



Republic of Rwanda
Ministry of Education



RTB | RWANDA
TVET BOARD

PNEUMATIC AND HYDRAULIC SYSTEMS INSTALLATION

ELTPH401

INSTALL PNEUMATIC AND HYDRAULIC SYSTEMS

Competence

RQF Level: 4

Learning Hours

Credits: 9



Sector: Energy

Trade: Electrical Technology

Module Type: Specific

Curriculum: ENGELT 4001-TVET Level 4 in Electrical Technology

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Purpose statement	This module describes the skills, Knowledge and attitude required to install pneumatic and hydraulic systems. Learner will be able to Perform pneumatic and hydraulic system pre- installation activities, install pneumatic and hydraulic systems and perform pneumatic and hydraulic post-installation activities. Learner will be also able to connect hydraulic-pneumatic components, to test Air/oil leakages, functionality of installation and to elaborate cost of whole installation.					
Learning assumed to be in place	Industrial Technical Drawing, Install Electrical Control Circuit and Accessories,					
Delivery modality	Training delivery		100 %	Assessment		Total 100%
	Theoretical content		30%	Formative assessment	30%	50%
	Practical work:		70%		70%	
	• Group work and presentation	30%				
	• Individual work	40%				
			Summative Assessment		50%	

Elements of competencies and performance criteria

Elements of competency	Performance Criteria
1. Perform pneumatic and hydraulic system pre- installation activities	1.1 Workplace is properly prepared according to the workplace preparation policy and procedures
	1.2 Tools, materials and equipment are properly selected according to the types and use
	1.3 Control and power circuit diagram is correctly drawn in accordance with pneumatic and hydraulic symbols and drawing technics.
	1.4 Control and power circuit diagram of pneumatic and hydraulic system are correctly simulated using simulation software
2. Install pneumatic system	2.1 Pneumatic system components are properly fixed according to the fixing technics and drawing elements of the Control and power circuit.
	2.2 The components of pneumatic system are correctly assembled based on joining technics and procedures.
	2.3 Pneumatic system is accurately tested according to the testing technics

	and pressure rating (parameters)
3. Install hydraulic system	3.1 Hydraulic system components are properly fixed according to the fixing technics and drawing elements of the Control and power circuit.
	3.2 Hydraulic system components are properly assembled according to assembling techniques and procedures
	3.2 Hydraulic system is accurately tested according to the testing technics and pressure rating (parameters)
4. Perform pneumatic and hydraulic post-installation activities	4.1 As-built diagram is correctly developed based on as-built diagram drawing procedures
	4.2 Workplace is properly rearranged according to the waste disposal procedures
	4.3 Cost is correctly estimated according to the cost estimation procedures

Intended Knowledge, Skills, and Attitude

Knowledge	Skills	Attitude
✓ Site assessment ✓ Technical drawing ✓ Tools, materials, and equipment ✓ Safety precautions ✓ Pneumatics and hydraulic machines ✓ Stands of machines ✓ Ways of fixing machines ✓ Control and power circuits for pneumatics and hydraulic machines	✓ Hand sketching ✓ Pneumatic and hydraulic machine installation ✓ Test electrical parameter of pneumatic and hydraulic installation ✓ Test air/oil leakage in pneumatic and hydraulic installation ✓ Interpret warning signage ✓ Elaboration of BOQ ✓ Reporting ✓ Develop as-built drawing	✓ Honest ✓ Polite ✓ Self-motivated ✓ Skilful ✓ Decisive ✓ Punctual ✓ Humble ✓ Patient ✓ Responsible ✓ Flexible ✓ Observant

✓ Electrical tests ✓ Oil/air leakage ✓ Piping in pneumatic and hydraulics ✓ Bill of material ✓ Market survey ✓ Budget estimation ✓ Running Parameters of the machine ✓ Warning signage ✓ As-built drawing ✓ Report elaboration		✓ Goal oriented ✓ Self-confident ✓ Attentive ✓ Cooperative ✓ Faithful
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Course content

Learning outcomes	At the end of the module the learner will be able to: 1. Perform pneumatic and hydraulic system pre-installation activities 2. Install pneumatic system 3. Install hydraulic system 4. Perform pneumatic and hydraulic post-installation activities
Learning outcome 1: Perform pneumatic and hydraulic system pre-installation activities	Learning hours: 20
Indicative content	

