PUNJAB BOARD OF TECHNICAL EDUCATION

21-A, Kashmir Block Allama Iqbal Town, Lahore

www.pbte.edu.pkTel # 042-99260273 email: rnd.pbte@gmail.com

SAY NO TO CORRUPTION

No: PBTE/R&D/2026/21 Dated: 28-01-2026

NOTIFICATION

In pursuance of the NAVTTC Notification No. (D.G) (SS&C)/2021-QD-1 dated 26.11.2025, it is notified that the newly developed curricula of the following short courses have been approved by National Vocational & Technical Training Commission (NAVTTC) for their implementation with immediate effect in all institutes affiliated with PBTE.

- Advance Health Safety, Environment & Fire Safety Officer (6-months Course)
- Heat Exchanger Maintenance Technician (6-Months Course)
- Quality Assurance & Quality Control Technician (3-Months Course)
- Fabrication Supervisor (3-Months Course)
- Pressure Vessel Maintenance Technician (3-Months Course)

Soft copy of the curricula of the said courses may be downloaded from the website of PBTE i.e. www.pbte.edu.pk/textbooks.html.

SECRETARY

CC to:

1- PS to Chairperson PBTE, Lahore.
2- PA to Secretary PBTE, Lahore.
3- PA to Controller of Examinations PBTE, Lahore.
4- PA to DG Academics TEVTA, Lahore.
5- PA to DG Operations TEVTA, Lahore.
6- The Principals concerned.
7- Deputy Controller of Examinations (Conduct) PBTE, Lahore
8- Deputy Controller of Examinations (Secrecy) PBTE, Lahore.
9- System Analyst PBTE, Lahore.
10-Assistant Controller of Examinations (Technical) PBTE, Lahore.
11-Assistant Controller of Examinations (Conduct) PBTE, Lahore.
12-Assistant Controller of Examinations (Secrecy) PBTE, Lahore.
13-Assistant Controller of Examinations (P&P-I) PBTE, Lahore.
14-Assistant Controller of Examinations (P&P-II) PBTE, Lahore.
15-Assistant Secretary (Recognition) PBTE, Lahore.
16-IPS PBTE, Lahore.
17-IOW PBTE, Lahore.
18-Web Administrator PBTE, Lahore to upload on website of PBTE.
19-Notification File.

HEAT EXCHANGER MAINTENANCE TECHNICIAN

06 Months Course





MANSOL TECHNICAL TRAINING SERVICES (PVT) LTD

E-210 Gulshan Ali Colony, New Airport Road, Lahore Cantt.

T: +92 42 37169399 E: mtti@mansol.com.pk W: www.mansol.com.pk

Training Objective

The prime objective of this course of Heat Exchanger Maintenance Technician is to develop and enhance the skill level of the incumbent in this trade of construction industry.

Semi-skilled and skilled worker produced by this training would help to reduce unemployment and poverty in the society. This curriculum is designed to train the Matric / Intermediate / DAE or above qualification pass persons who are facing a lot of problems to do the work as Heat Exchanger Maintenance Technician in the field of construction industry.

This training program will provide opportunity to those who want to equip themselves with such knowledge and skills which will be helpful for their employment after completing this training of 06 months and would enable them to start their own business with professional approach.

Further, this Curriculum is developed by considering the requirements of local and international market and need of the trade enabling the pass-outs to meet the job market to reduce the shortage of Semi-Skilled and Skilled workers in the area.

CURRICULUM SALIENTS:

Entry Level	Matric
Total Duration of Course	06-Months (24 Weeks)
Total Training Hours	800 hrs 6.7 hrs / Day 33.5 hrs / week
Training Methodology	80 % Practical 20 % Theory
Instructional Media	Urdu / English

SKILL PROFICIENCY DETAILS

After completion of the course, the trainee must be able to:

1. Observe all safety precautions regarding tools, equipment, and work environment.
2. Use common working hand tools (measuring, tightening, leveling, chiseling tools) efficiently and maintain them properly.
3. Operate power tools such as grinders and drill machines safely and accurately.
4. Maintain and handle equipment like cutting machines, grinders, and drill machines effectively.
5. Identify commonly used metals and distinguish between good and defective materials.
6. Mark flanges and gaskets as per engineering drawings and perform fabrication accordingly.
7. Use various fasteners including screws, nuts, bolts, and studs correctly.
8. Install and secure gaskets for proper sealing and fit.
9. Perform finishing, filing, and cleaning of metal surfaces with precision.
10. Join metals using methods such as bolting, welding, and temporary joints.
11. Apply proper tightening and loosening techniques for flanges, valves, bends, and pipelines.
12. Assemble and dismantle components of a heat exchanger following technical procedures.
13. Interpret basic technical drawings related to heat exchangers and associated piping.
14. Inspect and test heat exchanger parts for wear, leaks, or misalignment.
15. Follow shutdown and maintenance procedures for heat exchanger systems as per standard practices.

