Computerized Single Cylinder Four Stroke Petrol Engine Test Rig

Features

- Extensive range of Experiments
- Comprehensive teaching manual
- One-year warranty
- Esthetically designed and finished Rig.
- High Quality instrumentation

General Description

The engine is mounted on Sturdy base frame. The base frame is fabricated with mild steel "C" channel. The engine and the dynamometer are coupled using standard tyre coupling. A standard air tank is fitted with a differential pressure sensor for measuring the Actual volume of air drawn into the cylinder. The exhaust gas calorimeter provided within the rig enables the students to conduct precise heat balance sheet. The thermocouple and

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necessary signal conditioner for the measurement of temperature at various points in the calorimeter are suitably provided.

The panel is fabricated with suitable SWG CR sheet and as per IS standard; the front portion of the panel consists of computer, Printer, UPS and all instrumentations and signal conditioner related components. Power and control wiring are suitably marked using farul for easy troubleshooting. The panel is finished with powder coating.

The loading of the engine is controlled by the computer, hence precise loading is achieved.

Instruction Manual

Self-explanatory operating manuals are provided with each system. Detailed theory as well as practical exercises is included in the manual.

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Experiments

System Capabilities

1. Calculate Actual volume of Air.
2. Calculate Volumetric Efficiency.
3. Calculate specific fuel consumption (SFC).
4. Calculate brake Thermal Efficiency.
5. Calculate Brake power.
6. Heat Balance chart.
7. Calculate mechanical efficiency.
8. Calculate Frictional Power.
9. Calculate indicated Power.
10. PV and P-θ diagrams
11. Calculate 5% Mass Fraction Burnt Angle
12. Calculate 10% Mass Fraction Burnt Angle
13. Calculate 50% Mass Fraction Burnt Angle
14. Calculate 90% Mass Fraction Burnt Angle
15. Calculate 95% Mass Fraction Burnt Angle
16. Calculate 99% Mass Fraction Burnt Angle
17. Estimated End of Combustion Angle (EEOC)
18. Calculate Gross IMEP
19. Calculate Maximum Heat Release Rate
20. Calculate Maximum Heat Release rate crank angle
21. Calculate Maximum pressure rise rate
22. Calculate Maximum pressure rise rate crank angle
23. Calculate Maximum pressure
24. Calculate Maximum pressure crank angle
25. Calculate Start of Combustion
26. Calculate Total heat release

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Software (Engine Test Express)

Windows based powerful software for real time data measurement, auto zoom graphs, analog and digital display of data in the computer, store indefinite no of graphs for analysis. Facilities to export data to Microsoft excel. The data acquisition software is developed by legion brothers.

Product / components Specification

Engine	
Make	Greaves (Model : MK:25)
No of Cylinder	Single
Cooling	Air Cooled
Fuel	Petrol
Speed	2800 rev/m
HP	2.5 HP
Starting	Rope Start
Lubrication	Forced
Dynamometer	
Type:	Eddy current Dynamometer
Cooling	Air
Load Measurement method	Load Cell
Max Speed	3000 rev/m
HP	3 HP
Coupling Type	Direct Tyre

Exhaust Gas Calorimeter (EGC)	
Type	Pipe in Pipe
Material of Construction	Mild Steel
No of Temp measuring points in test rig	6

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Thermocouple Type	“K”
Water flow Control Valve	Gate Valve

Air Tank	
Type	Square (Size: 500mm X 500mm)
Material of Construction	Mild Steel

Method of Measurements

Air Flow rate Measurement method

Air Flow	
Type/Description	Differential pressure sensor is used to measure the pressure difference between the orifice plates. The differential pressure sensor gives a proportional voltage output with respect to the difference in pressure.
Range	150 mm of water column
Signal Conditioning	Standalone for each sensors

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Fuel flow rate Measurement method

Fuel Flow	
Type/Description	In the engine tests, the fuel consumption is measured as a mass flow per unit time Mf. a more useful parameter is the specific fuel consumption (sfs)- the fuel flow rate per unit power output. It measures how efficiency an engine is using the fuel supplied to produce work. Fuel consumption is measured by using optical sensors. These optical sensors are capable of detecting any liquid and give an output in type of signals. The system consists of a burette fitted with two optical sensors one at the high level and the other at the low level. As the liquid passes through the higher-level optical sensor, the sensor gives a signal to the computer to start the time. Once the liquid reaches the lower level optical sensor, the sensor gives a signal to the computer to stop the time and refill the burette. The time taken for consumption of fuel for a fixed volume is calculated.
Range	0-99 Kgs/hr
Signal Conditioning	Standalone for each sensor

