Jet Propulsion Test Stand
P372

- ***Demonstration and thermodynamic investigation of the simplest form of heat engine.***
- ***Low cost, aircraft propulsion system investigation.***
- ***Negligible operating cost and no moving parts requiring maintenance***
- ***Two year warranty***

Introduction

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.

Also supplied is a pulsejet engine, which utilises a cyclic combustion process but is unique in design in that like the ramjet, it has no moving parts.

The Hilton P372 Jet Propulsion Test Stand will provide interesting and instructive experimental activity for all students studying thermodynamics and propulsion and will be of particular interest to those studying:

- **Thermodynamics**
- **Heat Transfer**
- **Aeronautical engineering**
- **Combustion**
- **Propulsion**
- **Sound and vibration**
- **Environmental engineering**

Experimental Capabilities

- Complete performance analysis at various approach speeds. Calculation of exhaust velocities, measurement of temperatures, thrust, specific thrust, drag and fuel consumption.
- Collection of gas samples from any point within the ramjet motor.
- Demonstration and investigation of the ramjet principle.
- Total and static pressure plots along the ramjet engine axis.
- Demonstration and investigation of the pulsejet principle.
- Comparison of Propane with other gaseous fuels, e.g. Butane, Methane.
- Jet noise investigation using suitable additional instrumentation.

Description

Ram Jet Engine

For operation the ramjet requires incoming air to have a significant approach velocity in order to maintain combustion. The forward speed is simulated by a single stage blower delivering air through a 76mm diameter nozzle mounted 200mm in front of the air intake. The use of gaseous fuel makes a low operating speed and therefore a moderate air supply requirement well within the reach of any engineering laboratory.

The ramjet engine is fabricated from a heat resistant alloy and requires no maintenance even after many years of operation.

Propane, a fuel particularly suited for laboratory use, is fed to the engine by its own vapour pressure and is controlled by a single valve. An ignition system ignites the fuel/air mixture at the commencement of operation. Fuel gas flows into the engine through a purpose designed manifold and is measured using a gas flow meter. A unique flame holding baffle serves to create local turbulence and retains the combustion flame within the chamber allowing operation over a wide range of approach velocities.

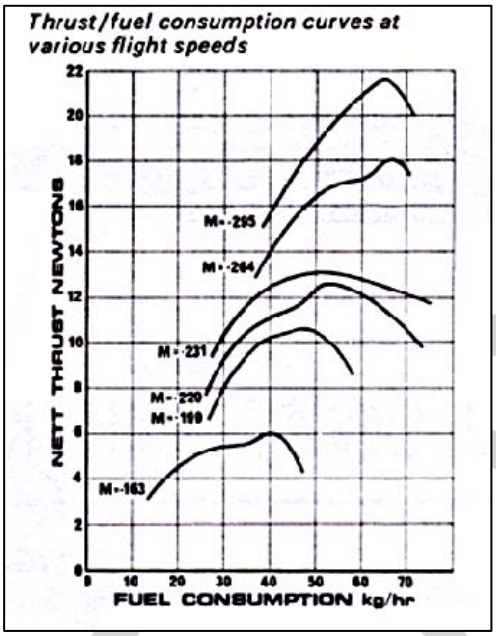
The engine is mounted on a damped linkage and is free to move between two stops along the axis of airflow. Loads are applied by two direct reading balances to match either thrust or drag so that the position of the ramjet is kept constant relative to the air supply nozzle.

