

Flow Velocity Measurement

There are two common methods of measuring flow velocity in a fluid (meaning gas or liquid). There are the impellor measuring instruments which measure the current produced by a small generator attached to an impellor wheel held in the fluid, and there are the methods based on the difference between dynamic and static pressure.

The impellor type is used widely due to low cost and simplicity of operation. Generally it will produce a standard current output of 0 – 20 mA, which can be connected to a wide variety of measuring instruments and data loggers. It has certain disadvantages in that it is not very resistant to temperature or corrosive influences as a result of its construction. The output is only really correct for one fluid at a set pressure and temperature. This is fine for measurements at relatively constant conditions, but does set limitations on the process. Although it should, theoretically, be possible to calculate the output from density, flow rate, vane angle and other factors, in practice these are used with a factory calibration curve and produce very reliable results within their limitations.



The second type of instrument uses the difference between static and dynamic pressure in a flowing medium. The most common type is the Pitot tube. This consists of an angled tube



with the opening facing into the flow. It is generally constructed in two walled form, so the outside of the tube can have a second opening at 90° to the flow to register the static pressure.

From the differential pressure, static pressure and density of the medium it is then possible to calculate the flow rate of the fluid. Since this method contains no moving parts and the material of the tubing is the only limiting factor for temperature, this method is clearly more universal than the impellor wheel. The disadvantages are still present, however. The results are presented as two pressure readings which must then be converted to a flow rate using the other factors, which should be known at least roughly. This requires the use of dedicated measuring instruments with the capability of carrying out these calculations, but presents no real problem today.

Both of these methods will provide the pressure reading at one point in the flow field. Flow in pipes or other enclosed environments can have two different profiles. There is laminar flow, typical of low flow rates, where the fluid at the wall is practically stationary and most of the flow occurs in the centre of the pipe. There is then turbulent flow, typical of high flow rates, where the flow velocity is more or less constant across the diameter of the pipe, with a thin boundary section of lower flow rate close to the wall. The change from one type of flow to the other depends on a factor called the Reynolds Number, which will not be discussed here further. Suffice to say that attempts are generally made to keep flow in the turbulent region for

reasons of efficiency amongst others. This is the reason why a golf ball does not have a smooth surface. The numerous indentations ensure that the flow remains turbulent at almost all times. A smooth golf ball will not fly as far or as straight!

With turbulent flow it is much easier to calculate the total flow rate in a pipe, since it can be taken as roughly constant across the diameter. A check at a number of points will provide this information and, using a number of measurements, it is possible to provide a very accurate view of the total flow rate.

Information about the calculations will be made available on the website separately.