



armfield

GASOLINE ENGINE

CM11
issue 2



Biofuel compatible



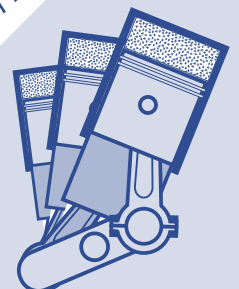
The Armfield CM11 Gasoline Engine provides a self contained engine test rig which allows students to investigate a range of engine performance characteristics. The unit is designed to be linked to a computer, and is supplied with sophisticated educational data acquisition software.

FEATURES

- ▶ *Four cylinder automotive engine*
- ▶ *Eddy current dynamometer to vary engine load*
- ▶ *Plotting of characteristic torque and power curves against engine speed*
- ▶ *Full software control of system, including load and throttle settings*
- ▶ *Closed loop software control of brake loading to maintain constant engine speed during measurements*
- ▶ *Secondary water cooling by heat exchanger, with measurement of temperature change and flow rate*
- ▶ *Engine manufacturer's diagnostic software, also displays ignition timing and injection characteristics*
- ▶ *Measurement of exhaust oxygen content by Lambda sensor*
- ▶ *Remote emergency stop, and facility for safety interlocks*
- ▶ *Optional operation on LPG and biofuel, as well as gasoline*
- ▶ *Optional measurement of cylinder pressure, and plotting this on a p-v diagram*
- ▶ *Option to allow ignition and injection characteristics to be varied*

Internal Combustion Engines

CM



DESCRIPTION

CM11 is a self-contained integrated multi-cylinder engine, dynamometer and instrumentation system. It is based on a 1-litre 4-cylinder automotive engine as used in the Volkswagen Polo car. This engine is a modern design, with electronic engine management of ignition and fuel injection settings.

The Armfield CM11 can be run on a wide variety of biofuels and ethanol mixes. It can be used for fuel testing and comparison exercises. (After each run on non-standard fuel, the engine should be run for a short time on standard gasoline.

An eddy current dynamometer provides a variable load on the engine, allowing the characteristic power and torque curves to be reproduced in the laboratory. The system comes complete with extensive instrumentation, including rpm measurement, torque (from which power can be calculated), plus various temperatures, pressures and flows (see Technical Specification).

The whole system is designed to be linked to a computer using the software provided. This provides real time monitoring of the various sensors, with a wide range of data logging and graphical display options. The dynamometer and throttle can both be controlled electronically from the software, which makes installation into a closed test cell very straightforward, and allows for remote computer operation. A safety 'watchdog' facility ensures the system shuts down safely in the event of computer failure or software lock-ups. The interfaces are compatible with packages such as LabView and MatLab for users who wish to provide their own control and monitoring software. A further advantage of the computer control is that stable rpm readings can be easily achieved using the closed loop control function on the dynamometer drive.

A closed loop primary water-cooling system is incorporated, complete with a heat exchanger for connecting into a secondary cold water supply.

Also included in the supply is the Volkswagen diagnostic software.

This communicates to a PC, and gives the user direct access to view the current parameters used by the engine control unit (ECU), such as ignition timing, injector opening times, and many more. In particular the injector opening times can be used to calculate an accurate fuel consumption figure for the engine. The ECU also records any engine faults and these are accessible by this software. (Note if the CM11-14 option is specified, the engine manufacturers' software is replaced by alternative software that does not include the diagnostic function).

The ECU software can either be run on the same computer as is used for control and data logging, or can be run on a separate computer, according to user preference.

TECHNICAL DATA

Engine Data

Engine model: Volkswagen AER
Displacement: 999cc
Bore: 67.1 mm
Stroke: 70.6 mm
Cylinders: 4
Nominal power: 37kW @ 5000 rpm
(running on gasoline with the engine manufacturer's ECU)

Nominal torque: 86Nm @ 3400 rpm
(running on gasoline with the engine manufacturer's ECU)

Dynamometer data

Dynamometer type: Eddy current
Cooling: Air cooled
Max Power: 55kW for 20 minutes

Instrumentation and Sensors

Engine speed counter
Load cell to measure torque
Inlet air flow measured by orifice plate
Inlet air temperature
Secondary cooling water flow and temperatures (inlet and outlet)
Lambda sensor

Also the VW diagnostic software can be used to monitor a wide variety of internal engine functions, in particular the ignition timing and fuel injector opening times. The injection characteristics can be used to establish the gasoline consumption rate.

OPTIONS

The CM11 can be ordered with a number of optional accessories. These must be ordered with the CM11. They cannot be fitted retrospectively.

CM11-12 Engine Indicator Set

The engine indicator set comprises a high temperature pressure sensor integrated into a spark plug. A separate charge amplifier provides signal conditioning to generate a voltage which can be logged on the computer. A special routine in the Armfield software allows for high speed data acquisition of this signal, and automatically plots the results on a p-v diagram. **Note:** The spark plug used in this arrangement is not identical to the other sparkplugs. This sensor is a high precision unit and is physically delicate.

