



# Density and Concentration Meter





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DIMF 2.0 with HART®-Transmitter for measuring the operating density in the bypass



# Applications of the DIMF Density and Concentration Meter

## Versatile Applications

The possible applications of the DIMF series range from settling sludges to highly corrosive chemical liquids. In the chemical and petrochemical branches, the concentrations of acids, alkaline solutions or the density of mineral oil products are measured and controlled. This saves the time-consuming process of taking samples or replacing mechanical measuring equipment. The continuous measurement increases and assures the product quality as well as process efficiency.

In the food branch, the precise Brix measurement used for manufacturing fruit juices results in savings of the raw product and produces a constant product quality. Considerable energy savings are attained for the control of multistage evaporating systems in the sugar industry. The brewing sector has also recognized the advantages and the potential for savings with this measuring principle. Further applications include the continuous monitoring and control of fermentation processes, the measurement of dry matter in slurries or suspensions and product recognition for filtration, separation or mixing processes.

A densimeter model with type design approval from the PTB for fiscal metering is also available. In conjunction with the flow computer (which monitors the filling process) and a volume meter the mass can be determined and as an option the concentration of the products can also be monitored.

## Branches

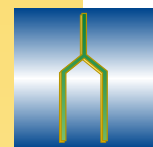
Chemical, petrochemical, soft drinks industry, sugar industry, food industry, pharmaceutical industry, mineral oil industry, steel industry, cement industry, paper and cellulose industry, machine construction, color and dyeing industry, photo industry, manufacture of electronics and semiconductors, environmental protection systems and waste treatment plants etc.

## Liquids to be Measured

Hydrocarbons, aqueous solutions, liquid sugar, liquefied gases, liquid mixtures, fruit juices, chocolate, doughs, oil, acids, alkaline solutions, alcohol, ammonia, solvents, pastes, colors, foams and slurries, cooling or heat transfer medium (glycol) etc.

## Measuring Tasks

Continuous monitoring of density, mass flow measurement, fiscal measurements, quality control, monitoring of waste water, product recognition, dosing, injection or blending of additives, control of chemical reactions, measurement of concentrations; monitoring and control of distillation, filtration, sedimentation, mixing or fermentation processes; process control, measurement of solid percentages in liquids, measurement of foams and suspensions etc.



## DIMF Series Sensors

For the continuous measurement of the density and concentration of liquids

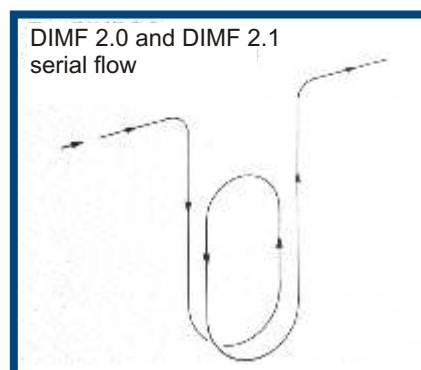
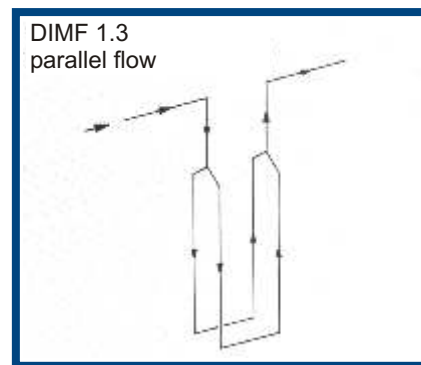
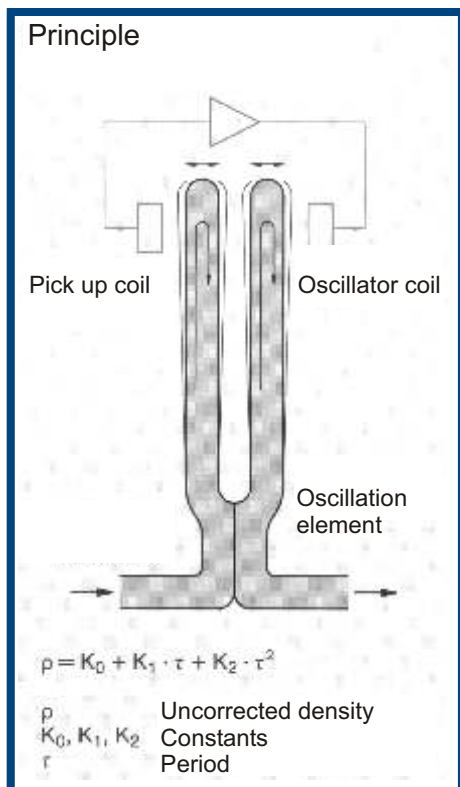
### Measurement Principle