- **Workplace preparation**

- ✓ workplace preparation policy and procedures

- **Types of tools, materials and equipment used in installation of pneumatic and hydraulic systems**

- ✓ Types of tools, materials and equipment used in installation of pneumatic system
 - ✚ Description of tools (Toolkit, fittings, Drawing instruments, Grippers)
 - ✚ Description of materials (Oil, Lubricant, Accessories, Cleaning cloths and brush)
 - ✚ Description of equipment (Compressors, Pneumatic valves, Accumulators, Air service unit, Pneumatic actuators, Pneumatic sensors, Piping and plumbing fittings and other accessories)
- ✓ Types of tools, materials and equipment used in installation of hydraulic system
 - ✚ Description of tools (Toolkit, Hydraulic transfer hoses and fittings, Drawing instruments, Grippers)
 - ✚ Description of materials (Oil, Hydraulic flanges, Lubricant, Accessories, Cleaning cloths and brush)
 - ✚ Description of equipment (Reservoir, Pumps, Hydraulic valves, Filters, Hydraulic actuators)

- **Pneumatic and hydraulic symbols used to draw control and power circuit**

- ✓ Pneumatic symbols
- ✓ Hydraulic symbols

- **Simulating control circuits**

- ✓ Control and power circuit of pneumatic system
- ✓ Control and power circuit of hydraulic system
- ✚ automation studio

Resources required for the learning outcome

Equipment	Reservoir, Pumps, Hydraulic valves, Filters, Hydraulic actuators, Compressors, Pneumatic valves, Accumulators, Air service unit, Pneumatic actuators, Piping and plumbing fittings and other accessories, Hydraulic flow meter, Portable electrical drilling machine, Manometer, Gauges
Materials	Oil, Lubricant, Accessories, Cleaning cloths and brush, Paper
Tools	Toolkit, Hydraulic transfer hoses and fittings, Drawing instruments, Pens and pencils
Facilitation techniques	▪ Demonstration,

	▪ Individualised method, ▪ Simulations, ▪ Group discussion, ▪ Trainer guided, ▪ Practical exercises
Formative assessment methods I(CAT)	▪ Written evidence, ▪ Oral presentation, ▪ Performance evidence, ▪ Product evidence

Learning outcome 2: Install pneumatic system	Learning hours: 30
Indicative content	
• Fixation and drawing of pneumatic system components ✓ Pneumatic system drawings (Control and Power circuits) ✓ Fixing and joining technics of pneumatic system components • Assembling of pneumatic system components ✓ Pneumatic system hosepipe joining technique • Indirect control of pneumatic system installation ✓ actuators  Linear actuators  Rotary actuators ✓ Logic AND function pneumatic system installation  Linear actuators  Rotary actuators ✓ Logic OR function pneumatic system installation  Linear actuators  Rotary actuators ✓ Memory and speed control of pneumatic system installation  Linear actuators  Rotary actuators ✓ Time delay pneumatic system installation  Linear actuators  Rotary actuators ✓ Indirect control pneumatic system installation	

✚ Multiple actuators (Linear)