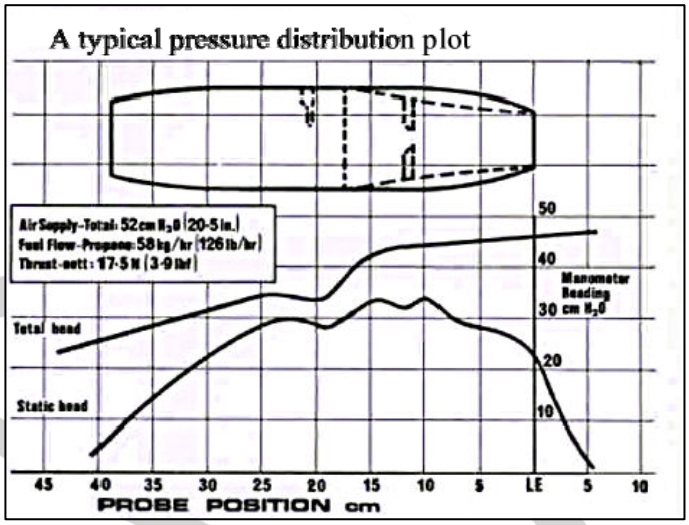
A water cooled pitot-static tube allows the pressure distribution through the engine to be examined at various operating conditions

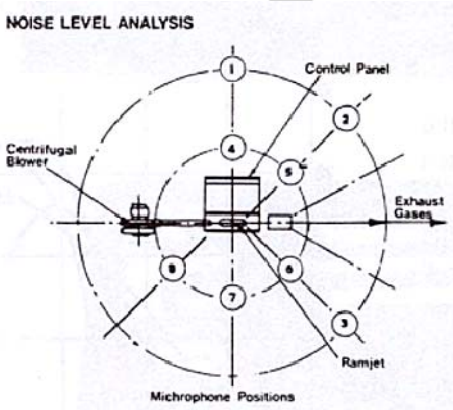
The ramjet engine simulates the basic principles of all gas turbine engines but with no moving parts. Operation of the unit is simple and students are able to cover a wide range of experiments in a short time period.

NOTE: The policy of P.A.Hilton Ltd is one of continual improvement and we reserve the right to change this specification without notice.

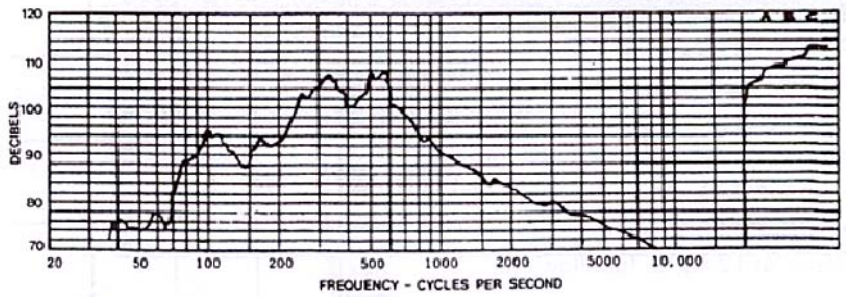
Typical Ramjet Test Results







MICHROPHONE POSITION	1·52m (5ft)	3·04m (10ft)
1	–	106
2	–	109
3	–	111
4	110	–
5	115	–
6	116	–
7	112	–
8	109	–



1/3 Octave Frequency Analysis with microphone at position No. 7 1·52m (5 ft) near Free Field conditions. All readings tabulated in Decibels above reference of ·0002 Dynes/CM² Results of tests by "Keith Blackman" Ltd. London N.17.

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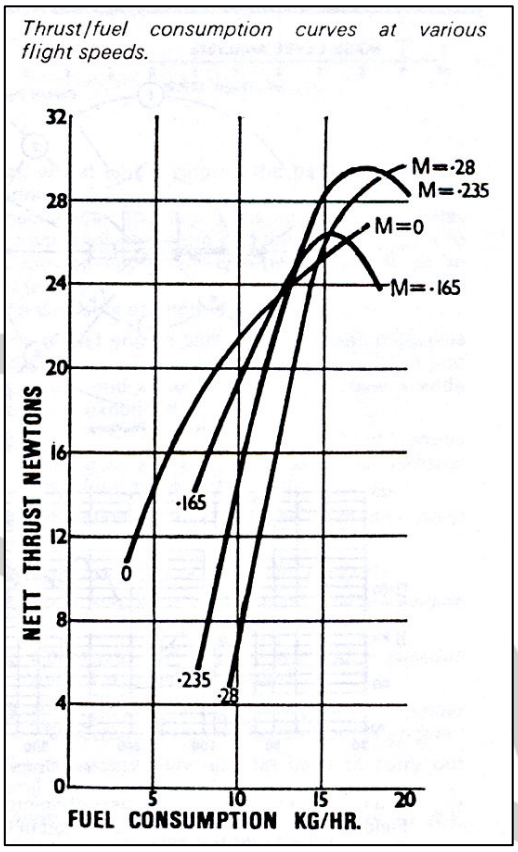
Pulsejet Engine



