H-6640

Air Flow Unit

Purpose

The Hampden **Model H-6640** Air Flow Unit is designed to provide the basic air flow facilities necessary to perform fundamental experiments in fluid mechanics and heat transfer. With this unit, the student is able to investigate the characteristics of fans and, with the optional heat transfer modules, investigate the characteristics of liquid to liquid and air to liquid heat transfer.

MODEL H-6640 Air Flow Unit shown with optional **H-6640-10A, -10B, & -20** Heat Exchangers
Dimensions: 36"H x 120"W x 32"D - Weight: 650 lbs.

Description

The unit consists of a four-section air duct securely fastened together with a removable middle section which can easily be removed and replaced with optional heat exchangers. The entry and exit sections (which are identical) contain Lexan® observation windows for a visual inspection of the air duct and any experiment being conducted. A detachable centrifugal fan is supplied with the basic unit (Optional: **Model H-6640-50 Axial Fan**) and is equipped with an electrical starter and reducing section. The end section of the air duct is equipped with an adjustable choke plate used to control the flow rate. Also, the inlet section contains provisions for mounting resistance screens of various values to provide further means of regulating the flow rate.

The velocity profile at any point in the plane duct can be determined by using the pitot-static tube in conjunction with the vernier pitot tube positioner and precision manometer. The average pressure in the duct is measured with a triple T-ring.

The air duct is constructed out of four smooth, white plastic faced, laminated wood having a cross section of 5.9" x 11.8" and an overall length of 76.8". The centrifugal fan has an output of 520 scfm (245 slps) giving a maximum air velocity of 18.0 ft/s (5.5m/s). The manometer is a bench mounted inclined-vertical type with a range of 0-2" WC and 2-10" WC. The former has an accuracy of 0.01" WC and the latter has an accuracy of 0.10" WC. The pitot-static tube has a modified Prandtl-type tip and is mounted on a manual traverse unit. The manual traverse unit has an accuracy of 0.01". The entire setup is permanently mounted on a mobile bench constructed out of 14 gauge square mechanical tubing with a plastic laminated wood core 1-1/16" bench top. The bench comes with metal storage trays. The overall bench dimensions are 36"H x 120"W x 32"D and requires floor area of 180" x 98" to provide all-around access to unit when in operation. An instruction manual is included covering the basic operation of the bench and recommended experiments.

Experimental Modes

The Hampden **Model H-6640** Air Flow Unit serves as the basic unit to support many experimental setups, such as:

A. Establish the volume flow rate vs. static pressure relationship for the fan.
B. Determine the cut-off pressure for the fan.
C. Determine the velocity profile inside the duct both upstream and downstream of the removable middle section.
D. Conduct liquid to air heat transfer experiments:
   1. Liquid-to-air heat transfer for plain copper tube banks.
   2. Liquid-to-air heat transfer for finned copper tube banks.
   3. Liquid-to-air heat transfer for humidified air to determine the dew point, frost formation and other heat transfer phenomena.
E. Perform a heat balance analysis on the unit using the flow rates and the inlet/outlet temperatures of the liquid and air streams.

Power Required

120V AC-1ϕ-50/60Hz

Optional Equipment

H-6640-10A Plain-Tube Heat Exchanger
H-6640-10B Finned-Tube Heat Exchanger
H-6640-20 Expansion Coil Heat Exchanger
H-6640-40 Air Temperature Measurement Package
H-6640-50 Axial (Propeller) Fan and Reducer Section

All Hampden units are available for operation at any voltage or frequency

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H-6640-10 Liquid-to-Air Heat Transfer Modules

Purpose

The Hampden **Model H-6640-10** Liquid-to-Air Heat Transfer Modules are designed to permit student study of liquid-to-air heat transfer. Air flows over tube banks in which either hot or cold water flows. The tube banks are of two types; one constructed out of bare copper tubing, the other constructed out of finned copper tubing.

Description

These heat transfer elements are designed to be used with the Hampden **Model H-6640** Air Duct and are quickly inserted and secured through the use of 1/4 turn quick-connect/disconnect fasteners.

The tube banks are housed in a short section of duct constructed out of white plastic-faced, laminated wood. Within each duct, the tubes are arranged in three (3) vertical staggered rows. Each insert has an insulated header to divide the flow within a row. These headers are interconnected by a flow control valve to operate the heat exchanger as a single or triple pass unit. The external connections to the inserts are made by flexible rubber hoses with quick-connect/disconnect fittings. These fittings feature a positive shut-off to prevent leakage when coupling or uncoupling the inserts. The hot or cold water supplies may be supplied by the Hampden **H-6850** Heat Transfer Bench or any other suitable source which has provisions for measuring the flow rate.

This unit also comes equipped with 4 dial thermometers which can be inserted into the 4 temperature wells located on each module. These temperature wells are self-sealing and are used to monitor the water temperature.

The heat transfer elements consist of the following:

1. **Rectangular Duct**: Cross section 12"H x 11.4"W x 6"D
2. **H-6640-10A Plain Tube Heat Exchanger**: 3 rows of 11 tubes each constructed out of 5/8" OD copper tube with a 0.064" wall. The total heat transfer area of the heat exchanger is 5.33 sqft.
3. **H-6640-10B Finned Tube Heat Exchanger**: 3 rows of 2 tubes each constructed out of 5/8" OD copper tube with a 0.036" wall carrying fins with a 1-5/16" OD fins with a thickness of 0.015". Each 12" tube contains 4 fins per inch (total 47 per tube). Total heat transfer area - 5.14 sq ft.

H-6640-20 Expansion Coil Heat Transfer Module

Purpose

The Hampden **Model H-6640-20** Expansion Coil Heat Transfer Module is used to investigate the phenomena associated with humidified airstreams. This module is designed for use with the Hampden **Model H-6640** Air Flow Unit and can be operated from the Hampden **Model H-6720** Refrigeration Unit.

Description

Water vapor is injected into the airstream and forced over a finned heat exchanger in which 134a Refrigerant flows. The water vapor will condense on the fin surface when the local dew point is reached and will crystallize to form frost. The student is able to investigate the effect that humidity content and frost build up have on the heat transfer rate.

With the clear top, the student will also be able to observe the formation of frost on the fins. Additionally, the effect of obstructions in the duct on the air flow profile can be observed by the pattern of frost buildup on the fins.

The source of water vapor is a steam generating unit in which a pair of 1000 W immersion heaters are installed. The heaters are wired to a variable temperature controller so that a multitude of steam generation rates can be achieved. The water vapor is fed into the duct by a pair of steam injectors on opposite sides of the duct located downstream of the expansion coil. An air straightener is located upstream of the steam injectors before the expansion coil. The steam generator is fed by an inverted clear plastic one liter bottle which allows the water level to be continuously observed.

The wet and dry bulb temperatures are monitored both upstream and downstream of the expansion coil and the refrigerant temperatures are monitored at the inlet and outlet ports of the expansion coil. These temperatures, together with air and refrigerant flow rates, will allow the student to determine the heat transfer rates.

The unit is mounted on a white, plastic faced wooden housing which can be quickly inserted into the Hampden **Model H-6640** Air Flow Unit.

All Hampden units are available for operation at any voltage or frequency

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