The main function of the Tesca Heat Transfer Base Unit 32270 is to provide the required cold and hot water circuits. To do this, the supply unit is equipped with a heated tank and pump for the hot water circuit, connections for the cold water circuit and a switch cabinet with displays and controls. A temperature controller controls the hot water temperature. The flow rate in the hot water and cold water circuit is adjusted using valves. The cold water circuit can be fed from the laboratory mains or from Water Chiller.
Tesca Heat Transfer Base Unit 32270 can be used to investigate and compare different heat exchanger designs. The complete experimental setup consists of two main elements: 32270 as supply and control unit and choice of Modules as given herein.Water is used as the medium.
The heat transfer unit to be investigated is connected to the supply unit. The hot water flows through the heat exchanger. Part of the thermal energy of the hot water is transferred to the cold water. Reversing the water connections changes the direction of flow and thus allows parallel flow or counter-flow operation.
The main function of the 32270 is to provide the required cold and hot water circuits. To do this, the supply unit is equipped with a heated tank and pump for the hot water circuit, connections for the cold water circuit and a switch cabinet with displays and controls. A temperature controller controls the hot water temperature. The flow rate in the hot water and cold water circuit is adjusted using valves. The cold water circuit can be fed from the laboratory mains or from Water Chiller.

Specifications

- Supply unit for heat exchangers
- Hot water circuit with tank, heater, temperature controller, pump and protection against lack of water
- Cold water circuit from laboratory mains or water chiller
- Temperature controller controls the temperature of hot water
- Flow adjustable using valves
- Digital displays for 6 temperature and 2 flow rate sensors
- Water connections with quick-release couplings
- Stirring machine connection with speed adjustment (WL 110.04)
- Optional Tesca software: educational software and data acquisition
- Software for data acquisition via USB under Windows 7, 8.1, 10

Note: Specifications are subject to change.

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Technical Specifications

Pump

- Power consumption: 120W
- Max. flow rate: 600L/h
- Max. head: 30m

Heater

- Power output: 3kW
- Thermostat: 0...70°C
- Hot water tank: approx. 10L

Measuring ranges

- temperature: 6x 0...100°C
- flow rate: 2x 20...250L/h

Interface In-built Module (Optional):

This control interface is common for the 'Tesca' Heat Exchangers and can work with one or several exchangers.
The Control Interface is part of the SCADA system.
Control interface with process diagram on the front panel.
The unit control elements are can be computer controlled.

- Simultaneous visualization in the computer of all parameters involved in the process.
- Calibration of all sensors involved in the process.
- Real time curves representation about system responses.
- All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
- Shield and filtered signals to avoid external interferences.
- Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process.
- Real time PID control for parameters involved in the process simultaneously.
- Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time, of the three control constants (proportional, integral and derivative constants).
- Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.

Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

Optionally, Tesca offers software for data acquisition and an educational software. With explanatory texts and illustrations, the educational software significantly aids the understanding of the theoretical principles. With the aid of an authoring system, the teacher can create further exercises.

Sensors record the temperatures and flow rates. The measured values are read from digital displays and can be transmitted simultaneously via USB directly to a PC where they can be analyzed using the software.

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Linear Conduction Heat Transfer Apparatus : Order Code - 32270A

Features

- Complete instrumentation for study of Linear Heat Transfer phenomenon.
- Direct reading of Temperature, Voltage, Current.
- Computerized Data Acquisition System.

Tesca Linear Conduction Heat Transfer Apparatus 32270A has been designed for students to study the phenomena of heat transfer through conduction in a metal or different metal sections. The setup consists of a Heating Section, Cooling Section & Specimens of different metals. The specimens can be fitted in between Heating & Cooling section. Test specimens of same metal or different metals can be clamped in between the heating & cooling sections.
Temperature sensors record the surface temperature along length of the specimen. Instruments are provided to measure the Temperatures, Power Input to heater & Cooling Water Flow rate.

Detailed Operation & Maintenance Manual is provided along with the trainer.

Specifications

Input heat section.
Electric heater, computer controlled.
Refrigeration section with a surface cooled by water.
Interchangeable central sections:
With brass of 25 mm of diameter.
With brass of 10 mm of diameter.
With stainless steel of 25 mm of diameter.
Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
Water flow regulation valve.
Thermal paste is supplied to demonstrate the difference between poor and good thermal contact between the sections.
19 Temperature sensors, "T" type (high precision):
17 Temperature sensors distributed in the heating section (4 sensors), refrigeration section (4 sensors) and central sections (3 sensors in each central section).
Temperature sensor at the water inlet of the unit.
Temperature sensor at the water outlet of the unit.
Power measurement from the computer.

Optional

(A) Data Acquisition System

- An electronic signal conditioning system Stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(B) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting

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simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Experimental Capabilities
- Determination of Heat transfer rate through solids.
- Determination of Thermal conductivity of different materials.
- Determination of contact resistance in Composite slab.

Scope of supply
- Complete test equipment.
- Operation manual in CD and book.
- Experiment manual in CD and book.

Radial Heat Conduction Module : Order Code - 32270B

Features
- Complete instrumentation for study of Radial Heat Transfer phenomenon.
- Direct reading of Temperature, Voltage, Current.
- Optional Computerized Data Acquisition System.

Tesca Radial Conduction Heat Transfer Apparatus Module 32270B has been designed to demonstrate the application of the Fourier Rate equation to simple steady-state conduction radially through the wall of a tube. The arrangement, using a solid metal disk with temperature measurements at different radii and heat flow radially outwards from the centre to the periphery, enables the temperature distribution and flow of heat by radial conduction to be investigated. Temperature sensors record the surface temperature at different radii of the specimen disk. Instruments are provided to measure the Temperatures, Power Input to heater & Cooling Water Flow rate.
Detailed Operation & Maintenance Manual is provided along with the trainer.

