

PNEUMATIC SYSTEM INSTALLATION AND MAINTENANCE

UNIT CODE: 0714 451 14A

TVET CDACC UNIT CODE: ENG/CU/IA/CR/03/5/MA

Relationship to occupational standards

This unit addresses the unit of competency: Install and maintain pneumatic systems

Duration of unit: 220 hours.

Unit description

This unit covers the competencies required in installation and maintenance of pneumatic systems. These competencies include; applying knowledge of perfect gases, operating air compressors, conducting pneumatic system site survey, planning pneumatic system installation and installing pneumatic system and maintaining pneumatic systems.

Summary of learning outcomes

By the end of the unit of learning, the trainee will be able to;

S/No	Learning Outcome	Duration (Hrs.)
1	Apply knowledge of perfect gases	10
2	Operate air compressors	10
3	Conduct pneumatic system site survey	30
4	Plan pneumatic system installation	50
5	Install pneumatic systems	70
6	Maintain pneumatic systems	50
	TOTAL	220 HRS

Learning outcomes, content and suggested assessment methods

Learning outcome	Content	Suggested assessment methods
1. Apply knowledge of perfect gases	1.1 Laws of perfect gases 1.1.1 Boyle's law 1.1.2 Charles' law 1.1.3 Gay-Lussac law 1.1.4 Joule's law 1.1.5 Avogadro's law 1.2 General gas equation 1.2.1 Derive and apply general gas equation $PV=mRT$ 1.3 Characteristic equation of gas 1.3.1 Application in engineering calculations 1.4 Universal gas constant 1.4.1 Define universal gas constant 1.4.2 Apply universal gas constant equation in engineering calculation 1.5 Specific heat 1.5.1 Constant volume 1.5.2 Constant pressure	Written tests

2. Operate air compressors	2.1 Classification of air compressors 2.1.1 According to working 2.1.2 According to action 2.1.3 According to number of stages 2.2 Single stage reciprocating air compressor 2.2.1 Work done by a single stage reciprocating air compressor without clearance volume 2.3 Work done during 2.3.1 isothermal compression 2.3.2 polytropic compression ($PV^n = \text{Constant}$) 2.3.3 isentropic compression 2.4 Power required to drive a single-stage reciprocating air compressor 2.4.1 Calculations 2.5 Work-done by reciprocating air compressor with clearance volume 2.5.1 Calculations 2.5.2 Determine multistage compression 2.6 Power required to drive a two-stage reciprocating air compressor 2.7 Minimum work required for a two-stage reciprocating air compressor	• Written tests
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3. Conduct pneumatic system site survey	3.1 Identifying site survey aspects. 3.1.1 User requirements 3.1.2 System requirements. 3.1.3 Space and layout considerations. 3.1.4 Environmental conditions 3.1.5 Safety regulations and standards. 3.1.6 Air quality assessment. 3.1.7 Compatibility with existing systems 3.2 Assembling site survey tools and equipment 3.2.1 Classification of tools and equipment 3.2.2 Uses of tools and equipment 3.3 Performing the site survey 3.3.1 Conducting measurements and evaluations. 3.3.2 Documenting site conditions 3.4 Generating the site survey report 3.4.1 Compiling findings. 3.4.2 Presenting data according to workplace procedures	• Project • Practical • Third party report • Portfolio of evidence • Written tests • Oral questioning
4. Plan pneumatic system installation	4.1 Pneumatic system design 4.1.1 Pneumatic system components. • Compressors, valves, actuators, and filters	• Project • Practical • Third party report • Portfolio of evidence • Written tests • Oral questioning

	• Types of pneumatic cylinders (single-acting, double-acting) 4.1.2 System design • Circuit design principles • Sizing and selecting components 4.1.3 Factors to consider while designing Pneumatic system layout. 4.1.4 Design of Pneumatic system layout. 4.2 Operation and Control 4.2.1 System Operation • Basics of pneumatic control • Flow control and pressure regulation 4.2.2 Automation in pneumatics • Introduction to electronic controls • Integration with PLCs and other control systems 4.3 Pneumatic system installation workplan 4.3.1 Pre-installation planning (objectives, scope, timeline, and assign roles) 4.3.2 Site preparation 4.3.3 Delivery & inspection 4.3.4 Mechanical installation	
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	4.3.5 Electrical installation 4.3.6 Software installation & configuration 4.3.7 I/O and communication testing 4.4 Pneumatic system supplies 4.4.1 Types of pneumatic system supplies • Pressure gauges • Vacuum gauges • Pressure regulators • Pipes and tubes • Connectors • Air compressors • Control valves • Dryers • Pneumatic system reservoir • Enclosures • Fittings • Safety valves 4.4.2 Interpretation of pneumatic system design symbols. 4.4.3 Uses of pneumatic system supplies. 4.4.4 Safety precautions to undertake while handling pneumatic system supplies. 4.5 Practice: Plan pneumatic system installation	
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5. Install pneumatic system	5.1 PPE 5.1.1 Types of PPE. • Helmet • Hand gloves • Safety shoes • Harness • Safety goggles 5.1.2 Uses of PPE 5.2 Pneumatic system piping installation. 5.2.1 Types of joints. 5.2.2 Pneumatic system fittings 5.2.3 Tools and equipment. 5.2.4 Interpretation of installation layout. 5.3 Mounting pneumatic system accessories and equipment 5.3.1 Accessories 5.3.1.1 Couplers 5.3.1.2 Check valves 5.3.1.3 Flow meters 5.3.1.4 Pressure gauges 5.3.1.5 Installation valves 5.3.2 Equipment 5.3.2.1 Pneumatic valves 5.3.2.2 Pneumatic cylinders 5.3.2.3 Compressors 5.3.2.4 Pneumatic pumps 5.3.2.5 Positioners 5.4 Pneumatic system test	• Project • Practical • Third party report • Portfolio of evidence • Written tests • Oral questioning
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	5.4.1 Functionality test 5.4.2 Leakage test 5.4.3 Pressure test 5.4.4 Air quality test 5.4.5 Flow rate test 5.5 Calibration of pneumatic control 5.5.1 System parameters 5.5.2 Pneumatic system accessories Calibration against system parameters. 5.5.2.1 Control valve 5.5.2.2 Pressure gauges 5.5.2.3 Flow metres 5.6 House Keeping and waste disposal 5.7 Practice: Install pneumatic system installation	
6. Maintain pneumatic systems	6.1 Pneumatic system maintenance 6.1.1 maintaining pneumatic system. 6.2 PPE Usage 6.2.1 Helmet 6.2.2 Hand gloves 6.2.3 Safety shoes 6.2.4 Harness 6.2.5 Safety goggles 6.3 Uses of pneumatic system maintenance tools, equipment and spares 6.3.1 Tools 6.3.1.1 Tape measure	• Project • Practical • Third party report • Portfolio of evidence • Written tests • Oral questioning

