Density measuring method for liquids

Comparison of the key technologies for the process industry

Endress+Hauser
People for Process Automation

Vibronics: Liquiphant M + FML621

Measuring error:
±0.02 g/cm3 standard calibration (0…80 °C)
±0.005 g/cm3 special calibration (0…80 °C)
±0.002 g/cm3 field calibration (point of operation)
Reproducibility: ±0.002 g/cm3(standard),
±0.0007g/cm3(special o. field calibr.)
Measuring range: 0.3…2.0 g/cm3
Process temp.: 0…+80 °C, Process pressure: -1..25 bar
Viscosity: 0.. 350 mPa·s (FTL51C ... 50 mPa·s)

Coriolis: Promass (all except 40E)

Measuring error:
±0.01 g/cm3 standard calibration (-50…200 °C)
±0.001 g/cm3 special calibration
±0.0005 g/cm3 field calibration o. reference cond.
Reproducibility: **±0.00025 g/cm3**
Measuring range: 0…2 g/cm3 (larger upon request)
Process temperature: -50…200 °C (-200..+350 °C)
Process pressure: 400 bar

Radiometric: Gammapilot M FMG60

Measuring error:	acc. to application up to ±0.001 g/cm3 field calibration
Reproducibility:	**±0.0005 g/cm3**
Measuring range:	acc. to application
Process temperature:	Unaffected
Process pressure:	Unaffected

Advantages and limitations of Liquiphant Density

Advantages	▪ Installation directly in tanks or pipe ▪ All sensor materials (also enamel, PFA, ECTFE) and process connections of the Liquiphant family ▪ 1 process connection for density and level limit detection ▪ Price advantage compared to flexural resonator/ultrasonicss
Contact E+H	▪ For the time beiing, release of every application by PC-M
STOP	▪ Flow speed > 2 m/s ▪ Buildup, corossion, gas bubbles at the sensor ▪ Nominal pipe widhts < DN50, distance to wall/ cover insufficient ▪ Highly viscous liquids < 350 mPas or 50 mPas

Advantages and limitations of Coriolis

Advantages	▪ SIL2-evaluates density output ▪ First mass meter standardized for density (BASF) ▪ Approved acquisition of density, temperature, mass flow
Contact E+H	▪ >2g/cm³ (e.g. mercury 5g/ cm³ works)
STOP	▪ Inhomogeneous media ▪ Pipes > DN250 ▪ Product deposits, abrasion, caravation

Advantages and limitations of Gammapilot

Advantages	▪ Extreme process/ambient conditions (Solution if nothing else works) ▪ Non-contact measurement /class tube, reactors) ▪ High resistance, no seals
Contact E+H	▪ Sizing via Gamma Project Team
STOP	▪ Outgassing media ▪ Product deposits ▪ Field calibration not possible (e.g. toxic media) ▪ Insufficient measurement effect

Advantages of Liquiphant in comparison to Promass

- Installation directly in tanks
- Simultaneous density and level limit detection (extension)
- Resistant to aggressive media (coating)
- 5 sensors may be connected to a density controller
- Data logger (up to 1 month)
- Flexible customer solutions with FML621: 2D/3D concentration tables, media recognition, formula editor, limit value signaling, display parameterizable
- Nominal widths above DN 250

Advantages of Liquiphant in comparison to Gammapilot

- Field calibration not imperative
- No handling permit, radiation protection officer
- Flexible customer solutions with FML621: 2D/3D concentration tables, media recognition, formula editor, limit value signaling, display parameterizable

Advantages of Promass in comparison to Liquiphant

- No inlet/outlet runs
- Small nominal widths starting DN 1
- Flow speeds >2 m/sec
- Suitable for custody transfer
- Unaffected by viscosity
- Multiparameter (temperature, mass, density, viscosity)
- High accuracy / repeatability
- Also densities > 2 g/cm3
- Up to 350 °C
- Ext. temperature sensor not required
- Compact instrument
- SIL2