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Speed measurement method

Engine Speed	
Type/Description	A non-contact PNP sensor is used to measure the engine RPM. A PNP sensor gives a pulse output for each revolution of the crankshaft. The frequency of the pulses is converted into voltage output and connected to the computer.
Range	0-9999 RPM
Signal Conditioning	Standalone frequency to voltage converter

Water Flow measurement method

Water Flow	
Type/Description	Acrylic Body Rotameter
Range	40-400 LPH for Engine cooling
Range	10-100 LPH for calorimeter Cooling

Torque or load measurement method

Torque at Dynamometer	
Type/Description	Torque is measured using a load cell transducer. The transducer is a strain gauge base. The output of the load cell is connected to the load cell transmitter. The output of the load cell transmitter is connected to the USB port through interface card.
Range	0-50 Kgs
Signal Conditioning/transmitter	Standalone

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Measurement of Temperatures at different points

Type Range Signal conditioning/transmitter Location	"K" 0-300ºC Standalone Inlet water temperature in calorimeter
Type Range Signal conditioning/transmitter Location	"K" 0-300ºC Standalone Outlet water temperature in calorimeter
Type Range Signal conditioning/transmitter Location	"K" 0-1500ºC Standalone Inlet exhaust gas temperature in calorimeter
Type Range Signal conditioning/transmitter Location	"K" 0-1500ºC Standalone Outlet exhaust gas temperature in calorimeter
Type Range Signal conditioning/transmitter Location	"K" 0-300ºC Standalone Inlet water temperature to engine
Type Range Signal conditioning/transmitter Location	"K" 0-300ºC Standalone Outlet water temperature from the engine cylinder
Type Range Signal conditioning/transmitter Location	"K" 0-300ºC Standalone Ambient

All the measured parameters from the sensor are connected to the computer

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Cylinder Pressure

Description

Very precise and robust pressure sensor with an inline charge amplifier for combustion pressure measurement application. The sensor will have almost an unlimited life time for combustion pressure measurement application. Optimized piezoelectric sensor for continuous cylinder pressure monitoring of engines. The sensor is connected to the charge amplifier with a robust integrated high temperature Viton cable. The good linearity and long term stability ensures reliable and repeatable measurements over a long period of time.

The sealing takes place at the shoulder of adapter and requires a flat and smooth machined sealing area. The charge amplifier accepts a power supply between 7 ... 32 VDC and has a range of 0...100 bar (40 mV/bar) and works with a time constant of 5 s.

Technical Specification

Pressure range		bar	0...100
Type	Piezoelectric		
Cooling	Air Cooled		
Calibration at 200 °C		bar	0...100
Sensitivity (±0,5 %)		mV/bar	25
Frequency range (-3 dB)		Hz	0,016...20‘000
Linearity		%FSO	≤± 1

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Shock		g	2000
Operating temperature range	mounting location Viton cable connection max. short overload <1 h electronics	°C °C °C °C	-50...300 200 240 -10...110
Sensitivity shift	200±150 °C 200±50 °C	% %	≤± 2,5 ≤± 1
Thermo shock (Kistler testengine 9,5 bar p_{mi}; 1500 1/min)		bar	≤ -0,5
Time constant	for cylinder measuring for calibration	s s	≈ 5 >2500
Signal output (at 1mA load)	max. min.	V V	4,4...5 > 0
Signal span		V	3,0
Zero line		V	1,9...2,2
Supply voltage		VDC	7...32
Supply current		mA	6
Output impedance		Ω	100
Mounting torque of sensor in adapter		Nm	15
Connector at sensor 8 pole male(protection class valid with connected cable)		DIN M12x1	IP67