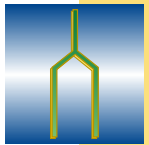
The DIMF series of density sensors provides the possibility for the continuous measurement of the density and concentration of liquids, liquid mixtures and multiphase fluids.

The central component of the DIMF series of density sensors is an oscillation element consisting of an oscillation fork, type DIMF 1.3, or an oscillation pipe, type DIMF 2.0 and DIMF 2.1. The liquid to be measured flows through the oscillation element, which is electromagnetically excited and oscillates at its characteristic frequency. Changes in density result in changes in the characteristic frequency.

These frequency changes are measured. The frequency is registered directly by the transmitter, type TR, and transformed into a signal proportional to the density and concentration. At the same time, an integral temperature sensor measures the temperature of the material. This temperature is then used to make corrections. In doing so, the temperature influence of the oscillation element and the temperature behavior of the liquid density are also considered.

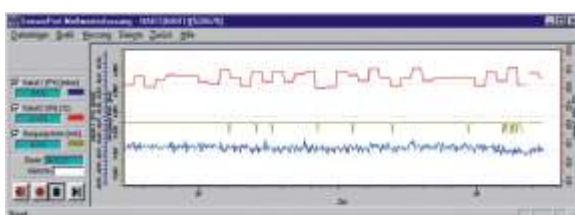
The corrections are made directly in the transmitter, type TR. The frequency and the temperature can be transmitted to a Bopp & Reuther density computer or to a density-massflow converter, series CSM, and processed further there.





## Characteristics

- The measurement principle as well as the rugged and patented design of the oscillation element make the DIMF series insensitive to the viscosity of the liquid being measured, as well as to flow, pressure and vibrations.
- All DIMF sensors measure independent of the installation position and need no maintenance.
- The thin layer temperature sensor, which is integrated into the DIMF, reacts extremely quickly to temperature changes of the liquid.
- DIMF series density sensors are completely welded and do not have any seals. Due to the absolutely tight welding of the casing and the use of high quality glass bushing insulators for the electrical lines, the sensors work independent of atmospheric pressure fluctuations. The hermetically closed casing precludes any formation of condensation on the oscillation element so that measurement errors at low temperatures can not occur. The sensor is self draining and - depending on the type - CIP or SIP capable.
- The oscillation fork of the DIMF 1.3 density sensor is manufactured from a nickel-iron-chromium alloy with optimized thermoelastic characteristics. This results in a high long-term stability and reproducibility and a very low temperature dependency of the sensor.
- The oscillation pipe of the density sensor, DIMF 2.0, is made of stainless steel, 1.4571, for the standard model, but can also be made of Hastelloy or Tantal. Since the wall thickness of the oscillation pipe can be varied, this density sensor can be employed for almost all existing liquids and operating pressures. The oscillation pipe can be cleaned with a scraper because it does not have any corners or stagnant areas.
- The oscillation pipe of the density sensor, DIMF 2.1, is made of stainless steel, 1.4571, for the standard model, but can also be made of Hastelloy. The oscillation pipe can be cleaned with a scraper because it does not have any corners or stagnant areas.
- Every single one of our measuring instruments is tested on a high-precision calibration device, if desired in accordance with application specific parameters.
- The Transmitter TR supports the HART® protocol. Thus the density meter DIMF 1.3 T... , DIMF2.0 T... and DIMF 2.1 T... can be configured via user-friendly software tools such as SensorPort, PACTware and AMS. SensorPort may also be used to record and display measured data (see picture below). A DTM driver complying with FDT 1.2 specifications is provided for easy integration into state-of-the-art computerized process control or the configuration tool PACTware.



