Flow Boiling Demonstration Unit

TFEB

Technical Teaching Equipment

Electronic Console

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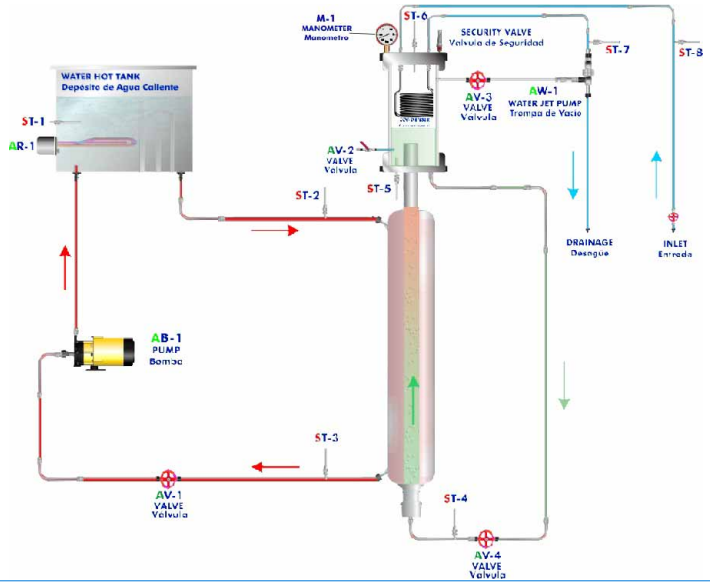
Products
Products range
Units
9.-Thermodynamics & Thermotechnics

PROCESS DIAGRAM AND ELEMENTS ALLOCATION



Note:
ST= Temperature sensor.
AR= Heating resistance.

ISO 9001:2000
Certificate of Approval

European Union Certificate

Certificates ISO 14001: 2004 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate
Worlddidac Member

INTRODUCTION

The flow boiling occurs in some point of the metal tubes of every vapour generation units such as vopour boilers, turbines, evaporators, etc. Usually, it occurs during the starting of these systems, until the vapour pressure is reached, causing two-phase flow: liquid and vopour. In some cases cavitation can occur.

The importance of studying the two-phase flow is due to the negative influence of this type of flow on the machines efficiency.

DESCRIPTION

The TFEB unit has as main component an experimental tube made of two glass concentric tubes. In these tubes two fluids flow crosscurrent: refrigerant, which flows by convection and in an ascendant way through the internal tube, and hot water, which flows in a descendant way through the external tube. This unit has been designed for using SES36 refrigerant gas, free of CFC´s, compatible with the Environment.

Refrigerant circuit:

The main circuit will be where the different stages of the two-phase flow will be visualised by student. This circuit is composed of:

- Internal glass concentric tube, where the refrigerant liquid flows.
- Regularion valve for the input flow to the experimental tube.
- Condensing chamber, that is complemented with a pressure meter which allows to determine the presence of air in the system, a security valve to protect it from possible over pressure. With a temperature sensor the refrigerant temperature into the tank will be visualized. Other temperature sensor shows the temperature of the saturated vapour in the condensing chamber.

Heating circuit:

Basically, this second circuit is composed of:

- External glass concentric tube, through which hot water flows to transfer the hot to the internal tube fluid.
- Thermostatic bath, with a resistance of 600W. It heats the water in the tank.
- Centrifugal pump for recirculation.

The heat transfer can be valued because there are two temperature sensors in the refrigerant liquid, in the input and in the output of the concentric tubes.

Finally the condensing chamber has a security valve. It also can be used if we want to carry out the refrigerant charge operation.

SPECIFICATIONS

Anodized aluminium structure and panels in painted steel (epoxi paint).

Main metallic elements in stainless steel.

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

Experiment visualisation tube of 1500 mm. length composed by two glass concentric tubes.

Refrigerant control valve. It is needed for regulating the refrigerant flow during the experiment.

Condensing chamber: silicate boron of high resistance cylinder; internal diameter of 90 mm., external of 100 mm. and 300 mm. length.

Security valve, placed on the top of the condensing chamber. It is needed to avoid overpressures. It also can be used to the refrigerant charge.

Condensate coil, formed by a nickel-plated copper tube with a superficial area of 0.043 m^2.

Thermostatic bath, that heats the water that flows by the experimental tube periphery. It includes a heating resistance of 600W.

Centrifugal pump for hot water impulsion.

Water control valve. It is placed on the water conduction line and it regulates the water flow that enters in the condensate coil.

Water jet pump for extracting the air and controlling the refrigerant pressure.

8 Temperature sensors "J" type, distributed along the process to know the heat transfers occurred.

Pressure meter, to know the experiment pressure.

Water flow meter.

Drain and security valve. If a high pressure in the condensing chamber is produced, the valve ats at the selected pressure.

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The unit incorporates wheels for mobility.

Electronic Console:

- **Metallic box.**
- **Temperature sensors connections.**
- **Digital display for temperature sensors, with PID control over the process temperature.**
- **Selector for temperature sensors.**
- **Pump switch.**

Cables and Accesories, for normal operation.

Manuals:

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

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.-Observation of:

- Single-phase liquid flow.
- Sub-cooled boiling.
- Bubbly flow.
- Slug regime.
- Annular flow.
- Film boiling.
- Drop flow (mist).
- Single-phase vapour flow.

2.- Demonstration of a heating process accompanied by vapour formation within a tube, including:

- Circulation promoted by natural convection.
- Nucleation in sub-cooled and saturated liquid.
- Convective heat transfer to sub-cooled liquid.
- Slugging.
- Droplet entrainment.
- Annular flow.
- Complete dry out to superheated vapour.

3.-Demonstration of effect of air in condensers.

4.-Demonstration of two phase flow with increasing vapour content.

5.-Effect of flow rate on the evaporation process.

6.-Effect of temperature on the evaporation process.

7.-Effect of pressure on the evaporation process.

8.-Relationship between pressure and temperature.

9.-Film condensation.

REQUIRED SERVICES

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

-Water supply: 6 l/min., with pressure of 10 m. of height approx.

-SES36 refrigerant gas.

DIMENSIONS & WEIGHTS

TFEB:

Unit:	-Dimensions: 750 x 700 x 2100 mm. approx.
	-Weight: 70 Kg. approx.
Electronic Console:	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 10 Kg. approx.

AVAILABLE VERSIONS

Offered in this catalogue:

- TFEB. **Flow Boiling Demonstration Unit.**

Offered in other catalogue:

- TFEC. **Computer Controlled Flow Boiling Demonstration Unit.**

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

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