Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

WATER PUMP OPARATION

WIROP301

Operate water pump

Competence

RQF Level: 3

Learning Hours 50

Credits: 5

Sector: Agriculture and food processing

Trade: Water and Irrigation

Module Type: SPECIFIC

Curriculum: AFPWIR3001- TVET Certificate III in water and irrigation

Issue Date: May, 2022

Purpose statement	This module describes the skills, knowledge and attitude required to operate a water pump. At the end of this module, learners will be able to prepare for pumping activities; operate a pump; conclude pump operations. Qualified learners deemed competent to this competency may work alone or with others on routine tasks in marshland, hillside, small scale irrigation, garden, greenhouses, agricultural land, rain water harvesting, In situ rain water harvesting and ground water harvesting related activities under minimum supervision.					
Delivery modality	**Training delivery**		**100%**	**Assessment**		**Total 100%**
	Theoretical content		30%	Formative assessment	30%	50%
	Practical work:		70%		70%	
	• Group project and presentation	20%				
	• Individual project /Work	50%				
			Summative Assessment			50%

Elements of Competency and Performance Criteria

Elements of competency	Performance criteria
1.Prepare for pumping Activities	1.1. The pumping schedule is carefully read and the given instructions from the supervisor are well interpretation.
	1.2. The suitability of Irrigation water in terms of quality and quantity is methodically checked before starting a pump.
	1.3. Pump operator and irrigation operator are effectively communicated between to determine when to start and shut off the pump engine according to operational purposes.
	1.4. Pump is properly positioned to receive and deliver water in accordance with organizational requirements.
	1.5 Pump and priming process are properly engaged in accordance with manufacturer's specifications and organizational guidelines

1. Operate a pump	2.1. Pump components, ancillary equipment and principles of operation are appropriately utilized to deliver water from the water source in accordance with pump appliance capability.
	2.2. Pump is properly operated in accordance with manufacturer's specifications, organizational procedures and workplace health and safety (WHS) guidelines
	2.3. Pump performance is appropriately operated and accurately observed to ensure better achievement in terms of required pressure and flow.
	2.4. Pumping problems are regularly monitored and pumping safety conditions are well maintained to ensure maximum efficiency of operation and take appropriate action in accordance with organizational procedures
	2.5 Critical mechanical malfunctions are timely reported to the supervisor according to organizational procedures.
3. Conclude pump operations	3.1. Pump operations are regularly inspected in accordance with operational specifications and procedures.
	3.2. Operating data such as pumping pressure and duration, pumped water discharge and quantity of fuel used are regularly recorded in order to determine pumping efficiency
	3.3 Pumping activities are timely reported to the supervisor in accordance with irrigation requirements.

Course content

Learning outcomes	**At the end of the module the learner will be able to:**
	1. Prepare for pumping activities 2. Operate a pump 3. Conclude pump operations

Learning outcome 1: Prepare for pumping Activities	Learning hours: 20

Indicative content

- Reading the pumping schedule and better interpretation of given instructions from the supervisor.
  - ✓ Types of irrigation pumps:
    - Displacement Pump, Submersible Pump, Turbines pumps, Booster Pump, Floating Pump, Jet Pump
  - ✓ Sources of pump energy
  - ✓ Pumping schedule
    - Pumping duration
    - Pump capacity
- Checking the irrigation water suitability in terms of quality and quantity before starting a pump.
  - ✓ Irrigation water sources
  - ✓ Irrigation water quality
  - ✓ Irrigation water quantity
- Communication between pump operator and irrigation operator in order to determine when to start and shut off the pump engine.
  - ✓ Irrigation water sources
  - ✓ Irrigation water quality
  - ✓ Irrigation water quantity
- Positioning of pump to receive and deliver water.
  - ✓ Pump priming process
  - ✓ Total dynamic head
  - ✓ Net positive suction head
  - ✓ Pump starting and shutting down process
  - ✓ Pump standards:
    - API, ISO, ASME, ANSI
- Engaging pump and priming process

Resources required for the learning outcome

Equipment	Pumps, pump engine/ Power sources, computer, Satellite phone, Stop watch, Hydrometer Turbidity meter, flow meter, TDS meter
Materials	Flip chart, Books, Pen or Pencil, water, Coupling fittings, Notebooks, Water body,pipes

Tools	pH meter, tool box
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: Operate a pump	**Learning hours: 20**
Indicative content	

- Utilization of pump components, ancillary equipment and principles of operation to deliver water from the water source.