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Crank Angle Encoder

Technical Specification

General specifications	
Pulse count (ppr)	360
Electrical specifications	
Operating voltage	5 V DC ± 5 %
No-load supply current I_0	Max. 70 mA
Output	
Output type	Pulse
Operating current	max. per channel 20 mA , conditionally short-circuit proof (not with U_b)
Output frequency	max. 200 kHz
Rise time	100 ns
Connection	
Connector	type 9416, 12-pin, type 9416L, 12-pin
Cable	Ø7.8 mm, 6 x 2 x 0.14 mm2, 1 m
Standard conformity	
Protection degree	DIN EN 60529, IP65
Climatic testing	DIN EN 60068-2-3, no moisture

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	condensation
Emitted interference	DIN EN 61000-6-4
Interference rejection	DIN EN 61000-6-2
Shock resistance	DIN EN 60068-2-27, 100 g, 3 ms
Vibration resistance	DIN EN 60068-2-6, 10 g, 10 ... 2000 Hz
Ambient conditions	
Operating temperature	-20 ... 60 °C (253 ... 333 K), fixed cable
Storage temperature	lens -40 ... 70 °C (233 ... 343 K)
Mechanical specifications	
Material	
Housing	aluminium, powder coated
Flange	aluminium 3.1645
Shaft	stainless steel 1.4305
Mass approx.	350 g
Rotational speed.	max 12000 min -1
Moment of inertia	≤ 25 gcm2
Starting torque	≤1.5 Ncm

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Data Acquisition Card

Technical Specification

- 14 Analog Inputs (12-16 Bits Depending on Speed)
- UE9-Pro Adds 24-bit Low-Speed ADC for 20-Bit Effective Resolution
- ±5 or 0-5 Volt Maximum Analog Input Range
- 2 Analog Outputs (12-Bit, 0-5 Volts)
- 23 Digital I/O
- Up to 2 Counters (32-Bits Each)
- Supports Software or Hardware Timed Acquisition
- Maximum Input Stream Rate of 50+ kHz (Depending on Resolution)
- Capable of Command/Response Times As Low As 1.2 Milliseconds
- Built-In Screw Terminals for Some Signals
- USB 2.0/1.1 Full Speed Interface
- Ethernet 10Base-T Interface
- Dual-Processor Design with 168 MHz of Total Processing Power
- Electrical Isolation Possible with Ethernet Interface
- No Power Supply Needed for USB Operation
- Includes USB and Ethernet Cable, Power Supply, and Screwdriver
- Enclosure Size Approximately 3" x 7" x 1" (75mm x 185mm x 30mm)
- Rated for Industrial Temperature Range (-40 to +85 Degrees C)

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Analog Inputs:

The Data acquisition card has 14 external analog inputs (AIN0-AIN13). AIN0-AIN3 are available on screw terminals and also on the DB37 connector. All 14 analog inputs are available on the DB37 connector.

Each analog input can be configured individually as unipolar (four ranges from 0-5 volts to 0-0.625 volts) or bipolar (±5 volts). Analog input resolution is 12-bits at max speed (12 us conversion time), increasing up to 16-bits at slower speeds (2.7 ms conversion time).

Command/response (software timed) analog input reads typically take 1.2+ ms depending on number of channels and communication configuration. Hardware timed input streaming has a maximum rate that varies with resolution from 250 samples/s at 16-bits to 50+ ksamples/s at 12-bits.

Analog Outputs:

The Data Acquisition Card has 2 analog outputs (DAC0 and DAC1) that are available both on screw terminals and the DB37 connector. Each analog output can be set to a voltage between 0 and 4.9 volts with 12-bits of resolution. The analog outputs are based on a true voltage reference.

The analog outputs are updated in command/response mode, with a typical update time of 1.2-4.0 ms depending on communication configuration.

Digital I/O:

The Data Acquisition Card has 23 digital I/O channels which can be individually configured as input, output-high, or output-low. 8 of these lines are called flexible digital I/O (FIO) and can be software configured as up to 6 timers and 2 counters.

The first 4 FIO are available on screw terminals and the DB37 connector. All 8 FIO and 3 MIO are available on the DB37 connector, and 8 EIO and 3 CIO are available on the DB15 connector.

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Command/response (software timed) reads/writes typically take 1.2-4.0 ms depending on communication configuration. The digital inputs can also be read in a hardware timed input stream where up to 16 inputs count as a single stream channel.

Counters:

Up to 2 FIO can be configured as 32-bit counters.

I/O Protection:

All I/O lines on the Data Acquisition Card are protected against minor over voltages. The AIN lines can withstand continuous over voltage of ±15 volts, the FIO lines can withstand up to ±10 volts, while the EIO/CIO/MIO lines can withstand up to ±6 volts.