Data acquisition with SensorPort



## The DIMF Family

The DIMF series density sensors can be combined with various evaluation electronics. A modular concept is used, which can be adjusted to the requirements for all density measurements.



Density sensor  
DIMF 1.3  
With oscillation fork

- Preferred for:
- best measurement accuracy
  - highest reproducibility
  - fiscal metering
  - narrow spatial conditions
  - non-aggressive liquids



Density sensor  
DIMF 2.0  
With oscillation fork

- Preferred for:
- high operating temperatures
  - higher operating pressures
  - aggressive liquids
  - food industry

or



Density sensor  
DIMF 2.1  
With oscillation fork

- Preferred for:
- high flowrates
  - installation into the main pipe
  - aggressive liquids
  - food industry

The density sensors can be combined with a PV preamplifier or a TR transmitter alternatively.



PV preamplifier with  
frequency output

- Ex i
- two-wire-technology
- separate temperature connection (PT 100 in 4-wire-system)



TR transmitter with analog  
output 4-20mA, HART® and  
local display

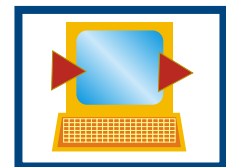
- Ex i
- two-wire-technology
- density / concentration
- temperature compensation

Other peripheral equipment:



e.g. density computer CSM can be  
connected to the PV preamplifier  
for

- temperature compensation
- density measurement
- mass measurement
- fiscal metering



evaluation instruments\* can be  
connected to the TR transmitter  
for

- control
- monitoring critical values
- product recognition

\* depending upon the type also for use in the hazardous area

## DIMF 1.3 and DIMF 2.0

### with TR Transmitter

For the continuous monitoring of density, quality control, product recognition, dosing, injection or blending of additives, control of chemical reactions, measurement of concentrations, monitoring and control of distillation, filtration, sedimentation, mixing or fermentation processes in all manufacturing branches.

- output signal proportional to density and concentration
- two-wire-technology
- 4-20 mA-output, HART-protocol
- local display with keys for setting the parameters
- setting of the parameters via HART-protocol (SensorPort, PACTware, AMS)
- operation possible with HART hand-held terminal HHT 275
- DTM device driver available complying with FDT 1.2 specifications
- various units of measure such as  $\text{kg/m}^3$ , Ma%, Vol%, °Brix, Bé, °API ...
- complex product data may be configured as a table of set points (desired values)
- integrated measuring of temperature
- ZELM 99 ATEX 0008 X  
Standard: II 1/2G EEx ia IIC T4  
Tantal model: II 2G EEx ia IIC T4

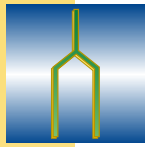


### with PV Preamplifier

For the continuous monitoring of density, fiscal metering, quality control, product recognition, dosing, injection or blending of additives, control of chemical reactions, monitoring and control of distillation, filtration, sedimentation, mixing or fermentation processes in all manufacturing branches.

- two-wire-technology (frequency output)
- integrated measuring of temperature with sensor PT 100  
temperature output in 4-wire-technology
- DMT 00 ATEX E 092 X  
II2G EEx ib IIC T6/5





## Custom-Built Solutions

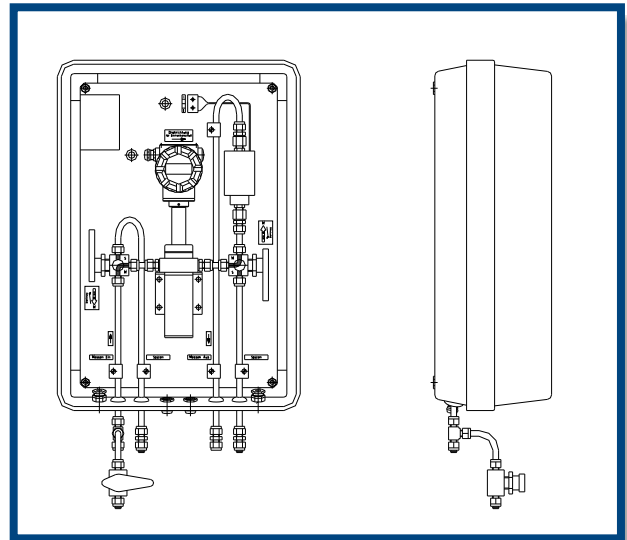
Critical measuring tasks require specific density measuring instruments adapted to the individual requirements of our customers. For this purpose we offer tailor-made solutions according to the varying needs of our customers.

