ET 796
Gas turbine jet engine

The illustration shows the jet engine without the protective grating

Description

- **gas turbine, operated as jet engine**
- **open gas turbine process**

Jet engines are gas turbines which generate thrust. Jet engines are used on aircraft for propulsion due to their low weight and high performance.

The ET 796 trainer investigates the behaviour during operation of a jet engine. ET 796 includes the following components: jet engine (with compressor, annular combustion chamber, turbine, and propelling nozzle), fuel system, starter and ignition system, and measurement and control equipment. The gas turbine works as an open cyclic process, with the ambient air being drawn out and fed back in.

In the jet engine, the ambient air drawn in is first brought to a higher pressure in the single-stage radial compressor. In the downstream combustion chamber, fuel is added to the compressed air and the resulting mixture is ignited. The temperature and flow velocity of the gas increase. The gas flows out of the combustion chamber into the single-stage axial turbine and discharges a portion of its energy to the turbine. This turbine drives the compressor. In the propelling nozzle, the partially expanded and cooled

gas expands to ambient atmospheric pressure and the gas accelerates to almost the speed of sound. The high-speed gas outflow generates the thrust. In order to reduce the outlet temperature, the exhaust gas stream is mixed with the ambient air in a mixing pipe. The gas turbine is started fully automatically with the aid of an electric starter.

The annular combustion chamber is between the compressor and the turbine. With optimum fuel utilisation, low pressure loss, and good ignition properties, the ring shape of this combustion chamber is typical of the design used in jet engines. The movable turbine platform, with a force sensor, enables measurement of the thrust.

The speed, temperatures, and mass flow rates of the air and fuel are recorded using sensors. 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.

Learning objectives/experiments

- behaviour during operation of a jet engine including start-up procedure
- determination of the specific thrust
- determination of the specific fuel consumption
- determination of lambda (fuel-air ratio)

G.U.N.T. Gerätebau GmbH, Hanskampring 15-17, D-22885 Barsbüttel, Telefon (040) 67 08 54-0, Fax (040) 67 08 54-42, Email sales@gunt.de, Web www.gunt.de
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Page 1/3 - 11.2023

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1 jet engine, 2 mixing pipe, 3 turbine platform, 4 force sensor for thrust measurement, 5 gas turbine controls, 6 displays and controls trainer
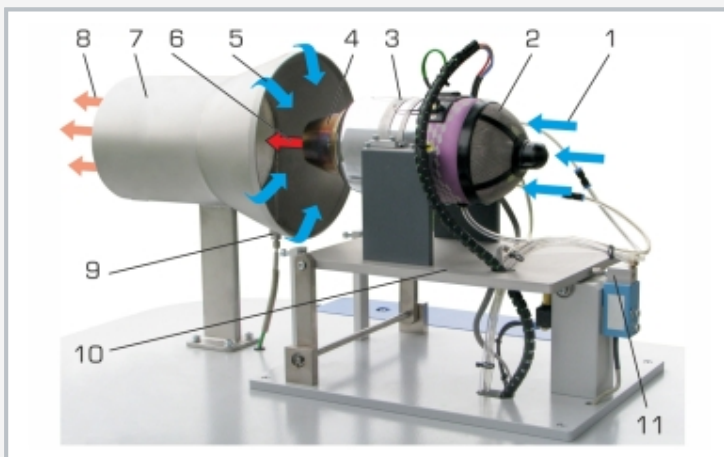
open gas turbine process
1 cold air, 2 air inlet with safety guard, 3 gas turbine, 4 propelling nozzle, 5 ambient air, 6 exhaust gas, 7 mixing pipe, 8 cooled exhaust jet, 9 temperature sensor in the mixing pipe, 10 moveable turbine platform, 11 force sensor for thrust measurement
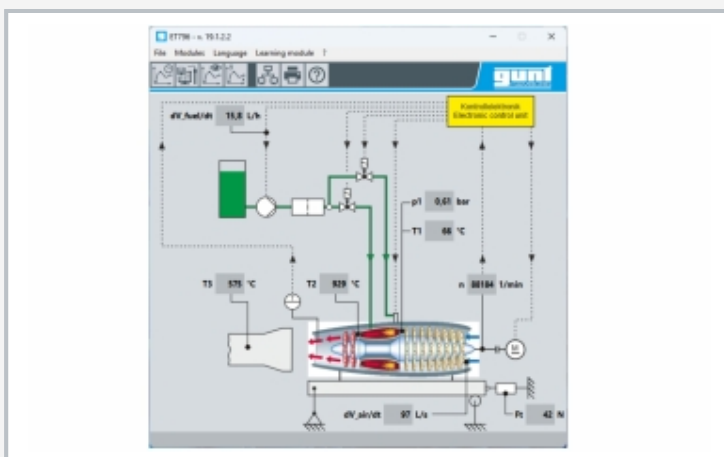
Software screenshot

Specification

[1] experiments relating to the function and behaviour during operation of a jet engine
[2] gas turbine with radial compressor and axial turbine as jet engine
[3] single-shaft engine
[4] protective grating for the jet engine
[5] turbine mounted on moving base with force sensor for thrust measurement
[6] electric starter for fully automatic start-up
[7] additional remote control for display and control of the jet engine
[8] GUNT software for data acquisition via USB under Windows 10

Technical data

Jet engine
- max. thrust: 80N at $120000min^{-1}$
- speed range $35000...120000min^{-1}$
- fuel consumption: max. 22L/h (full load)
- exhaust gas temperature: 610°C
- sound level at 1m distance: max. 130dB(A)

Fuel: kerosene or petroleum + turbine oil
Starting system: electric starter
1 tank for fuel: 5L

Measuring ranges
- differential pressure: 0...150mbar
- pressure: 0...2,5bar (combustion chamber)
- temperature: 2x 0...1200°C / 1x 0...400°C
- speed: $0...120000min^{-1}$
- consumption: 0...25L/h (fuel)
- force: 0...±200N

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 1230x800x1330mm
Weight: approx. 112kg

Required for operation

ventilation $1000m^3$/h, exhaust gas routing required
PC with Windows recommended

Scope of delivery

1 trainer
1 turbine oil (250mL)
1 GUNT software + USB cable
1 set of instructional material
1 manufacturer's instruction manual (turbine)

Optional accessories

for Remote Learning
GU 100   Web Access Box
with
ET 796W   Web Access Software