✓ Types of Main pump components

- Pump housing, Discharge outlet, Suction inlet, Mechanical seal, Impeller, Engine or motor, Shaft

✓ Pump ancillary equipment

✓ Principles of pump operation

- Operating a pump

✓ Operational processes for pumping

- Opening the Hydrant, engaging the pump, operating the hose, priming the pump, connecting the water tank to pump, operate a starting button

- Operation and observing pump performance to ensure better achievement in terms of required pressure and flow

✓ Pump performance indicators (Pump energy efficiency)

✓ Pump efficiency and its power

✓ Factors affecting pump efficiency:

- Impeller design, Improper priming, Insufficient NPSH, Reduced capacity, Wrong direction of rotation, Clogging of suction pipeline and impeller, Improper shaft alignment, Noisy operation

- ✓ Pressure measurement devices:
  - Manometer
  - Pressure regulator
  - Pressure gauge
- Monitoring pump problems and maintain pumping safety conditions

✓ Failures:

- Suction troubles
- Pump system troubles
- Mechanical troubles

✓ Symptoms of pump component malfunctions:

- Pump does not start, Pump does not prime, Pump outputs insufficient product, Pump requires excessive power, Pump vibrates or overheats

✓ Elements of a standard report

- Report critical mechanical malfunctions to the supervisor.

✓ Failures

✓ Symptoms of pump component malfunctions:

✓ Elements of a standard report

Resources required for the indicative content	
Equipment	Pump engine, Pumps, Water tank, Flow meter, water tank
Materials	Flip chart, Books, Lubricants, Fuels, Water, Pipes, Pipe fittings, Technical manual, Flip chart, Markers
Tools	Electrical tester, tool box, Screwdriver
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: Conclude pump operation	**Learning hours: 10**
Indicative content	
• Inspection of pump operations ✓ Specifications for pump operation • Recording operating data such as pumping pressure and duration, pumped water discharge and quantity of fuel used ✓ Pumping data recording devices Pressure gauge Flow meter Stop watch ✓ Pump closing process • Reporting pumping activities to the supervisor ✓ Report formats	
Resources required for the indicative content	
Equipment	Pump and its accessories, pump engine computer, Pressure gauge, Stopwatch, Flow meter, Printer
Materials	Pens ,Flip chart, Books, Technical manual, Water, Markers, Handbook, Report formats
Tools	Irrigation tool box
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

Twigire farmer association is growing tomatoes on 50 ha by using simple traditional irrigation way. This field is located in Kirehe district, Mpanga sector, cell of Nasho.

At the beginning of this season, the association members realized that handling watering can to irrigate 50 Ha tomatoes field is very tiring and time consuming and hence not technically productive, they developed a micro sprinkler irrigation system and purchased a pump which will help to deliver irrigation water from Cyambwe Lake to the new developed sprinkler scheme.

For this, they would like to employ a competent pump operator.

The task should meet the following specifications:

- Conducting preparatory activities prior pumping
- Operate a pump
- Conclude pump operations

The task duration is 6hours

Resources

Tools	**Irrigation tool box**
Equipment	Pump, Pump engine/electricity/flow meter/ Pressure regulating valve, Pressure gauge
Materials/ Consumables	Water, Fuel, 110 mm suction pipe, 90 mm delivery pipe, Foot valve, Delivery valve, Pipe fittings such as tee, elbow, and rubber ring joint

