

# ET 810

## Steam power plant with steam engine



### Description

- functional model of a steam power plant
- demonstrates the function of a steam engine

In a steam engine, thermodynamic energy in the form of vapour pressure from steam generators is converted into mechanical energy. This can be used further downstream in the process to generate electricity or to power machinery and vehicles.

A steam power plant consists of a heat source for generating steam, a turbine or steam engine with a generator, and a cooling device for condensing the exhaust steam.

The ET 810 trainer contains the main components of a steam power plant: a gas-fired steam boiler, a single-cylinder piston steam engine with a generator, a condenser, a feed water tank, and a feed water pump.

The steam boiler generates water steam and supplies it to the piston steam engine. A piston and a crank mechanism convert the energy from the steam into mechanical energy.

A generator in the form of a DC motor generates electricity from the mechanical power. Four light bulbs are used as consumers of the resulting electrical energy. The exhaust steam is condensed in a water-cooled condenser.

Safe operation is ensured by safety devices that monitor the boiler temperature and a safety valve.

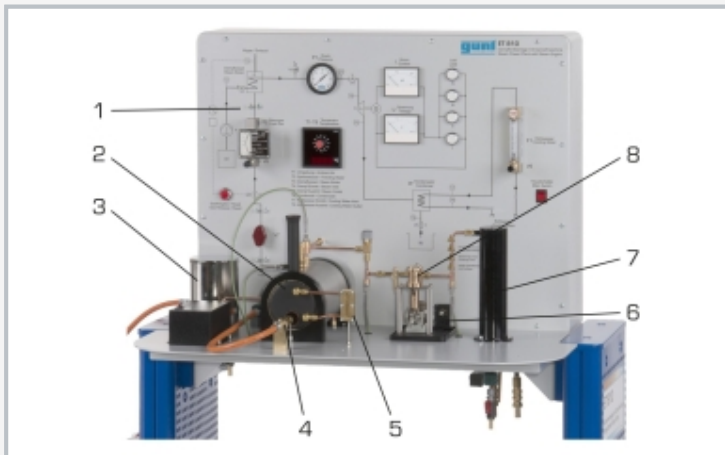
Sensors record the temperature, pressure, and flow rate at all relevant points. The measured values can be read on displays. Current and voltage from the generator are measured and displayed in the experimental unit.

### Learning objectives/experiments

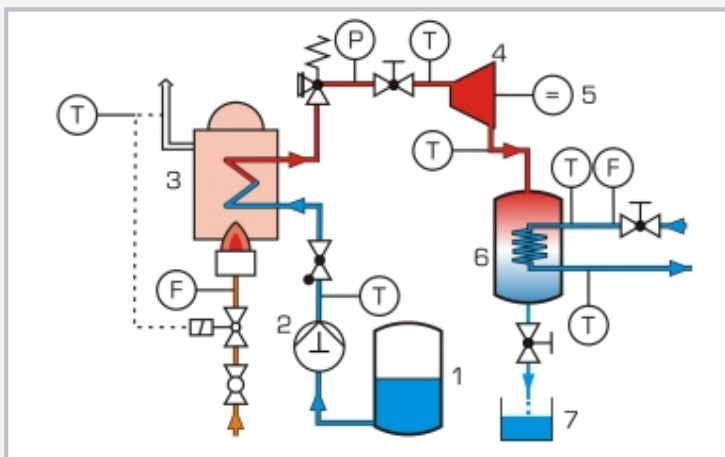
- demonstration of the function of a steam engine
- familiarisation with the components of a steam power plant and how they interact
- recording the vapour pressure curve
- effect of re-evaporation and backfeed of cold water
- determining fuel consumption, the amount of steam generated, the boiler efficiency, and the capacity of the condenser

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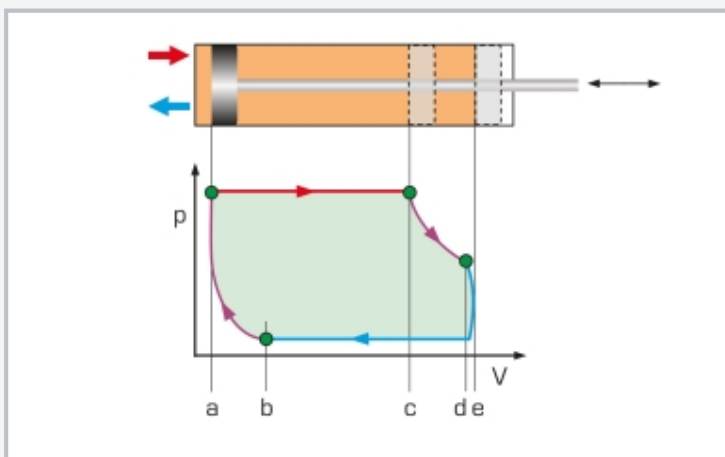
## Steam power plant with steam engine



1 process schematic with displays and controls, 2 steam boiler, 3 feedwater tank, 4 burner, 5 boiler water level indicator, 6 generator, 7 condenser, 8 steam engine



1 feedwater tank, 2 feedwater pump, 3 steam boiler, 4 steam engine, 5 generator, 6 condenser, 7 condensate tank; T temperature, P pressure, F flow rate; orange: gas, red: steam, blue: water



p,V diagram: p pressure, V volume; a top dead centre and inlet opens, c inlet closes, d outlet opens, b outlet closes; red: inlet, blue: outlet, green: work done, purple: compression and expansion

### Specification

- [1] demonstration of a steam power plant with single-cylinder piston steam engine
- [2] gas-fired boiler for steam generation
- [3] water-cooled condenser
- [4] DC generator
- [5] light bulbs as consumers
- [6] sensor and display for temperature, pressure, flow rate, voltage and current
- [7] safety valve and temperature monitoring for safe operation

### Technical data

#### Steam engine

- power: max. 5W
- speed: max. 1200min<sup>-1</sup>
- cylinder: Ø 20mm

#### Generator

- DC motor: max. 3,18W at 6000min<sup>-1</sup>

#### Gas-fired boiler

- safety valve: 4bar
- gas connection 3/8"L (propane or butane)

#### Measuring ranges

- temperature: 8x -20...200°C
- pressure: 0...6bar
- flow rate:
  - ▶ 0...110L/h (gas)
  - ▶ 15...105L/h (water)
- voltage: 0...10VDC
- current: 0...250mA

230V, 50Hz, 1 phase  
230V, 60Hz, 1 phase  
120V, 60Hz, 1 phase  
LxWxH: 1700x810x1440mm  
Weight: approx. 110kg

### Required for operation

water connection, drain, gas supply 3/8"L (propane gas or butane gas)

### Scope of delivery

- 1 trainer
- 1 set of hoses
- 1 oil (100mL)
- 1 set of accessories
- 1 set of instructional material