Specifications
- Power Supply with power regulator
- Brass disk of 110 mm of diameter and 3 mm of thickness.
- Electric heater, computer controlled.
- Peri-spherical cooling tube.
- Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
- Water flow regulation valve.
- 8 Temperature sensors, "T" type (high precision):
- 6 Temperature sensors distributed in the unit.
- Temperature sensor at the water inlet of the unit.
- Temperature sensor at the water outlet of the unit.
- Power measurement from the computer.

Optional
(A) Data Acquisition System
- An electronic signal conditioning system Stand alone data acquisition modules Windows based data acquisition software Data Logging

Note: Specifications are subject to change.

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- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(B) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Experiment Capabilities

- Fourier's equation and determining the rate of heat flow through solid materials
- Measuring the temperature distribution during radial heat conduction
- Determine the thermal conductivity of the disc or cylinder material

Services Required

- Electric Supply 220 - 240V AC, 16 A, Single Phase, Earthed.
- Tap water supply & Drainage.

Thermal Radiation Apparatus Module : Order code - 32270C

Features

- Experimental unit for investigating thermal and visible radiation
- Wide range of experiments1
- User-friendly software with options for saving, printing and creating diagrams

Tesca Thermal Radiation Apparatus Module 32270C contains a blackbody emitter with a thermopile for the investigation of thermal radiation, a light source with lux-meter for illuminance measurements, and absorption plates with thermocouples for the investigation of Kirchhoff's laws. The intensity of thermal and visible radiation can be adjusted. Colour filters and apertures extend the range of experiments.
The measured values are displayed digitally on the measuring unit. At the same time, the measured values can also be transmitted, optionally directly to a PC via USB. The data acquisition software is included.

Specifications

- [1] Investigating thermal and visible radiation
- [2] Blackbody emitter with thermopile to investigate thermal radiation

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- White light source with luxmeter to investigate visible radiation
- Absorption plate and reflection plate fitted with thermocouples to investigate Kirchhoff's laws
- Intensity of thermal radiator and light source adjustable
- 3 colour filters with holder (red, green, infrared), aperture
- Luxmeter to measure the illuminance
- Thermocouples to measure the temperature
- Thermopile to measure the radiation capacity
- Optional software for data acquisition via USB under Windows Vista or Windows 7

Technical specifications

Consists of a metal plate with a heating element at one side and a lamp in the another side. Lengthwise of the metal plate you can place the elements supplied with the unit.
Heating element (ceramic), computer controlled.
Lamp 150 W, with diffuser.
The unit is provided with accessories for light experiments and radiation experiments.

Light accessories:
Lux-meter that allows to measure the intensity of the light:

Scale:	Resolution:	Accuracy:
0 to 1999 lux	1 lux	
2000 to 19990	10 lux	
20000 to 50000	100 lux	8%
Selection of light	Day, Tungsten, fluorescence or mercury	
Sensor	Photodiode with filter of adjustment of filter	
Sample frequency:	0.4 s	
Work temperature:	0 to 50 ºC.	

Filters:
They allow to filtrate the light in the experiments.
There are:
3 Grey Neutral Density A153 filters.
Grey Neutral Density A152 filter.
Grey Neutral Density A154 filter.
3 Filter portholes.

Radiation accessories:
Radiometer (50 x 50 mm, 5µv (w/m²)). It allows to measure the intensity of the radiation.
Planes surfaces. They are elements for studying the radiation and each one contains one.
Planes surfaces. They are elements for studying the radiation and each one contains one temperature sensor:
Polished aluminium.
Anodized aluminium.
Brass.
2 Black bodies.
Variable slit or aperture. It allows to regulate the area of the radiation.
7 Temperature sensors, "T" type (high precision).
Power measurement from the computer.
Radiation measurement from the computer.
Lux measurement from the computer.

Optional

(A) Data Acquisition System

- An electronic signal conditioning system Stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

Note: Specifications are subject to change.

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(B) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Experiments

- Lambert's cosine law
- Inverse-square distance law (Lambert)
- Stefan-Boltzmann constant
- Kirchhoff's laws
  * absorptivity
  * reflectivity
  * emissivity

Scope of Delivery

- 1 frame
- 1 thermal radiator
- 1 light source
- 1 luxmeter
- 1 thermopile
- 2x absorption plate
- 2x reflection plate
- 3 colour filters with holder
- 2x aperture
- 1 software CD + USB cable
- 1 set of connecting cables
- 1 manual

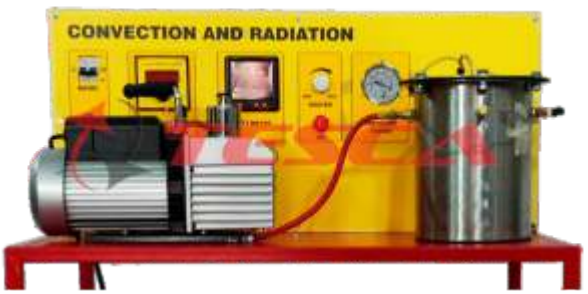
Requirements

- 220-240V, 50Hz, 1 Phase Mains AC Supply

Convection and Radiation Module : Order Code - 32270D

Features

- Heat transport between heating element and vessel wall by convection and radiation1
- software for data acquisition



Under real conditions, the heat transport between two objects is normally substance-bound, i.e. convection and/or heat conduction, and not substance-bound, i.e. radiation, at the same time. Determining the individual heat quantities of one type of transfer is difficult.

Note: Specifications are subject to change.

