

# RANKINE CYCLE STEAM TURBINE S220



# Year 1 study

## Features

- Operates on a true Rankine Cycle with boiler, turbine, feed-pump and condenser.
- Stabilises in minutes and allows rapid data collection.
- Bench top unit allows similar experimental procedures to full size plant.
- Optional power generation module.
- Optional Computerised Data Acquisition.

## Description

The unit is supplied as two complimentary modules. An independently certified electric boiler with safety valve, automatic control system and fail safe pressure switches, provides steam at up to 8 Bar gauge to a solenoid valve. This in conjunction with an optical sensor limits the maximum turbine speed to a safe level. Steam flow to the turbine can be throttled by a hand valve and the boiler, turbine inlet and condenser pressures are indicated on gauges. The impulse turbine is driven by a convergent divergent nozzle and turns a brake wheel with speed sensor and digital indicator allowing true shaft power to be determined. An optional electrical power generator is also available for demonstration purposes. The turbine exhausts into a condenser and this passes water to a similar water reservoir. The reservoir connects to a boiler feed pump. Like full size real power plant the condenser operates at subatmospheric pressure and the unit incorporates an air extraction system. The boiler feed pump and non-return valves to the boiler complete the full Rankine cycle. Instrumentation includes all relevant system pressures, system temperatures, and cooling water flow rates, turbine speed and brake load. A combination of digital and analogue displays show the recorded parameters.



Steam



## Related Laws/Applications

- Thermodynamics
- Heat Transfer
- Chemical Engineering
- Mechanical Engineering
- Power Engineering
- Marine Engineering
- Plant and Process Engineering

## Learning capabilities

- Investigation of a true Rankine Cycle Steam plant.
- Determine of cycle thermal efficiency based on shaft power.
- Determination of friction losses at various exhaust pressures.
- Investigation of turbine torque/speed and power/speed characteristics.
- Investigation of steam quality by throttling.
- With the optional power generation module demonstration of electrical power generation.

## **Technical Specification**

- Boiler: Independently certified electric boiler with automatic control
  Pressure switches Fail safe pressure cut out and large capacity relief valve
- Turbine: Single stage, axial flow impulse (De Laval) turbine on a vertical shaft mounted in corrosion resistant sealed ball bearings -Convergent-divergent nozzle discharges at 20° to plane of turbine rotation - Rotor has blades with 40° inlet and discharge angles -Rotor Ø50mm. - Maximum turbine speed 40,000 rpm Ø50mm
- Water cooled Condenser: Condenses turbine exhaust steam allowing heat rejection from the system to be measured.
- Feed Water Reservoir: Collects condensate from the condenser for return via the feed pump to the boiler.
- Feed Pump: low volume flow pump.
- Flow Meters: For condenser cooling water. Allows measurement of heat rejection from the condenser.
- Digital Thermometer: 0.1°C resolution, with multi-way selector switch for all relevant temperatures
- · Pressure gauges: For all relevant system pressures.
- Turbine Tachometer: Digital display and over speed cut out.
- Turbine brake load: Digital indicator.

## **Recommended Ancillaries**

• S220A - Optional Generator Demonstration Module

## What's in the Box?

- 1 x S220 Unit
- 3 x 3m Reinforced PVC hose
- 1 x Power lead
- Couplings
- Insulation
- · Gloves and ear defenders
- · 2 x Brake band
- 2 year spares ('o' rings and seals)
- Instruction manual
- · Packing list
- Test sheet

## You might also like

• S201 - Steam Generator and Service Module

## Weights & Dimensions

- Weight: 118 kg
- Length: 2000mm
- Width: 655mm
- Height: 650mm

### **Essential Services**

- 6.0kW, 380/415Volts, 3 phase + neutral, 50Hz (With earth/ground).
- 6.0kW, 210/220Volts, 3 phase, 60Hz (With earth/ground).
- 6.0kW, 220/230Volts, single phase, 50Hz (With earth/ground).
- Cold Water: Continuous supply 5 litres/ minute at 25m head, intermittent supply at 25 Litre/minute.
- Boiler Feed: Water Small quantity (10litres) de-mineralised or distilled for initial fill. Then approximately 1 litre/10 hours running.

### **Operational Conditions**

• Noise level up to 103db @ 1m from turbine

## **Ordering information**

To order this product, please call PA Hilton quoting the following codes: S220/415 - Rankine Cycle Steam Turbine (415V / 3PH / 50Hz) S220/220 - Rankine Cycle Steam Turbine (208V / 3Ph / 60Hz) S220/230 - Rankine Cycle Steam Turbine (230V / 1PH / 50Hz) S220/415/SC - Rankine Cycle Steam Turbine Computer Linked (415V / 3PH / 50Hz) S220/220/SC - Rankine Cycle Steam Turbine Computer Linked (230V / 1PH / 50Hz)

S220/230/SC - Rankine Cycle Steam Turbine Computer Linked (230V / 1PH / 50Hz)

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