✓ Co-ordinated pneumatic system installation

✚ Linear actuators

• **Testing of pneumatic system components / parameters**

✓ Types of measuring/testing instruments used in pneumatic systems

✚ Pressure gauges

✚ Thermometers

✚ Viscometers

✚ Tachometers

Resources required for the learning outcome

Equipment	Computer, Multi-meter, Tachometer, Thermometer, Manometer, Head Protection, Eye and Face Protection, Hearing Protection, Respiratory Protection, Hand Protection, Foot Protection, Body Protection., Fall Protection, Skin Protection, First aid, Compressor, Valves, Actuators, Miscellaneous
Materials	Fuses, Wires, Nut, Bolt, cable clips, Insulators, Welding holder, grease, lubricants, scotches, markers, pipes and hoses, pipe fittings, Switch box, Junction boxes, Spring, Female plugs, Male Plugs, Extension Cords, Drill bits, wall plugs, clips, Pneumatic Hose pipe, Charcoal, pneumatic joints.
Tools	Wires tripping pliers, Side cutter pliers, Combination pliers, long nose pliers, Spirit level, Tape measure, Steel rulers, Star screw driver, Flat screw driver, Hand drilling machine, Electric screw driver, Crimping tools, Electrical hammer, Claw hammer, Ball pen hammer, Mallet hammer, Spring bender, Hack saw, Electrician knife, Allen key, Still Brushes, Span, Scissor, Vanier caliper.
Facilitation techniques	▪ Demonstration, ▪ Individualised method, ▪ Simulations, ▪ Group discussion, ▪ Trainer guided, ▪ Practical exercises
Formative assessment methods /(CAT)	▪ Written evidence, ▪ Oral presentation, ▪ Performance evidence, ▪ Product evidence

Learning outcome 3: Install hydraulic system

Learning hours: 30

Indicative content

- **Fixation and drawing of hydraulic system components**
 - ✓ Hydraulic system drawings (Control and Power circuits)
 - ✓ Fixing and joining technics of hydraulic system components
- **Assemble hydraulic system components**
 - ✓ Direct control of hydraulic system installation
 -  Linear actuators
 -  Rotary actuators
 - ✓ Indirect control of hydraulic system installation
 -  Linear actuators
 -  Rotary actuators
 - ✓ Logic AND function hydraulic system installation
 -  Linear actuators
 -  Rotary actuators
 - ✓ Logic OR function hydraulic system installation
 -  Linear actuators
 -  Rotary actuators
 - ✓ Memory and speed control of hydraulic system installation
 -  Linear actuators
 -  Rotary actuators
 - ✓ Time delay hydraulic system installation
 -  Linear actuators
 -  Rotary actuators
 - ✓ Indirect control hydraulic system installation
 -  Multiple actuators (Linear)
 - ✓ Co-ordinated hydraulic system installation
 -  Linear actuators
- **Testing of hydraulic system components and parameters**
 - ✓ Types of measuring/testing instruments used in hydraulic systems

-  Pressure gauges
-  Thermometers
-  Hydraulic Flow Meters
-  Viscometers
-  Tachometers

Resources required for the learning outcome

Equipment	Computer, Multi-meter, Tachometer, Thermometer, Manometer, Head Protection, Eye and Face Protection, Hearing Protection, Respiratory Protection, Hand Protection, Foot Protection, Body Protection., Fall Protection, Skin Protection, First aid, Compressor, Valves, Actuators, Miscellaneous
Materials	Fuses, Wires, Nut, Bolt, cable clips, Insulators, Welding holder, grease, lubricants, scotches, markers, pipes and hoses, pipe fittings, Switch box, Junction boxes, Spring, Female plugs, Male Plugs, Extension Cords, Drill bits, wall plugs, clips, Charcoal,
Tools	Wire stripping plier, Side cutter plier, Combination plier, long nose plier, Spirit level, Tape measure, Steel rulers, Star screw driver, Flat screw driver, Hand drilling machine, Electric screw driver, Crimping tools, Electrical hammer, Claw hammer, Ball pen hammer, Mallet hammer, Spring bender, Hack saw, Electrician knife, Allen key, Still Brushes, Span, Scissor, Vanier caliper
Facilitation techniques	▪ Demonstration, ▪ Individualised method, ▪ Simulations, ▪ Group discussion, ▪ Trainer guided, ▪ Practical exercises
Formative assessment methods I(CAT)	▪ Written evidence, ▪ Oral presentation, ▪ Performance evidence, ▪ Product evidence

Learning outcome 4: Perform pneumatic and hydraulic post-installation activities		Learning hours: 10	
Indicative content			
• Developing as-built diagram ✓ As-built drawing procedures • The waste disposal procedures were followed to rearrange workplace ✓ Main groups of waste ✓ Steps necessary to properly manage waste (identify, evaluate and manage) • cost estimation ✓ Elements of bill of quantity (BOQ) ✓ BOQ table			
Resources required for the learning outcome			
Equipment	Computer		
Materials	Papers, Marker pen		
Tools	Pencils, Calculator		
Facilitation techniques	▪ Demonstration, ▪ Individualized, ▪ Trainer guided, ▪ Group discussion, ▪ Practical exercises		
Formative assessment methods /(CAT)	▪ Written assessment, ▪ Oral presentation, ▪ Performance assessment		

