

# FLUXUS<sup>®</sup> HPI Series

Non-Intrusive Flow Measurement for  
the Midstream Sector

Versatile. Precise. Safe

Refineries

Tank Farms

Crude Oil Pipelines &  
Terminals

Products Pipelines &  
Terminals

NGL Pipelines &  
Terminals

**External Measurement  
of Internal Flow**



# FLEXIM Ultrasonic Clamp-On Flow Measurement

## The Ideal Solution for Pipeline Management



**FLEXIM's HPI flow meter series addresses the needs of demanding high-precision flow measurement applications found in the Midstream Industries.**

### Integrated System

By combining the attributes of FLEXIM's highly accurate and reliable non-intrusive ultrasonic flow measurement with temperature and, where necessary, pressure inputs, the integrated system is the ideal solution for hydrocarbon applications, where the fluid viscosity can significantly vary over the temperature range.

The internal HPI flow computer allows the meter to report:

- ▶ Operational and standard (net) volume and mass flow
- ▶ Density, API number and Specific Gravity
- ▶ Sonic ID (for Interface Detection)
- ▶ Liquid ID (for Fluid Identification)
- ▶ Leak detection (data source based on multiple HPI flow meters)

**FLEXIM's HPI flow meter eliminates measurement errors associated with multiple devices at various places and provides a complete turn-key solution to your metering needs.**



### Industry Standards

The integrated flow computer calculates all output variables in accordance with Industry Standard Algorithms such as GPA TP-25, ASTM1250 and D4311.

### Traceable Certified Accuracy

Recognizing the need for traceable certified accuracy in the midstream sector, FLEXIM delivers all its meters with a multi-point wet flow calibration certificate. In combination with a well-developed flow profile, **repeatability will remain within 0.15% and the calibratable accuracy is 0.5% of reading or better.**

### Unparalleled Turn-Down

FLEXIM's unlimited flow range and excellent sensitivity allow the system to accurately measure extremely low flow rates during start-up and shut-down procedures associated with product batching applications. **No other flow metering device can match FLEXIM's turndown and low flow capability.**



## Cutting-edge Features of FLEXIM's ultrasonic non-intrusive flow measurement

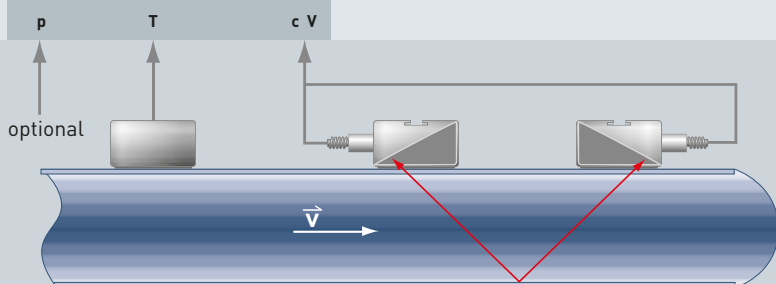
- ▶ Automatic Fluid Identification and Interface Detection
- ▶ Bi-directional flow metering
- ▶ Superior temperature stability – No zero drift
- ▶ Certified and traceable Multi-Point wet flow calibration
- ▶ Robust “Fit for Purpose” Flexibility and Stability using VARIOFIX mounting fixtures
- ▶ Operational capabilities from  $-40\text{ }^{\circ}\text{C}$  up to  $+200\text{ }^{\circ}\text{C}$
- ▶ Shear and Lamb wave transducer technology for a wide application range in liquids and gases
- ▶ Large data logging capacity
- ▶ Dual-beam operation providing asymmetric flow-profile compensation and built-in redundancy
- ▶ Extremely high turndown range - capability of measuring at very low flow rates

