World leading supplier of engineering teaching equipment

Energy Ranges

Combustion

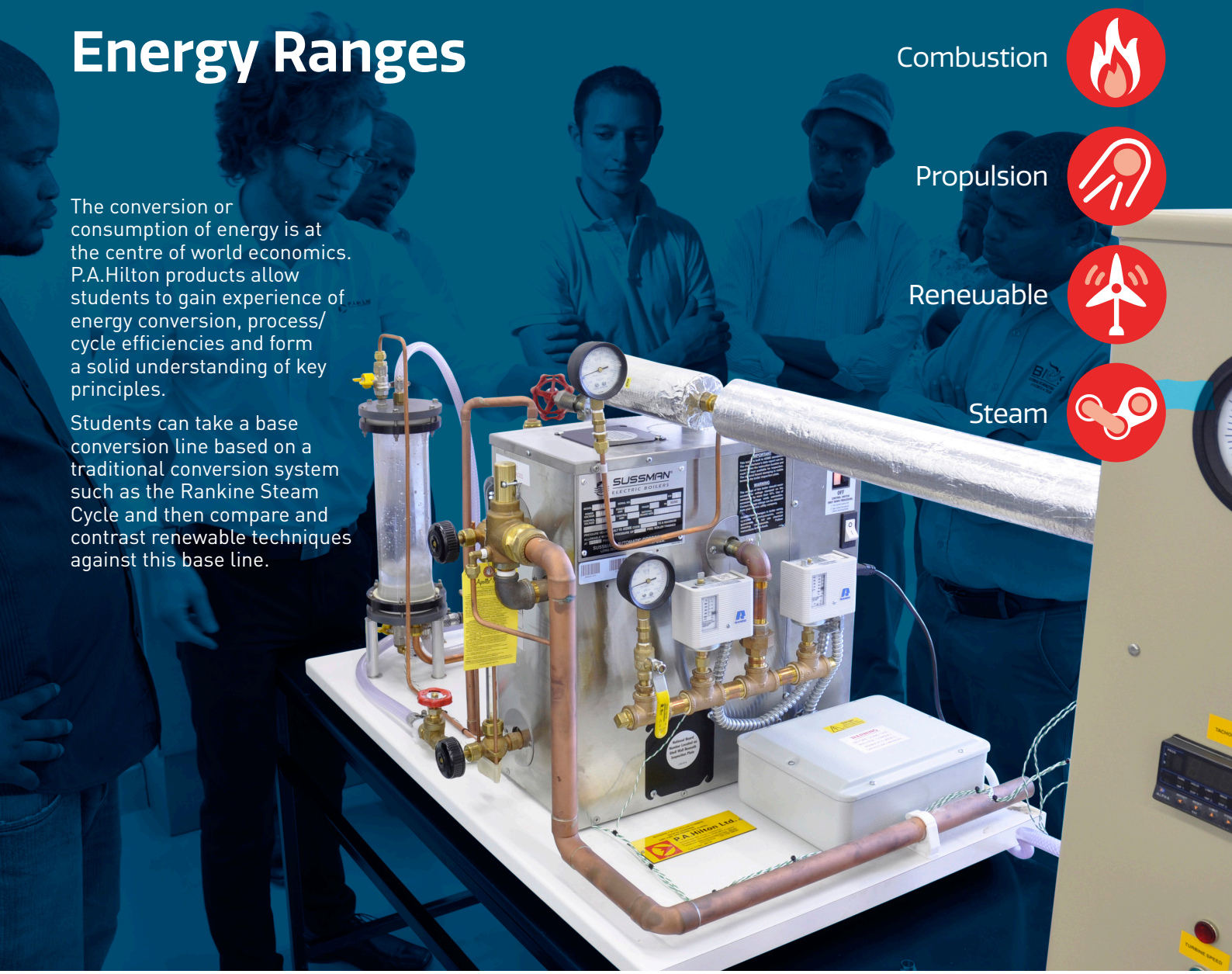
Propulsion

Renewable

Steam

The conversion or consumption of energy is at the centre of world economics. P.A.Hilton products allow students to gain experience of energy conversion, process/ cycle efficiencies and form a solid understanding of key principles.

Students can take a base conversion line based on a traditional conversion system such as the Rankine Steam Cycle and then compare and contrast renewable techniques against this base line.



