Republic of Rwanda
Ministry of Education

RTB | RWANDA TVET BOARD

SOLAR WATER HEATER INSTALLATION

RENSW301

Install Solar Water Heater

Competence

RQF Level: 3

Learning Hours 30

Credits: 3

Sector: Energy

Trade: Renewable energy

Module Type: Specific

Curriculum: ENGREN3001- TVET Level 3 in Renewable Energy

Issue Date: April 2022

<table>
<tr><td>Purpose statement</td><td colspan="6">This module describes the skills, knowledge and attitude required to install solar water heater. At the end of this module, learners will be able to analyze the site for solar water heater installation, install solar water heater and carry out test. Qualified learners deemed competent to this competency may work alone or with others on routine tasks under minimum supervision.</td></tr>
<tr><td>Learning assumed to be in place</td><td colspan="6">Physics, basic plumbing</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="3">Summative Assessment</td><td>50%</td></tr>
</table>

Elements of Competency and Performance Criteria

<table>
<tr><th>Elements of competency</th><th>Performance criteria</th></tr>
<tr><td rowspan="7">1. Set the Site</td><td>1.1. Materials, equipment and tools are properly selected according to the work to be done</td></tr>
<tr><td>1.2. The drawings are properly interpreted as per design</td></tr>
<tr><td>1.3.The dimensions are precisely taken and correctly marked based on direction of sun</td></tr>
<tr><td>1.4. The materials for structural support are properly prepared according to the drawings</td></tr>
<tr><td>1.5.The structural support is accurately painted according to the design</td></tr>
<tr><td>1.6. Holes are precisely drilled considering the size of bolts and nuts</td></tr>
<tr><td>1.7. The structural support are properly assembled and fixed according to the design</td></tr>
<tr><td rowspan="4">2. Install solar water heater</td><td>2.1.Materials, equipment’s and tools are properly selected according to the size of solar collectors and solar water tank</td></tr>
<tr><td>2.2.Solar water tank and collectors are correctly fixed on the prefabricated structural support according to the drawing</td></tr>
<tr><td>2.3.The tank water supply and collectors are accurately connected according to the design</td></tr>
<tr><td>2.4.The outlet pipe is accurately connected from the solar water tank to required destination with respect to the pipe length required</td></tr>
</table>

	2.5.The heat insulators are adequately laid around the pipes considering minimum heat loss
3. Carry out test	3.1. The water flow is carefully inspected in line with desired water pressure.
	3.2.The water leakage is carefully tested according to the work done
	3.3.The water temperature is properly tested according to the work done

Learning outcomes	**At the end of the module the learner will be able to:** 1. Set the site 2. Install solar water heater 3. Carry out test
Learning outcome 1: Set the Site	**Learning hours: 10**

Indicative content

- **Selection of tools, materials and equipments**
- ✓ The types of tools
- ✓ The types of equipment
- ✓ The types of materials
- **Interpretation of the drawings**
  - ✓ Symbols
  - ✓ Types of drawings
  - ✓ Scale
- **Marking the dimensions based on direction of sun**
- **Preparation of materials for structural support**
  - ✓ Types of materials
- **Drilling holes of bolts and nuts**
  - ✓ Different types of bolts and nuts
  - ✓ Types of drilling machines
  - ✓ How to use drilling machines?
- **Painting the structural support**
  - ✓ Types of paints
  - ✓ Methods of painting
  - ✓ How to paint
- **Assembling and fixing structural support**
  - ✓ Basic of welding
  - ✓ Different methods of fixing the structural support

Resources required for the learning outcome

Equipment	▪ Drilling machine (fixed and hand), pipe bender machine, welding machine , Ladder

Materials	▪ Metals for making support, union joints, PVC pipes, Steel pipes,
Tools	▪ Tape measure, Bit's kit, drill bits, bolts and nuts, t-joint, Screws drivers Kits, Allen key
Facilitation techniques	▪ Demonstration ▪ Individualized ▪ Trainer guided ▪ Group discussion
Formative assessment methods	▪ Written assessment ▪ Oral presentation ▪ Performance assessment

Learning outcome 2: Install solar water heater	**Learning hours: 10**

Indicative content

- **Selecting materials, tools and equipment of solar collectors and solar water tank**
  - ✓ Types of tools
  - ✓ Type of materials
  - ✓ Types of solar water heaters
  - ✓ Types of solar collectors
- **Fixing solar water tank and collectors**
  - ✓ Solar water heater stand
- **Connecting the tank water supply and collectors**
  - ✓ Cold water supply to the solar water heater
- **Connecting the outlet pipe from the solar water tank**
  - ✓ Types and sizes of pipes
  - ✓ Different methods of joining pipes
  - ✓ Hot water supply to the building
- **Laying the heat insulators around the pipes**
  - ✓ Type of insulators

Resources required for the indicative content

Equipment	▪ Solar water heater set, Drilling Machine, Heat gun, pipe joining machine, pipe bender machine, welding machine, Ladder, Drilling machine (fixed and hand), pipe bender machine, Welding machine

