



## P7675 CONDENSER STEAM BENCH

### PRINCIPLE EXPERIMENTS

- ◆ To investigate the overall heat transfer coefficient of a condenser under conditions of inlet and outlet pressure, and rate of cooling flow
- ◆ To demonstrate that condensing steam is a closed system will produce a vacuum

### FEATURES

- ◆ Compact modular design
- ◆ Low capital cost
- ◆ Easy Installation
- ◆ Comprehensive instrumentation
- ◆ Utilises industrial standard horizontal shell and tube type condenser
- ◆ Pressure test certificates supplied for major components engine

### INTRODUCTION

Condensation occurs when a saturated vapour is in contact with a surface whose temperature is equal to or below the saturation temperature. Usually a film of condensate is formed on the surface, as condensation proceeds the thickness of this film becomes the major thermal resistance opposing condensation. This mechanism of condensation is known as film-type condensation.

An alternative type of condensation, known as drop-wise condensation occurs when the wall is not uniformly wetted by the condensate which appears in many small droplets at various points on the surface. Individual droplets form and grow, may coalesce with adjacent droplets, to form rivulets. Gravity overcomes adhesion and the rivulet, will flow to the bottom of the surface capturing and absorbing droplets in its path and leaving dry surface and absorbing droplets in its path and leaving dry surface in its wake. Film-type condensation is more common and much more dependable than drop-wise condensation.

Drop-wise condensation is particularly hard to promote, requiring clean non-wettable surfaces which in practice rapidly become fouled and induce wetting of the surface and the formation of film-type condensation, this is unfortunate as drop-wise condensation heat transfer coefficients can be an order of magnitude higher than those obtained in film-type condensation. It is considered that film-type condensation occurs in this apparatus.

### DESCRIPTION

Cussons P7675 Steam Bench Consists of a sturdy framework and panels of all steel construction, fitted with a student work surface, interconnecting back panel and adjustable feet.

The steam bench includes a water-cooled multi-tube condenser, a steam feed line to supply a regulated supply of steam at reduced pressure and a condensate tank complete with a sight glass. Cooling water flow rate is metered in the supply line and regulated by a control valve in the drain line. Bourdon type pressure gauges are provided from pressure indications and thermocouples are used to measure temperature, which may be individually selected for display on an analogue temperature meter.

### STEAM HEADER ASSEMBLY

Mild steel steam header welded in accordance with BS 2633 (1973) to supply steam to a feed line, and fitted with a pressure measuring point connected to a 0-16 bar Bourdon type pressure gauge and a temperature measuring point equipped type with a type K thermocouple. The steam header is enclosed within a header box and fully insulated with mineral wool.

## CONDENSER

Water cooled surface condenser with copper tube and mild steel shell, designed for a working pressure of 3 bar, and capable of condensing steam at a rate of 31 kg/hr at approximately atmospheric pressure,

Fillings:

- relief valve set at 1 bar and venting to atmosphere.
- steam feed line, including a Vee-Reg control valve and a pressure reducing valve, pre-set and padlocked, and fitted with a pressure measuring point a -1 to 3 bar bourdon type pressure gauge and a temperature measuring point quipped with a type K thermocouple.
- condenser outlet line, including an isolating valve, discharging to a condensate tank and fitted with a pressure gauge, and a temperature measuring point equipped with a type K thermocouple.
- cooling water supply pipework, including a control valve and a 2-22 l/min flowmeter with shatterproof tube, and fitted with a temperature measuring point equipped with a type K thermocouple.
- cooling water drain pipework, including an isolating valve, and fitted with a temperature measuring point equipped with a type K thermocouple.

## CONDENSATE TANK

A rectangular mild steel fabricated tank, working capacity 26.4 litres

Fitting:

- level sight gauge housed in brass fitting.
- graduated scale, 0-50 cm (1 cm = 0.472 litres).
- drain line, including an isolating valve.
- overflow pipe.

## ADDITIONAL INSTRUMENTATION

A 0-250°C analogue temperature display meter connected to each of the type K thermocouples through a five-position switch for selection of required temperature for display.

## CERTIFICATION

The steam header is pressure tested at 21 bar and the condenser is pressured tested at 5.21 bar and supplied with test certificate.

## SERVICE SYSTEMS

The bench is equipped with independent service lines relating to water supply (untreated), blowdown and drainage. These lines inter-connect with similar facilities on other steam benches to provide a common service facility.

## INTER-CONNECTING OF STEAM BENCHES

To enable steam benches to be linked to form a system, utilising common steam supply and service systems, the steam bench is supplied complete with:

- an inter-connecting back panel and student work surface.

- a set of 4 stainless steel flexible hoses for the steam and service connections.
- section of aluminium-clad lagging for the flexible steam hose.

## TENDER SPECIFICATION

Steam bench designed for investigating the overall heat transfer coefficient of condenser tubes for varying conditions of condenser inlet and outlet pressure and rate of cooling water flow, together with demonstration of vacuum creating capability of condensing steam in a closed system. The bench comprises, a multi-tube surface condenser with steel body and copper tubes, and fitted with a relief valve set to vent to atmosphere at 1 bar and a steam discharge line including an isolating valve and pressure and temperature measuring points; a mild steel fabrication condensate tank fitted with 0-50 cm graduated scale, an overflow pipe and a drain line including an isolating valve; steam feed pipework, including an isolating valve, and fitted with pressure and temperature measuring points; condenser cooling water supply and drain pipework, with an isolating valve and a safety flowmeter in the supply line and a control valve in the drain line, both lines being fitted with temperature measuring points. A fully insulated steam header line, fitted with a 0-16 bar Bourdon type pressure gauge and temperature measuring point supplies steam to the feed line. A type K thermocouple is fitted at each temperature measuring point and connected to a 0-250°C analogue temperature meter via a 5-position selector switch. Condenser steam inlet and outlet pressures are indicated on separate -1 to 3 bar Bourdon type pressure gauges. The forgoing are installed on sturdy frame complete with panels of all-steel construction and service facilities relating to water supply, blowdown and drainage. To enable the unit to be integrated into a steam bench system, a set of 4 stainless steel flexible inter-connecting hoses and a section of aluminium-clad lagging for the flexible steam header.

## SERVICES

*Steam Supply:-*

Maximum working pressure of 10.34 bar and maximum temperature of 235°C, which can be supplied by Cussons P7670 Steam Boiler Bench, a Cussons Steam Plant, or clients own steam line.

*Water Supply:-*

From bench water service line.

## SHIPPING DETAILS

Case size:	2.80 m <sup>3</sup>
Gross weight:	520 Kg
Nett Weight:	408 Kg

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