Integrated/Summative assessment

Integrated situation

BRALIRWA plc is required to hire technician who is responsible of installing new electro pneumatic/electro hydraulic which can help in packaging operations, as electrician you are hired to perform this task, some materials and equipment are available in logistics' store include magnetic sensors and push buttons. Prepare missing tools, materials and equipment needed to perform the task. The owner was advised to consider the cost when pneumatic or hydraulic system is used and decide accordingly, two linear actuators

are recommended. You as Electrician you are requested to draw helpful diagram and install the system. This task must be carried out within 12 hours.

Resources

Equipment	Computer, Compressor, Hydraulic pump, Hydraulic Flow Meters, Portable Electrical drilling machine, Linear actuators, Hydraulic reservoir, Electrical motors, Accumulator, Sensors, Manometer, Valves, Gauges, Filter, Regulator, Lubricator
PPE	Safety glass, Face shield, Safety shoes, insulating (rubber) gloves, Insulating sleeves, Hard hats, Flame-resistant (FR) clothing
Tools	Electromechanical toolkit, Hydraulic Transfer Hoses and Fittings, Drawing tools, Grippers
Materials/Consumables	Oils, Hydraulic Flanges, and Valves, lubricant, Couplings, Accessories, Cleaning cloth / brush

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
1. Perform pneumatic and hydraulic system pre-installation activities (25%)	1.1.Workplace is properly prepared according to the workplace preparation policy and procedures	Policies of preparing work place are well applied			2
		Procedures of preparing work place are well followed			2
	1.2.Tools, materials and equipment are properly selected according to the types and use	Tools description are well described			3
		Materials are well described			3
		Equipment is well described			3
	1.3.Control and power circuit diagram is correctly drawn in accordance with pneumatic and hydraulic symbols and drawing technics.	Pneumatic symbols are well drawn			3
		Hydraulic symbols are well drawn			3

	1.4. Control and power circuit diagram of pneumatic and hydraulic system are correctly simulated using simulation software	Control and power circuit of pneumatic system are properly simulated			3
		Control and power circuit of hydraulic system are properly simulated			3
2. Install pneumatic system (30%)	2.1. Pneumatic system components are properly fixed according to the fixing techniques and drawing elements of the Control and power circuit.	Pneumatic system components are well fixed and joined			2
		Control and Power circuits are well interpreted			3
	2.2. The components of pneumatic system are correctly assembled based on joining techniques and procedures.	Direct control of pneumatic system installation was correctly done			2
		Indirect control of pneumatic system installation was correctly done			2
		Logic AND function of pneumatic system installation was properly done			3
		Logic OR function pneumatic system installation was properly done			3
		Memory and speed control of pneumatic system installation was correctly done			3
		Time delay pneumatic system installation was done			3
		Indirect control pneumatic system installation was correctly done			3
		Co-ordinated pneumatic system installation was correctly done			2
	2.3. Pneumatic system is accurately tested according	Pneumatic measuring			2

	to the testing technics and pressure rating (parameters)	instruments are well used			
		Pneumatic testing instruments are well used			2
3. Install hydraulic system	3.1.Hydraulic system components are properly fixed according to the fixing technics and drawing elements of the Control and power circuit.	Hydraulic system components are well fixed and joined			2
		Control and Power circuits are well interpreted			3
	3.2 hydraulics system components are properly assembled according to assembling technics and procedures	Direct control of hydraulic system installation was correctly done			2
		Indirect control of hydraulic system installation was correctly done			2
		Logic AND function hydraulic system installation was properly done			3
		Logic OR function hydraulic system installation was properly done			3
		Memory and speed control of hydraulic system installation was correctly done			3
		Time delay hydraulic system installation was done			3
		Indirect control hydraulic system installation was correctly done			3
		Co-ordinated hydraulic system installation was correctly done			2
	3.2.Hydraulic system is accurately tested according to the testing technics and pressure rating (parameters)	hydraulic measuring instruments are well used			2
		hydraulic testing instruments are well used			2
4. Perform pneumatic and hydraulic	4.1.As-built diagram is correctly developed based on as-built diagram drawing procedures	As-built drawing procedures are properly followed			3

post-installation activities (15%)	4.2.Workplace is properly rearranged according to the waste disposal procedures	Waste is correctly grouped			3
		Steps of managing waste were correctly followed			3
	4.3.Cost is correctly estimated according to the cost estimation procedures	Cost estimation objectives were properly achieved			3
		Cost estimation was correctly prepared			3
Total marks		100			
Percentage Weightage		100%			
Minimum Passing line % (Aggregate): 70%					