KNOWLEDGE PROFICIENCY DETAILS

After completion of the course, the trainee would have gained knowledge about:

1. Understand applicable safety precautions when working with hand tools, power tools, and heat exchanger equipment.
2. Identify and explain common types of materials used in heat exchanger fabrication and maintenance.
3. Describe the function and usage of common marking and measuring tools.
4. Understand the types and applications of grinders, cutting tools, and gripping tools used in heat exchanger work.
5. Recognize and discuss different types of fasteners, screws, studs, nuts, and other hardware used in assembly.
6. Explain finishing techniques including filing, grinding, and surface priming or painting.
7. Understand the function of various flanges, valves, fittings, and gaskets, along with correct tightening and loosening procedures.
8. Describe different types of heat exchangers (e.g., shell and tube, plate type) and their applications.
9. Explain the purpose and use of hand tools, power tools, and pneumatic tools in maintenance and assembly work.
10. Understand basic procedures involved in maintenance, inspection, and minor repair of heat exchanger systems.
11. Explain rigging activities, lifting techniques, and safety measures involved.
12. Discuss the importance of hydro jetting in cleaning and maintenance operations.
13. Understand different types of work permits and their role in safe job execution (e.g., hot work permit, confined space permit).
14. Explain the step-by-step process of dismantling and assembling heat exchangers for maintenance.
15. Describe basic concepts of pressure, temperature, and flow as applied to heat exchanger performance.
16. Understand corrosion types and prevention methods relevant to exchanger components.
17. Discuss the role of alignment and torque control in flange and gasket installations.
18. Identify inspection points and parameters for ensuring operational safety and efficiency of heat exchanger

Scheme of Study

Heat Exchanger Maintenance Technician
(06-Months Course)

Sr. No	Main Topics	Theory Hrs.	Practical Hrs.	Total Hrs.
1	**Introduction to Heat Exchanger**	20	80	100
2	**Safety & work Environment protocols**	20	80	100
3	**Types and Applications of Heat Exchangers**	24	96	120
4	**Mechanical Design of Heat Exchangers**	24	96	120
5	**Operation and Maintenance of Heat Exchangers**	26	104	130
6	**Performance Enhancement and Optimization of Heat Exchangers**	26	104	130
7	**Water Treatment Techniques**	20	80	100
	TOTAL	**160**	**640**	**800**

Detail of Course Contents

Heat Exchanger Maintenance Technician
(06-Months Course)

Sr. No	Main Topics	Theory Hrs.	Practical Hrs.	Total Hrs.
1	**A- Introduction to Heat Exchanger** **1. Introduction to Heat Exchanger** A heat exchanger is a device that used for heat transfer between multiple fluids without direct mixing. These exchangers are crucial for efficiently transferring heat between different fluids. It is also used for transfer heat for cooling a hot fluid or heating a cold one. **2. Modes of Heat Exchanger** There are three modes of Heat Exchanger for heat transfer: • **Conduction:** Conduction involves heat transfer through direct contact of materials. • **Convection:** Convection involves heat transfer through the movement of fluids. • **Radiation:** Radiation involves heat transfer through Electro Magnetic Waves. In Heat Exchanger these three modes work together. • **Basic thermal principles:** • Basic thermal principles involve how heat moves and thermal energy is transferred between objects with different temperatures. • The main Basic Principles are: Conduction, Convection, and Radiation. • **Importance & Application of Heat Exchanger:** • Heat Exchanger is an important device which is used for Heat	20	80	100