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Tesca Heat Transfer by Convection & Radiation Module 32270D trainer enables users to match the individual heat quantities to the corresponding type of transfer. The core element is a metal cylinder in a pressure vessel. A temperature-controlled heating element is located at the centre of the cylinder. Sensors capture the wall temperature of the cylinder, the heating temperature and the heating power. This metal cylinder is used to examine the heat transfer between the heating element and the vessel wall.
The pressure vessel can be put under vacuum or positive gauge pressure. In the vacuum, heat is transported primarily by radiation. If the vessel is filled with gas and is under positive gauge pressure, heat is also transferred by convection. It is possible to compare the heat transfer in different gases. In addition to air, nitrogen, helium, carbon dioxide or other gases are also suitable.
A rotary vane pump generates negative pressures down to approx. 0,02mbar. Positive gauge pressures up to approx. 1bar can be realized with compressed air. Two pressure sensors with suitable measuring ranges are available for the pressure measurement: the negative pressure is captured with a Pirani sensor; a piezoresistive sensor is used for experiments with a filled cylinder.
The measured values can be read on digital displays. At the same time, the measured values can also be transmitted directly to a PC via USB, where they can be analyzed with the software.
The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Specifications

- Heat transfer between heating element and vessel wall by convection and radiation
- Operation with various gases possible
- Experiments in vacuum or at a slight positive gauge pressure
- Electrically heated metal cylinder in the pressure vessel as experimental vessel
- Temperature-controlled heating element
- Vacuum generation with rotary vane pump
- Instrumentation: 1 temperature sensor at the heater, 1 temperature sensor at the vessel wall, 1 power sensor at the heating element, 1 Pirani pressure sensor, 1 piezo-resistive pressure sensor
- Digital displays for temperature, pressure and heating power
- Software for data acquisition via USB under Windows Vista or Windows 7

Technical Specifications

- Heating element
  - Output: 20W
  - Radiation surface area: approx. 61cm²
- Pump for vacuum generation
  - Power consumption: 370W
  - Nominal suction capacity: 5m³/h
  - Final pressure with gas ballast: 20*10-3mbar
  - Final pressure without gas ballast: 5*10-3mbar
- Measuring ranges
  - Negative pressure: 0,5*10-3...1000mbar
  - Pressure: -1...1,5bar rel.
  - Temperature: 2x 0...200°C
  - Output: 0...20W
- Centrifugal fan (computer controlled) of 2650 rpm, which provides a maximum flow of 1200 l/min. and allows to the air to reach a maximum velocity around 5 m/s.
- Stainless steel duct with interior cover, including:
  - Temperature sensor, "T" type (high precision), in order to measure the temperature of inlet air.
  - Flow sensor for measuring the air flow generated in the duct.
  - Temperature sensor, "T" type (high precision), in order to measure the temperature of outlet air.
- Heater:
  - Copper cylinder with exterior cover: Interior heating element (computer controlled).
  - Temperature sensor, "T" type (high precision).
  - Power measurement from the computer.

Optional

(A) Data Acquisition System

- An electronic signal conditioning system Stand alone data acquisition modules Windows based data acquisition

Note: Specifications are subject to change.

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software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(B) Computer Control Software
- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Requirements
- 230V, 50/60Hz, 1 phase
- Compressed air: 1500mbar

Extended Surface Heat Transfer Module : Order Code - 32270E

Tesca Extended Surface Heat Transfer Module 32270E is a bench-top unit designed to demonstrate the temperature profiles and heat transfer characteristics for an extended surface. It studies the effect of adding fins to a body in order to extend its surface for a change in the cooling rate. Fins of different materials and cross section shapes are used to analyse the effect of cooling.

Specifications
- Heating element (computer controlled), embedded in a copper capsule to permit a good contact with the interchangeable fins. The copper capsule is isolated by a coat of Teflon.
- The fins are interchangeable, providing two different materials: brass and stainless steel and three different cross section shapes: square, circular and hexagonal.
- The power to the heating element is controlled from the computer.
- 11 Temperature sensors, "T" type (high precision).
- Power measurement from the computer.

Optional
(C) Data Acquisition System
- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(D) Computer Control Software
- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.

Note: Specifications are subject to change.

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- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Experimental Capabilities

- To show how heat transfers from the surface of a solid bar or rod
- To show the temperatures on, and heat flow through, the solid bar to its surroundings

Radiation Errors in Temperature Measurement Module : Order Code - 32270F

Tesca Radiation Errors in Temperature Measurement Module 32276 is a bench-top unit to demonstrate how temperature measurements can be influenced by sources of thermal radiation.
The objective of this module is to measure the error in a black thermocouple due the radiation with respect with another normal thermocouple where there are not radiative shielding in comparison when there are radiative shielding, error in function of material of the thermocouple's capsule, size of the thermocouple, etc.

Specifications

- Centrifugal fan (computer controlled):
  - 2650 rpm.
  - Maximum flow of 1200 l/min.
  - It allows to the air to reach a maximum velocity around 5 m/s.
- Stainless steel duct with interior cover, including:
  - Temperature sensor, "T" type (high precision), in order to measure the temperature of inlet air.
  - Flow sensor for measuring the air flow generated in the duct.
  - Temperature sensor, "T" type (high precision), in order to measure the temperature of outlet air.
- Copper cylinder with exterior cover:
  - Interior heating element (computer controlled).
  - Temperature sensor, for measuring the temperature of the cylinder.
- 5 Temperature sensors, "T" type (high precision), with different styles and sizes installed in the duct to demonstrate the differences in readings obtained:
  - Temperature sensor of bare.
  - Temperature sensor of inconel.
  - Temperature sensor of s/steel.
  - Temperature sensor of black s/steel.
  - Temperature sensor of ceramic.
- Power measurement from the computer.

Optional

(A) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display

Note: Specifications are subject to change.

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- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(B) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Unsteady State Heat Transfer Trainer Module : Order Code - 32270G

Heat conduction is the transport of heat between the individual molecules in solid, liquid and gaseous media under the influence of a temperature difference. Steady heat conduction is the term used when heat transport is maintained permanently and uniformly by adding heat. In transient heat conduction, the temperature distribution in the body is dependent on location and time.
Thermal conductivity λ is a temperature-dependent property of a material that indicates how well the heat propagates from a point in the material.

