Forced Convection Heat Transfer Experiment

Figure 1 The TD1 Apparatus

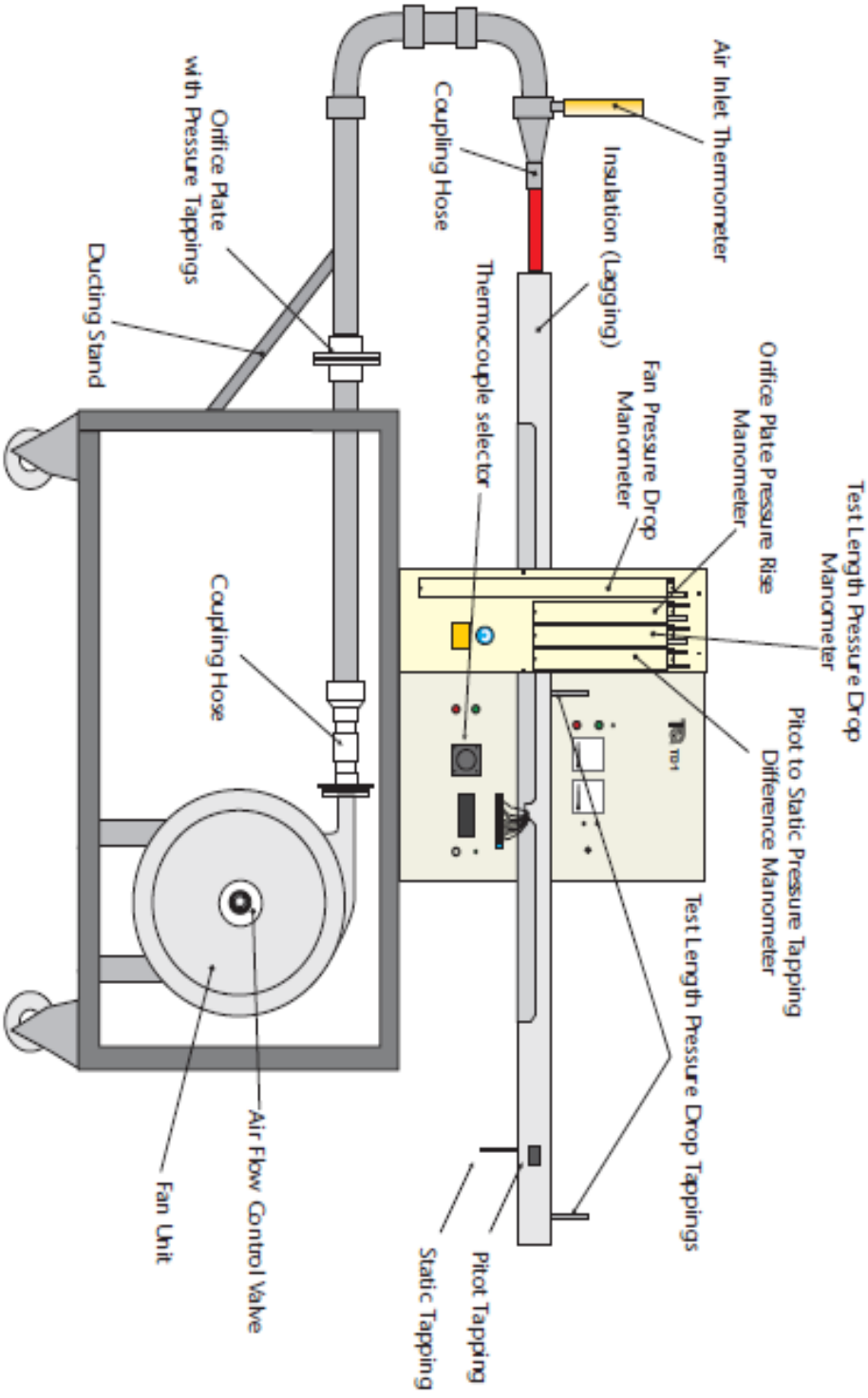

Figure 2 General Layout

Figure 2 shows the general arrangement of the TD1 Forced Convection Heat Transfer apparatus. The apparatus consists of an electrically-driven centrifugal fan, which draws air through a control valve and discharges into a U-shaped pipe. The fan speed remains constant throughout. A British Standard* orifice plate is fixed in this pipe to measure the airflow rate. This pipe is connected to a copper test pipe, which discharges to atmosphere. The test pipe is electrically heated by a heating tape wrapped around the outside of the pipe. The power input to the tape is varied by adjustment of a power control on the apparatus; the input levels are measured by a voltmeter and ammeter on the instrument panel. The test pipe is insulated with fibreglass lagging. The apparatus supports the pipework.

The test length, situated within the heated section of the test pipe, has pressure measuring tappings at each end, which are connected to manometers on the instrument panel. Other manometers fixed to the instrument panel measure fan discharge and the orifice pressure drop.

A thermometer measures the air temperature at the inlet to the test pipe.

