



## STEAM TURBINE MODULE S211



Year 1  
study

### Features

- Designed to complement the S200 Steam Generator and Service Module
- Stabilises in minutes and allows rapid data collection.
- Bench top unit allows similar experimental procedures to full size plant.
- Low running and maintenance costs

### Description

The S211 Steam Turbine Module is compact and incorporates a small axial flow impulse steam turbine, a water cooled friction brake, a water cooled condenser and all the necessary controls and instrumentation. It is designed to be connected to the S200 from which it obtains its supply of steam and to which it rejects air and condensate. Together the S200 and S211 form a Complete Rankine Cycle Steam turbine with sub-atmospheric condenser.

Steam from the S200 Steam Generator and Service Module enters through the left-hand end face, passing through a solenoid valve and a throttle valve before entering the turbine nozzle.

The turbine shaft is mounted vertically and runs in sealed ball bearings. It is fitted with a gland to reduce the ingress of air when the turbine is exhausting below atmospheric pressure. The turbine rotor is positioned at the lower end of the shaft and the brake is at the upper end.

The turbine is of the single stage, axial flow impulse (De Laval) type and has a single convergent-divergent nozzle to expand the steam. After passing through the rotor blades the steam flows directly into a glass walled water cooled condenser.

At the bottom of the condenser is a diverter valve which has two positions. In one position both air and

condensate from the turbine condenser are returned to the dump condenser of the S200. In the other position, air only is returned to the S200 and the condensate is retained in the turbine condenser. In this way the steam consumption of the turbine may be measured directly by volume.

The brake drum at the upper end of the shaft runs against a belt which is tensioned by a pulley moved by the load adjuster to vary the frictional resistance. The frictional force is measured by a load cell and is displayed by a digital meter on the panel. Water for cooling the brake drum is supplied to a fitting at the top of the shaft and is later collected and drained away as it leaves the periphery of the drum.

An optical sensor senses the rotational speed of the turbine and this is displayed by a digital tachometer on the panel.

### Related laws

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

### Learning capabilities

- Determination of torque, power and specific steam consumption when operating:
  - at constant inlet pressure but with varying exhaust pressure
  - at constant exhaust pressure but with varying inlet pressure.
- Determination of power to heat ratio when used as a back pressure turbine.
- Determination of friction losses at various exhaust pressures.
- Determination of Isentropic Efficiency.
- Determination of Thermal Efficiency.

### Technical Specification

- Turbine:
  - Single Stage, axial flow impulse (De Laval) turbine.
  - Convergent-divergent nozzle discharges at 20° to plane of rotation and rotor has blades with 45° inlet and discharge angles.
  - Rotor diameter 50mm.
  - Turbine may be used for any inlet condition up to 8 bar 220°C and exhaust to vacuum.
  - Maximum speed 40,000 rev. min<sup>-1</sup>
  - Power up to 100W approx. (according to conditions).
- Brake:
  - Water cooled brake drum Ø42mm, tensioned by manually adjusted pulley.
  - Friction force measured by load cell.
- Condenser:
  - Strong glass walled chamber with water cooling coil.
  - Fitted with two-way diverter valve and calibrated for condensate measurement.
- Gauges:
  - 1 x for steam pressure at nozzle inlet – Range 0 to 8 bar g.
  - 1 x for pressure in condenser – Range -1 to +1 bar g.
- Multi-point Digital Temperature Indicator: five Type K thermocouples. Resolution 0.1K.
- Digital Tachometer: Range 0 to 99999 rev. min<sup>-1</sup>.
- Digital Brake Load Indicator: Range 0 to 10N.
- Flow Meter: Range 4 to 50 G S-1.
- SAFETY:
  - Polycarbonate screen for brake, with interlock to stop turbine if screen is removed.
  - Lock-out with manual reset if turbine exceeds 40,000 rev. min<sup>-1</sup> and condenser pressure is excessive.
  - Turbine guard ring.
  - Condenser relief valve.

### Essential Ancillaries

- S200
- (or S220)

### Recommended Ancillaries

- S210A

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COUNTRY OF ORIGIN - UK WARRANTY PERIOD - 2 YEARS

**What's in the Box?**

- 1 x S211 + 3m Power lead
- 1 x 3m Reinforced PVC hose
- Couplings
- Insulation
- Gloves and ear defenders
- 2 year spares ('o' rings and seals)
- Instruction manual
- Packing list
- Test sheet

**You might also like**

- S220
- S201

**Weights & Dimensions**

- Weight: 34 kg
- Weight: 38 kg (115V Version)
- Length: 750mm
- Width: 360mm
- Height: 650mm

**Essential Services**

- 200W, 220/240V, Single Phase, 50Hz. (With earth/ground)
- 200W, 110/120V, Single Phase, 60Hz. (With earth/ground)
- Mains Water: Sediment free water at 3 litre/min at 15m head.
- Steam Supply and Air Condensate Extraction: As provided by S200 Steam Generator and Service Module.

**Ordering information**

To order this product, please call PA Hilton quoting the following codes:

S211/230

S211/115

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