



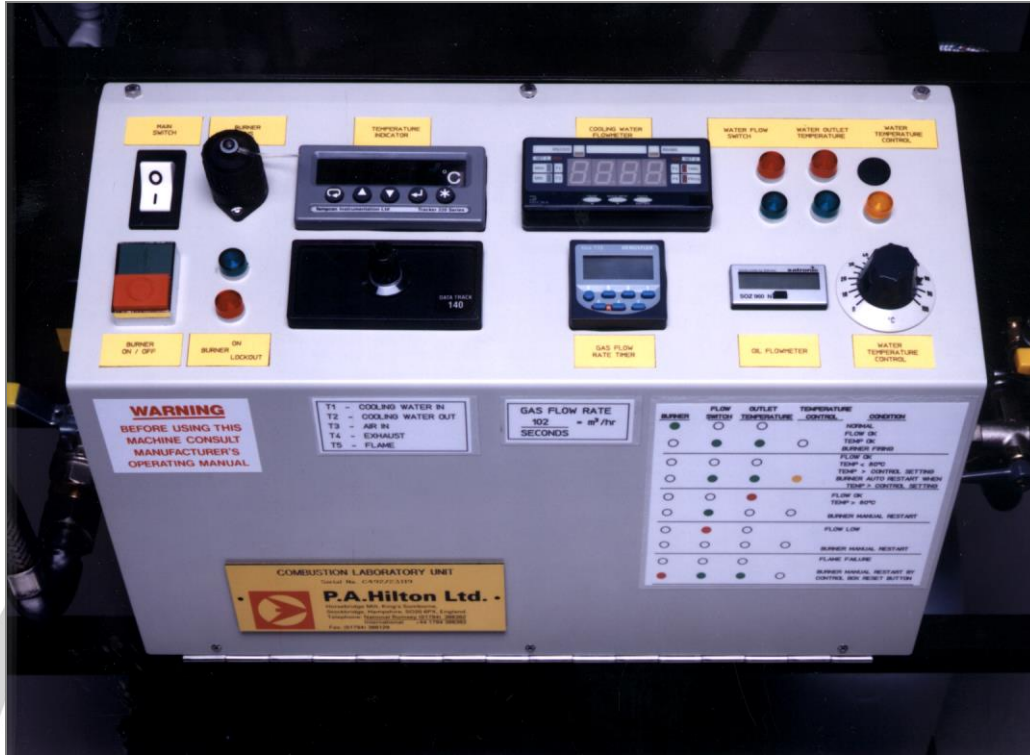
Combustion Laboratory Unit C492



Figure 1: C492 Unit with Optional C492A fitted



Figure 2: C492 Console



Introduction

In spite of the contributions made by nuclear, hydraulic, solar, wind and other renewable energy sources, the vast majority of energy is derived from combustion of hydrocarbon fuels.

These fuels, in general, are finite in quantity, and it is vital that they are used efficiently and economically to conserve resources and reduce pollution. A sound knowledge of the factors which affect the efficient combustion of fuels is essential for everyone involved with energy use.

The Hilton Combustion Laboratory Unit enables students to study many aspects of combustion and burner operation using burners typical of those used commercially. Light oils or gas can be burned using the appropriate burner. The unit is frame mounted, is fully instrumented and requires only a conventional single phase electrical supply, cooling water and the chosen fuel. As a purpose built training unit it is designed for supervised student operation by including several safety features. A hand held digital gas analyser supplied allows the O_2 content of the flue gas to be determined and this in turn allows calculation of the air /fuel ratio, excess air and combustion efficiency.

For advanced students or research, an optional high specification gas analyser is available that allows investigation of CO, NO and SO_2 in addition to the standard analysis.

The unit will be of wide interest to all those concerned with the combustion of fuels and energy conservation, from the burner maintenance technician, to research and test engineers.



