STANDARD TEST PROCEDURE FOR MEASUREMENT OF PERMEABILITY OF FILTER FABRICS

1. **SCOPE**

    This method can be used to provide a simple quality control test to determine the permeability of a fabric. Permeability measured by this test is expressed as millimetres head loss at a flow velocity of 10mm/second.
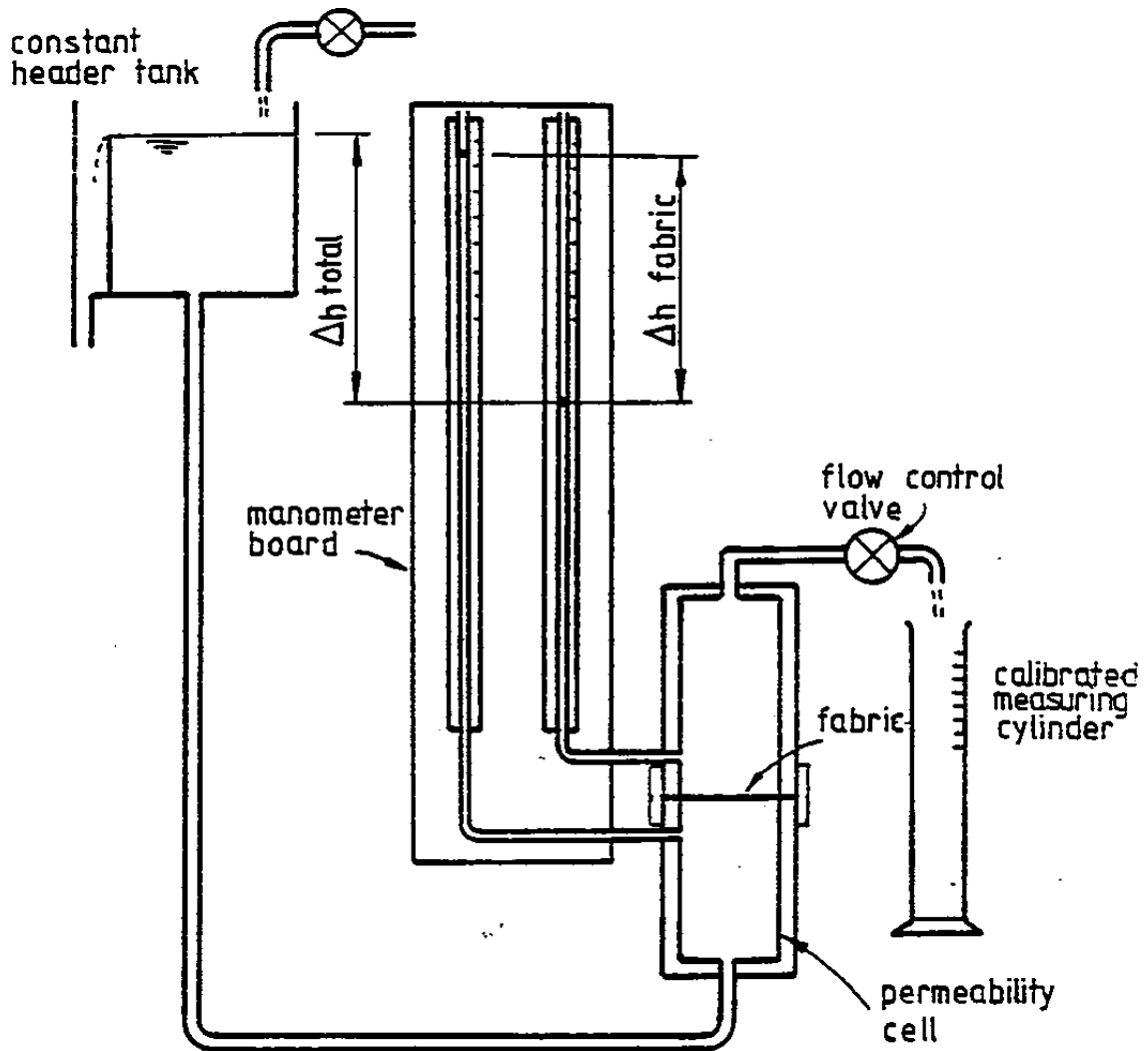
2. **APPARATUS**

    (a) Permeability apparatus including cell with provision for locating the fabric sample and with manometer outlets above and below the sample; (a minimum cell diameter of 70mm is recommended) constant head apparatus; manometer reading board calibrated in mm head of water (a 300mm rule fixed to a backing board between the two manometer tubes is suitable for this purpose); flow control valve on the cell outlet.