Power Supply:

Power can be provided by the USB cable or an external 5 volt supply (included). When only Ethernet is connected, and an isolated power supply is used (such as the included wall-wart), the entire Data Acquisition Card is electrically isolated.

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Software Screen Shots

Main sheet

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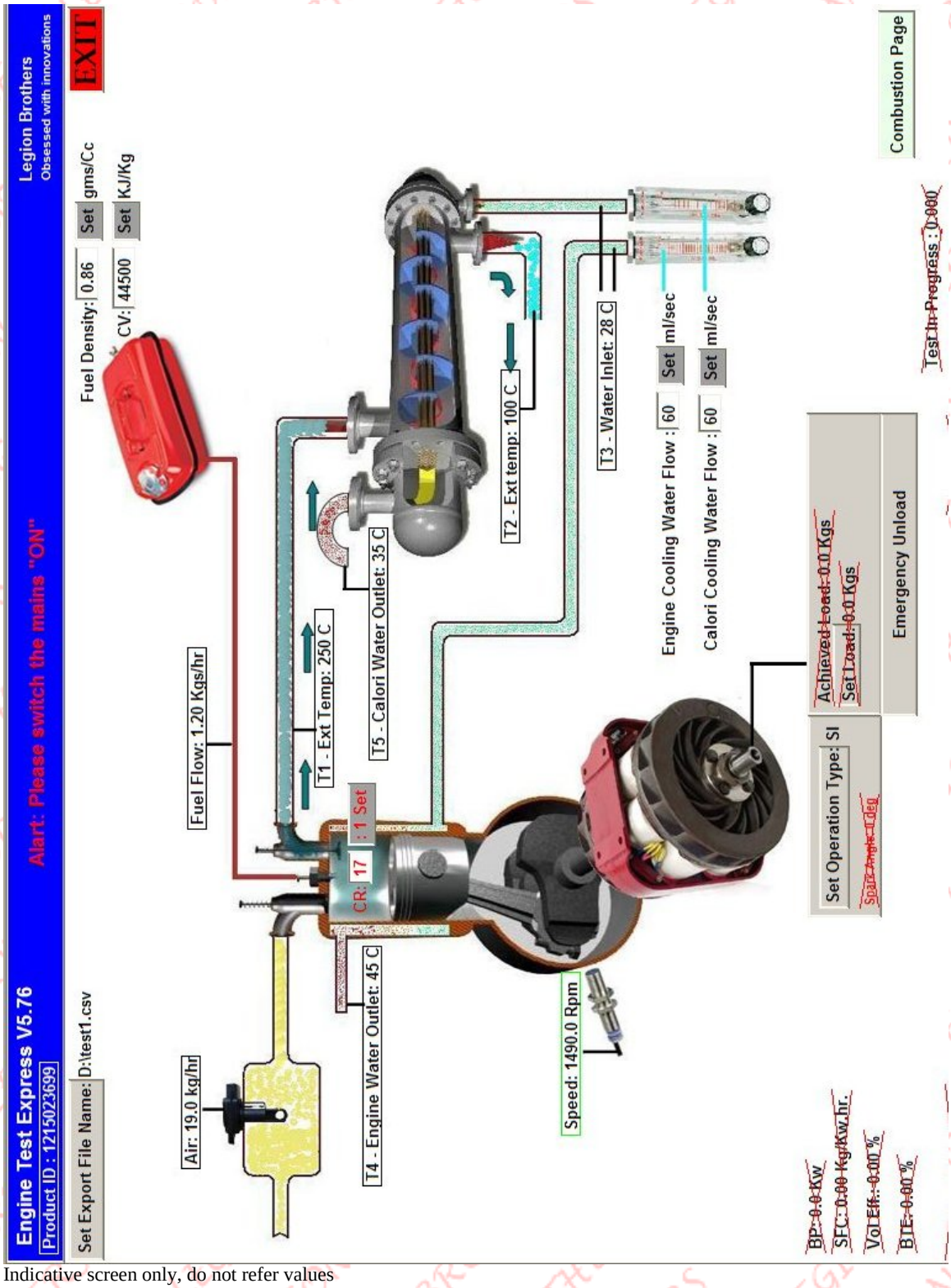