Tesca Unsteady State Heat Transfer Trainer Module 32270G can be used to study both steady and transient heat conduction. The trainer consists of a heat source and a heat sink, between which cylindrical samples made of different metals are inserted. Each sample is fitted with 12 temperature measurement points. The temperature measurement points are designed to has as little influence on the temperature as possible and the core temperature of the sample is measured.
The heat source consists of an electrically heated hot water circuit. An electronic controller ensures the heating water is kept at a constant temperature. The heat sink is realised by means of a water cooling system. An elevated tank ensures a constant cooling water flow rate.
A temperature jump can be generated by appropriate regulation of the cooling water flow. Optionally PC can be used to display the transient temperature distribution in the sample over time and place.
The temperatures of the sample, heating and cooling water, as well as the electrical heating power and the cooling water flow rate are displayed digitally on the switch cabinet and can be transmitted simultaneously via USB directly to a PC where they can be analysed using the software included. The thermal conductivity λ can be calculated from the measured data.

Specifications

1. Investigation of steady and transient heat conduction in metals
2. Determining the thermal conductivity
3. Heating water circuit as heat source, electronically regulated
4. Electric heater with PID controller
5. Elevated tank with overflow for generating a constant cooling water flow rate
6. Samples made of 5 different metals
7. Cooling water temperature and flow rate measurement
8. Digital displays: electric heating power, temperatures, cooling water flow rate
9. Optional software for data acquisition via USB under Windows 7, 8.1, 10

Note: Specifications are subject to change.

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Technical Specifications

- Dual concentric open top tanks filled with water, total tank capacity: 40 l, 300 x 350 x 400 mm concentric tank: 1.2 l, diameter: 70 mm.
- Different shapes of different size and material are studied:
  - Brass sphere (diameter: 40 mm).
  - Brass sphere (diameter: 25 mm).
  - Stainless steel sphere (diameter: 40 mm).
  - Stainless steel sphere (diameter: 25 mm).
  - Brass cylinder (diameter: 15 mm, length: 150 mm).
  - Stainless steel cylinder (diameter: 15 mm, length: 150 mm).
  - Aluminum rectangular slab (40 x 10 x 150 mm).
  - Stainless steel rectangular slab (40 x 10 x 150 mm).
- Each shape is fitted with a temperature sensor at the center of the object.
- The shapes are installed in special holder at the center of the top cover of the large tank. The holder also
- has a temperature sensor that enters in the water bath at the same time as the shape.
- Heating element (immersion heater). The high power allows reaching the steady state faster. It is computer
- controlled.
- Water pump with variable speed (computer controlled). It allows to reach a maximum flow of 4 l/min.
- 2 Temperature sensors, "T" type (high precision), allow to control the stability of the temperature of the
- water bath.
- Flow sensor, range: 0.25 – 6.5 l/min.
- 2 Temperature sensors, "T" type (high precision):
  - The first one permits to record the evolution of the temperature of the shape at its center.
  - - The second one, works as a stopwatch, it will indicate the precise moment in which the shape I ssubmerged.
- Level switch.
- Power measurement from the computer.

Optional

(C) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(D) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard. This module requires Control Interface Module and Data Acquisition.

Note: Specifications are subject to change.

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Experiments

- Unsteady heat conduction
- Transient heat conduction
- Temperature/time profiles
- Calculate thermal conductivity λ of different metals

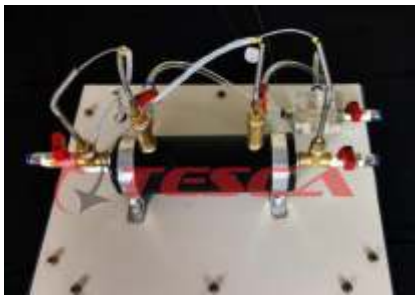
Required for Operation

- Water Supply
- Drain

Thermal Conductivity Unit for Liquids and Gases Module : Order Code - 32270H

Thermal conductivity is an important property which determines heat transfer by conduction. It is essential to determine the thermal conductivity of liquids and gases as the heat transfer is influenced by the presence of liquids and gases, although conduction heat transfer process is more predominant in solids. Also, thermal conductivity of liquids and gases play an important role in convection heat transfer problems. Study of thermal conductivity of liquids and gases is of interest to the students of several branches of science, engineering and technology involved in heat transfer studies such as mechanical, chemical, automobile and aerospace engineering.

Tesca Thermal Conductivity Unit for Liquids and Gases Module 32270H has been designed to study steady state one dimensional heat conduction in liquids and gases. Provision is made to determine the thermal conductivity of fluids such as air, water and oil. The unit consists of concentric cylinders separated by a small annular gap. The inner cylinder is heated by the heater and the outer cylinder is cooled using water jacket. Heat is transferred between inner and outer cylinders through the annular gap containing the test fluid. The annular gap has been selected to ensure minimum heat transfer by convection and radiation heat transfer is made negligible by using polished surfaces. Thus, the heat transfer takes place basically by conduction through the annular gap containing the test fluid. Arrangement is made for easy injection and removal of the test fluid. The unit is well insulated to minimize heat losses and to ensure one dimensional heat transfer through the annular gap. Thermocouples are provided to measure temperature drop across the annular gap. Measurement and control panel is provided.



Heat Exchanger

Specifications

- Aluminum body (cylinder) with brass jacket that contains the test fluid and the refrigeration water.
- Variable heating element (in the cylinder), computer controlled. Heating element power controlled from computer. The power is measured by a sensor.
- 6 Temperature sensors, "T" type (high precision).
- Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
- Water flow regulation valve.
- Valves. Syringe.

Power measurement from the computer.

- Heater, 0-200W variable, with thermostat, max. temp. 900C.
- Inner cylinder, Aluminium, 40mm diameter, 200mm long.
- Outer cylinder with cooling water jacket and flow control valve.
- Annular gap: 0.5mm.

Note: Specifications are subject to change.

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- Test medium inlet and exit, with provision for filling and removal of test fluid.
- Thermocouples, 2 Nos., K-type, 0–1000C.
- Power meter, 0-200W.
- Measurement and control panel with digital display.

Optional

(E) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(F) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard. This module requires Control Interface Module and Data Acquisition.