CM11-13 LPG Fuel System

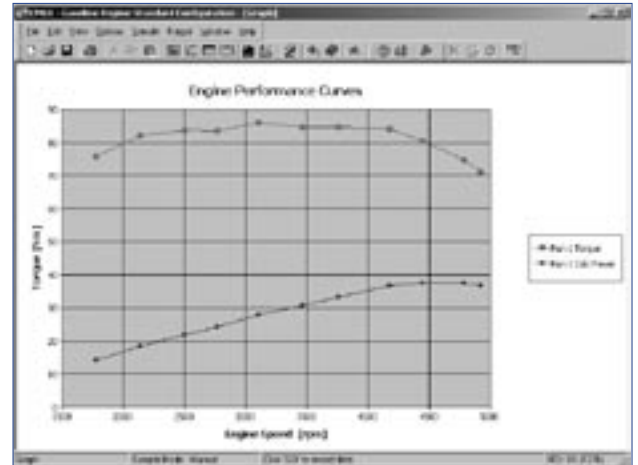
The LPG option includes the pipework, solenoid valves, injectors and an LPG control unit to allow the engine to be run on Liquid Petroleum Gas (LPG) as well as gasoline. The engine is started on gasoline, and when hot enough, can be switched to run under LPG by software request.

The equipment is supplied with a flexible feed pipe terminating in a 6mm OD copper tube and a self sealing quick release connector suitable for fitting to the LPG bottles available in many countries.

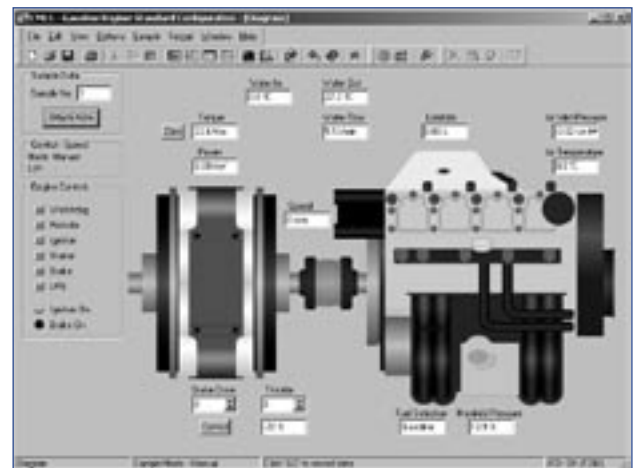
The user must supply a liquid offtake LPG bottle, and if necessary a suitable fitting to the feed pipe.

CM11-14 Ignition and Injection Control (Cannot be fitted together with CM11-13)

The CM11-14 option replaces the VW ECU with an aftermarket unit which allows the ignition timing and the fuel injection characteristics of the engine to be changed by the user. The students can produce their own characteristic maps and compare the engine performance with the manufacturer's data.



CM11 - Software graphical display



CM11 - Software Mimic diagram

INSTALLATION AND SERVICES

The CM11 should be installed in a well ventilated area with exhaust gas extraction facilities. The unit is supplied on wheels for ease of movement, these can be removed and the unit bolted to the floor for permanent installation.

Apart from the master on/off switch, and the cooling water, everything can be controlled by computer, allowing the engine to be installed in a dedicated test cell, and operated from outside the cell. It is supplied with a 5 metre USB lead, giving a maximum distance between the unit and the controlling computer of approx 4m.

The following services are required:

Electricity: 220-240V, single phase, 10 Amp

Cooling water: 6 L/min at 3 bar pressure, <20°C

ORDERING SPECIFICATION

- *A four cylinder, 1.0 litre, water cooled, normally aspirated engine complete with all services and ancillaries required to run the engine in a laboratory environment.*
- *Variable load, eddy current dynamometer which acts as a brake, allowing direct measurement of engine torque.*
- *Biofuel compatible*
- *Supported on strong tubular steel framework via flexible mounts. Frame houses fuel tanks, battery, electrical enclosures, etc.*
- *Protected by guards around all moving parts, and around key hot surfaces. Safety interlock switches are incorporated to prevent operation with guards removed.*
- *Throttle and brake load can be controlled from a computer.*
- *Standard instrumentation includes sensors for:*
 - *Engine speed*
 - *Torque*
 - *Air flow*
 - *Cooling water temperature (inlet and outlet of heat exchanger)*
 - *Cooling water flow*
 - *Exhaust gas Lambda sensor*
- *Sensor variables are logged in real time on a customer supplied computer via a USB interface, using sophisticated educational software. The software includes full data logging and analysis functions, and incorporates detailed teaching material.*
- *Optional Engine Indicator set allows production of real time P-V diagram.*
- *Optional LPG System allows engine to run on LPG fuel.*
- *Optional Ignition and Injection Control system allows user to investigate the effects of alterations to fuel injection and ignition timing.*

ESSENTIAL EQUIPMENT

The user must have access to one or two PCs (according to preference). Two free USB ports are required, one to run the Armfield data logging and control software, and one to run the VW diagnostic software. One free serial COM port is required to run the ECU software supplied with the CM11-14 option. The operating system requirements are Windows 98, 2000, ME or XP.

OVERALL DIMENSIONS

*Height: 1.50m
Width: 1.50m
Depth: 1.00m*

SHIPPING SPECIFICATION

*Volume: 3.00m³
Weight: 500kg*

Armfield Limited
Bridge House, West Street, Ringwood,
Hampshire BH24 1DY, England

Tel: +44 (0)1425 478781 Fax: +44 (0)1425 470916
E mail: sales@armfield.co.uk
URL: <http://www.armfield.co.uk>

USA Office:
Armfield Inc.
436 West Commodore Blvd (#2)
Jackson NJ 08527

Tel: (732) 928-3332 Fax: (732) 928-3542
E mail: info@armfieldinc.com