         A suitable apparatus layout giving critical dimensions is shown in Figure A2.

    (b) Measuring cylinder of adequate capacity for the flow rate and size of cell used. (A 1000ml measuring cylinder has been found suitable for a 70mm diameter apparatus.) If the cylinder is to be used to determine flow rates the graduation lines shall be at intervals which allow the volume of water to be measured to an accuracy of 1% of the total volume. Alternatively the volume of water may be determined by weighing.

    (c) A balance readable and accurate to 1g (optional).

    (d) A source of vacuum, for example, a good filter pump or a vacuum pump capable of maintaining a pressure of less than 20mm mercury (optional).

3. PROCEDURE

(a)   Trim the filter fabric specimen to size and soak in de-aired water for a minimum period of 12 hours. Alternatively de-air specimen in water under vacuum.

(b)   Place the fabric specimen in the permeameter. Ensure that the fabric is not loose fitting nor so tight that the fabric is stretched enlarging the pores.

(c)   Assemble the apparatus and fill the constant head tank ready to start the test.

Figure A2: Filter Fabric Permeability Apparatus

Note: An alternative flow control system is to have an open outlet with an adjustable header tank.

(d)   Open the outlet valve and adjust the flow until the rate is estimated to be about 10mm/sec (10mm/sec - 1cm/sec is the recommended standard velocity for quality control tests).

(e)   Allow the system to stabilise then place the measuring cylinder under the outlet and record the time for the cylinder to fill with water. Record the time measured as *t* and the volume (as determined either directly from the calibrated cylinder or alternatively by weighing) as υml.

(f)   Calculate the velocity, from the equation

$$v = \frac{4\upsilon \times 10^{3} \, mm/\sec}{\pi D^{2} t}$$

where D = diameter of the cell (mm).

(g)   Adjust the velocity and repeats steps (e) and (f) until two results are obtained with velocities above and below 10mm/sec and within the range 9 to 11mm/sec. These velocities are to be recorded as v_1 and v_2 respectively. The corresponding head losses h_1 and h_2 are measured as the difference between the manometers above and below the fabric for the two velocities.

(h)   The head loss at a velocity of 10mm/sec can be calculated assuming a linear relationship between the head loss and velocity over the range 9-11mm/sec

$$\Delta h_{10} = \frac{10(\Delta h_2 - \Delta h_1) - v_1 \Delta h_2 + v_2 \Delta h_1}{v_2 - v_1}$$

6.   REPORTING OF RESULTS

Report the following results:

(a)   The head loss at the flow velocity of 10mm/sec.

(b)   State the history of the fabric sample; for example, unused, previously tested, pretreated or unknown.

7.   NOTES

If the head loss relationship is required over a range of flow rates, this can be carried out by repeating steps (e) to (g) for a number of low rates. Plot the results on a log-log scale to determine the hydraulic gradient, n, in the general equation $h = v^{n}$. Convention is to use units of cm and cm/sec for head loss and flow rate

respectively. The resistance factor, a, is determined as the head loss at a flow rate of 1cm/sec (10mm/sec).

If lamina flow can be assumed *(n = 1)* the permeability of the fabric can be obtained form the equation.

$$k = \frac{Lv}{\triangle h}$$

i.e.

$$k = \frac{L}{a}$$

where L   =   thickness of the filter fabric as measured using the ASTM D 1777-64 (reapproved 1975) Standard Method for Measuring Thickness of Textile Materials.