PA Hilton

sales@pahilton.co.uk

Energy

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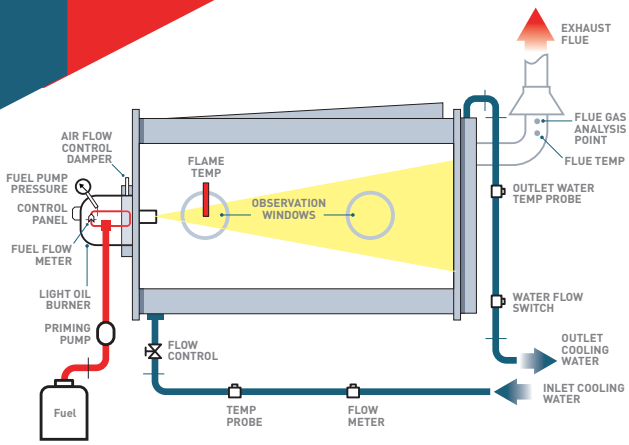
In spite of the contributions made by nuclear, hydraulic, solar, wind and other renewable energy sources, the vast majority of energy is derived from combustion of hydrocarbon fuels. These fuels, in general, are finite in quantity, and it is vital that they are used efficiently and economically to conserve 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.



"Heat was not formally recognised as a form of energy until about 1798, when Count Rumford, a British military engineer, noticed that limitless amounts of heat could be generated in the boring of cannon barrels and that the amount of heat generated is proportional to the work done in turning a blunt boring tool."

www.britannica.com/science/thermodynamics

Neem biodiesel is currently being explored as a future biofuel and was extracted chemically from the vegetable oil. Many of its properties are still under investigation and our aim was to study its noxious-gas emission profiles from blends with regular petroleum diesel. The distinct advantage of a real-time study is acquisition of in situ data on the combustion behavior of gas components with actual progression of time. Mixtures of neem biodiesel and petroleum diesel corresponding to neem additives of 5%, 10%, 15% and 25% were tested for combustion efficiency and emitted gases using a high-performance gas analyzer. Our study, therefore, investigated the overall efficiency of the combustion process linked to emissions of the following gases: O2, CO2, NO, NOx and SO2. The results for the 95/5% blend compared to the neat sample were most promising and showed no serious change in performance efficiency (←2%). NO/NOx emission trends displayed maxima/minima, suggestive of interconvertible chemical reactivity. Declining CO and SO2 emissions were consistent with rapid chemical conversion. The CO and SO2 concentrations fell well below the toxic atmospheric limits in less than 300 s. The results are generally encouraging for blends below 10%. The potential environmental impact of the study is discussed.

Real-Time Study of Noxious Gas Emissions and Combustion Efficiency of Blended Mixtures of Neem Biodiesel and Petrodiesel
Avin Pillay 1,* , Arman Molki 2,* , Mirella Elkadi 1, Johnson Manuel 1, Shrinivas Bojanampati 2, Mohammed Khan 1 and Sasi Stephen 1

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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.

C492 Combustion Laboratory Unit

- Enables students to study many aspects of combustion theory and burner operation using the optional gas and oil burners. Domestic heating simulation can also be demonstrated via the in-built water temperature control
- Research paper based on this unit https://www.mdpi.com/2071-1050/5/5/2098 Image is of a C492 at Portsmouth University

C100 Internal Combustion Engine Test Stand

- A regenerative engine test bed that allows the investigation of torque-speed, power-speed, specific fuel consumption, thermal and mechanical efficiency over a wide range of conditions on both petrol and diesel* engines

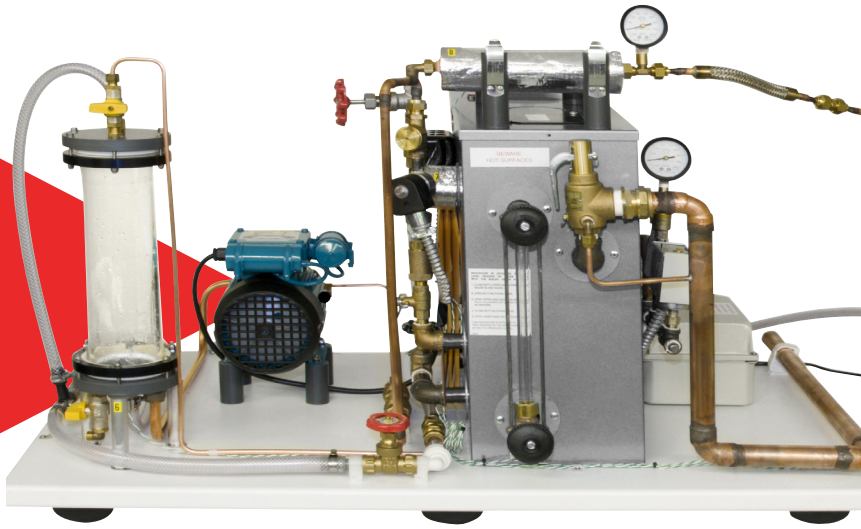
C552 Flame Propagation and Stability Unit