Experiments

- Study of steady state one dimensional heat conduction through liquids and gases.
- Determination of thermal conductivity of different fluids such as air, oil, water etc.,

Services required

- Electric supply, single phase, 220 – 240V, 50Hz.
- Water supply

Free & Forced Convection Heat Transfer Unit Module : Order Code - 32270I

Features

- Visual demonstrations of Free & Forced convection from surface.
- Surfaces of different shapes for investigation of heat transfer.
- Comprehensive instrumentation for measurement of temperature, air flow rate & power.

Tesca Free & Forced Convection Heat Transfer Unit Module 32270I has been designed for students to study the phenomena of natural (free) and forced convection. The unit consists of mainly a bench mounted vertical air duct and a control panel. Demonstration of convection is achieved in this apparatus by studying temperature profiles and heat flux in the air duct with three alternative heat transfer surfaces, i.e. vertical flat plate, array of cylindrical pins and finned surface.

Note: Specifications are subject to change.

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Each of these surfaces may be installed separately in the wall of the vertical duct. The surfaces incorporate an electrical heating element, and a temperature sensor for accurate temperature measurement. An acrylic window is provided in the duct wall opposite the mounted exchange surface to allow flow pattern visualization. For forced convection, a variable speed fan fitted to the duct draws ambient air through a flow straightener and over the exchange surface. The air velocity, whether occuring by free or forced convection, is indicated on a velocity detector probe of which is inserted in the tunnel upstream of the exchanger. A separate temperature probe measures the in-going and out-going air temperature of the selected exchanger.
Detailed Operation & Maintenance Manual is provided along with the trainer.

Specifications

- Air duct: Transparent Air duct, circular cross section
- Fan: Variable Speed Fan
- Heat transfer surfaces: a) Vertical flat plate b) An array of cylindrical pins c) Finned surface
- Digital display for heater power output
- Temperature Indicator
- Anemometer for Air Velocity
- Controller for variable heater power output
- Controller for fan.
- Stainless steel tunnel of rectangular section, 700 mm long, painted and resistant to corrosion. In the
- tunnel three type of different heat exchangers can be set.
- Methacrylate viewer that allows a good visualization of the exchanger that is in use.
- Stabilizers to guarantee an uniform air flux.
- 8 Temperature sensors, "T" type (high precision):
  2 Temperature sensors measure the air temperature at the inlet and outlet of the area of hea texchange.
  Temperature measurements, at different distances of the base of the pins and fins exchangers, are made by other 5 temperature sensors that are introduced by one side of the tunnel.
  Temperature sensor in the exchangers.
- Maximum working temperature: 120 ºC.
- Flow sensor for measuring the air flow generated in the tunnel.
- 3 Aluminum exchangers:
  - Flat heat exchanger (100 x 100 mm).
  - Pins heat exchanger. 17 pins, each one of 10 mm diameter and 125 mm longitude.
  - Fins heat exchanger. 9 fins, each one of 100 x 125 mm.
- Heating element for each exchanger, computer controlled.
- Variable speed fan, computer controlled, which generates air flux through the tunnel, range: 0 – 1200 l/min.

Optional

(G) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(H) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.

Note: Specifications are subject to change.

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- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Experiment Capabilities

- Investigate the relationship between power input and surface temperature in free convection on flat, finned and pinned plates
- Investigate the relationship between power input and surface temperature in forced convection on flat, finned and pinned plates
- Investigation of the use of extended surfaces to improve that transfer from the surface
- Determination of the temperature distribution along extended surface

Three Axes Heat Transfer Module : Order Code - 32270J

Tesca Three Axes Heat Transfer Module 32270J is a bench-top unit designed to carry out heat transfer experiments and exercises studying the direction in three axes.

Specifications

- Brass cylinder to study heat transfer.
- Electric heater, computer controlled.
- Refrigeration section with a surface cooled by water.
- Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
- Water flow regulation valve.
- 11 Temperature sensors , "T" type (high precision):
  - Temperature sensor at the water inlet of the unit.
  - Temperature sensor at the water outlet of the unit.
  - 5 Temperature sensors at different depth in a specific cross section.
  - 4 temperature sensors longitudinally distributed.
- Power measurement from the computer.

Optional

(A) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(B) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

Note: Specifications are subject to change.

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- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Metal to Metal Heat Transfer Module : Order Code - 32270K

Tesca Metal to Metal Heat Transfer Module 32270K is a bench-top unit designed to study of the heat transfer of different metallic materials situated in series.

Specifications

- Input heat section. It includes:
- Electric heater, computer controlled.
- Interchangeable central sections. They are formed by two different cylinders chosen from the four cylinders supplied:
  - Copper cylinder of 25 mm of diameter.
  - Brass cylinder of 25 mm of diameter.
  - Stainless steel cylinder of 25 mm of diameter.
  - Aluminum cylinder of 25 mm of diameter.
  - 4 temperature sensors, "T" type (high precision) for each cylinder.
- Refrigeration section with surface cooled by water. It includes 4 temperature sensors, type "T" (high precision).
- Water flow regulation valve.
- Two temperature sensors, "J" type, for the cooling water inlet and outlet.
- Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
- Thermal paste is supplied to demonstrate the difference between poor and good thermal contact between the sections.
- Power measurement from the computer.

Optional

(C) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(D) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the

Note: Specifications are subject to change.

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unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Optional

(E) Data Acquisition System
- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(F) Computer Control Software
- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Ceramic Heat Transfer Module : Order Cdoe - 32270L

Tesca Ceramic Heat Transfer Module 32270L is a bench-top unit designed to study of the heat transfer of different ceramic materials.

Specifications
- Input heat section. It includes:
  - Electric heater, computer controlled.
  - 4 temperature sensors, "T" type (high precision).
- Interchangeable central sections. There are two types:
  - Ceramic cylinder with a thermal conductivity of 1.46 W/m·ºC.
  - Ceramic cylinder with a thermal conductivity of 0.49 W/m·ºC.
  - 3 temperature sensors, "T" type (high precision), for each cylinder.
- Refrigeration section with surface cooled by water. It includes 4 temperature sensors, "T" type (high precision).
- Water flow regulation valve.
- Two temperature sensors, "J" type, for the cooling water inlet and outlet.
- Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
- Thermal paste is supplied to demonstrate the difference between poor and good thermal contact between the sections.
- Power measurement from the computer.