	6.3.1.2 Laser distance meter 6.3.1.3 Camera 6.3.1.4 Flow meters 6.3.1.5 Pressure gauges 6.3.1.6 Stationery 6.3.1.7 Infrared thermometer 6.3.1.8 Ladder 6.3.1.9 Flashlight 6.3.1.10 Leakage testers 6.3.1.11 Hand tools 6.3.2 Equipment 6.3.2.1 Air analyzers 6.3.2.2 Ladder 6.4 Pneumatic system maintenance tasks • Inspection • Testing and measurements • Air quality check • Pressure check • Cleaning • Tightening • Replacing components • Replacing consumables 6.5 Maintenance report 6.6 Practice 6.6.1 Hands-on Installation and Maintenance 6.6.2 Practical exercises in installing pneumatic systems 6.6.3 Simulated troubleshooting scenarios	
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	6.7 Project Work 6.7.1 Group projects on designing and implementing a pneumatic system 6.7.2 Presentation of project outcomes and experiences	
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Suggested delivery methods

- Group discussions
- Demonstration by trainer
- Online videos
- Power point presentation

Recommended resources for 25 trainees

S/No.	Category/item	Description/specifications	Quantity	Recommended ratio (item: trainee)
A	Tools			
1.	Multimeters	For measuring voltage, current, and resistance	25 pcs	1:1
2.	Clamp meters	For measuring electrical current	5 pcs	1:5
3.	Power analyzers	For analyzing power quality and consumption	5 pcs	1:5
4.	Thermal imaging cameras	For visualizing heat patterns and identifying issues	5 pcs	1:5
5.	Wrenches	For tightening and loosening fasteners	4 pcs	4:25
6.	Screwdrivers	For driving screws; various types included	5 pcs	1:5
7.	Pliers	For gripping and bending wires	5 pcs	1:5
8.	Hex Keys	For hexagonal screws and bolts	5 pcs	1:5
9.	Cutters	For cutting wires and cables	5 pcs	1:5

10.	Tape measures	For measuring lengths and distances	5 pcs	1:5
11.	Calipers	For measuring internal and external dimensions	5 pcs	1:5
12.	Alignment lasers	For precise alignment of components	2 pcs	2:25
13.	Plumb bobs	For vertical alignment in installations	5 pcs	1:5
B	Learning facilities & infrastructure			
14.	Lecture/theory room	Approximately 60 sqm	1	1:25
15.	Workshop	Approximately 80 sqm	1	1:25
16.	Laboratory	Approximately 80 sqm	1	1:25
C	Materials and supplies			
17.	Pressure gauges	For measuring pressure in pneumatic systems	25 pcs	1:1
18.	Vacuum gauges	For measuring vacuum levels in systems	25 pcs	1:1
19.	Pressure regulators	For controlling and regulating pressure	25 pcs	1:1
20.	Pipes and tubes	For various pneumatic and hydraulic applications	100 pcs	4:1
21.	Connectors	For connecting pipes and tubes	100 pcs	4:1
22.	Air compressors	For supplying compressed air for pneumatic tools	25 pcs	1:1

23.	Valves	For controlling the flow of fluids in systems	25 pcs	1:1
24.	Enclosures	For housing electrical and mechanical components	25 pcs	1:1
25.	Fittings	For connecting different sections of pipes and tubes	25 pcs	1:1
26.	Safety valves	For ensuring safety in pressure systems	25 pcs	1:1
27.	Pneumatic cylinders	Single/ double	10 pcs	2:25
28.	Sensors	Assorted	10 pcs	2:25
29.	Controllers	Controlling automatic pneumatics system	5 pcs	1:5
D	Equipment			
30.	Safety glasses	Eye protection for all trainees	25 pcs	1:1
31.	Gloves	Hand protection during training and operations	25 pairs	1:1
32.	Hearing protection	To safeguard against loud noises	25 pcs	1:1
33.	Hard hats	Head protection while working	25 pcs	1:1
34.	Oscilloscopes	For visualizing electrical signals	2 units	2:25
35.	Megohmmeters	For testing insulation resistance	5 units	1:5
E	Miscellaneous			

36.	Lubricating equipment	For maintaining smooth operation of mechanical components	1 unit	1:25
37.	Vacuum pump	For creating a vacuum for testing and operations	1 unit	1:25
F	Reference materials			
38.	Component and equipment manuals	Comprehensive guides on all tools and equipment	Adequate	
39.	Pneumatic system installation manuals	For proper setup and maintenance of pneumatic systems	Adequate	
40.	Other reference materials	Journals, past papers, and online resources for further study	Adequate	