## Proven Benefits

- ▶ Installation without any process shut-down
- ▶ Integrated solution - no need for density meter and flow computer
- ▶ No wear and tear as the transducers are mounted outside the pipe
- ▶ Improved product quality due to exact Interface Detection
- ▶ Product management possibilities due to exact Fluid Identification
- ▶ Easily deployable flow rate data source for leak detection systems
- ▶ Maintenance free due to permanent coupling pads - No recalibration needed
- ▶ Highly economical and cost independent of line size

### FLUXUS<sup>®</sup> HPI Meter

- Multi-Product Model
  - Single-Product Model
  - Interface-Detection Model
- Sonic ID (Interface Detection)
  - Liquid ID (Fluid Identification)
  - Operational and Standard Volume & Mass Flow
  - Density, API Number, Specific Gravity



c : Sonic velocity of the fluid | V: Volume flow rate | T: Temperature | p: Pressure

The FLUXUS<sup>®</sup> HPI flow meter employs FLEXIM's sophisticated shear and Lamb wave transducer technology which can be used on any kind of pipe material.

By measuring the difference in the transit-time between up- and downstream ultrasonic signals, the average flow velocity can be determined and the sound speed of the fluid (sonic velocity) is calculated. Being equipped with a temperature and - optionally - a pressure input, the FLUXUS<sup>®</sup> HPI flow meter is able to compensate the changing viscosity and to unambiguously identify the respective fluid.

# Fluid Identification



Most hydrocarbons can be distinguished by their sonic velocity when corrected for the effect of temperature. The FLUXUS® HPI meter continually measures the sonic velocity through its clamp-on transducers and the temperature by means of a clamp-on RTD probe or a 4–20 mA current signal.

By doing so, the flow meter automatically determines the fluid in the pipe by comparing the measured values with the stored data of the sonic velocity (Sonic ID) of a multitude of hydrocarbons over a broad temperature range. By recognizing changes in the sonic velocity of the media, an interface change can clearly be detected, helping to trigger valves or vents in storage or pipeline systems.

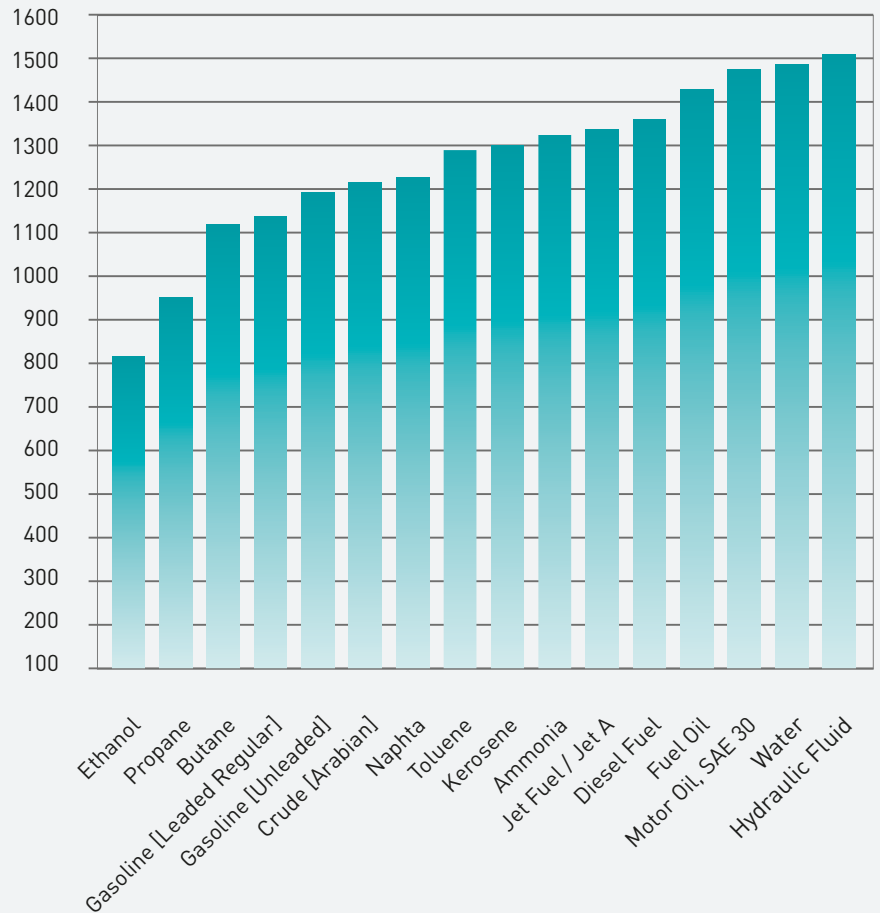
FLEXIM's HPI meter provides the high accuracy and repeatability needed for leak detection and minimization of product losses.