- Allows investigation of the relationship between flame speed and air – fuel ratio for a variety of slow burning gaseous fuels. Numerous accessories are provided to explore how flames can be controlled and manipulated

C200 Bomb Calorimeter

- Allows measurement of the calorific value of liquid and solid fuels by a fundamental rate of rise method

The Rankine cycle is a model used to predict the performance of steam turbine systems. It was also used to study the performance of reciprocating steam engines. The Rankine cycle is an idealized thermodynamic cycle of a heat engine that converts heat into mechanical work while undergoing phase change. It is an idealized cycle in which friction losses in each of the four components are neglected. The heat is supplied externally to a closed loop, which usually uses water as the working fluid. It is named after William John Macquorn Rankine, a Scottish polymath and Glasgow University professor. This is the basis of traditional systems of electrical generation.



S201 Steam Generator And Service Module

- A bench top unit which provides a gas fired steam generator for wet or superheated steam. A condensing unit with air ejector and a closed feed water system allow the Rankine cycle to be investigated. Exhaust emissions can be analysed via the provided instrumentation and the unit may also be connected to the S211 Turbine.

RE540 Photovoltaic Trainer

- Demonstrates the practical application of a Solar (PV) Power Generation System

S211 Steam Turbine Module

- Bench top steam turbine module incorporating a single stage impulse steam turbine with water cooled friction brake, condenser, condensate measurement and all instruments and safety devices. Optional electric generator is also available.

RE551 Flat Plate Solar Energy Collector

- Allows thermal evaluation of a Flat Plate Solar Collector

This is a closed loop unit supplied as two complimentary modules containing the certified electric boiler, pump, impulse turbine and condenser. The unit allows students to identify and compare theoretical maximum efficiencies with actual overall results.

S220 Rankine Cycle Steam Turbine

- A desk-top, electrically heated, self-contained two-part unit which demonstrates a fully closed Rankine Cycle with sub-atmospheric condensing conditions. The unit combines the **S211** turbine with an Electrically heated steam generator plant.

RE551A Focussing Flat Plate Solar Energy Collector

- The Optional Focussing Solar Collector (Vacuum tube design) RE551A is designed to operate with the control and instrumentation console of the standard RE551 Flat Plate Solar Collection

RE510 Educational PEM Fuel Cell

- Demonstrates a High Watt Density PEM Fuel Cell, generating electrical power directly from hydrogen. Able to be electrically loaded both internally and externally by the operator.

RE570 Horizontal Axis Wind Turbine

- Allows investigation of an efficient three phase to DC Horizontal Axis Wind Turbine for the use of power generation

RE580 Combined Wind & Solar Generator Demonstrator

- Demonstrates the practical application of a Solar Power and Wind Powered Generation System on a small benchtop scale.

The ramjet, the simplest concept of aircraft propulsion, consists of an almost cylindrical duct, open at both ends. It relies on its forward speed to ram air into the forward opening. Fuel is burnt inside the duct to accelerate the air stream, which together with the products of combustion, issues from the rear as a high velocity jet. The change in momentum in the engine provides the propulsive force.

The unit ships with two easily interchangeable motors to allow students to compare differing heat engines with differing gaseous fuel types. The fully instrumented unit allows for the collation of exhaust velocities, temperatures, thrust, drag and fuel consumption.

P372 Jet Propulsion Test Stand

- Subsonic Ram Jet and subsonic Pulse Jet Engines demonstration and thermodynamic investigation of the simplest form of heat engine.

