ABB Instrumentation

Bulk gas flow measurement
Metering gas in large pipelines at high pressure

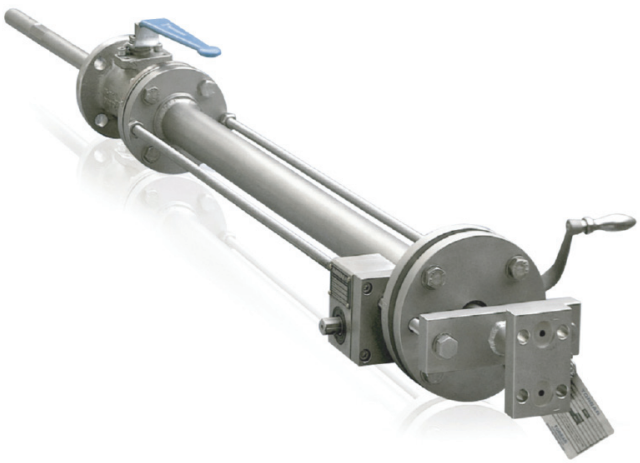
– Torbars provide cost-effective gas metering at high pressures in large pipelines
– Minimize pressure losses and energy costs
– Adaptable for underground metering locations with all secondary connections made above ground

Introduction

Torbar averaging pitot tubes can be applied to many situations where it is necessary to measure bulk gas flows at high or low pressure in large pipelines. Versions can even be supplied that can be inserted and withdrawn under pressure for inspection.

Torbars can also be supplied as a compact flow meter with integral temperature element, valve manifold and multivariable transmitter for compensated gas flow measurement.

Withdrawable (hot tap) Torbar with geared retraction



This document describes an application of Torbar compact flow meters on bulk gas compensated flow measurement within the gas transmission/distribution sector of the oil and gas industry.

The Irish Gas & Electricity supplier, Bord Gais Eireann, commissioned the construction of 2 sub-sea interconnector pipelines from Scotland as part of their project to secure gas supplies for Ireland through until 2025.

Gas from offshore platforms is firstly piped to the Moffat compressor station in northern Scotland. From there the gas travels along 2 pipelines under the Irish Sea, one of which comes ashore near Dublin at the Gormanston Above Ground Installation (AGI).

This second pipeline also links Scotland and Ireland (and incorporates a connection to the Isle of Man) and runs parallel to the first pipeline. It is some 190 km (118 miles) long and has a diameter of 750 mm (30 in). It was laid using the world's largest pipe-laying vessel, which took pipe sections, each 12 metres (39 feet) long, and welded them together in a continuous process as they were laid on the sea-bed.

The application

There are three regulator streams at Gormanston that feed the gas into the Irish National Grid network to satisfy the needs of almost 430,000 consumers. The gas in each stream needs to be metered and the flow corrected for variations in temperature and pressure. However, the application is not straightforward as it involves:

– metering locations underground
– connections for differential pressure and to secondary equipment to be above ground
– high pressures - approx 140 bar (2030 lb/in^2) with test pressure of 225 bar (3262 lb/in^2)
– large diameter carbon steel pipelines - 750 mm (30 in) diameter
– thick-walled pipe - approx 33 mm (1.3 in) wall thickness
– requirement for low pressure loss

The solution

Three specially modified Torbar Model 412 units were supplied in 316 stainless steel with flanged pipe connection and probe end supports. Each unit is fitted with 2 metre (80 in) long extended necks for the integral PT100 temperature elements and the integral manifold. Above ground, the top of each meter is fitted with a weatherproof box housing the manifold, a multivariable transmitter and the PT100 connector head.

The Torbars work very well and are within 2% of the readings of a fiscal ultrasonic meter. This has led to a further order for metering gas in the second phase of the AGI, measuring gas feeding a pipeline from Dublin to Belfast.

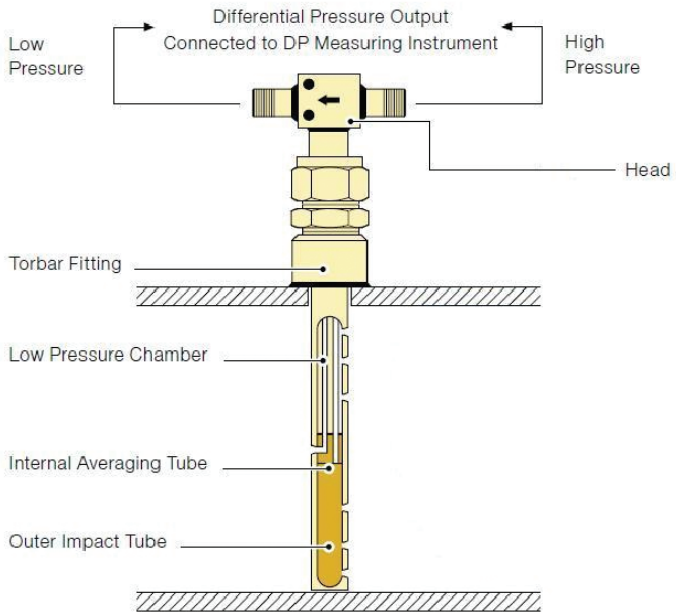
Key features and benefits

Unique profile shape

– enables high flow turndown

Dual averaging

– provides better accuracy under non-ideal conditions



One-piece outer tube

– providing optimum strength

Optional direct mounting transmitter arrangement

– for compact, cost-effective flow metering

Zero co-efficient drift

– ensures long term stability and accuracy

Low permanent pressure loss

– low energy consumption
– significant cost savings

Low installation and maintenance costs

– cost effective flow metering

How a Torbar Works

The Torbar measures the flow velocity at several points across the diameter of the pipe and produces an averaged differential pressure (DP) signal proportional to the square of the flow rate. The DP output is normally piped to a Differential Pressure transmitter in order to generate an electrical signal proportional to the flow rate. With certain designs and applications, the DP transmitter can be directly mounted onto the Torbar via an integral 3- or 5-valve manifold, forming a compact flow meter.

Torbar Construction

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

– Outer impact tube with one piece construction
– Internal averaging tube
– Low pressure chamber
– DP connection 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 pattern of ports on both the downstream and upstream faces.

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 at high velocities enabling a very wide range of flow measurement (turndown).

– Torbars are engineered and manufactured to stringent routines including BS, ANSI, ASME, ISO and DIN standards
– Welding is carried out by qualified welders to ASME IX and European standards
– Quality control system is approved to BS EN ISO 9001:2008
– Torbars are leak tested before dispatch
– Standard material of construction is 316L stainless steel but many other materials are available on request
– All Torbars have full material traceability

Other Applications

The low pressure drop characteristics of Torbars makes them particularly suitable for flows at low pressure. Their benefits also make them a cost effective solution for installations on large diameter pipelines. Their versatility in being available in alternative - even exotic – materials, in withdrawable-under-pressure designs and as compact flowmeters, leads to their use across a wide range of fluids and pipe sizes.

Here is an impressive listing of examples of fluids they have measured:

Gases

– Natural gas
– Flue gas
– Nitrogen
– Methane
– Carbon dioxide Hydrocarbon gas
– Combustion (stack) gas
– Exhaust gas
– Sour gas
– Coke oven gas
– Air
  – Ventilation
  – Compressed
  – Solvent laden
  – Saturated

Vapours

– Saturated steam
– Superheated steam
– Petrol vapour

Liquids

– Sea water
– Cooling water
– River water
– Waste water
– Potable water
– Liquid oxygen
– Crude oil
– Nitric acid
– Red wine
– Liquid petroleum

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