Pietro Fiorentini

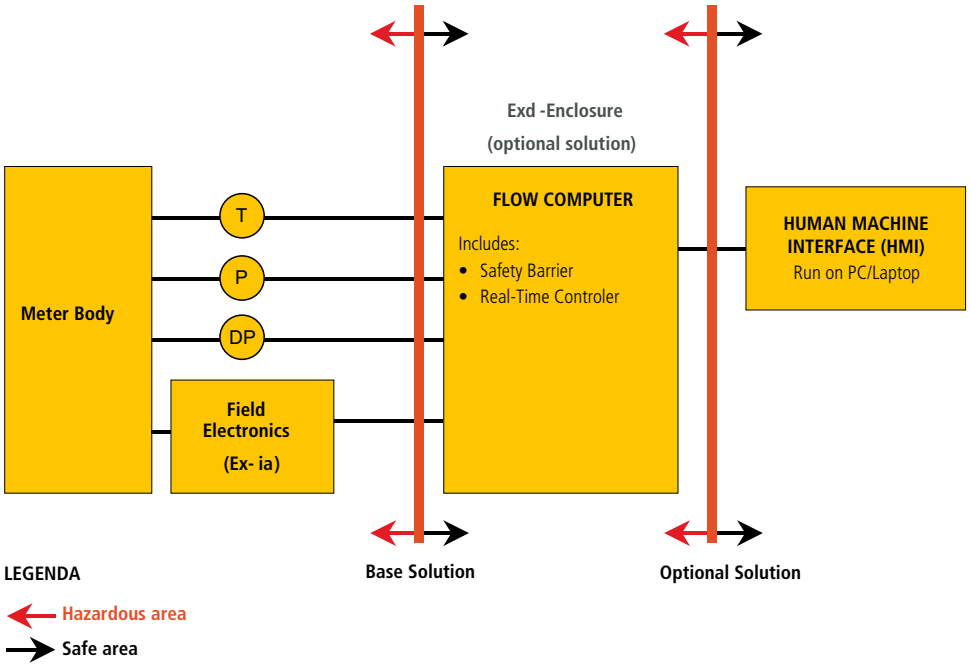
Flowatch

Multiphase Flow Meter

Key Components

Pietro Fiorentini's FLOWATCH is a non-intrusive, non radioactive, in-line multiphase meter for measuring flow rates of oil, water and gas from a well stream or in a pipeline. Its key components are:

> Meter Body
> DPT, PT and TT transmitters
> Field Electronics (Mounted on meter body)
> Flow Computer
> Human Machine Interface



Key Features

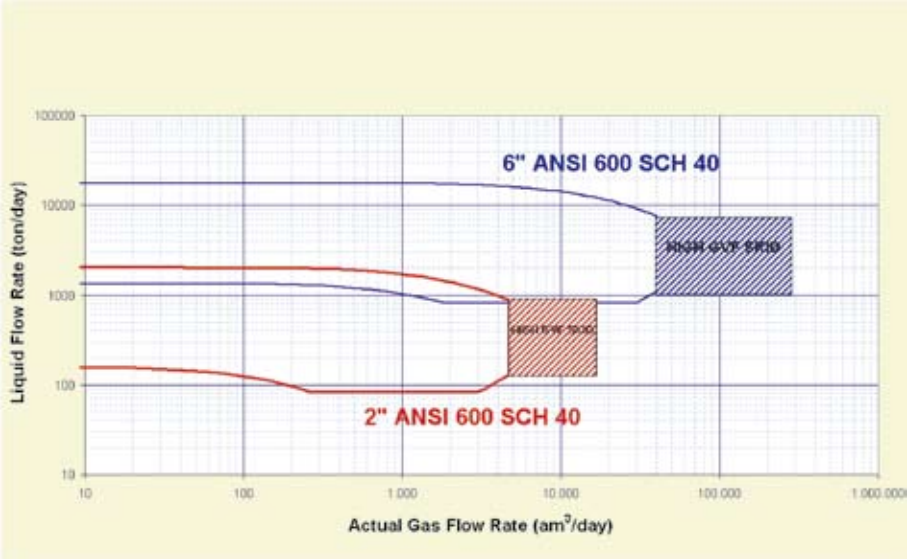
- Non radioactive: environmentally friendly and safe to operate.
- Compact Design: reduced space and weight, small footprint and no requirements for upstream and downstream straight pipe length.
- Easy to install and operate: vertically installed, no special requirement for upstream pipe geometry. Low pressure losses.
- Low maintenance: standard maintenance required for differential pressure, pressure and temperature transmitters.
- Field tested and installed by major oil and service companies world wide
- High reliability: robust and reliable components.
- High rangeability: covers wide operating range, all flow regimes. Low sensitivity to variation in oil properties, not influenced by presence of H_2S or CO_2.
- High flexibility: used for onshore and offshore applications such as individual well monitoring, well testing, allocation metering, mobile well testing.

PRINCIPLE OF OPERATION Flowatch

Based on well-established measurement principles:
> Venturi
> Capacitance/conductance
> Cross-correlation.

The main parts of the FLOWATCH meter are the Venturi insert and the electrodes incorporated inside the throat of the Venturi insert. The oil, water and gas flow rates are calculated based on the measurements obtained by the electrodes and the measurement of the differential pressure across the Venturi inlet. No separating devices, mixers, by-pass lines or radioactive sources are used. Velocity is calculated by cross-correlating the high resolution time signals from pairs of electrodes within the Venturi insert. The density is determined using the well known momentum equation ("Venturi equation").

