

# Aerodynamic Control Systems

Educational Training Equipment for the 21st Century

Bulletin 691-12C

## H-6910-12 Wind Tunnel

### Purpose

The Hampden **Model H-6910-12** Wind Tunnel has been designed to provide the fundamental air flow facilities necessary to perform any of the **H-6910-12** Series Wind Tunnel Experiments. This unit is mobile so that it is suitable for either a lecture hall demonstration or laboratory work.

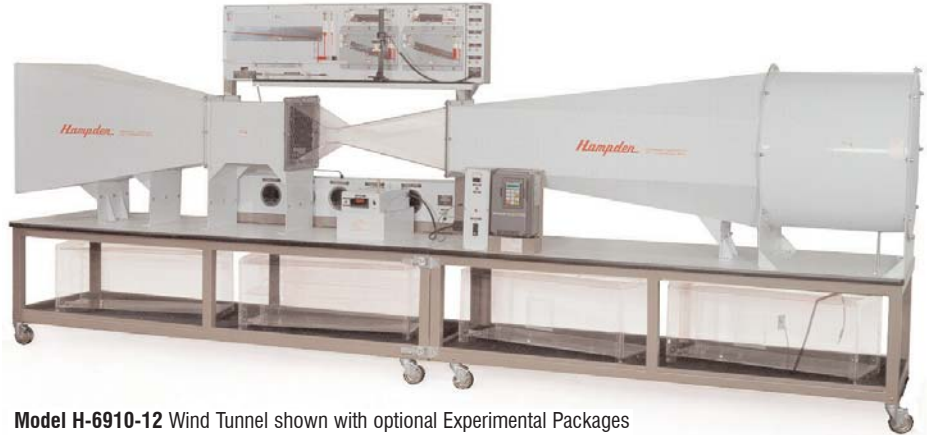
### Description

The unit is equipped with a bench, control panel, wind tunnel including an inlet cone, clear experiment section, outlet cone and screen; manual traverse unit, linear track with carrier; and main AC circuit breaker. The bench includes a shelf for storage and is mounted on eight casters.

The manual traverse unit is mounted on the carrier that rides along the table rail which includes a scale calibrated in millimeters. The manual traverse unit is used to position an air probe in the experiment section and is capable of both linear and rotary positioning. The linear scale is 25 cm long with minor divisions of 0.2 cm and resolution of 0.02 cm if the vernier is used. The protractor is graduated in 2° steps over a full 360°. With the vernier, it has a resolution of 0.2° (the rotational range of the manual traverse unit is limited to 40° either direction centered around zero). Interchangeable mounting collets are provided for locking probes firmly in place without damaging them.

This unit provides the following features:

- Provides full visibility of test section
- Fully instrumented for static and dynamic pressure
- Can be expanded to allow computer control and data acquisition.
- Air speed of greater than 9000 ft/min. (100 mph)
- 12" square test section
- Self-contained, fully mobile
- Low head-loss, aerodynamic flow straightener section



**Model H-6910-12** Wind Tunnel shown with optional Experimental Packages  
Dimensions: 73"H x 180"W x 30"D, Weight: 2,000 lbs.

- Low area ratios of both convergent and divergent sections provide uniform and efficient flow
- An Operating Instructions Manual, a Teacher's Manual and an Experiment Manual are provided. These manuals review the background theory and experimental procedures that can be performed with each piece of equipment.
- Many options offered to fully explore all areas of wind dynamics

### Specifications

This unit consists of a convergent section, straightener section, 12" x 12" x 24" I.D. test section, divergent section and fan section.

The 27" tubeaxial fan wheel has a top speed of 12,373 FPM @ 1750 RPM providing 9416 CFM at 1.5 inches water column static pressure. The fan is driven by a 5HP three-phase motor controlled by a variable frequency drive with 10 turn speed control 0-120Hz, percentage speed/load analog meter, on-off switch, and one digit LED diagnostic display.

The test section is constructed of Lexan® polycarbonate with end flanges designed for easy removal without the use of tools.

Also supplied with this unit is a pitot tube positioner. This instrument can accurately position the pitot tube to within 0.01 inches of its linear position and 0.2° of its angular position by use of vernier scales. The positioner has a maximum linear range of 12 inches and rotary range of 360°.

The mobile support frame is constructed of 2" square mechanical tubing with trusses and cross members to support the wind tunnel and work table. The mobile frame is mounted on four sets of casters with the outboard two front casters having brakes. The work surface is 48" long by 32" deep x 1-1/16" thick.

All steel components finished in instrument tan.

The electrical control box consists of a 3-pole main circuit breaker with associated pilot light, accessory power receptacle, and a 6-ft. 5/c power cord with cord rack.

### Services Required

208VAC-3 $\phi$ -60Hz

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

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## Optional Experiment Packages

The Hampden **H-6910-12** series of optional experiments are designed to be used with the Hampden **Model H-6910-12** Wind Tunnel. All experimental setups are quickly attached/removed from the wind tunnel through the use of quick connect fasteners. Any electrical equipment (digital displays, power supplies, etc.) is easily mounted in factory drilled cutouts and the electrical connections are made by quick connect adapters.