Optional

(G) Data Acquisition System
- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control

Note: Specifications are subject to change.

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- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(H) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Thermal Conductivity of Insulating Material Module : Order Code - 32270M

Tesca Thermal Conductivity of Insulating Powder Apparatus Module 32270M consists of an insulating powder, which is enclosed in a cavity of two concentric spheres. The inner space of the inner sphere contains the mica heater. Input to the heater can be adjusted by the variable transformer. The tappings on the surfaces of the inner sphere and outer sphere are used to find out the temperature difference between the spheres. This enables to find out the conductivity of powder.
The Apparatus comes with heater, control panel and consists of digital voltmeter.

Technical Specifications

- Input heat section.
- Electric heater, computer controlled.
- Refrigeration section with a surface cooled by water.
- Interchangeable central sections:
  - With nylon of 50 mm of diameter.
  - With Teflon of 50 mm of diameter.
  - With Bakelite of 50 mm of diameter.
- Flow sensor to measure the cooling water flow, range: 0.25 – 6.5 l/min.
- Water flow regulation valve.
- Thermal paste is supplied to demonstrate the difference between poor and good thermal contact between the sections.
- 19 Temperature sensors, "T" type (high precision):
- 17 Temperature sensors distributed in the heating section (4 sensors), refrigeration section (4 sensors) and central sections (3 sensors in each central section).
  - Temperature sensor at the water inlet of the unit.
  - Temperature sensor at the water outlet of the unit.
- Power measurement from the computer.

Note: Specifications are subject to change.

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Optional

(I) Data Acquisition System

- An electronic signal conditioning system stand alone data acquisition modules Windows based data acquisition software Data Logging
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results
- Signal Analysis

(J) Computer Control Software

- PID Computer Control + Data Acquisition + Data Management Software for Linear Heat Conduction Module.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Experimental Capabilities

- Determination of thermal conductivity of insulating powder
- Comparison of thermal Conductivity of insulating powder at different temperatures

Services Required

- Mains Power Supply 220/240V, 50Hz, Single phase
- Table for Set-up support.

Parallel Flow Module : Order Code - 32270N

Features

- Completely pre-assembled experimental unit with heaters

The heat transfer in and around pipes can be investigated using the base unit.
The heat transfer from the pipe wall to the medium is observed. A ring heater simulates the flow inside the pipe, while a rod heater reflects the conditions in the flow around a pipe.
The power and surface temperature of the two electrical heaters are measured and displayed on the base unit

Specifications

- Accessory for parallel flow module
- 2 Thermocouples type K: Temperature measurement at the top of the rod-type heater and at the inner surface of the ring heater
- Mounted in quick-action fasteners

Technical Specifications

- Air duct: D=60mm
- Ring heater: power: 220W; diameter: 60mm; length: 30mm
- Rod-type heater: power: 250W; diameter: 8mm; length: 130mm

Note: Specifications are subject to change.

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- Experiments
- Consideration of the relationships between Nusselt, Reynolds and Prandtl
- Determination of heat transfer coefficient
- Calculation of the air velocity

Mixed Flow Module : Order Code - 32270O

Features
- Completely pre-assembled experimental unit with heaters

The air duct with the pipe bundle heat exchanger is fitted to 32270 and heated electrically.
The heat transfer between the pipe wall and medium can be studied. Baffles guide the air through the pipe bundle in a cross-flow. The number of deflections can be varied by removing and adding baffles.
The power and surface temperature at the heater are measured and displayed on the base unit

Specifications
- Accessory for 32270
- Pipe bundle: 1 rod-type heater, 18 pipes
- Rod-type heater placed in the centre of the pipe bundle
- Up to 8 baffles can be added
- Thermocouple type K: temperature measurement on the heater sleeve surface
- Mounted in base unit with quick-action fasteners

Technical Specifications
- Rod-type heater power: 250W
- Pipe diameter: 100mm

Experiments
- Relationships between Nusselt, Reynolds and Prandtl
- Characteristics of a pipe bundle heat exchangers
- Pressure loss across the entire measured section
- Determination of heat transfer coefficients

Cross Flow Heat Transfer Module : Order Code - 32270P

Tesca Cross Flow Heat Transfer Module 32270O is designed to study heat transfer between two fluids in cross flow configuration.
Hot water flow coming from the base unit enters and leaves a radiator perpendicular to an air current, which is generated by a fan.
The heat exchanger allows to measure water and air temperatures at the inlet and outlet of the exchanger.

Technical Specifications
- Heated element:
  - Diameter: Minimum 12.0mm (Nominal)
  - Material: Copper
  - Built in thermocouple: K-type
  - Noise levels: Greater than 85dB
  - Main part size in assembled condition: Min. 1500mm long x 1150mm high x 380mm front to back
- Radiator located across the air duct.
- The fins of the radiator are made of aluminum and have a heat transfer area of 35000 mm².
- Axial fan with speed control from computer (PC). It provides a maximum air velocity of 3 m/s.
- Four "J" type temperature sensors to measure input and output water and air temperatures.
- Velocity sensor to measure air velocity, range: 0 – 4 m/s.
- Two ball valves.
- Easy connection to the Base Service Unit TH 016.

Optional:
- Analog and digital PID control. PID menu and set point selection required in the whole work range.

Note: Specifications are subject to change.