The versatility of the Hilton Ramjet Test Rig is increased with the use of a Pulsejet Engine. Like the Ramjet the Pulsejet engine is manufactured from heat resistance materials.

The Pulsejet, which operates over the entire range of the Ramjet simulated flight speeds, allows students to explore the characteristics of a device capable of generating static thrust. Students will discover the essential differences between the performance of the Pulsejet and the Ramjet.

The former exhibits characteristics favouring low speed operation whilst the latter is at its best at high flight speeds.

The Pulsejet also illustrates, very simply, the benefit that can be derived from pressure waves in some thermal power units; the Pulsejet depends for its operation upon wave action and incorporates a unique valve system with no moving parts.

The Pulsejet engine may be operated on the Jet Propulsion Test Stand P372 in place of the Ramjet engine.
Instrumentation, safety devices and controls are provided by the Jet Propulsion Test Stand P372.

Specification

Jet Propulsion Test Stand P372

General

A sub-sonic gas fuel ramjet allowing investigation of thrust, drag, specific fuel consumption and the axial pressure distribution through the engine. Also comprising a gas fuelled pulsejet engine with no moving parts.

All relevant instrumentation and safety devices are supplied on an integrated engine balance and control panel onto which either engine may be installed.

Detailed

Engine(1) A sub-sonic gas fuelled ram jet engine, with overall dimensions of 127mm diameter and 390mm length manufactured from a heat resistant alloy.

Engine(2) A sub sonic gas fuelled pulse jet engine with overall length of 1.85m manufactured from a heat resistant alloy.

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Test Stand A combined engine mount and load balance allows thrust and drag measurement during engine operation. A water cooled pitot-static probe allows the pressure distribution within the engine to be measured during operation. The control panel includes engine starting controls, flame failure safety cutout, fuel and pressure distribution instrumentation.

Air Supply Air for the ramjet motor is provided by a floor mounted single stage air blower.

Instrumentation

Engine balances, dual scale (2)
For thrust and drag measurement.

Pressure Manometers (3)
To measure air supply total pressure and engine probe total and static pressures.

Fuel flow Flowmeter (2)
To measure Propane gas to the pulsejet and ramjet engines.

Thermometers (2)
To record gas and air temperatures.

Pressure Gauges - dual scale (2)
To measure fuel supply and delivery pressures.

Dimensions

Height: 1760mm Depth: 910mm (Approx)
Width: 3050mm Weight: 212kg (Approx)

Accessories and Spares

Unit supplied with:
One experimental operating and maintenance manual in English, Spanish, French.
Accessories and spares for 2 years normal operation.
List available on request.

Services Required

Electrical: **A**:380/415V 3 Phase, 50Hz
(With Neutral and earth/ground).
Line current up to 19A at 380V

or

B: 210/220V 3 Phase, 60Hz
(With Neutral and earth/ground).
Line current up to 30A at 220V

Gas Fuel Supply: Commercial bottled propane, pressure regulated to 2.7 Bar gauge.

Cold Water: Continuous supply, 10 litres per second at 15m head.

Ordering Information

Order as: P372 Jet Propulsion Test Stand

Electrical Specification

Either: **A**: 380/415V 3 Phase, 50Hz
(With Neutral and earth/ground).

Or

B: 210/220V 3 Phase, 60Hz
(With Neutral and earth/ground).

Language

Either: English, Spanish, French.

Shipping Specifications

Net Weight: 212kg. (Approx)
Gross Weight: 378kg. (Approx)

Also Available On Request

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

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