

# Optical Diagnostics and Rapid Compression Machine for Low and Zero-Carbon Fuels and Combustion Research



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### Facilities Overview

- Rapid Compression Machines are widely used to study engine sprays and combustion under controlled, repeatable thermodynamic conditions.
- Application of optical diagnostics enables investigations of spray characteristics, fuel-air mixing, ignition, flame and formation of emissions.
- Flexible tool for the development and validation of computational models essential in advancing cleaner combustion technologies.
- The AEC-RCM at Brighton is a highly configurable, 2-stroke single cylinder, loop scavenged design based upon the Ricardo Proteus engine platform.

### AEC-Rapid Compression Machine (RCM) Test Facility

### Optical Head With Multiple Injector Capability

Top view

Bottom view

### Engine Specifications

Bore	135	mm
Stroke	150	mm
Compression ratio	9:1	
Displacement volume	2.2	Litre
Speed	100-1000	rpm
Peak motoring pressure	120	bar
Variable back pressure control		
Exhaust separator		
Dilution tunnel		

### Key Facility Features

**Flexible Experimental Platform**

- Single-cylinder, two-stroke, Schnürle loop-scavenged configuration.
- Twin ported intake, single exhaust. Quiescent chamber at TDC
- Variable speed : 100–1000 rpm.
- Heated and boosted intake system with variable back-pressure control.
- Interchangeable combustion chambers components.
- Adaptable configurations.

**Combustion and Flow Control**

- Conventional Cylinder head with quiescent chamber
- Pre-chamber Cylinder head with tuneable turbulence generation
- Multiple fuel injection configurations including dual fuels

**Optical Access for laser-based diagnostics and high-speed imaging**

- Top-hat optical chamber with 4 orthogonal side windows.
- Brewster-angle (PDA) optical chamber with 3 side windows
- Plan (top) view optical window pre-chamber cylinder head

### Research Applications

**Fuel spray and combustion Investigations**

- Liquid hydrocarbons, bio- and synthetics
- Zero carbon hydrogen and ammonia
- Dual-fuel concepts
- Compression and spark ignition

**Typical Studies**

- Spray breakup
- Droplet size distribution
- Evaporation and mixture preparation
- Flame development and propagation
- Chemical species formation
- Soot formation

## Optical Diagnostics for Combustion Research – Optical Engines and Rapid Compression Machine

### Phase Doppler Anemometry

### Spray Characteristics

### Long-range microscopy analysis

### Air Motion and Turbulence (PIV/LDA)

### Combustion Analysis

### Optical Engine Visualisation

### Engine Experimental Data

### Engine CFD Model

### Advanced LASER Technique (LII)

### Key Attributes

- Fundamental investigations of spray, ignition, and combustion phenomena under engine-relevant conditions
- Modular chamber design, configurable injection and optical access
- Flexibility: hydrogen, ammonia, methanol, bio-derived fuels, and dual-fuel concepts
- Provides validation data for injection and combustion model development

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