Advantages of Promass in comparison to Gammapilot

- Multiparameter
- Field calibration not imperative
- External temperature sensor not required
- Suitable for custody transfer
- SIL2

Advantages of Gammapilot in comparison to Liquiphant

- Non-contact
- Larger nominal widths
- Compact instrument
- Unaffected by viscosity
- High resistance
- Installation without interrupting the process

Advantages of Gammapilot in comparison to Promass

- Non-contact
- Large nominal widths > DN250
- High resistance
- Installation without interrupting the process

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Influence of application and installation

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Liquiphant Density

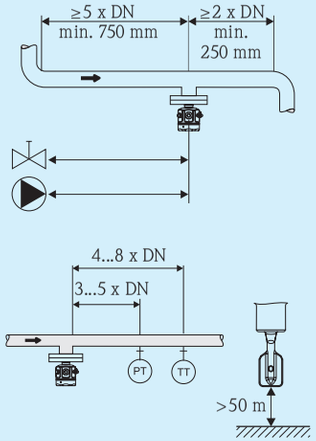
Measurement inaccuracy influenced by:
- Flow conditions (observe inlet/outlet run distance to wall, depth of immersion)
- Internal pipe Ø < 100 mm
- Speed of flow > 2 m/s
- Buildup, changes in viscosity, gas bubbles, corrosion, mech. damage to fork
- Inhomogeneous media

Promass F (all except 40E)

Measurement inaccuracy influenced by:
- Cavitation
- Inhomogeneous media
- Deposits, abrasion, corrosion

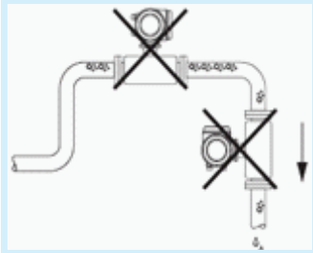
Gammapilot M FMG60

Measurement inaccuracy influenced by:
- Quality of field calibration
- Deposits
- Gas bubbles



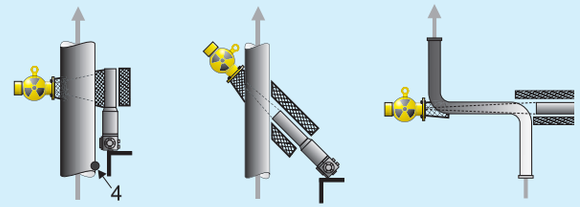
Installation:
(Excerpt; please use engineering guides)

- Inlet runs, distance to wall and liquid surface, observe permitted nominal pipe width
- Ext. pressure sensor if pressure change > ±6 bar
- Ext. temperature sensor, if temp. is not constant



Installation:
(Excerpt; please use engineering guides)

- Observe installation instructions for mass flowmeters



Installation:
(Excerpt; please use engineering guides)

- Positioning of the instrument depends on the measuring path penetrated by the rays and the density measuring range (reullt of Applicator sizing).
- Provide opening for sampling (calibration)

TOP - Vibronics: Liquiphant Density
- Installation directly at tanks or pipes
- Density/concentration measurement + level limit with one instrument
- Sensor materials and process connections of Liquiphant M

TOP - Coriolis: Promass
- Density measurement with Promass has been tried and tested in operation for years
- High accuracy
- SIL 2
- Suitable for custody transfer

TOP - Radiometry:Gammapilot M FMG60
- Works when other methods are unreliable
- Non-contact -> high resistance, no seals
- Installation without interrupting the process

TOP - Endress+Hauser properties for all three measurement principles
- 3 physically different solutions (online measuring methods) for different requirements (in situ, inline, non-contact) of one density measuring point

These offer during operation:

- High safety: Process facilities are not opened for sampling, no transport of aggressive/toxic media, no operator on site (health protection)
- Cost savings: Omission/reduction of daily reference samples, avoidance of product losses due to immediate process correction (online measurement)
- Product quality: More accurate measuring results since there is no transformation of samples during transport to the laboratory for analysis

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