Indicative screen only, do not refer values

This sheet presents the PV, P-Teta and the rate of pressure raise

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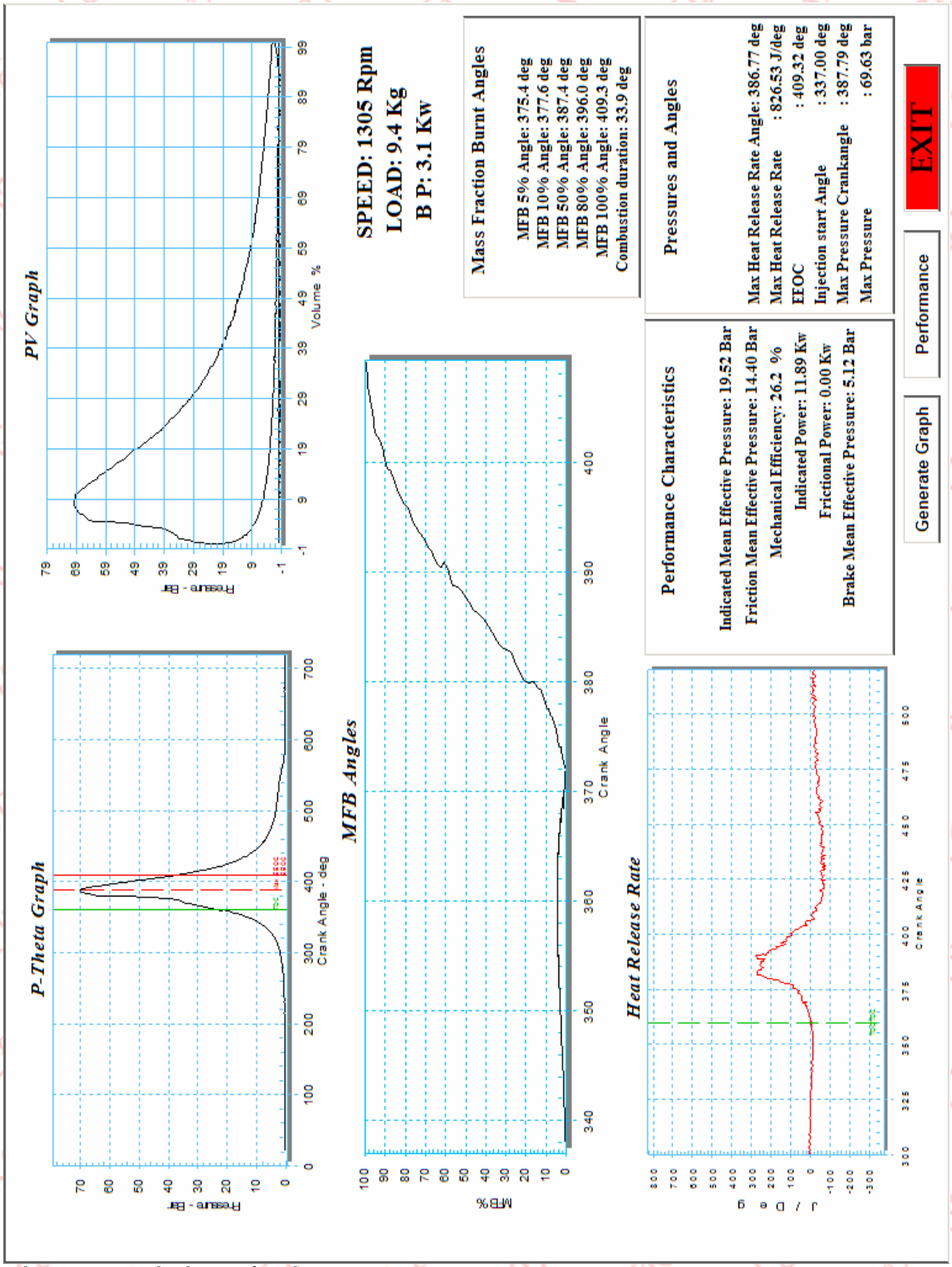

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Computer

Computer components

Dual Core Desktop, Ups and Inkjet printer is supplied along with the test rig.

Dimension

1. Base Frame : 1300 x 1450mm
2. Panel : 1550 x 580mm

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