### **H-6910-12-5X Manometer Package**

The Hampden **Model H-6910-12-5X** Manometer Package is intended to be used with the Hampden **Model H-6910-12** Series Wind Tunnel Experiments. The manometers included precisely indicate pressure/differential pressure being monitored by a given pitot tube. This manometer package comes equipped with five manometers that are panel mounted.

Provided is a mobile support frame.

### **H-6910-12-6 Manometer Package**

The **Model H-6910-12-6** Manometer Package consists of a sealed panel, 20 manometer tubes with fittings, manifold, beaker with tube fitting, and interface tubing. It has a 15" scale length.

### **H-6910-12-10 Bernoulli's Equation Apparatus**

The **Model H-6910-12-10** is designed to investigate the validity of Bernoulli's Equation. The total and static pressure is measured along the centerline of a convergent/divergent channel at varying flow velocities to verify experimentally Bernoulli's Equation. Off-Centerline measurements can also be taken with two different types of pitot tubes, one being a traditional total/static tube and the other being a Kiel probe. (Probes sold separately in **Model H-6910-12-80** Probe Package.) This allows the student to compare the total pressures where the fluid streamlines are converging or diverging for the two pitot tubes.

### **H-6910-12-25 Free Jet/Flow In Bends Demonstrator**

The **Model H-6910-12-25** consists of:

Free Jet Demonstrator – is designed to investigate the characteristics of a free jet. The total pressure in the free jet is measured by traversing a pitot tube across the jet diameter at several points along the axis of the jet. The velocity

profile of the jet can be determined along with the flow direction. The apparatus can be used to show the decrease of the jet centerline velocity, radial distribution of the jet at different points along the jet axis and conservation of momentum of the jet.

Flow In Bends Demonstrator – is designed to demonstrate the phenomena associated with fluid flow in bends. Air is passed through a 90° bend which contains provisions for measurement of the static pressure at points on both inner and outer surfaces of the bend. Static pressure taps are also located radially around the bend at one location. The student can measure the pressure differential on the bend and the radial pressure distribution around the bend.

### **H-6910-12-40 Boundary Layer Demonstrator**

The **Model H-6910-12-40** is designed to investigate boundary layer phenomena. Air flowing over a flat plate is used to form both laminar and turbulent boundary layers. This unit comes equipped with two flat plates, 26" x 6.5", one on which a laminar boundary layer will form while on the other boundary layer is forced to be turbulent at the leading edge. Also supplied are a boundary layer probe with a flattened top to measure the total pressure in the boundary layer. When used in conjunction with the pitot tube positioner, these allow very accurate measurements of the boundary layer.

### **H-6910-12-55 Lift and Drag Force Demonstrator**

The **Model H-6910-12-55** is designed to investigate the force of drag on a body. Geometric shapes with the same projected area, but with different cross-sections, are mounted in a fluid stream and the pressure distribution is measured around the body. This unit comes equipped with two 2-dimensional bodies; cylinder, flat plate, three 3-dimensional bodies; sphere and pair of hemispherical disc; digital panel meter; excitation power supply and amplifier. The drag force is determined by traversing the wake of a body with the 3-dimensional probe to measure the pressure distribution around the body. The 3-dimensional probe can measure total pressure, static pressure, yaw angle and pitch angle.

### **H-6910-12-70 Pressure Wing & Rake**

The **Model H-6910-12-70** consists of a NACA0020 Aerofoil section with nineteen pressure taps. Also provided is a Wake Survey Rake.

### **H-6910-12-71 Wing with Slat, Flap and Load Cell Interface**

The **Model H-6910-12-71** consists of a NACA0020 Aerofoil Section wing with adjustable flap. The flap and slat are removable.

### **H-6910-12-72 Pressure Cylinder**

The **Model H-6910-12-72** consists of a 2" dia. cylinder with nineteen pressure taps finished flush with the outer surface. The outer end of each tap exits from the center of the cylinder.

### **H-6910-12-73 Flutter Wing**

### **H-6910-12-80 Probe Accessory Package**

The **Model H-6910-12-80** consists of:

- 1 - Kiel Probe
- 1 - Pitot-Static Pressure Probe
- 1 - Directional Probe - Three Dimensional
- 1 - Pressure Dividing Choke
- 3 - Universal Tee Connectors
- 1 - Storage Case

## Computer Data Logging

This feature adds five differential pressure transducers, one air velocity transmitter, one rotary transducer, lift/drag input (for **H-6910-12-55** option), angle of attack (for **H-6910-12-71** option), and one fan speed input into the system. One interface package containing National Instruments I/O modules is provided for interfacing into an IBM compatible computer through the RS-232 port.

Computer is not included. Templates for LabVIEW® control software are included.

Specify **Model H-6910-12-CDL** ♦

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

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