Materials	▪ Insulators, steel pipes, t-joint, PVC pipes, union joints.
Tools	▪ Tape measure, Bit's kit, drill bits, bolts and nuts, Screw Driver kit, Ladder, Spanners (open and closed spanners), Pipe wrench,
Facilitation techniques	▪ Demonstration ▪ Individual and group work ▪ Practical exercise ▪ Trainer guided ▪ Group discussion
Formative assessment methods	▪ Oral presentation ▪ Performance assessment

Learning outcome 3: Carry out test	**Learning hours: 10**
Indicative content	
• **Inspecting the water flow** ✓ Pressure gauge • **Testing the water leakage** ✓ Observation of leakage • **Testing the water temperature** ✓ Methods of testing	
Resources required for the indicative content	
Equipment	▪ Conductivity Meter, Thermometer, Compressor,
Materials	▪ Water, Smoke
Tools	▪ Liquid Expansion Thermometer, Thermocouples, Resistance Temperature Detector
Facilitation techniques	▪ Lectures ▪ Demonstration and simulation ▪ Practical exercise ▪ Trainer guided ▪ Group discussion
Formative assessment methods	▪ Written assessment ▪ Oral presentation

	▪ Performance assessment

Integrated/Summative assessment (For specific module)

Integrated situation

Fatima hotel is located in Musanze District, Cyuve Sector, Rwebeya Cell, needs to install three solar water heaters on their main building by using the Galvanized mild steel pipes. The solar water heaters are designated to deliver 900 litres.

- The first solar water heater supplies Manager office by using direct system
- The second solar water heater supplies staff room by using indirect system
- The third solar water heater supplies the presidential room by mixing 2 systems, direct and indirect

As solar water heater installer you are given the task to install these solar water heaters. Identify the materials, equipments and tools to be used, and perform installation of solar water heaters.

This task must be carried out within 5 hours

Resources

Tools	Tape measure, Bit's kit, drill bits, bolts and nuts, Screw Driver kit, Ladder, Spanners (open and closed spanners), Pipe wrench, t-joint, Screws drivers Kits, Allen key, Hammer Pipe wrench, Adjustable spanner, Water pliers, Hydraulic crimping pliers, hacksaw, chisel, hammer, Plumber tool kit, Cleaning cloth, Sponge
Equipments	Solar water heater set, Drilling Machine, Heat gun, pipe joining machine, pipe bender machine, welding machine, Ladder, First aid kit, water boost pump, Heat gun, Blower machine, Recycle bin, Overcoat and overall, Gloves, Safety shoes, Helmet, Earmuff, Nose protection mask, Brushes, Goggles, hose
Materials/ Consumables	Insulators, Metals for making support, PVC pipes, Steel pipes Union joints, T-Joint, Plug, Valve, Bolt, Nuts, Pipe elbows, , non-return valve, galvanized pipes , PPR pipes, Clips, Screws, water

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
		Tools selected			3

Learning outcome 1: (30%)	1.1.Materials, equipments and tools are properly selected according to the work to be done	Materials selected			3
		Equipments selected			3
	1.2.The materials for structural support are precisely prepared with respect to the design details	Materials prepared			3
	1.3.The structural support is accurately assembled and painted according to the design	Method of painting			3
		structural support painted			3
		structural support assembled			5
	1.4.The structural support is carefully fixed with respect to the proper inclination angle and orientation	methods of fixing the structural support			3
		the structural support fixed			4
Learning outcome 2: (50%)	2.1. Materials, equipments and tools are properly selected according to the size of solar collectors and solar water tank	equipments selected			3
		materials selected			3
		tools selected			3
	2.2. Solar water tank and collectors are correctly fixed on the prefabricated structural support according to the drawing	Solar water heater fixed			6
		Collectors fixed			6
	2.3.The tank water supply and collectors are accurately connecting	tank water supply connected			8
		Collectors connected			8
	2.4. The outlet pipe is accurately connected from the solar water tank to required destination with respect to the pipe length required	Outlet pipe connected			8
	2.5. .The heat insulators are adequately laid around the pipes considering minimum heat loss	heat insulators laid			5

Learning outcome 3: **(20%)**	3.1. The water flow is carefully inspected in line with desired water pressure.	water flow inspected			6
	3.2.The water leakage is carefully tested	Water leakage tested			6
	3.3.The water temperature is properly tested	Water temperature tested			8
Total marks		**100**			
Percentage Weightage		**100%**			
Minimum Passing line % (Aggregate): 70%					

References:

1. Solar Water Heating Systems in Georgia Prepared for: USAID/Caucasus
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4. http://audience.cerma.archi.fr/cerma/pageweb/theorie/solaire/rayont_solaire.html
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6. Calculation software for irradiation:
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8. http://iamest.jrc.it/pvgis/apps/pvest.php?lang=en&map=europe
9. Institut national de l'énergie solaire :
10. http://www.ines-solaire.com/outils.htm
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