

# ET 851

## Axial steam turbine



### Description

- laboratory-scale axial single-stage steam turbine
- variety of safety and monitoring equipment
- design of a complete steam power plant together with the ET 850 gas-fired steam generator
- alternative steam supply via electrical steam generator ET 852

Steam turbines are turbomachines. In practice, steam turbines are mainly used in power plants to generate electricity. A distinction is made between turbines depending on the flow direction and state of the steam, the working process, and steam supply and discharge.

The ET 851 experimental unit is a single-stage axial impulse turbine with a vertical axis. The steam required is generated by the steam generator ET 850, gas-fired or ET 852, electrical. The turbine can be operated with saturated steam or superheated steam. The steam is expanded in the turbine and condensed via the water-cooled condenser. Load is applied to the turbine via an eddy current brake. The turbine has a non-contact labyrinth seal on the shaft with a sealing steam circuit.

The turbine is fitted with various safety devices in order to prevent damage such as by excessively high speed or pressure in the system.

Sensors record the temperature, pressure, and flow rate at all relevant points. Turbine speed and torque are measured electronically at the eddy current brake. The measured values can be read on digital displays. At the same time, the measured values can also be transmitted directly to a PC via USB. The data acquisition software is included.

The ET 851 axial steam turbine, together with the ET 850 gas-fired steam generator, forms a complete laboratory-scale steam power plant. Alternatively, the electrical steam generator ET 852 can be used for steam supply.

### Learning objectives/experiments

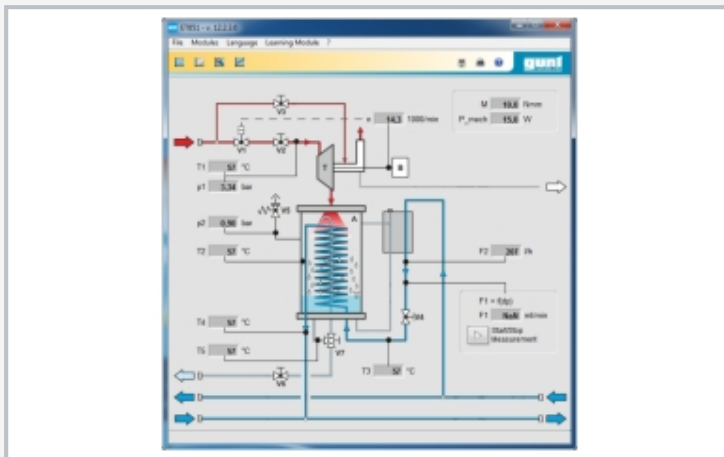
- principle of operation of a steam turbine:
  - ▶ steam consumption of the turbine
  - ▶ turbine output at different settings
  - ▶ investigation of the losses occurring in different turbine components
  - ▶ power and torque curve
  - ▶ overall efficiency compared to the theoretical efficiency

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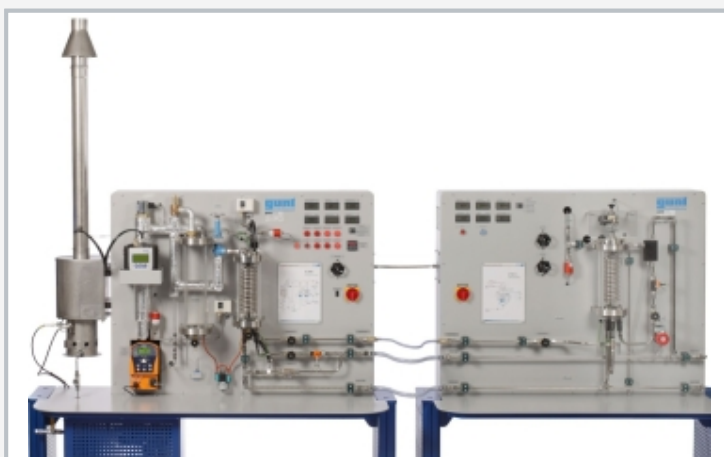
## Axial steam turbine



1 displays and controls, 2 valve for sealing steam, 3 steam connection, 4 valve for steam inlet, 5 process schematic, 6 water connections, 7 pressure sensor for condensate measurement, 8 condenser with coil, 9 cooling water flow rate sensor, 10 turbine, 11 eddy current brake, 12 pressure sensor



Software screenshot: process schematic



Left: ET 850 steam generator and right: ET 851 axial steam turbine; assembled ready for operation, together both units form a complete steam power plant

### Specification

- [1] single-stage axial impulse turbine, mounted in corrosion-resistant, sealed ball bearings
- [2] load on the turbine by eddy current brake
- [3] condenser with water-cooled coiled tube
- [4] steam supply from steam generator ET 850, gas-fired or ET 852, electrical
- [5] various safety devices for safe operation
- [6] sensors and digital indicator for speed, temperature, pressure and flow rate
- [7] GUNT software for data acquisition via USB under Windows 10

### Technical data

Single-stage axial impulse turbine

- rotor inner diameter: 54mm
- max. speed: 40000min<sup>-1</sup>
- max. inlet pressure: 9bar abs.
- max. outlet pressure: 1bar abs.
- nominal power output: 50W

Measuring ranges

- pressure:
  - ▶ 0...16bar (steam)
  - ▶ 0...1,6bar (condenser)
- differential pressure: 0...50mbar
- flow rate: 0...720L/h (cooling water)
- speed: 0...50000min<sup>-1</sup>
- torque: 0...70Nmm
- temperature: 0...400°C

230V, 50Hz, 1 phase  
 230V, 60Hz, 1 phase  
 120V, 60Hz, 1 phase  
 UL/CSA optional  
 LxWxH: 1530x790x1770mm  
 Weight: approx. 180kg

### Required for operation

water connection: 350L/h, drain  
 PC with Windows recommended

### Scope of delivery

- 1 trainer
- 1 GUNT software + USB cable
- 1 set of instructional material

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### Required accessories

061.85000	ET 850	Steam generator
or		
061.85200	ET 852	Steam generator, electrical

### Optional accessories

for Remote Learning		
010.10000	GU 100	Web Access Box
with		
061.85100W	ET 851W	Web Access Software