"The ramjet was conceived in 1913 by French inventor René Lorin, who was granted a patent for his device."

en.wikipedia.org/wiki/Ramjet

R560 Water-Water Heat Pump

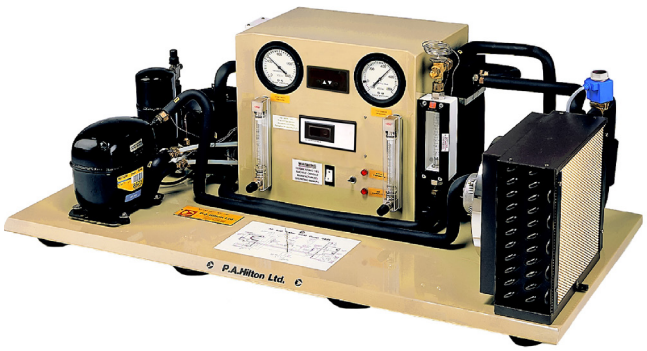
- A water to water heat pump that allows a complete refrigerant pressure-enthalpy cycle diagram to be drawn at all operating conditions.

RE590 Ground Source Simulator

- A self-contained ground source simulator tank containing ground source coils, complete with a high pressure circulating pump and hoses for connection to the R560

R515 Mechanical Heat Pump

- A mechanical (air to water) heat pump that allows a complete refrigerant pressure-enthalpy cycle diagram to be drawn at all operating conditions



R833 Air And Water Heat Pump

- Vapour Compression Heat Pump that allows Performance Investigation from both Air and Water Sources

F823 Solar/Heat Source Vapour Turbine

- A desktop vapour Rankine turbine unit operating from a unique working fluid. Suppled as standard with a mains powered electric heat source or can be operated with optional solar panels and installation package (F823S)

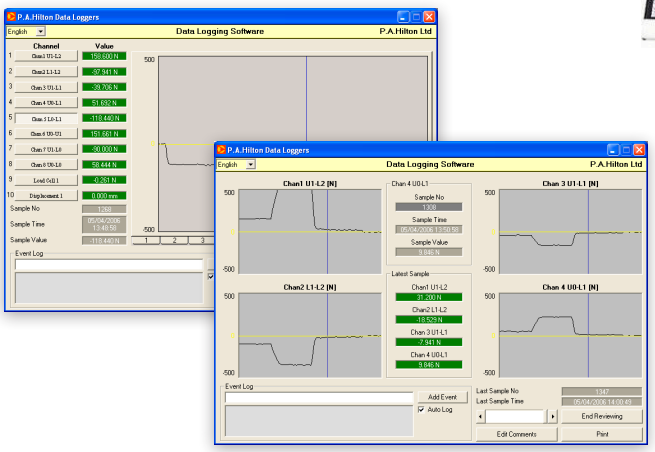
R853 Vapour Jet Refrigerator/Heat Pump

- Enables the demonstration and investigation of the use of a Rankine cycle to drive a Vapour Compression Cycle. The unit is supplied with a standard electric heat source or an optional set of solar panels can be added to demonstrate the generation of work from solar radiation

Maximise students per session, so **more efficient use of lab** and **student time.**

Hilton Data Acquisition Upgrade

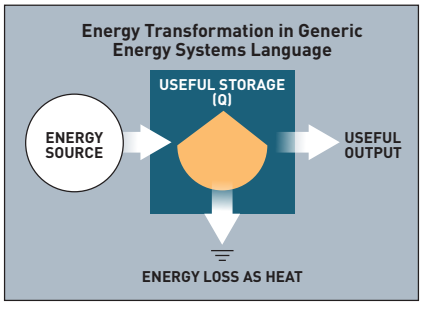
- Available for most of the Hilton Heat Transfer units
- Allows key experimental parameters of temperature, pressure and flow to be measured, displayed, recorded, printed and graphically/ numerically displayed on a host computer or laptop
- Data files can be exported to Excel or another spreadsheet programme
- Allows for rapid data acquisition where equipment maybe being used for research



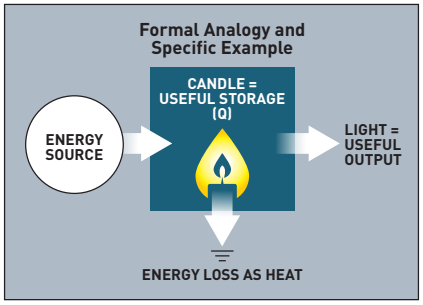
Other Experiments Available (refer to PA Hilton website for details)

H953 – Water/Water Turbulent Flow Heat Transfer Unit

H971 – Laminar/Viscous Flow Heat Transfer Unit



$$\text{Energy Efficiency \%} = \frac{\text{Useful Output}}{\text{Total Input from Source}} \times \frac{100}{1}$$



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