



Computerised Variable Compression Ratio Diesel Engine Test Rig



Features

- Extensive range of Experiments
- Compression ratio variable from 5:1 to 20:1
- Comprehensive teaching manual
- One year warranty
- Esthetically designed and finished mounting frame
- High Quality instrumentation
- Engine is automatically loaded by the computer.
- Facilities to export data to Microsoft excel

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.

The Engine consists of a variable compression ratio head assembly.

A standard air tank is fitted with a Differential pressure sensor for measuring the Actual volume of air drawn into the cylinder. The thermocouple and necessary signal conditioner for the measurement of temperature at various points 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 and UPS. The rear portion of the panel consists of all instrumentations and signal conditioner related components. Power and control wiring are suitably marked using farul for easy troubleshooting. A standard circuit drawing is normally pasted behind the panel door. The panel is finished with powder coating.

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

The test rig is provided with Eddy Current Dynamometer

Instruction Manual

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

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. Calculate mechanical efficiency.
7. Calculate Frictional Power.
8. Calculate indicated Power.

9. PV and P- θ diagrams
10. Calculate 5% Mass Fraction Burnt Angle
11. Calculate 10% Mass Fraction Burnt Angle
12. Calculate 50% Mass Fraction Burnt Angle
13. Calculate 90% Mass Fraction Burnt Angle
14. Calculate 95% Mass Fraction Burnt Angle
15. Calculate 99% Mass Fraction Burnt Angle
16. Estimated End of Combustion Angle (EEOC)
17. Calculate Maximum Heat Release Rate
18. Calculate Maximum Heat Release rate crank angle
19. Calculate Maximum pressure rise rate
20. Calculate Maximum pressure rise rate crank angle
21. Calculate Maximum pressure
22. Calculate Maximum pressure crank angle
23. Calculate Start of Combustion

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.

Branded Dual Core computer, inkjet printer with suitable UPS as per below mentioned spec,

Installation and demo included

Product / Component Specification

Legion Brothers

#472/5, srigandhadakavalu, Kottigepalya.

Vishwaneedam Post. Bangalore – 560091.

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Engine	
Make	Legion Brothers
Compression Ratio	Variable from 5: 1 to 20:1
No of Cylinder	Single
Cooling	Water
Fuel	Diesel
Speed	1400-1500 RPM
HP	3 to 5HP
Starting	Manual Crank start
Lubrication	Forced
Dynamometer	
Type:	
Make (Selectable by the client)	PowerMag
Cooling	Air
Load Measurement method	Strain Gauge
Max Speed	3000 rev/m
HP	5 HP
Coupling Type	Direct

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Air Flow rate Measurement method

Air Flow

Type/Description	Differential pressure
Range	0-99 m3/hr
Signal Conditioning	Standalone for each sensors

Fuel flow rate Measurement method

Fuel Flow

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Type/Description	In the engine tests, the fuel consumption is measured as a mass flow per unit time M_f . 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

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

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

Measurement of Temperatures at different points

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Type	“K”
Range	0-300°C
Signal conditioning/transmitter	Standalone
Location	Inlet water temperature to Engine jacket
Type	“K”
Range	0-300°C
Signal conditioning/transmitter	Standalone
Location	Outlet water temperature from Engine Jacket
Type	“K”
Range	0-300°C
Signal conditioning/transmitter	Standalone
Location	Ambient
Type	“K”
Range	0-1500°C
Signal conditioning/transmitter	Standalone
Location	Exhaust Temperature

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

Cylinder Pressure

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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
Make			Kistler
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
Shock		g	2000
Operating temperature	mounting location	°C	-50...300
	Viton cable connection	°C	200

range	max. short overload <1 h electronics	°C °C	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

Crank Angle Encoder

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Technical Specification

General specifications	
Pulse count (ppr)	360
Electrical specifications	
Operating voltage	5 V DC \pm 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	\varnothing 7.8 mm, 6 x 2 x 0.14 mm ² , 1 m
Standard conformity	
Protection degree	DIN EN 60529, IP65
Climatic testing	DIN EN 60068-2-3, no moisture 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

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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 gcm ²
Starting torque	≤1.5 Ncm

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)

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 μ s 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.

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.

