

Automatic Hydrotest Unit for Heat Exchanger

Dr. S. A. Patil^[1], Prof. G. N. Jagdale^[2], Miss. A. B. Pawar^[3], Mr. A. A. Sayyed^[4], Mr. C. R. Sabale^[5]

sapcoeh@rediffmail.com^[1], coem.mech101@gmail.com^[2], aditipawar7920@gmail.com^[3],

ashrafsayyed16399@gmail.com^[4], chetansabale299@gmail.com^[5]

Department Of Mechanical Engineering, PDEA's College Of Engineering Manjari, Pune.

Abstract

Hydrostatic test most formally known as hydrotest is a type of test that is performed to check leakage in weld joints and assembled parts of different parts of pressure vessel and pipe lines. Hydrotest involves the filling of water or liquid in the pressure vessel and pressured it and check whether there is any leakage by the of pressure gauge or transmitters. The automatic hydrostatic test bed system is the system to eliminate manual intervention and make the system automatic. This test bed uses proportional control technology to realize the automatic load and automatic control of hydraulic motor, greatly improved stability accuracy and strong controllability of the automatic test bed system.

INTRODUCTION

Heat exchanger (cooler) are used is many pressurized conditioned applications. So Hydrostatic test of coolers are mandatory requirement as per any design code. Earlier we were performing hydrotest of coolers manually with the help of pump and gauges. Due to maximum human intervention, there was a chance of manual error and failure of test.



Fig.1.Previous hydrotest unit

Design of Automatic Hydrotest unit

We had a brainstorming session with the operator and engineers and come with an idea to perform hydrotest automatically to reduces operator fatigue, increase safety and increase productivity. To achieve the desired result, we decided to take the automatic hydrotest unit as a project. Hydro testing, more formally called hydrostatic testing, is a type of test that is performed on pressure vessels to check for leaks. Hydro testing involves completely filling up a pressure vessel with water and then pressurizing it. Once pressurized, leaks can be detected.

The hydraulic motor type test bed system, and the use of how computer measurement and control. This test bed uses proportional control technology to realize the automatic load and automatic control of hydraulic motor, greatly improved stability, accuracy and strong controllability of the hydraulic motor test bed controlling system. Hydrostatic pressure testing is a diagnostic technique to check the linkage or the proof at the joints weather it is welded or assembled. This test involves testing of pressure vessel. Pipelines and different storage tanks.

To performed the test, a hydrotest pump used which helps to pressurize component. The component is filled with desired liquids like water, oil, chemical's or any desired media. The media is then pressurized to the desired pressure with the help of pump. Pressure is held up to a desired time period and no pressure drop is allowed during the period. No pressure drop is the proof of the joint correctness. Calibrated pressure gauge is used them to check the pressure.

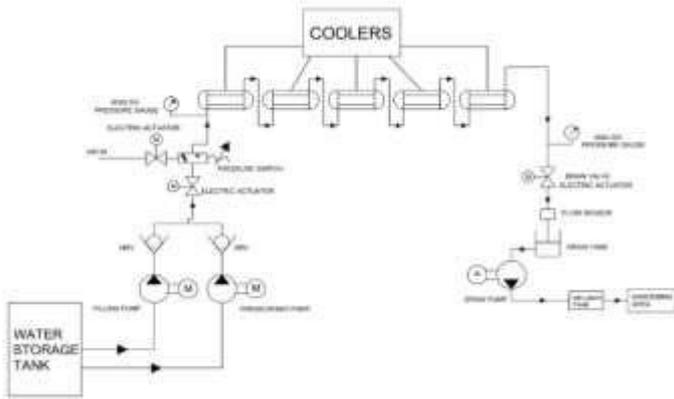


Fig. 2. Circuit Diagram

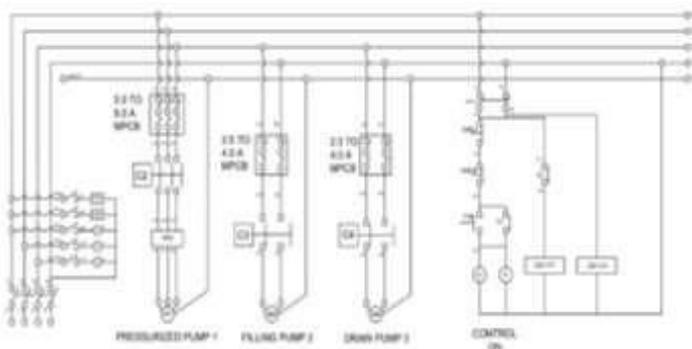


Fig. 3. Design of electric control panel

Execution of automatic hydrotest unit

Prepare the heat exchanger for hydro test by providing necessary blinds and venting arrangement.

There will be two stage of hydrotest shell side and coil side.

If it is shell pressure test, open tube side channels for inspection of tube areas. Tubes and welds shall be clean and dry.

Minimum two calibrated Burdon tube pressure gauge shall be used for testing. The pressure gauge shall be positioned in such a way that they are clearly visible to the operator controlling the pressure during test.

Before the start filling pump electric actuator 1 and 2 is ON.

Starting the filling pump to water fill up the heat exchanger and continuous flow of water sense the flow sensor and signal passing the HMI to OFF the drain valve.