- models approved for fiscal metering
- high pressure models
- high temperature models (up to 210 °C)
- high precision models meeting specific customer requirements
- models whose electronic components may be mounted separately (e.g. for mounting on walls or pipes)
- density measuring units with protective housing
- special models with flow rate up to 100 l/m (higher flow rate on request)

Density measuring unit built into a protective housing incorporating a viewing window

optionally available with

- pump
- flow monitoring
- connection to rinsing equipment
- filter
- equipment for base or wall mounting



Density measuring units

DIMF 1.3 with preamplifier PV,  
strainer, flow and pressure  
monitoring



DIMF 2.0 with TR Transmitter  
high temperature model

- 210 °C maximum
- separate installation of transmitter on walls or onto pipes





## Design of the Density Measuring System

The density sensor can be integrated directly in the main line or as a bypass in a separate line or case, depending on the volume flow or nominal width. With high volume flows the sample liquid is lead from the main line to the density sensor in the bypass. The required pressure difference is produced by a flow restriction or an auxiliary pump. In most cases, however, the pressure difference or the pressure loss, which results from the installed components in the main line (for example valves, reducers, elbows etc.), is sufficient. The installation position and the flow direction do not influence the measuring results of either of the sensors.

The installation of the density sensor in a bypass is advantageous for many reasons:

- inexpensive installation
- very compact solution, design is independent of the nominal size of the main line
- the flow conditions in the sensor can be adjusted to existing systems easily
- check of the sensor without disturbing the process
- replacement without stopping the whole system

Due to its small dimensions, the DIMF 1.3 type can even be installed in a pressure-proof welded pocket directly in the main line.

For measurements in a storage tank, circulation through the density sensor is produced by means of an auxiliary pump.

If required both sensors can be installed in self-draining position.

## Requirements for trouble-free operation

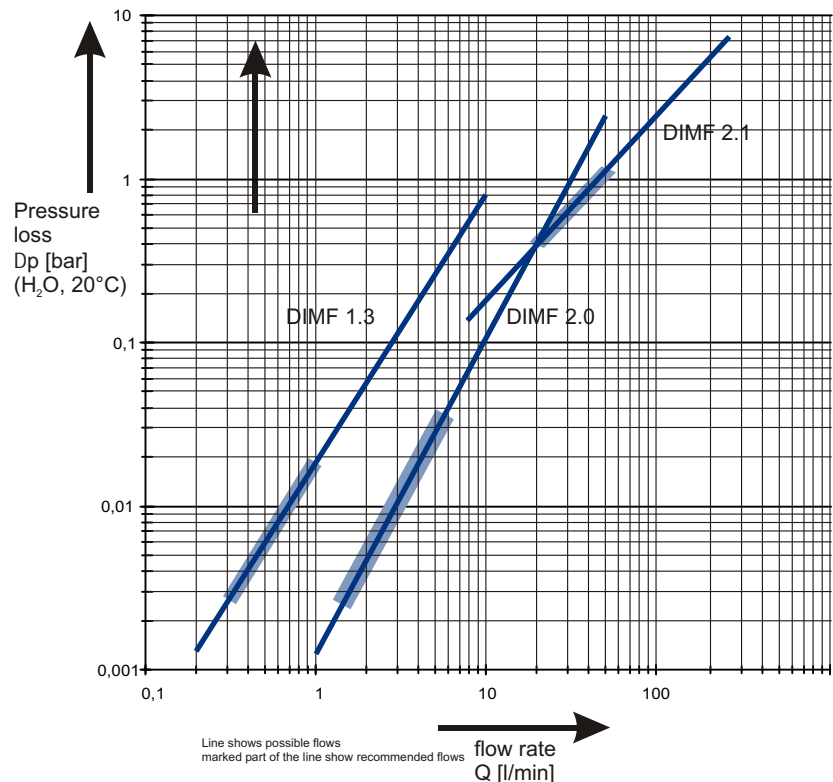
The DIMF series density sensors measure independent of flow and also with zero flow. Their use is therefore completely problem-free. You only have to insure, that the operating flow in the sensor