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- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (kilo samples per second).
- Calibration system for the sensors involved in the process.
- Allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Software part of the SCADA system from 'Interface In-built Module'

Experiments

- Determining the pressure losses created by the heat exchange rods and creating a chart of pressure drop against upstream pressure
- Calculating the inlet velocity and the mean velocity through the rods
- Determining the rate at which the heated rod cools down, within a bank of rods and by itself
- Plotting 'cooling curves' and using them to find the coefficient of heat transfer (h) for the heated rod at various position in the heat exchanger
- Determining the velocity distribution (profile) downstream of the rods
- Converting results into dimensionless values (typically using Nusselt, Prandtl and Reynolds equations)
- Comparing results and producing heat transfer coefficient curves

Water to Air Heat Exchangers set Module : Order Code - 32270Q

Fits on bench top and hot water supply, cooling air duct and all instruments needed for tests on cross-flow heat exchangers are available from Heat Transfer Base 32270 Water to Air Heat Exchangers include

- 32 tube heat exchanger: 32 off 10 mm diameter tubes in four rows, cross-flow, approx. surface area of 0.16 m2
- 16 tube heat exchanger: 16 off 10 mm diameter tubes in two rows, cross-flow approx. surface area of 0.08 m2
- Finned heat exchanger: Tubes in two rows, cross-flow with vertical fins, approx. surface area of 0.16 m2

Other tube diameters, number of tubes & rows available against request.

Experimental Capabilities

- Heat transfer between fluids through a solid wall
- Energy balance and efficiency
- Finding the heat transfer coefficient and Log Mean Temperature Difference (LMTD)
- Effect of water temperature (the 'driving force')
- Comparing actual midpoint water temperature with the average based on overall inlet and outlet temperatures
- Comparing temperature change between upstream and downstream tube banks
- Comparison of heat exchangers of different construction and heat transfer area

Table Top Refrigeration Module : Order Code - 32270R

Designed to provide students with a thorough understanding of various types of systems used in commercial and industrial applications. It permits students to understand the refrigeration cycle, including measurement of pressure, vacuum, flow rate and temperature.

Specifications

- Compressor
  - Hermetic : 450 Watt
  - Refrigerant : R-134A
  - Voltage : 240
- Condenser
  - Forced air coil with variable speed fan

Note: Specifications are subject to change.

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- Control devices
  - Low pressure switch
  - High pressure switch
  - Thermostatic expansion valve
  - Solenoid valves
  - Thermostatic controller
  - Wattmeter, Voltmeter, Ammeter
  - Thermometer
- Safety features
  - Safety pressure switch
  - Main breaker switch
  - Compressor breaker switch
- Evaporator
  - Air Cooled Type

Experimental Capabilities

- Basic function of refrigeration control components, such operating principles and common fault & trouble shooting method
- Study of COP calculation in Refrigeration Cycle
- Troubleshooting of refrigeration cycle failure symptom and caused
- Basic electric control circuit and system of common air Conditioning system
- Investigation on the operation of the compressor
- Familiarization with the operating of metering devices, for instance, thermostatic expansion valve, automatic expansion valve, capillary tube
- Study on the principles of evaporator and condenser – superheating and sub cooling, heat exchanger
- Investigation of refrigeration system

Advanced Air Conditioning : Order Code - 32270S

The trainer enables student to investigate the theoretical performance of air-conditioning system along with the various treatments utilized in the air flow distribution cycle including heating, cooling, humidification, dehumidification, recirculation and mixing, combination of cooling, heating, humidification & de-humidification.

Experiments Possibilities

- Demonstration of the processes and components used in heating, cooling, humidification, dehumidification of an air stream.
- Measurement of air psychometric condition before and after humidification, heating, dehumidification or cooling
- Determination of a heat and mass balance across each process resulting in heating, cooling, and humidity change
- Construction of a complete refrigeration cycle diagram for the air conditioner plant plus an energy balance between the refrigeration circuit and the change in air enthalpy and its mass flow across the evaporator
- Investigation of the volumetric efficiency of refrigeration compressor under varying load
- Determination of specific heat capacity of air, by measurement of the range in psychometric condition cross a heating or cooling process
- Energy supply in the air heater
- Energy dissipation in the cooler
- Humidifying
- Heat load in the room:
  - Dry (sensitive) heat generator
  - Moist (latent) heat generator
- Mixing line

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(A) Computer interface & software options

'Sci-Cal' software & hardware has been designed for use with more than 200 'Tesca' trainers. 'Sci-Cal' comes in a module that can be fitted or mounted on the Tesca trainers very easily.
'Sci-Cal' box has 10 inches front HMI interactive panel, inside are i3 processor computer with it's own hard drive & software processor with 16 to 32 analog and 16 to 32 digital signal data-loggers. The 'Labview' processes the input signal with in-built data and formulae to tabulate results for the Tesca trainers.
'Sci-Cal' box has HDMI output for connection to a projector or an electronic whiteboard or a monitor.
'Sci-Cal' box has input ports for inputs from the Tesca trainer sensors.
'Sci-Cal' eliminates requirement of external computer.

Specifications

- 10" HMI panel front
- HDMI output for connection to a projector or an electronic whiteboard or a monitor
- In-built i3 computer processor & hard drive
- 16 to 32 analog and 16 to 32 digital input signal data-loggers
- PID Computer Control + Data Acquisition + Data Management.
- Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. Compatible with the industry standards.
- Registration and visualization of all process variables in an automatic and simultaneous way.
- Flexible, open and multi-control software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Analog and digital PID control.
- Menu for PID and set point selection required in the whole work range.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (Kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
- Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
- This module requires Control Interface Module and Data Acquisition.

Interface In-built Module:

This control interface is common for the 'Tesca' trainers and can work with one or several trainers.
The Control Interface is part of the SCADA system.
Control interface with process diagram on the front panel.
The unit control elements are permanently computer controlled.

- Simultaneous visualization in the computer of all parameters involved in the process.
- Calibration of all sensors involved in the process.
- Real time curves representation about system responses.
- All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
- Shield and filtered signals to avoid external interferences.
- Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process.
- Real time PID control for parameters involved in the process simultaneously.
- Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time, of the three control constants (proportional, integral and derivative constants).- Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.
- Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.
- Fault simulation optionally can be programmed into the system.

Note: Specifications are subject to change.

