Laminar/Viscous Flow Heat Transfer Unit

TFLVB

Technical Teaching Equipment

Electronic console

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INTRODUCTION

There are common physical situations in which, due to different purposes, it is required to transfer heat from a hot fluid to a cold fluid, for example energy saving (fuel) or obtaining a fluid at an optimal temperature. There is a wide variety of units, called heat exchangers, to transfer heat.

There are many different types of heat exchangers depending on their construction, operation, heat transfer mechanism, number of fluids involved, etc.

A type of exchange commonly used in industry is when a fluid is forced to flow around a solid, for example inside a tube and, due to the temperature difference between both elements, the heat exchange by convection takes place. Heat is transferred at a rate that depends on the properties of the fluid and on flow condition, laminar or turbulent.

The Laminar/Viscous Flow Heat Transfer Unit (TFLVB) allows to study heat transfer between hot oil flowing in laminar flow through an internal tube and cold water that flows through the annulus (ring-shaped area) between the internal and the external tubes.

GENERAL DESCRIPTION

The Laminar/Viscous Flow Heat Transfer Unit (TFLVB) is a laboratory scale unit designed to study heat transfer between hot oil flowing in laminar flow through an internal tube and cold water that flows through the annulus (ring-shaped area).

Oil circuit (hot fluid):

The hot oil flows along a closed circuit through the internal tube of the exchanger. An electric heating element, placed in the heating tank, heats the oil up to a specific temperature. The oil goes out of the tank impelled by a pump. A flow meter measures the oil flow. The oil cools down along the exchanger and then returns to the heating tank, starting a new cycle. There is a regulation valve at the inlet of the heating tank to determine the flow rate of hot oil in the circuit.

The flow of oil can also be controlled by changing the speed of the pump through the potentiometer (in the electronic console) and with the regulation valve located in the bypass.

There is a purge valve in the circuit to drain and clean the circuit and the heating tank.

Water circuit (cold fluid):

The cold water comes from of the tap and flows through the annulus formed between the internal and external tube of the exchanger.

The cold water flow is controlled by a regulation valve and is measured by a flow meter. Water enters the exchanger and its temperature rises. Afterwards, water goes out of the system.

The cold water can enter the exchanger by both ends (co-current or counter-current flow), depending of the position of the valves.

ISO 9000: Quality Management
(for Design, Manufacturing, Commercialization and After-sales service)

European Union Certificate
(total safety)

Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate and
Worlddidac Member

SPECIFICATIONS

Bench-top unit.

Anodized aluminium structure and panels of painted steel.

Main metallic elements of stainless steel.

Diagram in the front panel with similar distribution to the elements in the real unit.

Concentric tubes heat exchanger with hot oil flowing through the internal tube and cold water flowing through the ring-shaped area.

Exchanger length = 0.92 m.

Internal tube:

Internal diameter: $D_{int} = 10 \times 10^{-3}$ m. = 10 mm.

External diameter: $D_{ext} = 12 \times 10^{-3}$ m. = 12 mm.

Heat transfer internal area: $A_h = 0.0289$ m^2.

Heat transfer external area: $A_c = 0.0347$ m^2.

External tube:

Internal diameter: $D_{int,h} = 16 \times 10^{-3}$ m. = 16 mm.

External diameter: $D_{ext,h} = 18 \times 10^{-3}$ m. = 18 mm.

Heating tank made of stainless steel with a capacity of 6 l., with heating element.

Circulation pump for the hot oil.

3 Regulation valves to control the cold water flow and hot oil flow and the bypass flow of the pump.

4 Ball valves to fix a co-current or counter-current flow.

Oil flow meter.

Water flow meter.

7 "J" type temperature sensors to measure the temperature of the water, the oil and the wall at several points along the exchanger.

Bottle of Mobiltherm 605 oil for heat transfer.

Electronic console:

Metallic box.

Connectors for the temperature sensors.

Digital display for temperature sensors.

Sensor selector for temperature sensors.

Pump controller.

Heating element regulator.

Digital display for heating element control.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with following manuals: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

EXERCISES AND PRACTICAL POSSIBILITIES

1.- Demonstration of a concentric tube heat exchanger with co-current and counter-current flow in laminar/viscous flow.

2.- Energy balance of the heat exchanger.

3.- Determination of surface heat transfer coefficients on the oil and water sides and determination of the overall heat transfer coefficient.

4.- Flow influence on the heat transfer. Reynolds number calculation.

5.- Relationship between Nusselt Number and Graetz Number for Reynolds Numbers up to 1400.

REQUIRED SERVICES

Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.

Water supply and drainage.

DIMENSIONS & WEIGHTS

TFLVB:

Unit:	-Dimensions:	1000 x 770 x 670 mm. approx. (39.37 x 30.31 x 26.37 inches approx.).
	-Weight:	80 Kg. approx. (176 pounds approx.).
Electronic console:	-Dimensions:	490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.).
	-Weight:	10 Kg. approx. (22 pounds approx.).

AVAILABLE VERSIONS

Offered in this catalogue:

- TFLVB. Laminar/Viscous Flow Heat Transfer Unit.

Offered in other catalogue:

- TFLVC. Computer Controlled Laminar/Viscous Flow Heat Transfer Unit.

✱Specifications subject to change without previous notice, due to the convenience of improvements of the product.

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