Software Screen Shots

Main sheet

Engine Test Express V: 35.89 Legion Brothers
Obsessed with Innovations

Product ID : 1296822274

Ready for Next Load Alert: Please switch the mains "ON" EXIT

Operating Mode: Generating

Engine Loading

+ 1kW Load

+100 W Load

Unload Step

Unload All

0.0 kW

Test Load

Set Operation Type: CI
Injection Angle : 337 °

Field
0 V 0.00 A

Armature
0 V 0.0 A

SFC: 0.00 Kg/Kw.hr.
Vol Eff: 0.00 %
BTE: 0.00 %

Fuel Flow
0.00 kg/hr

Air Flow

Engine Water Outlet Temperature - T4
0.0 °C

Engine Cooling water Flow Rate

Calori Cooling water Flow Rate

Engine Out Exhaust Gas Temperature - T1
0.0 °C

Speed
0 RPM

Calorimeter Water Outlet Temperature - T5
0.0 °C

Calori Out Exhaust Gas Temperature - T2
0.0 °C

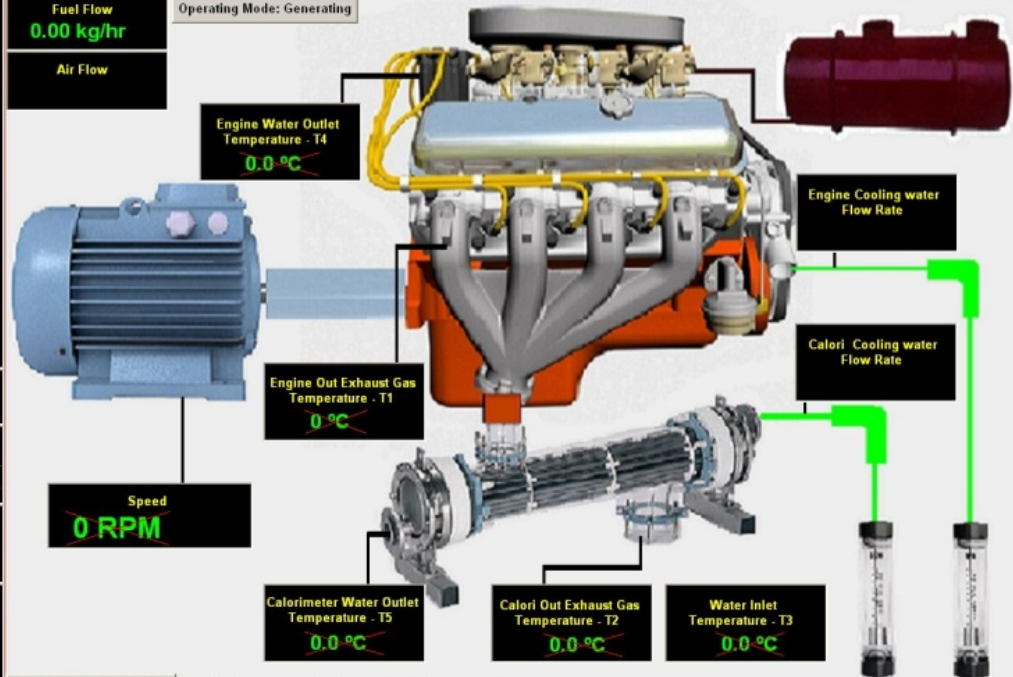
Water Inlet Temperature - T3
0.0 °C

Set Export File Name: C:\Users\Zz0U9191919191\Desktop\tee.csv

Fuel Density: Set gm/cc Switch On Engine

CV: Set kJ/kg Switch OFF Engine

CR: 1 Set Combustion



Control-06-2025

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Computer /components
Compaq Presario Desktop



Dual Core Computer

Printer
HP DeskJet Color Inkjet Printer



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UPS



APC BACK-UPS ES 500VA 230V

Features

- Audible alarms
- Automatic self-test
- Battery-protected and surge-only outlets
- Boost and Trim Automatic Voltage Regulation (AVR)
- Cold-start capable
- Data line Surge Protection
- Hot-swappable batteries
- Lifetime data recovery warranty
- Power conditioning
- Re-settable circuit breakers
- Safety-agency approved
- Transformer-block spaced outlets
- User-replaceable batteries

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