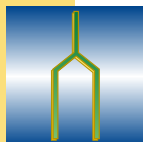
- updates the sample fast enough
- balances the temperature in the sensor
- avoids the collection of gas bubbles or deposits in the oscillation element
- does not cause cavitation in the oscillation element
- does not cause abrasion due to abrasive materials

Recommended reference values for the average operating flow in the sensor:

DIMF 1.3: approx. 0.5 to 1 l/min  
DIMF 2.0: approx. 2.0 to 5 l/min  
DIMF 2.1: approx. 20 to 50 l/min

(max. flow rates see technical data page 10)





## Technical Data for Density Sensors

Sensor Type	DIMF 1.3	DIMF 2.0	DIMF 2.1
density range – standard – for fiscal metering	0 to 5,000 kg/m <sup>3</sup> 400 to 2,000 kg/m <sup>3</sup> 450 to 2,000 kg/m <sup>3</sup>	0 to 5,000 kg/m <sup>3</sup> 400 to 2,000 kg/m <sup>3</sup>	0 to 5,000 kg/m <sup>3</sup> 400 to 2,000 kg/m <sup>3</sup>
measuring accuracy	< ± 0.1kg/m <sup>3</sup>	< ± 0.2 kg/m <sup>3</sup>	< ± 0.2 kg/m <sup>3</sup>
repeatability	< ± 0.02 kg/m <sup>3</sup>	< ± 0.05 kg/m <sup>3</sup>	< ± 0.05 kg/m <sup>3</sup>
temperature of material being measured	-40°C to +150°C -40°C to 100°C for DIMF 1.3 PKS	-40°C to +150°C high temperature model -40°C to +210°C on request	-40°C to +150°C
temperature compensation	via integrated Pt 100 in a serially connected computer, CSM	via integrated Pt 1000 directly in the TR transmitter	via integrated Pt 1000 directly in the TR transmitter
pressure influence	< 0.02 kg/m <sup>3</sup> /bar	< 0.02 kg/m <sup>3</sup> /bar	< 0.02 kg/m <sup>3</sup> /bar
operating pressure	100 bar	100 bar	40 bar
liquids to be measured	for non-aggressive liquids and liquid mixtures, in particular hydrocarbons	for highly aggressive liquids pastes, foams	for highly aggressive liquids pastes, foams
max. flow rate recommended	0 to 10 l/min 0.3 to 1 l/min	0 to 50 l/min 1.5 to 6 l/min	0 - 350 l/min 20 - 50 l/min
material: – for wetted parts	special alloy of NiFeCr and 1.4571	1.4571, Tantal, Hastelloy C 4 and B2, Monel 400, 1.4306, Inconel 600 others on request	1.4571, Hastelloy C 4
– housing	1.4571	1.4571	1.4571
smallest inner diameter peculiarities	2 x Ø 5 mm parallel model without seals on request: material certificates according to DIN EN 10204-2.2	Ø 10 mm model without seals on request: material certificates according to DIN EN 10204-3.1B	Ø 29,7 mm model without seals on request: material certificates according to DIN EN 10204-3.1B
weight	3 kg	4.2 kg	21 kg
process connections (2)	– female threads G ¼" ISO 228 – flange DN 10 PN 40 or ½" ANSI 150/300 RF (only available with temperature extension))	– Swagelok screw joints for pipe outside diameter of 12 mm – flange DN 15 PN 40 or ½" ANSI 150/300 RF – milk threads according to DIN 11851 PN 10 – sterile screw joints according to DIN 405 PN 16 – TRI-Clamp – others on request	– flanges DN 25 PN 40 or DN50 PN 40 – others on request
pressure equipment directive 93/27/EG	Classification in accordance with the sound engineering practice in order to ensure safe use and in accordance with the fluids of the group 1	Classification in accordance with the sound engineering practice of in order to ensure safe use and in accordance with the fluids of the group 1	Classification in accordance with the sound engineering practice in order to ensure safe use and in accordance with the fluids of the group 1

