

## P8600

### SERIES MULTI-CYLINDER ENGINE TEST BED

#### INTRODUCTION

The Cussons P8600 series is a self-contained manually operated engine test facility for automotive and industrial light duty multi-cylinder petrol and diesel engines having an instrumentation and control system purpose designed to study engine performance, economy and energy balance measurements. With suitable ancillary equipment, as specified in subsequent items, the system can be used for a comprehensive series of experiments.

#### EXPERIMENTAL CAPABILITIES AND MEASUREMENTS

- ◆ Measurement of maximum torque and maximum power with plotting of full throttle/rack power against speed curve
- ◆ Determination of brake mean effective pressures
- ◆ Analysis of torque speed characteristics
- ◆ Determination of fuel consumption characteristics
- ◆ Calculation of brake specification fuel consumptions
- ◆ Analysis of load characteristics at constant speed
- ◆ Determination of volumetric efficiency
- ◆ Air consumption, fuel consumption, air/fuel ratios
- ◆ Brake thermal efficiencies
- ◆ Exhaust, water, oil, fuel and air temperatures
- ◆ Pressure/time, pressure/volume and crank angle diagrams (with P4600/P4605)

#### DESCRIPTION

Cussons P8600 Series Multi-cylinder Engine Test Beds have been developed to provide a self contained facility for the practical demonstration of internal combustion engine technology.

A comprehensive instrumentation package is supplied mounted in an overhead frame which also carries all required services. The test bed is manually controlled and allows experimental analysis of engine performance parameters such as power, torque, speed and efficiency under various operating conditions, controlled and measured by a dynamometer and ancillary instrumentation.

We are able to offer the following versions of this facility dependent on the end users dynamometer requirements:

**P8601 MULTI-CYLINDER ETB WITH HYDROKINETIC DYNAMOMETER.**

**P8602 MULTI-CYLINDER ETB WITH EDDY CURRENT DYNAMOMETER.**

**P8603 MULTI-CYLINDER ETB WITH REGENERATIVE DYNAMOMETER**

The test facility is intended for installation within a suitable laboratory or client's acoustic test cell equipped with appropriate services for power, plant cooling water, fuel, ventilation air, exhaust silencing/dispersion and necessary mechanical lifting aids. Cussons can, if necessary, advise on the requirements for these services and can provide a complete facility design and procurement service at the client's request.

The test stand is designed for universal engine applications within the range of the dynamometer selected and can be provided with the various engines adapted for convenient installation.

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## SPECIFICATION

The main engine test facility system comprises the following elements:

### 1) TEST STAND BASE

#### DYNAMOMETER

The following dynamometer options can be supplied:

##### P8601 Hydraulic Dynamometer

Rated for 112 kW (150 bhp) at 9000 rpm. The dynamometer is water cooled and a suitable driveshaft guarding arrangement is provided.

##### P8602 Eddy Current Dynamometer

A high speed eddy current dynamometer rated for 150 kW (200 bhp) power absorption, 500 Nm maximum torque and 8000 rev/min maximum operating speed. The dynamometer is water cooled and equipped with a safety flow switch. Calibration equipment for the precision dynamometer load cell can be provided. A suitable driveshaft guarding arrangement is provided.

##### P8603 Regenerative Dynamometer

A swinging field DC dynamometer rated for 90 kW (135 bhp) power absorption, 200 Nm maximum torque and 6000 rev/min maximum operating speed. The dynamometer is air cooled and equipped with field thermostats. Calibration equipment for the precision dynamometer load cell can be provided. A suitable driveshaft guarding arrangement is provided.

#### BEDPLATE

All of the above dynamometers are fitted to a specially designed and fabricated steel bedplate complete with engine starting battery for 12v systems and the engine cooling package.

#### COOLING PACKAGE

The engine cooling package incorporates a pressurised, closed circuit engine jacket water system with control of the engine outlet temperature via a two port thermostatic valve positioned in the outlet of the raw water flow through the heat exchanger. The control temperature can be manually adjusted to enable optimum engine operating conditions to be achieved.

Engine oil temperature is also controlled in the same manner. The plant water supply to the lubricating oil cooler and the jacket water heat exchanger are connected in parallel, this overall system design leads to economic usage of water. Provision is made for measurement of the jacket water flow by means of an orifice plate and manometer. The cooling package can be easily removed from the test bed to enable engines incorporating their own cooling systems or air cooled engines to be tested.

## 2) OVERHEAD CONTROL & SERVICES FRAME

#### FUEL SUPPLY

The fuel supply system can draw fuel from a small sample supply tank housed on the console to the twin bulb glass burette enabling a measured amount of 50 ml, 100 ml or 150 ml of fuel to be used and the time recorded by a stopwatch (not included).

#### AIR FLOW

Air flow measurement is via a capacity damping tank and interchangeable orifice plates designed to cover the engine ranges supplied.

