

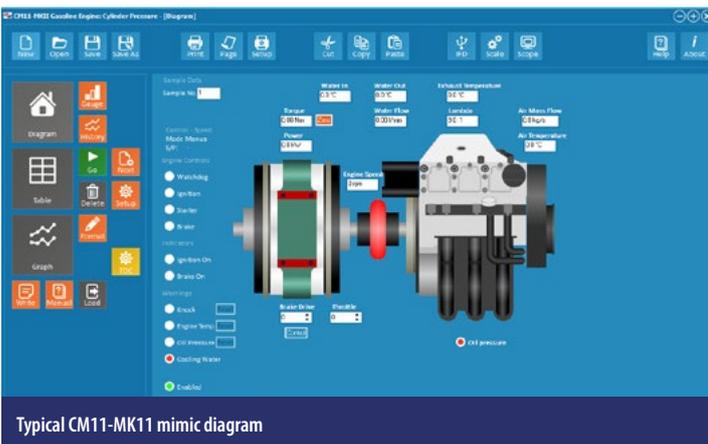
The Armfield CM11-MKII biofuel compatible Gasoline Engine provides a self-contained engine test rig, which enables students to investigate a range of engine performance characteristics.

The unit is designed to be linked to a computer, and is supplied with sophisticated educational data acquisition software.

**BIOFUEL COMPATIBLE**



CM11-MKII Integrated eddy current dynamometer to vary engine load



Typical CM11-MK11 mimic diagram



3-cylinder engine, as used in a number of VW cars

### Features / benefits

- ▶ Modern, high efficiency, 3-cylinder automotive engine
- ▶ Biofuel compatible
- ▶ Integrated 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
- ▶ User control of ignition timing and fuel injection now standard
- ▶ Secondary water cooling by heat exchanger, with measurement of temperature change and flow rate
- ▶ MKII version fitted with wideband Lambda sensor for improved performance
- ▶ Remote emergency stop and facility for safety interlocks
- ▶ Optional operation on LPG as well as gasoline and biofuel
- ▶ Optional measurement of cylinder pressure and plotting this on a p-V diagram

## Description

The Armfield CM11-MKII is a self-contained integrated, multi-cylinder engine, dynamometer and instrumentation system, based on a VAG (Volkswagen Automotive Group) 1.2 Litre, 3-cylinder engine, as used in a number of VW cars. This engine is a modern design, with electronic engine management of ignition and fuel injection settings.

The Armfield CM11-MKII 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, enabling 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 (not supplied) 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, which makes installation into a closed test cell very straightforward and enables for remote operation.

A safety 'watchdog' facility ensures the system shuts down safely in the event of computer failure or software lock-up.

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.

A feature of the system is the Engine Control Unit (ECU), which controls the ignition timing and fuel injection characteristics. The user has full access to this information and advanced users can vary the parameters to explore engine performance under different conditions.

The injector opening times are available from the ECU software and they can be used to calculate accurate fuel consumption.

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.

## Experimental content

- ▶ To produce a set of performance curves for the engine under varying loads
- ▶ To determine the volumetric efficiency of the engine under varying loads
- ▶ To measure the pressure inside the cylinder during a complete cycle, and to relate this to the position of the piston, producing a pressure-volume diagram, (requires CM11-MKII-12 engine indicator set)
- ▶ To measure the fuel consumption of the engine.

## Optional accessories

The CM11-MKII can be ordered with a number of optional accessories. These must be ordered with the CM11-MKII as 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 that can be logged on the computer.

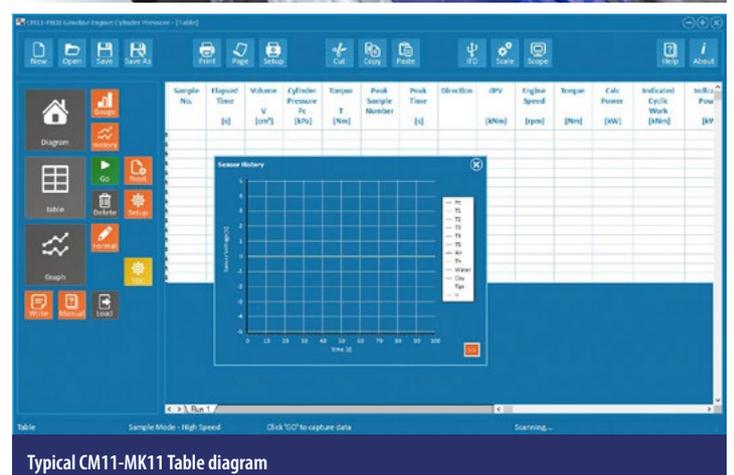
A special routine in the Armfield software enables for high speed data acquisition of this signal and automatically plots the results on a p-V diagram. Note: The spark plug used in this arrangement is not identical to the other sparkplugs. This sensor is a high precision unit and is physically delicate.

### CM11-13 LPG Fuel system

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

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.



## Installation

The CM11-MKII 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 remotely enabling the engine to be installed in a dedicated test cell and operated from outside the cell.

It is supplied with a 5m USB lead, giving a maximum distance between the unit and the controlling computer of approximately 4m.

## Technical details

Sample tube I/D	0.038m
Sample tube length	0.507m
Pump	24 L/hr
Flow meter range	0-3 L/min
Glass funnel	1.5L
Solenoid valves	2
Pressure range	0-5 psi

## Technical specifications

Engine Data	
Engine Model	VAG type AWY
Displacement	1198cc
Bore	76.5mm
Stroke	86.9mm
Cylinders	3 (6 valve)
Nominal Power	40kW @ 4700 rpm (running on gasoline)
Nominal Torque	106Nm @ 3750 rpm (running on gasoline)
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 (wideband)	

## Overall dimensions

Length	1.5m
Width	1.5m
Height	1.5m
Packed and crated shipping specifications	
Volume	3m <sup>3</sup>
Gross weight	500Kg

## Requirements

## Scale



- ▶ Electricity: 220-240V, single phase, 10 Amps  
Cooling water: 6 l/min at 3 bar pressure, <20°C
- ▶ The user must have a PC running Windows 7 or above, with 2 free USB ports, one to run the Armfield Data logging and one to run the ECU Software

## Ordering specification

- ▶ A modern, automotive, high efficiency 3-cylinder, 1.2 litre, water cooled, normally aspirated engine complete with all services and ancillaries required to run the engine in a laboratory environment
- ▶ Biofuel compatible
- ▶ Variable load, eddy current dynamometer, which acts as a brake, enabling direct measurement of engine torque
- ▶ Dynamometer completely integrated with the engine, mounted within the same frame
- ▶ Ignition and injection control system as standard, enables user to investigate the effects of alterations to fuel injection and ignition timing
- ▶ 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
- ▶ Throttle and brake load can be controlled remotely
- ▶ 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 enables production of real time p-V diagram
- ▶ Optional LPG System enables engine to run on LPG fuel



## The CM range of equipment

CM11-MKII:	Gasoline Engine	BIOFUEL COMPATIBLE
CM12:	Automotive Diesel Engine	BIODIESEL COMPATIBLE
CM14:	Axial Flow Gas Turbine	

Armfield standard warranty applies with this product

## Knowledge base

- > 28 years expertise in research & development technology
- > 50 years providing engaging engineering teaching equipment

Benefit from our experience, just call or email to discuss your laboratory needs, latest project or application.

An ISO 9001:2015 Company



Products CE certified

[armfield.co.uk](http://armfield.co.uk)

## Aftercare

Installation  
Commissioning  
Training  
Service and maintenance  
Support: [armfieldassist.com](http://armfieldassist.com)