Experimental Capabilities

- Familiarisation of the adjustment and operation of a commercial oil or gas burner.
- Assessment of a burner, including:
 - Firing rate
 - Turndown range
 - Flame stability
 - Flame shape
 - Flame radiation
 - Smoke emission
- Using either clean light boiler fuels, or natural gas or LPG
- The effect of air/fuel ratio on:
 - Combustion efficiency as measured by flue gas constituents and temperature.
 - Heat transfer
 - Energy balance
- Comparison of Flue Gas Analysis with theoretical predictions.
- Comparison of Oil and Gas Burners.
(With optional extra Burner)
- Comparative performance of different fuels or fuel additives.

Description

The Combustion Laboratory Unit is mounted on a frame, allowing easy access to the burner, controls and combustion chamber.

The package burner starts with an air purge, ignites its appropriate fuel (oil or gas) and automatically sets to a safe firing condition. Combustion air is provided by the integral fan, and a sensor monitors the flame, shutting the fuel valve in the event of flame failure. Air/fuel ratio and fuel firing rate can then be varied by the user.

Gas from either an LPG cylinder stored outside the building, or from local mains supply, is fed through pipes to the connections on the frame. Oil is supplied from portable tanks provisioned with the oil burner.

The flame burns within a stainless steel combustion chamber which is water cooled and of sufficient size to prevent flame impingement under normal conditions. Observation windows on the side of the chamber allow the flame to be observed.

A water cooled gas sampling probe and thermocouple probe allow conditions within the flame to be investigated

The unit allows similar locally supplied automatic package burners of up to 150kW to be operated and analysed.