#### CONTROLS

The test bed is arranged for manual control of the engine and dynamometer with a key switch for engine starting and manual throttle/rack control. An emergency stop push button is also provided.

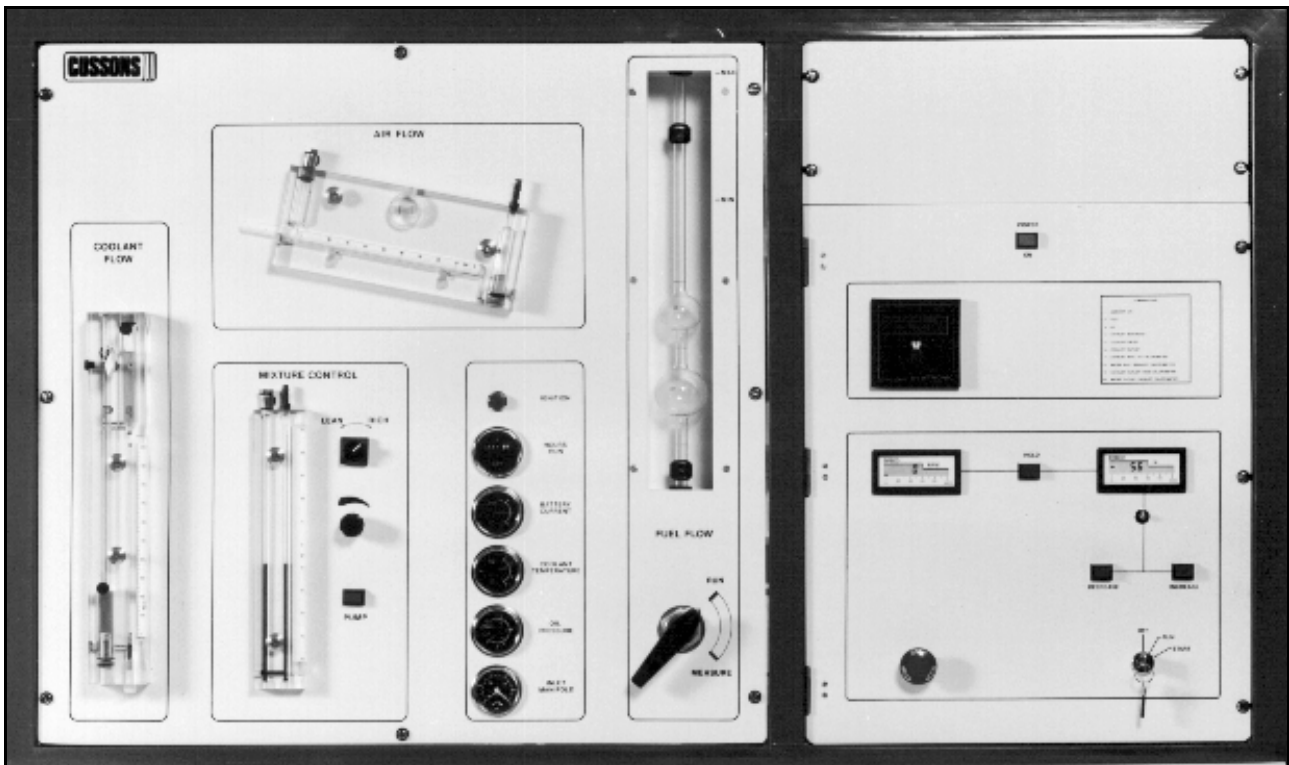
#### INSTRUMENTATION

The following instrumentation is supplied:

- Engine manifold vacuum gauge
- Engine oil pressure gauge
- Engine charging circuit ammeter
- Hours run indicator
- Air flow meter - orifice plate and sloping manometer
- Fuel flow meter - twin bulb burette
- Speed indicator (digital with analogue trend)
- Load indicator (digital with analogue trend)

Temperature indication - ten way indicator and type K thermocouples for:-

- Air inlet,
  - Fuel,
  - Engine coolant inlet,
  - Engine coolant outlet,
  - Lubricating oil,
  - Exhaust manifold,
  - (\*) Exhaust gas inlet to calorimeter,
  - (\*) Coolant inlet to calorimeter,
  - (\*) Exhaust gas outlet from calorimeter,
  - (\*) Coolant outlet from calorimeter
- (\*) These items for use with Cussons Exhaust Gas Calorimeter (P8262)



Instrumentation and Control Panel for P8600

### **SPECIFICATION** (continued)

#### **DYNAMOMETER CONTROL SYSTEM**

As following, dependent on dynamometer supplied:-

##### **P8601 Hydraulic Dynamometer Control**

This is a remote push button control for motorising the dynamometer sluice gates and is mounted in the remote console.

