Steam power plants are used to obtain useful power from fossil fuels by generating steam at high pressures and temperatures and absorbing the energy contained in the steam in a turbine or an engine. Boiler is an important component where steam is produced to operate the steam power plant. Understanding of the operation and control of the boiler is important for students of power plant engineering and various other fields including mechanical engineering, chemical engineering, electronics and control engineering.

Tesca Steam Boiler Demonstration Unit is a bench top model of typical oil fired steam boiler designed according to standard practices. The unit can be used to demonstrate the operation, working and control of boilers. It is specially designed to simulate about 15 faults to trigger the safety and control systems of the boiler and to demonstrate control and safety aspects of boilers. The unit consists of a water tube boiler with super heater, water cooled condenser and a feed water supply system to generate wet and superheated steam. Provision is made to control steam generation rate, feed water and water level control in the boiler drum, steam pressure and steam temperature. The unit is instrumented with various sensors to measure pressures, temperatures, flow rates and water level. Various control devices such as pressure switches and limiters, temperature limiters and water level limiters are provided. Control panel with digital displays for measured parameters are provided. Computer based data acquisition system with software is provided.

## Experiments

01. Study of the sequence of operation and working of boilers.
02. Study of control and safety devices in boilers – familiarization with their functions.
03. Study of the characteristics of boiler control devices.
04. Demonstration of various controls - (a) Steam generation control (b) Steam pressure control (c) Steam temperature control (d) Water level control in the boiler.
05. Simulation of various faults and study of the effects on working of boilers - (a) pressure switch and limiter (b) feed water and water level control (c) high and low water level limiter and (d) burner and flame monitoring.
06. Study of the effect of air feed on exhaust gas composition and burner adjustment.
07. Determination of steam quality using separating and throttling calorimeter.
08. Study of performance of the boiler – evaporation rate, thermal efficiency and overall efficiency.
09. Exhaust gas analysis using exhaust gas analyzer.
10. Determination of saturation pressure and temperature relationship for steam.
11. Determination of enthalpy of steam.
12. Study of the state of steam in enthalpy – entropy diagram.
13. Study of heat energy balance in boiler.
14. Analysis of heat transfer and heat transfer co-efficient in boiler.

## Important features

01. Steam boiler with super heater, stainless steel, 50 liters, nominal pressure: 12 bar, temperature: 3000C (max.), steam rate: 7.5 kg / hour, water tube type.
02. Burner, oil fired, 10 kW, fuel consumption: 1 kg/hour, operated with compressed air with fuel tank and pump.
03. Condenser, water cooled, glass, with suction pump to evacuate air.
04. Chimney.
05. Feed water supply system, water supply tank (100 liters), feed water pump, collector tank.
06. Compressor to supply air to burner.
07. Fan to produce forced drought.
08. Exhaust gas analyzer.
09. Temperature sensors for measurements in boiler, super heater, chimney, cooling water in condenser, thermocouples 0-4000C (3 Nos.), 0-1000 C (1 No.).
10. Pressure sensor for measurement in boiler, 15 bar.
11. Pressure safety valve, 12 bar.
12. Pressure switch, 0.5 – 12 bar.
13. Pressure limiter, 0.5 – 12 bar.
14. Alarm for steam pressure.
15. Flow rate sensors for fuel oil, feed water, condenser cooling water and air flow.

Note: Specifications are subject to change.

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16. Separating and throttling calorimeters for wet steam quality measurements.
17. Water level sensor.
18. Water level switches (2 Nos.).
19. Switch box for fault circuits.
20. Control panel with digital display of measured parameters.
21. Computer based data acquisition and analysis. (OPTIONAL)

## Measurements

1. Boiler pressure and temperature.
2. Super heater pressure and temperature.
3. Water level in Boiler.
4. Feed water flow rate to boiler.
5. Air flow rate to burner.
6. Fuel flow rate to burner.
7. Exhaust gas temperature.
8. Exhaust gas composition.
9. Quality of wet steam.
10. Inlet temperature of air.
11. Feed water temperature.

**Overall dimensions:**
Length: 2.5m, Width: 1m, Height: 2.5m.
**Required services:**
1. Electric supply, 220-240V, Single Ph. 50 Hz.
2. Water supply

The manual describing the details of the steam boiler demonstration unit, operation, maintenance, test data sample, test sheets, tables and other related materials for teaching will be supplied with the equipment.

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