## Standard Volume and Mass Flow Compensation:

Whether it is ASTM D1250, ASTM D4311 or GPA TP25 that you need for standard volume and mass flow compensation of the media in your pipe:

The integrated flow computer of the FLUXUS® HPI meter can do it all and provides you with additional information such as API number, base density, and the specific gravity.

m/sec **Sonic Velocities of some Fluids [at 15 °C]**



# FLUXUS® HPI Multi-Product Meter

Varying conditions and changing media – The FLUXUS® HPI Multi-Product detects it all



The FLUXUS® HPI Multi-Product flow meter is your choice when different fluids are passing successively through the pipe and reliable fluid recognition is needed. Up to 13 customized fluids can be stored in the HPI database, allowing the Multi-Product meter to identify the respective fluid unambiguously by its Liquid ID.

Using its associated temperature and – where necessary – pressure inputs, the integrated flow computer then carries out a standard volume and mass flow compensation in accordance with ASTM D1250, ASTM D4311 or GPA TP25.

The FLUXUS Multi-Product meter features the:

- ▶ Detection of the respective fluid and displays its name,
- ▶ Signals an interface change,
- ▶ Measures the standard volume and mass flow rate, as well as the
- ▶ API number, specific gravity and density at base conditions.

It also includes the full functional range of all FLUXUS® ultrasonic flowmeters: totalizers, dual-beam operation, signal amplitude measurement as well as diagnostic functions by means of FLEXIM's FluxData PC software.

## Barge Loading of Hydrocarbon Products

A 500.000 barrel Refined Products terminal loads barges with ethanol, diesel and unleaded gasoline. An accurate and reliable flow measurement as well as a high sensitivity to measure low and zero flows with swift response is crucial to regulate the total loads of each batch.

FLEXIM's HPI Multi-Product flow meter is the ideal solution for such an application as it offers a superior accuracy and counters the effects of a distorted flow profile and the huge variations in flow velocities.

By measuring sound speed and temperature, the flow meter clearly identifies the product flowing through the pipe and allows the customer to properly monitor the batch allocation.

### Advantages

- ▶ Huge turndown ratio and zero flow stability
- ▶ Highly accurate standard volume flow under challenging bi-directional conditions
- ▶ Product / Batch identification in real time
- ▶ Non-intrusive measurement – no installation requirements, no process shut-downs

## Flow Measurement in Storage Stations

For the operation of pumping and storage stations a reliable flow measurement is essential. Intrusive flow meters such as orifice plates or turbine meters often cause a lot of problems as they are subject to wear and tear and lead to false readings.

FLEXIM's HPI Meter offers the better solution in such applications as the ultrasonic transducers are simply mounted on the outside of the pipe and are thus not exposed to mechanical stress or clogging. Different product batches are easily recognized by the meter when comparing the measured Liquid ID to the internal HPI database. As Interface changes are detected with a high degree of sensitivity, the HPI meter helps to significantly reduce the amount of mix-up.