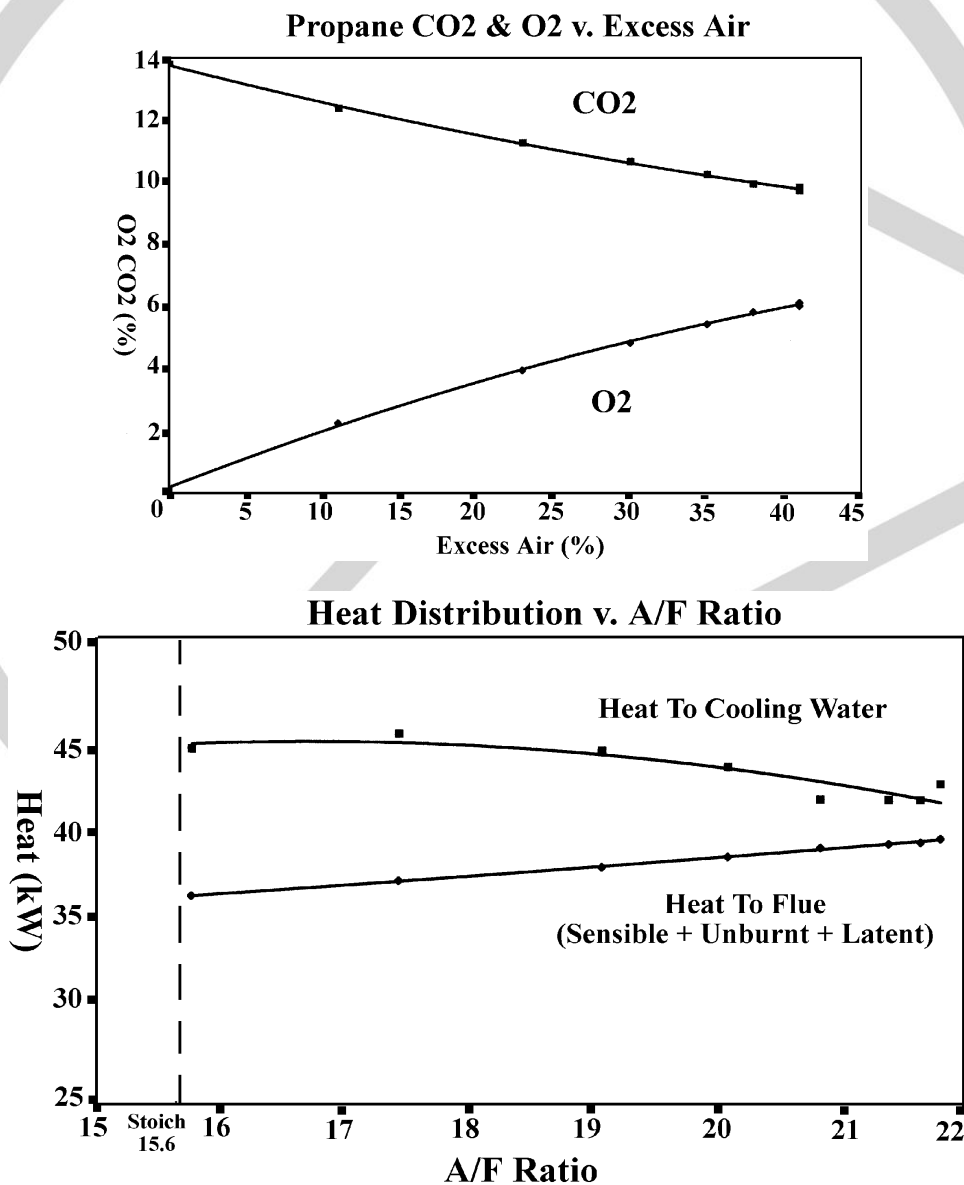
Experimental Results

The combustion products leave the combustion chamber through a duct in the end remote from the burner, and are turned to discharge vertically upward. Due to high flue temperatures, an air break transition piece is supplied between the chamber duct and the main flue, to entrain cool air and so reduce flue temperature. A flue system is available as an optional extra.

The unit must be installed in a well ventilated area, with access to the burner end and at least one of the two sides.

Electrical safety is provided by overload and earth leakage circuit breakers. The cooling water system has a flow switch and high temperature cut-out.

The standard instrumentation provides measurement of flue temperature, O₂ content, excess air, combustion efficiency, cooling water inlet and outlet temperatures, water and fuel flow, thereby allowing energy balances to be determined.





Specification

General

A fully instrumented water-cooled combustion chamber with oil and/or gas burner(s) for studying burner operation and the combustion process.

Detailed

A frame mounted burner training unit comprising a 450 diameter x 1000mm cylindrical water-cooled stainless steel chamber in which either an oil or gas burner can be fired and the flame observed through four 100mm diameter windows.

Internal electric and mechanical safety devices allow for supervised operation by students. Instrumentation to measure the water, air and exhaust temperatures, and flow rates of the cooling water, air and fuel. A hand held gas analyser supplied measures flue gas O₂ content and also displays combustion efficiency, excess air, and CO₂ content.

Smoke Number can be determined for the oil burner with the Smoke Tester supplied.

Further flue gas analysis including CO, NO and SO₂ can be performed on either burner by using the additional optional high specification Gas Analyser. Oil or Gas Burners up to 150kW can be used in the chamber.

Supplied with a detailed experimental operating and maintenance manual giving example experimental results and sample calculations.

Accessories and spares for two years normal operation together with a full two year warranty.

Dimensions

Height: 1700mm **Depth:** 2000mm
Width: 600mm **Weight:** 175kg

Services Required

Electrical: **A:** 220-240 Volts, Single Phase, 50Hz(With earth/ground).
Line current up to 3A at 230v

B: 110-120 Volts, Single Phase, 60Hz(With earth/ground).
Line current up to 6A at 110v

Water: Up to 25 litres m⁻¹ at a minimum of 10m head. Open drain for this flow rate.

Gas: LPG at maximum 2bar or mains natural gas at maximum 50mbar. Flow rate 1 to 3 g/s.

Oil: Kerosene, gas oil or other clean light fuels (density 790 - 835 kg/m³, viscosity 0.011 - 0.055 cm²/s@ 40 C). Flow rate 2 to 5 g/s.

Extraction Suitable ducting to extract 3m³/min of exhaust gases at upwards of 400°C out of the building – C492C recommended.

