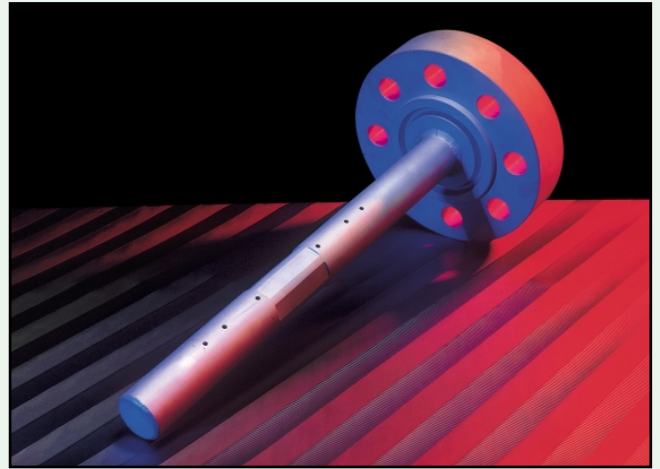


WHAT IS A TORBAR?

The **TORBAR** is a multiport self-averaging flow meter with a design based on the classical pitot tube concept of fluid flow measurement.

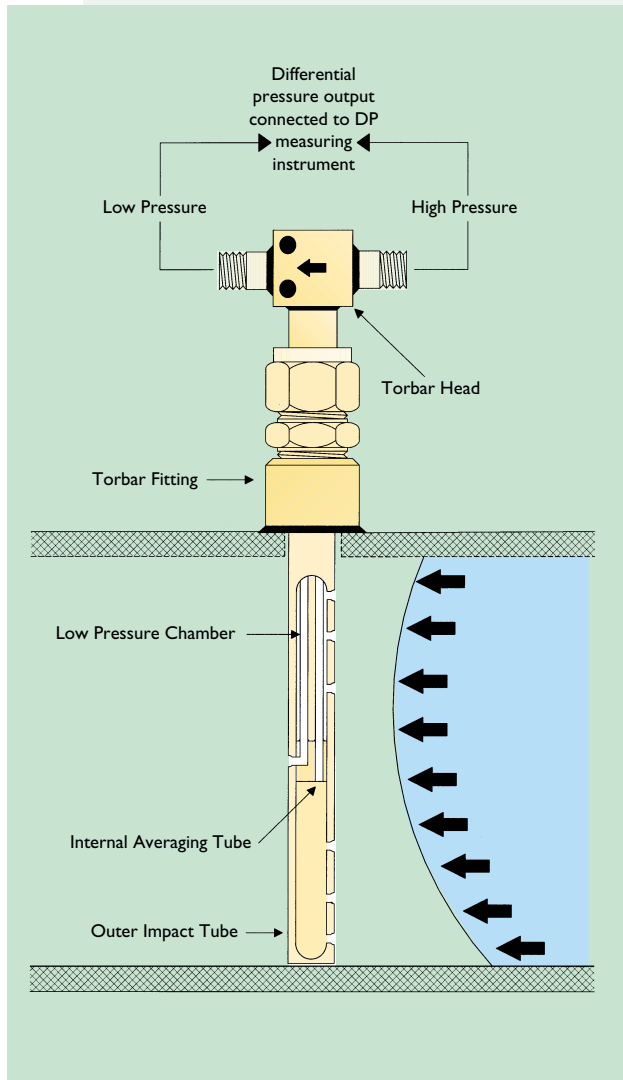
Since the introduction of the **TORBAR** in 1985, thousands have been installed into a wide variety of industries world wide. Refer to page 14 for details of typical applications where Torbars have been successfully used.

A comprehensive list of major projects and letters of reference from international companies are available on request.



HOW TORBAR WORKS

TORBAR produces an averaged differential pressure (DP) signal proportional to the square of the flow rate, (see Differential Pressure Calculations on page 11).



The DP output is normally piped to a Differential Pressure Transmitter in order to generate an electrical signal proportional to the flow rate. A D.P. gauge or switch can be used to provide local mechanical indication or flow rate switching. For certain applications, the DP Transmitter can be directly mounted on to the **TORBAR** via an integral 3 valve manifold. The total flowmeter package is called a **TRIBAR**. Full details are given on pages 16 & 17.

Each **TORBAR** is designed to span the process pipe diameter and comprises four basic components:

- **Outer impact tube - ONE PIECE CONSTRUCTION**
- **Internal averaging tube**
- **Low pressure chamber**
- **Head**

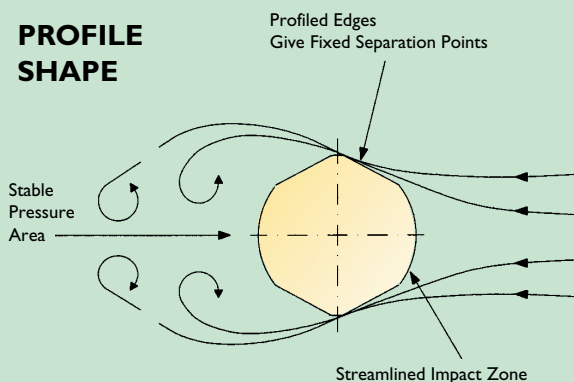
The outer impact tube has a number of pressure sensing holes facing upstream which are positioned at equal annular points in accordance with a log-linear distribution.