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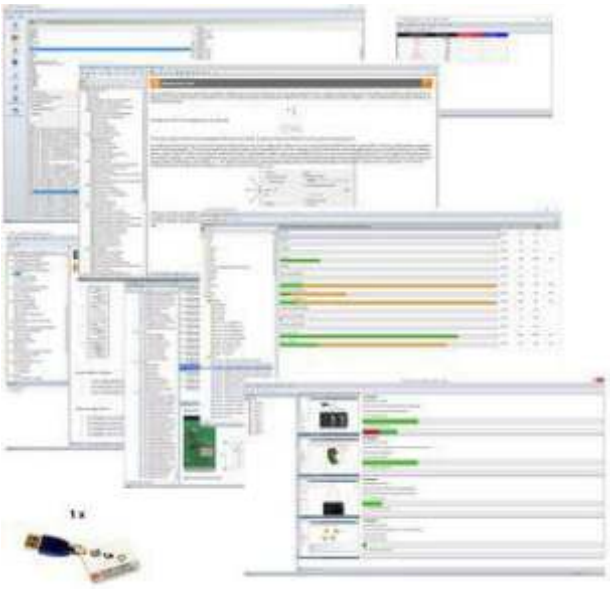
(B) Sci-Cal CLASSROOM MANAGER 6 SOFTWARE SUITE, SINGLE LICENSE

Sci-Cal Classroom Manager 6 software suite, single license
Sci-Cal Classroom Manager is a comprehensive set of administration software for the Sci-Train system and all Sci-Cal courses. Classroom Manager comprises the following independent program components:



Sci-Cal Manager: Administration of students and courses in LabSoft
Sci-Cal Reporter: Student reports and statistics
Sci-Cal Editor: Creation and editing of courses and tests
Sci-Cal Questioner: Creation of questions, measuring exercises and sets of questions for courses and tests

- Sci-Cal TestCreator: Automatic generation of tests on the basis of sets of questions
- Sci-Cal ControlCenter: Supervisors can view and allocate what various LabSoft training groups see on screen
- Sci-Cal TableEdit: Creation of tables and graphs for recorded measurements

Features:

- Ease of use of all programs thanks to graphical user interface in all component programs
- For use in local area networks or on stand-alone PC
- Ease of installation
- No additional database software required
- Access control via USB dongle
- Available languages: CS, DE, EN, ES, FR, RU, PT, ZH, LO

Sci-Cal Manager:

- Administration of Sci-Cal network installation
- Administration of an unlimited number of students and courses in Sci-Cal
- Addition, deletion and editing of courses and tests in Sci-Cal
- Addition, deletion and editing of students and student data
- Addition, deletion and editing of student groups (classes)
- Assignment of students to classes
- Activation of team function in Sci-Cal
- Assignment of courses and tests to students or classes

Sci-Cal Reporter:

- Electronic monitoring of student progress
- Graphical presentation of progress in courses and tests
- Presentation of student or group results
- Reports on courses, tests, single users or classes
- Summary of results and time

Note: Specifications are subject to change.

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- Export of data to clipboard or file
- Display and printing of tests which have been taken with the candidate's original answers
- Multiple search options for students, classes, courses or tests

Sci-Cal Editor:
- HTML editor for easy to use editing of Sci-Cal courses
- Editing of course pages
- Wizard for creation of new courses and course pages
- Automatic inclusion of new courses in an existing Sci-Cal installation
- Automatic creation of IMS-compatible navigation tree without the need for programming knowledge
- Moving course pages within the navigation tree at the click of a mouse
- Editing in WYSIWYG mode
- HTML view and page preview
- Insertion of graphics, animations and tables
- Insertion of test questions
- Page templates for a variety of page types

Sci-Cal Questioner:
- Program for creating and editing questions, practical measuring exercises and sets of questions (question files) for electronic evaluation
- Easy creation of exercises and questions for courses and tests
- 7 different types of question: single and multiple choice, missing text, assignment, matrices, arbitrary text, selection of images
- Ability to input meta data (points, time for questions, difficulty, required resources, etc.)
- Easy specification of tolerances for practical measuring exercises
- Changes to the assessment criteria for courses or tests (including after the test has been taken)

Sci-Cal Test Creator:
- Program for automatically creating electronic tests from sets of questions (question files)
- Automatic and manual selection of questions and measuring exercises
- Filter functions (e.g.: type of question, difficulty) for pre-selection of questions
- Automatic generation of tests according to a set time or number of questions
- Various test options: arbitrary order of questions in a test, immediate display of results after completion
- Automatic registration of tests in Sci-Cal
- Preview function showing the test as created

Sci-Cal Control Center:
- This program allows supervisors to view, allocate and control what various active Sci-Cal users see on screen via network interconnection
- View of screens as currently seen by Sci-Cal users
- Display of user progress: number of pages completed and questions answered (right and wrong) in a course
- Full-screen view and remote control (via mouse) of individual screen contents
- Allocation of screen views allowing users to see what is on other Sci-Cal users' screens
- Display of requests for help from Sci-Cal users

Sci-Cal Table Edit:
- Program for generating tables of values plus graphs, charts and diagrams for the purpose of measurements made in practical experiments using Sci-Cal platform
- Automatic plotting of tabulated measurement data in graphs
- Up to 7 Y-axes so that various measurement variables can be plotted on the same graph
- Various display options for measurements (points, lines, levels and more)

Includes:
- CD-ROM with Sci-Cal Classroom Manager
- 1 USB-dongle for operation of program

System requirements:
- Server or PC with Windows 8, 8.1 or 10

Note: Specifications are subject to change.

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- Microsoft Internet Explorer 10.0 or higher
- Minimum 200 MB free disk space
- 1 free USB-port for USB-dongle
- Local network for use of ControlCenter program

Accessories & Manuals

- All trainers & modules are provided with cables and accessories for normal operation.
- Manuals to include Services, Assembly and Installation, Starting-up, Safety, Maintenance, Calibration & Practices, Interface and Control Software(optional).

Services Required

- Electric Supply 230 V AC, 16 A, Single Phase, Earthed.
- Cold Water Supply & Drainage.
- Personal Computer with USB port, Windows operating system & all peripherals.

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