Ventilation Room must be adequately ventilated to provide 8m³/min of fresh air flow.

Ordering Information

Order as:

Combustion Laboratory Unit **C492**

Optional Items:

Gas Burner **C492A**
Oil Burner **C492B**
Flue Installation Package **C492C**
Flue Gas Analyser **C492D**
Data Acquisition Upgrade **CC493A**

Electrical Specification

Either: **A:** 220-240 Volts, Single Phase, 50Hz (With earth/ground).

B: 110-120 Volts, Single Phase, 60Hz (With earth/ground). (Supplied with transformer)

Language

Either: English, Spanish or French.

Shipping Specifications (Estimated)

Net Weight: 175kg.
Approximate Gross Weight: 225 kg.
Packing Case Dimensions: 1.0 x 1.8 x 2.2m
Packing Case Volume: 3.96m³

Accessories and Spares

Unit supplied with:

- One experimental operating and maintenance manual in English, Spanish or French.
- Accessories and spares for 2 years normal operation. List available on request.

Also Available On Request

- Further detailed specification.
- Additional copies of instruction manual.
- Recommended list of spares for 5 years operation.



C492 Optional Extra **Data Acquisition Upgrade CC493A**

Hardware details

The Optional Computerised Data Acquisition Upgrade CC493A consists of a 21 channel Hilton Data logger (D103), together with pre-configured, ready to use, Windows TM compatible educational software.

Factory fitted coupling points on the C492 allow installation of the upgrade to the unit at any time in the machine's extensive life.

The Hilton Data logger (D103) connects, using the cable supplied, to a standard USB port on the user-supplied PC. If more than one logger is required connection is via a second USB port or standard USB hub.

The combined educational software and hardware package allows immediate computer monitoring and display of all relevant parameters on the C492.

Software Details

The pre-configured menu driven Software supplied with the Computer Upgrade CC493A allows all recommended experiments involving the electronic transducers and instruments on the C492 to be carried out with the aid of computerised data acquisition, data storage and on-screen data presentation. This enhances student interest and speeds comprehension of the principles being demonstrated.

Students are presented with either raw data for later hand calculation or alternatively data may be transferred to most spreadsheets for computerised calculation and graphical presentation.

Data may be stored on disc and displayed at any time using the software supplied. Alternatively data may be transferred to any compatible spreadsheet together with individual time and date stamp on each reading for complex analysis.

Additional Data Logging Facility Supplied As Standard

The D103 is the third generation of Hilton Data Logger. It comprises an industrially proven 21 channel interface with 8 thermocouples (type T and K as standard) / differential voltage inputs ($\pm 100\text{mV DC}$), 8 single ended DC voltage inputs ($\pm 8\text{v}$), 4 logic or frequency inputs and one mains voltage input.

In addition there are on board 12v DC, $\pm 5\text{V DC}$ and $\pm 15\text{v DC}$ power supplies for most commercially available transducers.

The Hilton Data Logging software supplied as standard with the CC493A package allows the D103 to be disconnected from the C492 and used together with most standard transducers as a stand-alone computer data logger for the instrumentation and monitoring of existing laboratory equipment using locally sourced industrial transducers. The software is also backwards compatible with our many second generation D102 data loggers that are already in use worldwide.

Full data logger command protocol and communications details are provided in an extensive user manual that allows other software applications to communicate with the logger via the USB interface. Users can write their own software, typically in LabView, Matlab, C, C++, Visual Basic etc. This further expands the student project capabilities of the CC493A package from teaching and demonstration into the field of research and postgraduate study.

Computer Hardware Requirements

The menu driven Software supplied with the Computer Upgrade CC493A will operate on a PC which has at least 0.5Gb Mb ram, VGA graphics, 1Gb hard drive, CD drive and an available USB port. The software is Windows 2000, XP and 7 compatible.

Ordering Information

Order as: Data Acquisition Upgrade CC493A

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