conclude the pump maintenance activities (15 %) **(10%)**	4.1 The pump is properly shut down according to workplace procedures	Ind1 Processes of pump shutting down			5
	4.2. Pumping equipments are regularly cleaned according to workplace procedures	Ind1 Pump cleaning procedures			4
	4.3 The generated waste from both the pumping process and cleaning procedures are systematically	Ind1 Types of waste			4
		Ind2 waste disposal			3

	collected and disposed of according to workplace procedures	method			
Total marks					**100**
Percentage Weightage					**100%**
Minimum Passing line % (Aggregate): 70%					

References:

1. http://www.fao.org/waicent/faoinfo/agricult/aglw/ies

2. **Allahwerdi. 1986. Technological Dependency and choice of pumping technologies for Irrigation systems. UNIDO. ASAE, Undated. Transactions of the ASAE, St Joseph, MI. 417-423 pp.**

3. **Australia Irrigation Association. May 1996. Notes for Part B Examinations Colt Industries. 1975. Hydraulic Handbook. Cornell Pump Co. Undated. Installation and Care of Cornell Pumps.**

4. **FAO. 1986. Water Lifting Devices. FAO Irrigation and Drainage Paper 43. Prepared by: Fraenkel, P.L. Rome, Italy. Grundfos. Undated.**

5. **Keller, J. and Bliesner, R.D. 1990. Sprinkler and trickle irrigation. Chapman and Hall, New York. Longenbaugh and Duke. 1980. Farm Pumps Chapter of Design and Operation of Farm Irrigation Systems.**

6. **ASAE Monograph. Miller, R. 1991. Pumps. Macmillan, New York. Mono Pump.**