	Transfer between two or more fluids without direct contact with good energy efficiency. • Their applications range from heating and cooling in refining oil. • Heat Exchangers are designed in various configurations and sizes, allowing for their application in light and heavy Industries. • Efficient energy utilization and heat recovery reduce the need of additional fuel, leading to lower Greenhouse gas emissions.			
2	**B - Safety & work Environment protocols** • Personal safety & PPE • Work safety ethics and rules • Shutdown process • Confined space entry and ventilation • Testing (NDT & DT)	20	80	100
3	**C- Types and Applications of Heat Exchangers** • Heat Exchanger Types and Applications: Choice of Working Fluid • Heat Transfer Fundamentals and Heat Transfer Rates • Heat Exchanger Elements: Tube Bundles, Tube Sheets, Baffles and Nozzles • TEMA Nomenclature of Shell & Tube Heat Exchangers (STHE) • Air Cooled Heat Exchangers (ACHE) and Plate Heat Exchangers (PHE) • Condensers, Evaporators and Reboilers	24	96	120

4	**D- Mechanical Design of Heat Exchangers** • Mechanical Design of Heat Exchangers • Calculation of Basic Elements of STHE • Piping Loads on Exchanger Nozzles • Material selection and Construction of Heat Exchangers • Fabrication Technologies of Heat Exchangers • Workshop: Case Studies, Examples & Solutions	24	96	120
5	**E- Operation and Maintenance of Heat Exchangers** • Fouling and scaling in tubes and shells: Problem Solutions and Remedies • Inspection Techniques of Vital Elements of Heat Exchangers • Corrosion & Erosion Reduction Techniques, Fitness for Service Analysis (FFS) • Control in Operation: Tube Vibration & Troubleshooting • Cleaning, Maintenance and Repair Techniques: Tube Plugging and Re-tubing • Workshop: Case Studies, Examples & Solutions	26	104	130
6	**F- Performance Enhancement and Optimization of Heat Exchangers** • Performance Monitoring and Testing • Performance Validation • Heat Transfer Augmentation Techniques • Tubes with external and internal fins • Heat Integration Basics: Pinch Technology • Workshop: Case Studies, Examples and Solutions	26	104	130
7	**G- Water Treatment Techniques**	20	80	100

	• High Pressure Cleaning (Hydro Jetting) • Water Filling • Hydro testing • Leak Test			
	TOTAL	160	640	800

List of Practical's

Sr	Description of Practical
1	**Preparation and installation of Scaffolding on Heat Exchanger** Students will prepare and install scaffolding around the heat exchanger under proper supervision, ensuring that all safety procedures, height work guidelines, and scaffold inspection requirements are followed before starting maintenance activities.
2	**Isolation of Heat Exchanger** Students will isolate the heat exchanger by identifying and closing relevant inlet and outlet valves, applying lockout/tagout (LOTO) procedures, and verifying zero energy state prior to disassembly.
3	**Removal of Cover & Channel Head** Students will safely remove the heat exchanger cover and channel head using proper tools and lifting equipment, ensuring that all bolts, gaskets, and components are handled carefully to prevent damage or contamination.
4	**Bundle pulling and High Pressure (HP) cleaning** Students will perform tube bundle pulling operations using mechanical or hydraulic bundle pullers, followed by high-pressure water jet cleaning to remove deposits and scale, maintaining safe working distance and PPE compliance.
5	**Confined Space Entry / Exit of Heat Exchanger Shell** Students will demonstrate proper confined space entry and exit procedures, including atmospheric testing, use of entry permits, ventilation, and standby personnel, to ensure safety during internal inspection and cleaning.
6	**Internal Cleaning & Final Inspection of Inside Shell** Students will carry out manual cleaning and visual inspection of the internal shell surfaces, identifying corrosion, fouling, or damage, and documenting inspection findings for instructor verification.
7	**Re-Installation of Tube Bundle / Channel Head** Students will reinstall the tube bundle and channel head by aligning flanges, replacing gaskets, tightening bolts to specified torque, and confirming correct assembly sequence as per maintenance standards.
8	**Leak Test Shell & Tube Side & Final Box up** Students will perform a leak test on both shell and tube sides using approved methods (air or hydrostatic) to verify integrity, followed by final tightening, boxing-up, and re-fitting of covers.
9	**De-blinding & House Keeping** Students will remove all blinds and temporary connections safely, ensuring system restoration to normal configuration and performing thorough housekeeping to leave the worksite clean and hazard-free.

10	**Hydro Testing** Students will conduct hydrostatic testing of the heat exchanger at the specified test pressure under supervision, recording pressure readings, checking for leaks, and ensuring compliance with safety and inspection standards.