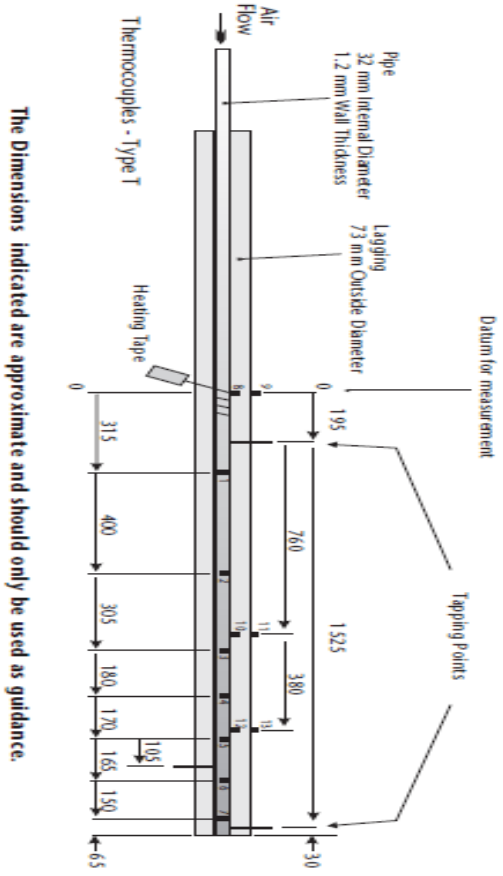

Figure3. Dimensions and positions of thermocouples

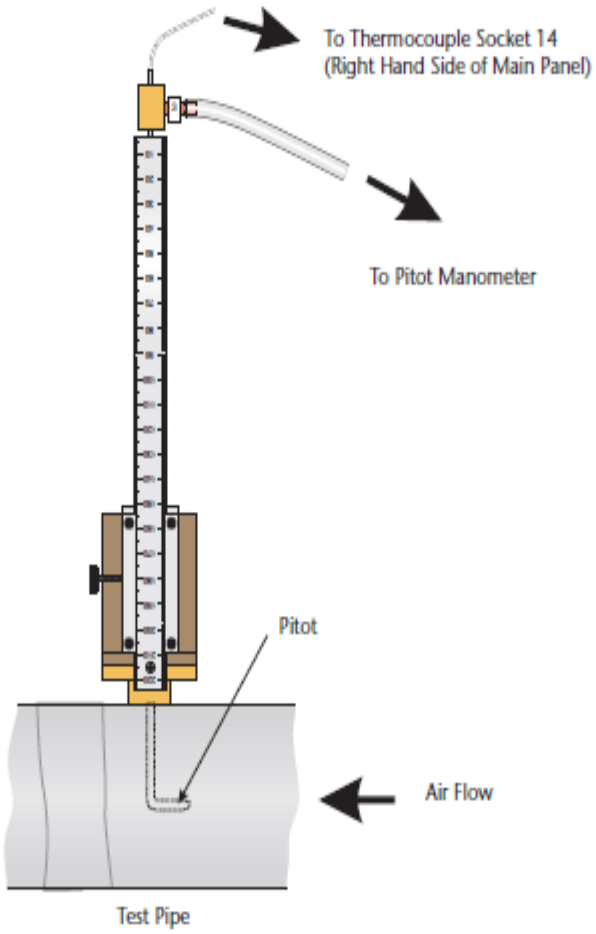

Figure4. Pitot assembly

Running the Equipment and Collecting Data

Procedure

1. Start the fan.
2. When air is flowing through the tube, slowly increase the electrical current to the heating coil until a suitable value has been reached.
3. Run the unit for 15 to 20 minutes, by which time it will have reached an equilibrium temperature. Check this by monitoring one of the thermocouples.
4. Set the pitot tube right against the far side of the duct and take readings of the manometer and temperature.
5. Without altering the current setting, traverse the pitot tube across the duct in intervals of 1 mm, and note the results. The distance from the pitot tube centreline from the duct wall when in contact with the wall is normally 1 mm.
6. After use, turn off the heater but allow the fan to keep working for approximately five minutes before you switch it off. This will help to cool the test pipe and reduce any possible damage to the thermocouples.

Data Collection Tables

TEST IDENTIFIER		
Date		
Atmospheric pressure	(mbar)	
Ambient temperature	(°C)	
Orifice pressure drop	(mm H_2O)	
Fan pressure	(mm H_2O gauge)	
Test length pressure drop	(mm H_2O)	
Inlet temperature test section	(°C)	
Heater voltage	(volts)	
Heater current	(amperes)	

TRAVERSE		
Distance from pipe wall (mm)	**Manometer (mmH_2O)**	**Temperature (^0C)**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
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31		

Pitot Traverse Readings (Blank)

STATIC PRESSURE AT PROBE Found by removing Pitot pressure pipe to manometer (see manual)	
mm water gauge	

Static Pressure Readings (Blank)

1) **Determine the velocity distribution along the tube.**
2) **Determine the fan isentropic eficiency.**