### Advantages

- ▶ No wear and tear - no clogging effects
- ▶ Quick and accurate detection of Interface changes - reducing amount of Transmix
- ▶ Accurate measurement on thick walled pipes and exotic pipe materials

# One Pipe, one media

## The FLUXUS® HPI Single Product suits you best



When the calculation of standard volume flow according to ASTM 1250, ASTM 4311 or GPA TP25 is necessary for only one product, the FLUXUS® HPI Single-Product meter is the economic alternative. Of course it shares the high precision and reliability of the HPI Multi-Product meter and thus makes it an ideal system for leak detection and proper pipeline management.

The FLUXUS HPI Single Product meter features the measurement of:

- ▶ Standard Volume and Mass Flow
- ▶ Base Density, API number and Specific Gravity



### Pipeline Check Metering

A major pipeline operator was looking for a check meter at an ethylene product pipeline to verify an orifice meter at a custody transfer point.

Though there was virtually no straight piping to work with, a four month test with a FLEXIM Single-Product meter (dual beam configuration) ensured that it proved capable of a consistent, highly repeatable as well as accurate flow measurement.

Moreover, the HPI meter was able to detect the failure of a flow compensating pressure sensor which caused the reference meter to spike. This successful test resulted in a permanent installation and more meters installed on the ethylene plant.

#### Advantages

- ▶ Ideal check meter at custody transfer points – zero point stability, no drift
- ▶ Excellent performance under non-ideal flow conditions
- ▶ Bi-directional flow capability – low cost of installation

### Pipeline Leak Detection

The HPI Single-Product meter also proves to be the solution of choice for professional Leak Detection on product pipelines.

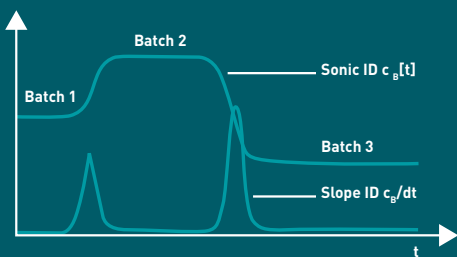
Besides its non-intrusiveness, the advantages of FLEXIM's HPI meter lie in its fast signal generation as well as the rapid digital signal processing and data output of highly accurate measurement values every 70ms.

Together with the associated pressure and temperature data, the flow computer hands out standard flow rates which can be continuously fed into the SCADA system allowing for an adequate pipeline monitoring, and thus informing directly and with a high degree of sensitivity about possible product spills.

#### Advantages

- ▶ Reliable and fast data generation for leak detection
- ▶ Data source for LUAF Analysis
- ▶ Calculation of standard flow rates according to ASTM and API standards

# Interface Detection



The slope signal shows a peak at every batch interface.

Even when the types of fluids passing through a pipe are not known, the FLUXUS®HPI meter can inform you about interface changes, while permanently measuring volume flow. The measured sound speed is compensated for the temperature according to a curve fitting the mean behavior of a set of different liquids. The sound speed at base conditions, or Sonic ID, is indicative of the currently sensed fluid. In order to provide easier detection of interfaces, the slope of the Sonic ID over time is calculated and shows a peak at each batch interface, which can help to trigger valves or vents in storage and pipeline systems.

## FLUXUS®HPI Interface Detection Meter

The FLUXUS®HPI Interface-Detection Meter is suited best for a reliable and accurate detection of Interface changes when different fluids are successively passing through a pipe. In addition, it measures the operational volume flow rate and derives the mass flow as well as the liquid's density and viscosity.

## Product Pipeline metering

When several products are passing successively through a product pipeline, operators are looking for a reliable measurement source detecting Interfaces reliably in real-time.

The HPI Interface Detection meter offers the accurate recognition of interface changes by detecting even the slightest deviations in the characteristic sonic velocity (Sonic ID) of the fluid. The HPI meter is thus used to trigger valves and vents and to significantly reduce the amount of Transmix.