The "total pressures" developed at each upstream hole by the impact of the flowing medium are firstly averaged within the outer impact tube and then to a second order (and more accurately) averaged within the internal averaging tube. This pressure is represented at the head as the high pressure component of the DP output.

The low pressure component is generated from a single sensing hole located on the downstream side of the outer impact tube. For bi-directional flow measurement, the **TORBAR** can be supplied with the same number of downstream ports as upstream. Bi-directional sensors have an inherently lower mechanical strength than the standard **TORBAR** and the figures given for Maximum Allowable DP on page 11 should be reduced by 50%.

PROFILE SHAPE - The **TORBAR** is an improvement on the round sensor design due to the unique profiled flats which are positioned around the downstream hole in order to define the separation point at which the flow lines "break-off" as the fluid passes around the outer impact tube. This feature creates a stable pressure area at the downstream pressure sensing hole thereby maintaining a more constant flow co-efficient K at high velocities enabling a very wide range of flow measurement (turndown).

PROFILE SHAPE



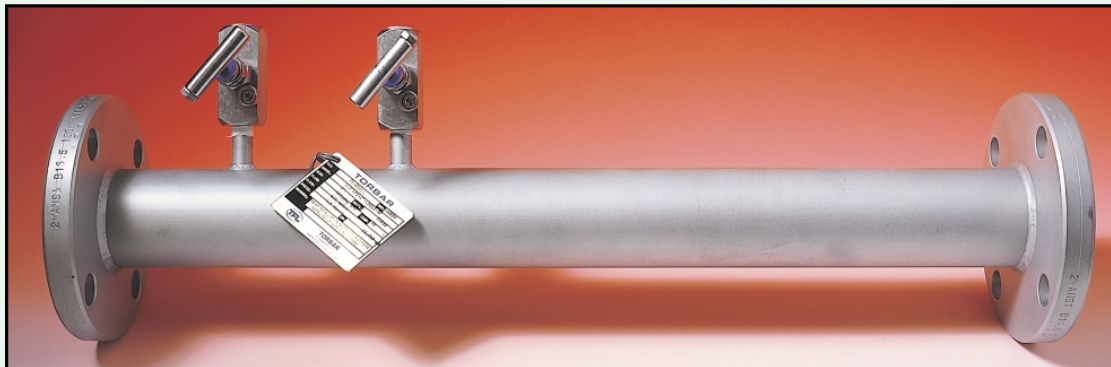
PROBLEM FLUIDS

The **TORBAR** is NOT suitable for the measurement of 2 phase fluids or when the fluid does not completely fill the cross section of the pipe.

Satisfactory flow measurement can be achieved for certain contaminated gas flows (such as flue gas) by using an air purging system. See page 15. For water flows which may contain a small amount of air, an air-venting package is recommended.

FEATURES

- Unique profile shape enables high flow turndown
- Dual averaging for better accuracy
- One-piece outer tube for optimum strength
- Suitable for pipe sizes from 10mm to 5000mm (and larger with a special 2 piece construction)
- Suitable for square or rectangular section ducts
- Available as hot-tap for insertion into pressurised pipes
- Optional direct mounting transmitter arrangement (see TRIBAR on pages 16 & 17)
- Zero co-efficient drift ensures long term stability
- Low permanent pressure loss means low energy consumption - and significant cost benefits



GENERAL SPECIFICATIONS

- TORBAR is suitable for liquid, gas, and steam flow measurement
- Accuracy $\pm 1\%$ of actual flow rate - verified by independent flow laboratories
- Repeatability of measurement $\pm 0.1\%$
- Reynolds number. Minimum $Re: 1.2 \times 10^4$
- Flow rate turndown typically 10:1 (100:1 of DP)
- Maximum working pressure up to 600 bar
- Maximum working temperature up to 1300 deg. C with selected materials and fittings
- Maximum viscosity 200 cp (mPas)
- Short upstream and downstream straight pipe lengths
- Long term accuracy unaffected by wear

CONSTRUCTION

- TORBARs are engineered and manufactured to stringent routines including BS, ANSI, ASME, ISO and DIN standards
- Welding is carried out by Lloyds qualified welders to ASME IX and European standards.
- Quality control system is approved to BS EN ISO 9002-1994
- TORBARs are leak tested before dispatch.
- Hydrostatic pressure testing and NDE is available by request for all models.
- Standard material of construction is 316L stainless steel but many other materials are available on request.
- All TORBARs have full material traceability.
- Material test certificates to EN 10204 (DIN 50049) and certificates of conformity are available for each component part of every TORBAR
- Stainless steel data plate as standard.



INDEPENDENT FLOW TESTS

The **TORBAR** accuracy and repeatability of measurement has been verified by independent testing laboratories in the United Kingdom. Refer to page 10 for more details.