List of Labs:

1. Mechanical Lab
2. Heat Exchanger Lab (I-Type & U-type)

LIST OF MACHINERY, EQUIPMENT & TOOLS

For 25 Students

Name of trade	Heat Exchanger Maintenance Technician
Duration	06 Months

Sr. No.	Description	Qty
1	PENCIL GRINDER	5
2	ANGLE GRINDER 4" (Electric & Noematic)	5
3	HAND SPIRIT LEVEL 12”	10
4	HAMMER BRASS 1kg	2
5	CENTER PUNCH	4
6	ADJUSTABLE WRENCH 12”	10
7	TRI SQUARE 6” & 8” (5 each)	10
8	RING SPANNER 27mm to 48mm	5
9	OPEN END SPANNER 27mm to 48mm	5
10	COMBINATION SPANNER 27mm to 48mm	5
11	SOCKET SET 27mm to 48mm	5
12	MEASURING TAPE 5m	5
13	STEEL SCALE 300mm	5
14	SPUD OPEN SPANNER 27mm to 48mm	5
15	SPUD RING SPANNER 27mm to 48mm	5
16	STRIKING OPEN SPANNER 27mm to 48mm	5
17	STRIKING RING SPANNER 27mm to 48mm	5
18	TONG / CROW BAR 1m	2
19	C CLAMP 2” & 6”	30
20	CHAIN BLOCK 2 Ton	2
21	TORQUE WRENCH	2
22	CHAIN WRENCH	5
23	WIRE SLING 2m	2
24	FLANGE SPLITTER	1
25	ROUND FILE	2
26	HALF ROUND FILE	2
27	FLAT FILE	2
28	SCRAPPER 4”	2
29	WIRE BRUSH	15
30	I BOLT ½” & 3/4 “	2
31	DIVIDER	2
32	FINGER SAVER	15
33	HEAVY DUTY SCREW DRIVER	6

LIST OF CONSUMALE MATERIALS FOR PRACTICALS

(For 06 Months Heat Exchanger Maintenance Technician)

Sr	Consumable Materials	Qty
1	ASBESTOS GASKET 6’ x 6’	4
2	BLIND SPADE 2x150	12
3	TEST SPADE 2x150	8
4	SPIRAL WOUND GASKET 2x150	30
5	EMERY PAPER 0 size	36
6	GRAPHITE TAPE 1/2“ & ¾” - Rolls	4
7	GLAND PACKING ¾” 10m box	1
8	BARICATION TAPE – Roll	2
9	COTTON WASTE – KG	20
10	WORK PERMIT – STATIONERY PAPER	30
11	COVERALL	25
12	SAFETY SHOES	25
13	SAFETY HELMET	25
14	SAFETY GOOGLE	25
15	WORKING GLOVES (COTTON) PAIR	100
16	MOLIKOT BOX	2
17	LIFTING BAG	2
18	FACE SHIELD	10
19	DIP TRAY	2
20	PAINT BRUSH 2”	6
21	SCRAPPER	10

EMPLOYABILITY OF PASS-OUTS

After completion the course successfully, the students would be able to join as Heat Exchanger Maintenance Technician in construction industry and also, they would be capable to start their own business. The pass-out of this course may work in the following sectors / areas and positions as skilled professional:

1. Plant construction (Power houses, Fertilizer plants, Cement plants, and Oil & Gas plants).
2. To start their own business.
3. To work in specific field like maintenance / shutdown services.
4. To work as contractor / sub-contractor.

QUALIFICATION OF TEACHER / INSTRUCTOR

a) Instructor

Diploma (Mech) with 5 years' experience

OR

Bachelor (Mechanical) with 2 years' experience

b) Demonstrator

Matric with 03-Years' experience in Construction Industry / Oil & Gas and the ability to use computers

REFERENCE BOOKS:

1. **FUNDAMENTALS OF HEAT EXCHANGER DESIGN**
   Author Ramesh K. Shah 1st Edition 2003
2. **FUNDAMENTALS OF INDUSTRIAL HEAT EXCHANGERS**
   Authors: Hossain Nemati, Mohammad Moghimi Ardekani, James Mahootchi, Josua P. Meyer 1st Edition - January 13, 2024
3. **HEAT EXCHANGER DESIGN**
   Author: Fraas, Arthur P - 1989

Curriculum Development Committee (CDC)

1.	Mr. Ibrar Ali Rana	Instructor
2.	Mr. Amir Aziz	Consultant Curriculum Development
3.	Mr. Ali Khalique Khan	Consultant Curriculum Development
4.	Mr. Saleem Akhtar Qureshi	Consultant Curriculum Development