### Advantages

- ▶ Reliable Interface Detection – reducing the amount of Transmix significantly
- ▶ Non-intrusive, cost effective solution replacing complex solutions
- ▶ Non-intrusive – no risk of leakages

## Dewatering of Storage Tanks

Water is an unwanted companion in storage tanks of crude oil and refined products as it causes corrosion and supports the bacterial decomposition of the petroleum product itself.

Tank dewatering at outlet pipes is therefore a must and to detect liquid interfaces (between petroleum and water), often conductivity, capacity or measurements by microwave are applied.

These solutions face disadvantages as they protrude into the pipe and are thus subject to product build-up leading to frequent servicing and a high degree of unreliability.

By applying FLEXIM's HPI meter, the operator obtains a highly sensitive and reliable measurement method. As the transducers are mounted outside the pipe wall, they are not subject to build-up and wear and tear by the medium.

By detecting even the slightest changes in the Sonic ID (sonic velocity), which corresponds to a liquid interface, the HPI meter can safely and rapidly trigger valves and vents, avoiding product losses and saving money.

### Advantages

- ▶ No maintenance and recalibration needed - no drift
- ▶ Highly sensitive and reliable in detecting liquid interfaces
- ▶ No upfront installation requirements



FLEXIM is an active leader in many areas of process instrumentation. As a worldwide pioneer in non-intrusive flow measurement of liquids and gases, FLEXIM has been leading the way in ultrasonic clamp-on flow metering for more than 20 years. In addition to non-intrusive flow measurement, FLEXIM specializes in innovative online process analyzers using ultrasonic technology and refractometry. Year after year, our Berlin based company continues its substantial investment in research and development in order to maintain and further improve its position as a technology leader. In keeping with its core principles, FLEXIM takes customer feedback very seriously. Every generation of FLEXIM's products is directly driven by customer and industry needs.

### The FLEXIM commitment to customer service

FLEXIM considers itself not only a manufacturer of measuring instruments, but also a provider of technical and consulting services. These services include instrument rentals, on-site measurements, laboratory analysis, project handling, training, commissioning and consulting services. The company's focus and dedication are directed towards providing the highest quality equipment with the best support and service possible.

## Technical Data

<b>FLUXUS®HPI:</b>	Flow metering of hydrocarbon products Ultrasonic clamp-on flow measurement acc. to the transit- time principle (Temperature measurement with clamp-on temperature probes (if used))
<b>Quantities of measurement:</b> <small>*[exact output variable depending on the HPI model configuration]</small>	Operational and standard volume and mass flow, Flow velocity, Sound speed, Customized Fluid Identification (Liquid ID), Automatic Interface Detection (Sonic ID, Sonic ID Slope), Base Density, API# and Specific Gravity
<b>Flow velocity:</b>	0.01 to 25 m/s
<b>Repeatability:</b>	0.15% of reading ± 0.01 m/s
<b>Calibrated Accuracy:</b>	
<b>NIST/PSB traceable wet flow*:</b>	± 1% of reading ± 0.01 m/s
<b>With field calibration**:</b>	± 0.5% of reading ± 0.01 m/s
<b>Degree of protection:</b>	Transmitter: ADM7407: IP65, ATEX / IECEx Zone 2 optional Transmitter: F705: IP66, ATEX / IECEx Zone 2 and FM Class I, Div. 2 optional Transducers: Up to IP68, ATEX / IECEx Zone 1 and 2, FM Class I, Div. 1 and 2 approved
<b>Gaseous &amp; solid content:</b>	<10%
<b>Integrated data logger:</b>	>100 000 meas. values - stores about 2 months of data at a 15 min storage rate
<b>Outputs types:</b>	Modbus RTU, HART analog 4 ... 20 mA, 0 ... 10 V, pulse , other protocols available
<b>Output data:</b>	All quantities of measurement

\* for measurement acc. to the transit time difference principle, under reference conditions and at  $v > 0.01$  m/s  
\*\* reference uncertainty <0.2%

More detailed information can be found in the ADM7407 and F705 meter datasheet

