STEAM GENERATOR and SERVICE MODULE
S201

Year 1
study

Features

- Designed to complement the S211 Steam Turbine Module
- Easy to understand and safe to operate
- Bench top unit allows similar experimental procedures to full size plant.
- Steam can be raised from cold in 2 minutes and most test started within 10 minutes

Description

A free standing bench top panel houses all instrumentation, a glass walled dump condenser, feed pump, a water jet air ejector, make-up tank and all other components with the exception of the steam generator, which is mounted on the left hand end of the panel. The steam generator is fuelled by L.P.G. (principally Butane and Propane mixes) or Natural Gas as (an optional extra item) which is burned in a ring type burner. Primary air from a small fan is mixed with the fuel to give a non-luminous flame and secondary air, controlled by a rotating shutter, is supplied to the burner. Combustion takes place in a ceramic fibre lined chamber and the hot combustion products flow upward through connected flat spiral coils of tube through which the water and steam flows. By manual adjustment of the feed water flow rate and/or the fuel flow rate the steam quality may be varied from very wet to super-heated. On leaving the coils the steam enters a small manifold fitted with a safety valve, pressure and temperature measuring points, and a stop valve. From the stop valve the steam flows through the insulated steam main through a lockable isolating valve to a union in the right hand side of the panel, to which other modules (for example, the S211 Steam Turbine Module) may be connected. The steam main is also connected to a manually adjusted, “dump valve” which discharges into the water cooled “dump condenser” mounted on the front of the panel. It is the setting of this valve which usually determines the pressure of the steam. The dump condenser is an important feature of this generator module and has several functions. Condensate from the dump condenser is pressurised by the feed pump and returned to the steam generator via a flow meter and feed check valve. The dump condenser also has suitably valved connections to the make-up tank, water jet air ejector and to a union in the lower right-hand side of the panel through which condensate and air is returned from a connected module. The S201 operates on a closed feed system and the only make-up required is to make good the loss associated with air extraction and any leakages.

Related Laws/Applications

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

Learning capabilities

- Determination of the efficiency of a steam generator.
- Determination of the air/fuel ration and percentage excess air.
- Calculation for dry flue gas loss, loss due to steam in flue gas and the construction of an energy balance for a steam generator.
- Investigation of effect of air supply on the CO2 constant of the flue gas and presence of CO + combustibles.
- Verifying the pressure/saturation temperature for steam.
- Determination of the enthalpy of steam from an energy balance on a condenser.
- Determination of the overall heat transfer coefficient in a condenser and the effect on this, of the presence of air.
- Use of a throttling process to determine steam quality.

Technical Specification

- Steam Generator: Stainless Steel, continuous coil type, producing steam at up to 10 bar 240°C at a rate of approx. 7.5 kg per hour.
- Burner: Ring type gas burner for LPG (Or Natural Gas by special order). Heat rate 7.0kW approx.
- Dump Condenser: Strong glass walled cylinder with water cooled coil
- Dump Valve: manually adjusted, relief valve.
- Feed System: Closed feed system with pump, pressure regulating valve and make-up tank. Maximum throughput approx. 3.5cm3 s-1.
- Air Extraction: Water jet air ejector.
- Three variable area meters for:
- - Fuel gas flow rate*- Range 800 to 4000cm3min-1
- - Feed water flow rate-Range 20 to 280cm3min-1
- - Condenser cooling water flow rate-Range 4 to 50 g/sec.
- *A Butane (C4H10) scale is fitted as standard but a correction graph is provided for mixtures of C4H10 and Propane (C3H8).
- 1 x digital CO2 meter with CO and O2 indicator.
- 2 x pressure gauges. Ranges 0 to 16 bar g and -1 to +1 bar g.
- 1 x multi-point digital temperature indicator with 8 type K thermocouples for all important temperatures.
- Manual control of:
- - Fuel flow rate
- - Feed water flow rate
- - Cooling water flow rate
- - Air extraction
- - Steam pressure via dump valve
- - Secondary air.
- Safety:
- - Steam generator constructed from small bore stainless steel tubes to a design approved by RSA (Royal & Sun Alliance), individually tested and supplied with a Test Certificate.
- - Safety valves fitted to steam generator and dump condenser.
- Burner lock-out with manual reset:
- - Excessive steam generator pressure.
- - Excessive combustion products temperature.
- - Excessive dump condenser pressure.
- - Failure of pilot flame, electricity supply or gas supply.
- Cut out with automatic reset for excessive steam temperature. Neon indicating lamps for above conditions.

What's in the Box?

- 1 x S201
- 1 x Transformer (115V only)
- 1 x 3m Reinforced hose
- 1 x 3m PVC drain hose
- 1 x 3m condenser hose
- 1 x 3m gas hose
- 1 x Dust cover
- 1 x Tools
- 1 x Flue kit
- 1 x 2 year spares

Weights & Dimensions

- Weight: 86 kg
- Weight: 90 kg (115V version)
- Length: 1400mm
- Width: 430mm
- Height: 925mm

Essential Services

- 200W, 220/240V, single phase, 50Hz (with earth/ground).
- 200W, 110/120V, single phase, 60Hz (with earth/ground).
- Raw Cooling Water (Sediment free):
- - Continuous 5 litre/min at 25m head.
- - Intermittent 25 litre/min to operate the water jet air ejector.
- High Quality Distilled Water:
- - Small quantities in bottles for feed water make-up as required (About 1 litre per 10 hours running).
- Flue:
- - The flue gases from this unit (at about 160°C) are produced at the same rate as from a large gas cooking hob – but CO may exceed 100 parts per million at reduced secondary air settings.
- - For operator safety a flue kit is included suitable for most installations (details available on request)
- Fuel Gas:
- - Principally Butane, Propane or mixtures of these at 28 to 30 mbar.
- - Or Natural Gas by special order.
- - The minimum gas heat rate required is 7.5 kW (6500 kCal per hour).
- - Gas consumption approx. 0.6 kg per hour.

Ordering information

To order this product, please call PA Hilton quoting the following codes:
S201/230
S201/115