

THERMODYNAMICS

T113D - Internal Combustion Engines Test Bed



1. General

The Engine Test Bed is fully self-sufficient and designed so as to allow an easy interchange of the engine on the frame where braking dc generator and internal combustion engines up to 8 kW are coupled together.

The braking dc generator can operate both as a motor in order to start the internal combustion engine under test and as a brake in order to measure its power output. A set of electrical resistances will dissipate as heat the output power which can be measured by means of a voltmeter and an ammeter. Then, the torque at the engine shaft will be calculated by measuring the revolving speed. The coupling of the braking dc generator to the internal combustion engine is obtained through a driving belt.

The electric control panel and the instrument panel are housed on wheeled frames separated from the test frame so as to avoid the vibrations transmitted by the internal combustion engine. The fuel tanks are located on the instrument panel and feed the engines by gravity; the same panel holds the damper fitted with the calibrated orifice for the feeding and measurement of the intake air.

2. Composition

Basic unit (Code 954320)

- Wheeled frame
- Braking dc generator: 8 kW at 3000 rpm, which can be used also to start the engines.
- Dissipating resistances
- Electric control panel including:
 - braking dc generator power supply;
 - main switch;
 - selector switch for the dc generator operation as a motor or as a brake;
 - adjustment knob (dc generator operating as a brake);
 - adjustment knob (dc generator operating as a motor);
 - ammeter 0-1.5A;
 - voltmeter

- Instrument panel including:
 - tilting scale differential micromanometer;
 - ammeter: 0-40A for the dissipation current measurement;
 - voltmeter: 0-250V for the dissipation voltage measurement;
 - No.2 graduated containers for the fuel consumption measurement;
 - digital rpm indicator;
 - digital stop watch.
- No. 2 tanks for the different fuels.
- Air flowrate measurement device including:
 - calibrated orifice
 - air damper

Available engines

The main features of the available engines are summarized in Table 1.

OPTIONALS

Exhaust Gas Temperature Measuring Unit (optional - code 952416), composed of:

- K-type thermocouple;
- digital indicator.

Exhaust Gas Calorimeter (optional - code 952414), composed of:

- gas/water heat exchanger;
- No. 3 thermocouples, 0-120°C;
- direct reading flowmeter 0-600 l/h.

Lean/Rich Mixture Device for Petrol Engines (optional - code 952417), composed of:

- membrane electric pump;
- U-manometer.

Auxiliary Cooling Unit (optional - code 952411), composed of:

- centrifugal electric pump;
- flowmeter 0-1200 l/h;
- thermostatic valve;
- No. 5 Pt100 thermoresistances.

SAD/End - Data Acquisition System for Endothermic Engines (for description and technical characteristics see separate catalogue) (optional code 914364)

The SAD/End computer-based system allows real time data acquisition from engine testing benches.

T156D - Kit for the chemical analysis of exhaust gases

The exhaust gas analyzer is available in two versions (for description and technical characteristics see separate catalogue):

- T156/1D code 953253 Kit for the chemical analysis of exhaust gases with NO_x analysis
- T156/2D code 953250 Kit for the chemical analysis of exhaust gases

The exhaust gas analyzer is suitable for petrol engines. It can be used to measure the values of carbon monoxide (CO), carbon dioxide (CO₂), unburned hydrocarbons (HC) and oxygen (O₂). On the basis of such values, the instrument automatically determines the air/fuel ratio, which is an indispensable term of reference in engine tuning. In the T156/2D version it is moreover possible to measure the nitrogen oxides, best known as NO_x, responsible for air pollution.



Code 953250 – Kit for the chemical analysis of exhaust gases



Code 952417 – Lean/rich mixture device

3. Exercises

Theoretical exercises

- Classification of i.c. engines, operating principles, thermodynamic cycles.
- Geometric, cinematic and dynamic relationships for ordinary crank mechanisms.
- Definition of the main parameters characterizing the operation of i.c. engines: torque and power output, specific fuel consumption, efficiencies, air/fuel ratio.
- Pollutant emission.

Practical exercises

- I.c. engine starting procedures and relative safety standards.
- Use of the braking dc generator to determine the engine power and calculate the torque.
- Determination of specific fuel consumption and engine efficiency.
- Determination of volumetric efficiency and air/fuel ratio.
- Determination of mechanical characteristic.
- Determination of regulation characteristic.
- Determination of torque, specific fuel consumption and efficiency as a function of air/fuel ratio (for petrol engines with optional Code 952417).
- Execution of main tests and determination of the engine characteristic curves on Personal Computer (with optional SAD/End).
- Determination of the engine thermal balance through the measurement of the following quantities:
 - quantity of heat absorbed by the coolant (with optional Code 952411);
 - quantity of heat absorbed by the exhaust gases (with optional Codes 952414 and 952416);
 - effective mechanical energy.
- Chemical analysis of the exhaust gases (with optional T156D/2) and evaluation of the influence of the air/fuel ratio on emissions.



Code 952414 – Exhaust calorimeter

4. Required Services

- Electric supply: 220/380 V single-phase, 50/60 Hz; 8 kW
- Hydraulic feeding: 2000 l/h max (only with optional Codes 952411 and 952414).

5. Weight and Dimensions

Basic unit

- Dimensions: 1200 x 780 x 1800 h mm
- Weight: 230 kg circa

Auxiliary Cooling Unit (optional)

- Dimensions: 940 x 540 x 2050 h mm
- Weight: 59 kg

Exhaust Gas Calorimeter (optional)

- Dimensions: 800 x 800 x 1770 h mm
- Weight: 56 kg

Exhaust Gas Temperature Measuring Unit (optional)

- Dimensions: 300 x 2500 x 200 h mm
- Weight: 5 kg

SAD/End - Data Acquisition System for Endothermic Engines (optional)

- Dimensions: 550 x 360 x 350 h mm
- Weight: 15 kg

T156D/2 - Kit for the chemical analysis of exhaust gases (optional)

- Dimensions: 400 x 180 x 450 h mm
- Weight: 8,6 kg

Table 1 - Main technical characteristics of available engines

Code	954310	954312	954315
Fuel	Petrol	Diesel	Diesel
No. of strokes	4	4	4
Cooling	Air	Air	Water
Displacement (cm ³)	163	315	505
Max power output* (kW)	4.1	5	4
Max power engine speed (rpm)	3600	3600	3600
Weight (kg)	17	35	50

*Power declared by the manufacturer after running-in and with standard air filter and silencer