##### **P8602 Eddy Current Dynamometer Control**

This system houses a servo control board and servo driver unit which together regulate the dynamometer field excitation. The servo control board provides full PID control and incorporates on board fault detection. The servo driver is a pulse width modulating device which regulates dynamometer current; this unit also has on board fault detection. The system is configured to provide closed loop speed control of the dynamometer and the speed set point is adjusted via a 10 turn potentiometer on the front panel.

##### **P8603 Regenerative Dynamometer Control**

This is a unit housing a microprocessor controlled Thyristor drive for controlling dynamometer excitation. The controller is an advanced 4 quadrant system, capable of configuring the dynamometer to both motor the engine or regenerate engine load efficiently back into the mains supply. Speed set point

is via a 10 turn potentiometer on the front panel. The system is fully interlocked and incorporates its own on board fault detection system.

#### **SAFETY PROTECTION SYSTEM**

- A) Overspeed trip - arranged to stop the engine and dynamometer if a preset maximum speed is reached.
- B) Loss of water flow - via differential pressure switch across an orifice plate in the dynamometer water inlet port.

Should water flow rate drop below minimum setting, the engine and dynamometer are stopped safely.

*(N.B. applies to P8601 and P8602 only, not required for P8603)*

#### **INSTALLATION MATERIALS**

P8635 Installation Materials Kit - provides a wide range of components for exhaust installation, cooling water installation and electrical installation of the test bed.

Items supplied include an exhaust silencer, flexible piping, copper tubing, a variety of elbows, valves and fittings, electrical cabling, flexible conduit and conduit glands etc.

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## ENGINE OPTIONS

The test beds are designed to accept a wide variety of engines whose power ratings fall within the dynamometer operating envelope. Where engines are supplied by Cussons Technology they will be suitably modified and flexibly mounted on a subframe which can quickly and easily fitted to the test bed.

### **P8613 Four Cylinder Water Cooled Spark Ignited Engine**

Ford MVH 418, 1800cc four cylinder water cooled gasoline engine, rated 85 kW at 5500 rpm. The engine has twin overhead camshafts with 4 valves per cylinder, multipoint sequential fuel injection and control of ignition and fuel injection via Ford EEC IV engine management system.

### **P8621 Four Cylinder Water Cooled Compression Ignition Engine**

Ford XLD 418, 1800cc four cylinder water cooled IDI diesel engine, rated 44 kW at 4800 rpm. The engine has a single overhead camshaft and rotary fuel injection pump.

### **P8622 Four Cylinder Turbocharged Compression Ignition Engine**

Ford XLD 418T, 1800cc four cylinder water cooled turbocharged IDI diesel engine, rated 55 kW at 4800 rpm. The engine has a single overhead camshaft, exhaust driven turbocharger and rotary fuel injection pump.

**N.B. The engines specified above are offered subject to availability and we reserve the right to supply an alternative of similar specification/performance.**

Additional engines available on request.

## OPTIONAL EQUIPMENT

<b>P8262</b>	Exhaust gas calorimeter
<b>P8632</b>	Ignition advance meter for gasoline engines
<b>P8633</b>	Modification of each engine to accept P4600/P4605 Engine Electronic Indicating equipment
<b>P8634</b>	Dynamometer calibration equipment

<b>P8635</b>	Installation materials kit suitable for P8601, P8602 and P8603
<b>P4600</b>	4 Channel Comprehensive Electronic Engine Indicating & Combustion Analysis System for Gasoline & Diesel
<b>P4605</b>	4 Channel Basic Electronic Engine Indicating & Combustion Analysis System for Gasoline & Diesel
<b>P8390/5</b>	Basic Emissions Analyser for HC, CO, CO <sup>2</sup> , O <sup>2</sup> , Lamda and AFR.

## SERVICES

### **P8601 Hydraulic Dynamometer ETB**

*Electrical supply:-* Dynamometer controller - 380/415V a.c., 6 Amp, 50 Hz three phase.  
Control Console - 240V a.c., 1 Amp, 50 Hz single phase.

*Water supply:-* 40 litre per kilowatt per hour.

### **P8602 Eddy Current Dynamometer ETB**

*Electrical supply:-* Dynamometer controller - 380/415v a.c., 16Amp, 50 Hz three phase.  
Control Console - 240V a.c., 1 Amp, 50 Hz single phase.

*Water supply:-* 200 l/min, minimum pressure 1 bar, maximum pressure 4 bar.

### **P8603 DC Regenerative Dynamometer ETB**

*Electrical supply:-* Dynamometer controller - 380/415V a.c., 250Amp, 50 Hz three phase.  
Control Console - 240V a.c., 1 Amp, 50 Hz single phase.

*Water supply:-* 100 l/min, minimum pressure 1 bar, maximum pressure 6 bar.

## SHIPPING SPECIFICATIONS

Either **P8601**, **P8602** or **P8603** complete with one engine

Weight: 1750 Kg gross, 1480 Kg nett  
Packed volume: 7.80 m<sup>3</sup>  
Number of cases: 1

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