OPERATING RANGE Flowatch



The upper limit of the operating envelope is determined by the maximum differential pressure set in the dP-cell, (typically 2500 mbar). The lower limit is determined by the corresponding minimum differential pressure at the left end and by the upper GVF limit (typically 97% for standard MPFM) at the right end . The vertical line at the far right end gives the upper velocity typically 25 m/s).
For High GVF operating condition (up to 99%) a partial separator is installed upstream the meter. In case of installation of Partial Separator (HGVF Skid) the operating envelope becomes larger in the Gas Flow direction.

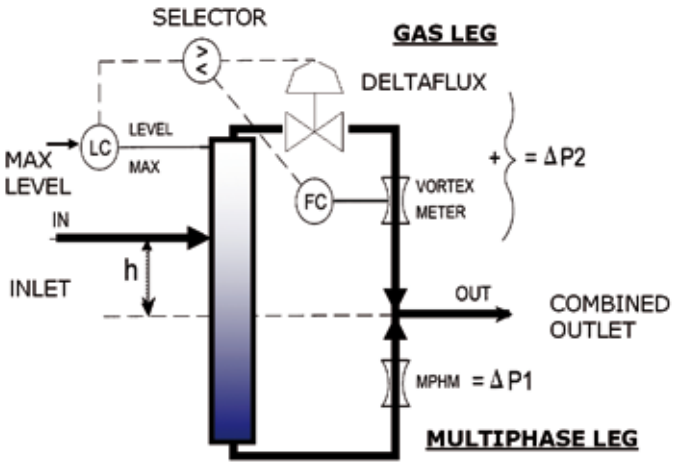
HIGH GVF SKID

Flowatch

The accuracy in the liquid flow rate and watercut will decrease as the GVF approaches 100%, as in any other multiphase flow meter. If a partial gas separation device is installed upstream the multiphase flow meter, the gas fraction through the meter is significantly reduced, e.g. from a level of 90-100% to 40-60% or lower, therefore the accuracy is significantly increased.

Thanks to the field proven experience of Pietro Fiorentini in gas-liquid separation, the partial separator is specifically designed in order to avoid any carry-over of liquid droplets in the gas leg. In this way the gas measurement in the Vortex meter is very reliable.

The gas flow rate through the Vortex meter is controlled by Pietro Fiorentini DELTAFLUX control valve, guaranteeing a very wide rangeability. Valve opening is adjusted in order to keep the minimum desired GVF through the Flowatch meter, also controlling the liquid level in the partial separator. All the parameters and control logic are handled by the flow computer.



FLOW COMPUTER

Flowatch

The Flow Computer, based on an industrial PC, calculates the flow rates and processes all the relevant data. It can be installed either locally (Ex-d') or remotely in a control room (safe area).
The Human Machine Interface (HMI) can be installed directly in the Flow Computer or in any other remote computer connected via Ethernet or RS485/422.
From the HMI it is possible to select the well to be tested/in operation. Relevant data, such as PVT, will be automatically loaded and field data will be stored accordingly.
Different authorization levels are available in order to change all the necessary set-up and configuration parameters, fluid parameters etc.
Standard Modbus communication protocol is available for data exchange with DCS / RTU SCADA etc..

ACCURACY

Flowatch

Expected typical deviation from the true values at 90% confidence level, as a function of GVF. Liquid Rate and Gas Flow Rate are expressed as relative uncertainties, while the Water Cut is expressed as absolute uncertainty.
Accuracy to be defined based on actual flow condition.

Table

GVF Range [%]	0-25	25-60	60-70	70-85	85-92	92-97
Liquid Flow Rate	4		6		9	10
Gas Flow Rate	-	10				
Water Cut	2			3		4

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PROCESS	Gas Volume Fraction	0 – 97% (standard) up to 99% HGVF
	Water Cut	0 – 100%
	Flow Regime	All
	Oil Density / Viscosity	All
	Water Salinity	All
METERING SECTION	Meter Body size	2” – 16”
	Flange Connection	ANSI, API or clamp flanges
	Meter Body Material	SS 316 standard - SS316L, Duplex, Inconel 625 or special alloys
	Electrodes, Insulating material	PEEK
	Design Pressure	0 ÷ 690 bar (10,000 psi)
	Design Temperature	0 ÷ 160 °C (32÷320°F)
	Certification	PED and ATEX approval
TRANSMITTERS (P, T, DP)	Type	Smart Hart® Transmitter
	Certification	EEx ia IIB T3
FIELD ELECTRONIC ENCLOSURE	Material	SS 316
	Certification	EEx ia IIB T4
	Ambient Temperature	-40 to 70°C (-40 to 158°F)
	Protection	IP65 (minimum)
CABINET	Type	- Standard 19” cabinet Wall Mounted - Standard 19” Cabinet Floor Mounted - Tabletop Version with desktop PC - EEx-d Explosion Proof with Laptop
	Certification	- IP54 (for Safe Area) - EEx-d IP65 (for Hazardous Area)
	Dimension	- 500 x 600 x 600 mm – Wall Mounted - 800 x 800 x 2100 mm – Floor Mounted - 210 x 400 x 500 mm - Desktop
FLOW COMPUTER	Operating System	Window XP English
	GUI, graphical user interface	Multilingual support
	Ports	RS232, RS422, RS485, or Analogue
	Communication type	RS422/485 or Ethernet TCP/IP, Modbus ASCII-RTU protocol
	Power Supply, power consumption	240 VAC @ 0,3 A, 24 VDC @ 1 A.

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