List of abbreviations

1. **RQF:** Rwanda Qualification Frame work
2. **TVET:** Technical and Vocational Education and Training
3. **PPE:** Personal Protective Equipment
4. **FR:** Flame resistor
5. **CAT:** Continuous Assessment Tests
6. **CAD:** Computer Aided Design

References

1. Reference books: 1. Hydraulic, valves, pumps and accumulators, Q.S. Khan
2. Festo, hydraulics basic level textbook, D. Merkle, B.Schrader, M.Thomes, 2003
3. Basic pneumatics, Jay F.Hooper, 2003
4. Willeck G.K; 1954: Basic Electricity
5. <http://www.ignou.ac.in/upload/Unit-2-62.pdf>
6. <https://readymag.com/ordermanagement/top-10-best-order-management-system-2016/>
7. <http://www.mathsisfun.com/measure/error-measurement.html>

Glossary

Activity: Activities include releases, events, and deployment plans that you develop, start, and complete with the product.

Learning outcomes: Statements that indicate what learners will know or be able to do as a result of a learning activity. Learning outcomes are usually expressed as knowledge, skills, or attitudes.

Learning hours: Amount of hours required to acquire the competency, including the time allocated to evaluation, which is estimated between 5 and 10% of the total learning time of the competency.

Control circuit: is a special type of circuit used to control the operation of a completely separate power circuit

Power circuit is an interconnected set of components that convert compressed gas (usually air) into mechanical work

Hosepipe: is a preconfigured hose connection and consists of the hose and the connected fittings and valves

Actuator: is a device that produces a motion by converting energy and signals going into the system. The motion it produces can be either rotary or linear

Linear actuator: is a means for converting rotational motion into push or pull linear motion.

Pneumatic linear actuators use compressed air to convert energy into mechanical motion. They consist of a piston, cylinder, and valve or port, which can produce linear or rotary mechanical motion.

Hydraulic actuator: is a device that is used to change the fluid's pressure energy into mechanical

Knowledge: means the result of the adoption of information through the learning process. Knowledge is a set of facts, principles, theories and practices related to area of work or study. In CBE context lifelong learning knowledge is described as theoretical and / or factual

Skills: are the ability to apply knowledge and use the principle of “know how” to perform a specific task and to solve the problem. In the context of the CBE Framework, skills are defined as cognitive (involving the use of logical, intuitive and creative thinking), practical (including physical skill and use of methods, materials, devices and instruments) and social skills (communication and cooperation skills, emotional intelligence and other

Pneumatic: is an aspect of physics and engineering that is concerned with using the energy in compressed gas to make something move or work.

Pneumatic system: is a collection of interconnected components using compressed air to do work for automated equipment

Credit: The acknowledgement that a person has satisfied the requirements of a module.

Duration: The time a task takes to run. Duration is measured from the time a task starts until it is resolved. When you create

Learning activities: Suggested activities that can be developed during lesson planning and activity preparation. The choice of learning activities must be tailored according to group size

Assessment: A process of gathering and judging evidence in order to decide whether a person has attained a standard of performance.

Delivery modality: describes various methods or formats in which training programs are delivered to participants.

Installation guide is a document or set of instructions that provides detailed information and guidance on how to correctly install and set up a particular product, system, or software. It serves as a reference for users or technicians, outlining the necessary steps, procedures, and requirements for a successful installation process. The installation guide typically includes information on safety precautions, system requirements, step-by-step instructions, troubleshooting tips, and any additional resources or support available. Its purpose is to help users navigate through the installation process effectively, ensuring that the product or system is properly installed and ready for use