After drain valve is OFF, The pressurized pump ON simultaneals after 10 sec filling pump OFF.

Increase the pressure in steps and hold the pressure for duration of 2 mins at each step at 30%, 60 % and 100 % of test pressure.

Hold the test pressure until complete check of the tube, welding joints & shell pressure parts at least for minimum half hour.

After complete inspection of all equipment, gradually depressurize the system. Drain valve ON to release the pressure and water flow in draintank.

Also, ON the Electric actuator 3 air flow in heat exchanger and get completely removed the water.

After depressurization, completely drain the water. Dry and carry out purging for through removal of water as per the requirement.

And OFF the system.

Content of hydro test system

Piston type pump :- It is used to pressurized water.
Centrifugal pump :- It is used to filling water in heat exchanger.

NRV :- Stop the back flow of water.

Electric Actuator :- It is used to control of water flow.

Pressure switch :- Control the pump ON OFF.

Burdon type pressure gauge :- In heat exchanger pressure are display in pressure gauge.

Flow sensor :- It is used to sense the continuous flow of water.

Drain tank :- After the release a pressure in heat exchanger the water flow in the drain tank and stored.

Heat exchanger :- It is used to reduce temperature and pressure.

Hose pipe :- It is used to continuous flow of water.

QRC :- It is used to mate fluid lines with system equipment.

Table :- It is used to all automatic set up are mounted.

SS tube :- Continuous flow the water. Flange :- It is used to two part are mate.

Gasket :- It is used to increase the life of flange.

Valve :- It is used to control the flow of water. Air

tube :- Passing air in tubes.

Screw tightening machine :- It is used totightening the screw.

Content Electric Circuit

- PLC
- MPCB
- MCB

- ADC
- Relay
- VFD
- SMPS
- Contactor
- HMI
- Burger alarm
- Air filter
- Exhaust fan

Result :-

	Manual hydro test	Automatic hydro test
Time for arrangement	30 min	15 min
Time for testing	45 min	30 min
Result processing	15 min	2 min

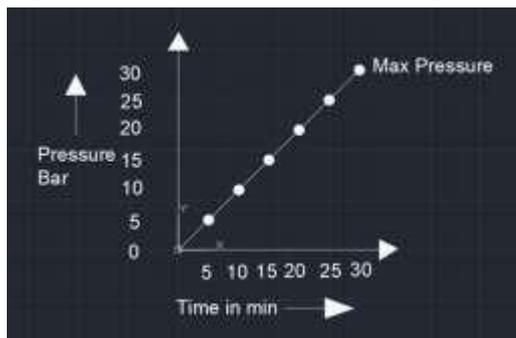


Fig. 4. Hydrotest graph (Safe operation)

We set pressure as per customer requirement. Increase the pressure in steps and hold the pressure for duration of 2 mins at each step at 30%, 60 % and 100 % of test pressure. Hold the test pressure until complete check of the tube, welding joints & shell pressure parts at least for minimum half hour.

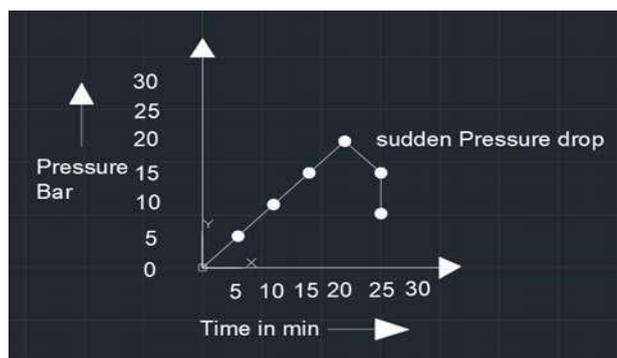


Fig. 5. Hydrotest graph (Sudden pressure)

system to be tested hydraulically for pressure strength and leakage.

Because of sudden pressure dropped to check the welded and flange connections of piping system for any possible leaks that may be present.

Conclusion :-

The main purpose of the project is to reduce the manual intervention of the workers which leads to the non-conformance. By introducing the automatic system, we will reduce the processed time and reduced the non-conformance. Heat exchanger are one of the most important heat transferred components used in various industries so by introducing automatic system we aim to make the process very much correct.

Reference :-

1. Marek Lipnicky and Zuzama Brodnianska, 2023, Enhancement of Heat Dissipation from the Hydraulic System Using a Finned Adaptive Heat Exchanger, 2023, 13.5479.
2. N. Hasan, 2022, Design of Cryogenic Heat Exchangers and associated Sub- Systems for Controlled Cool-down and Testing of Superconducting Magnets at FRIB, 1240012063.
3. C. BABU, M. SHRE VIJAY RAJ, SRIRAM, 2021, Testing of Heat Exchanger, 2581-7175.
4. Edreis Edreis and A. Petrov, 2020, Types of heat exchangers in industry,
5. their advantages and disadvantages, and the study of their parameters, 963(2020)012027.
6. Bernard Akindade adaramola, 2020, Hydraulic Pressure Testing Of Turbo Generators Radiators And Heat Exchangers For Effective Power Generation, 2395-3470.