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	

Learning outcome 1: Prepare for pumping activities **(30%)**	1.1. The pumping schedule is carefully read and the given instructions from the supervisor are well interpretation.	Ind.1Pumping instructions			3
		Ind.2 Pumping schedule(duration, frequency)			3
		Ind.3 Pump engine specification			3
	1.2. The suitability of Irrigation water in terms of quality and quantity is methodically checked before starting a pump.	Ind.1 Water quality			1.5
		Ind.2 Water quantity			1.5
		Ind.3 Water physical quality			1.5
		Ind.3 Water Chemical quality			1.5
	1.3. Pump operator and irrigation operator are effectively communicated between to determine when to start and shut off the pump engine according to operational purposes	Ind.1 Pump engine start up			1
		Ind.2 Irrigation and pumping schedule			2
		Ind.3 Pump engine shutdown			2
	1.4. Pump is properly positioned to receive and deliver water in accordance with organizational requirements.	Ind.1 slope			1
		Ind.2 geographical coordinate			1
		Ind.3 pump standard			1
		Ind.4 Horsepower			1
		Ind.5 Volumetric flow rate			1
		Ind.6 Outlet pressure			1
		Ind.7 Inlet suction			1
	1.5. Pump and priming process are properly engaged in accordance with	Ind.1 Valves opening			1
		Ind.2Organization Guidelines			1
		Ind.3 Priming			1

	manufacturer's specifications and organizational guidelines				
Learning outcome 2: Operate a pump **(40%)**	2.1. Pump components, ancillary equipment and principles of operation are appropriately utilized to deliver water from the water source in accordance with pump appliance capability	Ind.1 Pump operating manual			2
		Ind.2 Pump series (AT, TB, MC, TC, TMA)			2
		Ind.3 Pump components			4
		Ind.3 Pump ancillary (Overhead reservoir and or fertilizer tank)			3
	2.2. Pump is properly operated in accordance with manufacturer's specifications, organizational procedures and workplace health and safety (WHS) guidelines	Ind.1 Pump operating manual			2
		Ind.2Pump specifications:			2
		Ind.3WHS guidelines			2
	2.3 Pump performance is appropriately operated and accurately observed to ensure better achievement in terms of required pressure and flow.	Ind.1 Pump pressure and flow rate			2
		Ind.2 Pump efficiency			2
		Ind.3Pump power			2
	2.4 Pumping problems are regularly monitored and pumping safety conditions are well maintained to ensure maximum efficiency of operation and take appropriate action in accordance with	Ind.1No liquid delivery			1
		Ind.2 Not enough liquid delivered			1
		Ind.3 Not enough pressure			1
		Ind.4 Too much power			1
		Ind.5 Cures and remedies list			3

	organizational procedures				
	2.5 Critical mechanical malfunctions are timely reported to the supervisor according to organizational procedures.	Ind.1 Pump malfunctions checklist			2
		Ind.2 Cures/solutions checklist			2
		Ind.3 Organizational procedures			2
		Ind.4 complete report format			4
Learning outcome 3: Conclude pump operations **(30%)**	3.1. Pump operations are regularly inspected in accordance with operational specifications and procedures.	Ind.1 Pump monitoring form			1.5
		Ind.2 Data records handbook			1.5
		Ind.3 Pump operational manuals			1.5
	3.2. Operating data such as pumping pressure and duration, pumped water discharge and quantity of fuel used are regularly recorded in order to determine pumping efficiency	Ind.1 Pump pressure			1.5
		Ind.2 Pumping duration			2
		Ind.3 Pumped water amount			2
		Ind.4 Fuel used			2
		Ind 5 Pump efficiency			2
		Ind.6 Filled handbook			2
		Ind7 Recording tools(pressure regulator, manometer, pressure gauge, flowmeter),			2
	3.3 Pumping activities are timely reported to the supervisor in	Ind.1 Opening the Hydrant			2
		Ind.2 Engaging the Pump			2

	accordance with irrigation requirements.	Ind.3 Operating the hose			2
		Ind.4 Priming the pump			2
		Ind.5 Connecting the water tank to Pump			2
		Ind.6 report			3
Total marks					**100**
Percentage Weight age					**100%**
Minimum Passing line % (Aggregate): 70%					

Reference

1. MICHAEL, A.M. (2004) “Irrigation-Theory and Practice” 4th reprint, Vikas Publishing House, New Dehli.
2. PUNMIA, B.C. & PANDE, B.B.L. (1992) Irrigation and Water Power Engineering, Laxmi Publications (P) ltd., New Dehli.
3. SHARMA,R.K. & SHARMA, T.K. (2002) Irrigation Engineering (Including Hydrology), S. Chand & Company ltd., New Dehli.
4. (FAO), F. a. (2002) Irrigation Manual Planning, Development, Monitoring and Evaluation Module 5 Irrigation pumping plant.