## PV Preamplifier - Technical Data

Functions:	Excitation of the oscillation element to its characteristic frequency in the DIMF 1.3, DIMF 2.0 and DIMF 2.1 density sensor  The PV type preamplifier is connected to an evaluation computer.  Parameters displayed on the computer: density, concentration, operating temperature, mass etc.  Parallel operation of several density sensors is possible on a single computer.
Output:	Frequency dependent on operating density, not linearized, mounted on sensor power supply circuit, pulse ratio 1:1, approx. 800 - 1400 Hz, depending on the sensor type. Linearization and temperature correction in the computer.
Power supply:	24 VDC (min 15 VDC to 30 VDC) intrinsically safe
Connection:	2-wire technology via screw terminals and cable gland Pg 13.5
Temperature connection:	4-wire technology via screw terminals and cable gland Pg 13.5 (Pt 100 installed in DIMF)
Cable specification:	2 to 4 wire, shielded twisted pair
Ambient temperature - Storage and transport: - Operation:	-45°C to +85°C -45°C to +85°C
Ex-protection:	DMT 00 ATEX E 092 X II2G Eex ib IIC T6/5
Protection type:	IP 65
Casing measurements:	60 x 125 x 80 mm
Weight:	0.6 kg



DIMF 1.3 P..

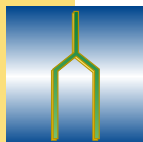


## TR Transmitter - Technical Data

Functions:	<p>Excitation of the oscillation element to its characteristic frequency in the DIMF 1.3, DIMF 2.0 or DIMF 2.1 density sensor.</p> <p>Display of two lines showing density, concentration, operating temperature etc. as well as four entry keys for operating the transmitter directly. Set parameters can easily be altered by users to allow for changing process data.</p> <p>Communication via HART®: parameters can be altered and measuring data be read with the help of softwaretools (SensorPort, PACTware).</p>
Programmable parameters:	Initial and final value of the output signal (minimal measuring range 5 kg/m <sup>3</sup> ) calibration and material specific constants, reference temperature, etc.
Output:	4-20 mA, HART®, linearized and temperature corrected, may be allocated to any desired parameter, e.g. operating density, reference density, concentration, solids contents, °Brix, °Plato or other commonly used units of density measure; complex material data programmable as a table of max. 400 set points.
Power supply:	24 VDC (min 14 V DC / max 30 V DC) intrinsically safe
Connection:	2-wire-technology via screw terminals and cable gland M20x1,5 or ½" NPT-threads for pipes (Conduit-System)
Cable specification:	2-wire, shielded and twisted
Ambient temperature - storage and transport: - operation:	-40°C to +70°C -10°C to +58°C -40°C to +70°C (on request)
Ex-protection:	<ul style="list-style-type: none"><li>- standard design intrinsically safe: ZELM 99 ATEX 0008 X II 1/2G EEx ia IIC T4 Model range II category 1/2 G measuring pipe designed for zone 0</li><li>- Tantal-model intrinsically safe: ZELM 99 ATEX 0008 X II 2G EEx ia IIC T4 Model range II category 2 G</li><li>- models featuring pressure proof housing (Exd) or enhanced safety (Exe) on request</li></ul>
Protection type:	IP 67
Casing measurements:	100 (D) x 155 (L) x 120 (H)mm
Weight:	1.2 kg







## Profile for DIMF 1.3, DIMF 2.0 and DIMF 2.1

<b>Inquiring Company</b>		Specialist	
Address		Phone	
Request / Order number		Date	
Our offer / order number		Date	
<b>1. Material to be Measured</b>			
1.1	Name and composition (Chemical formula)		
1.2	Density range	at      °C of	at      Kg/m <sup>3</sup>
1.3	Concentration range (only TR) any material, please attach parameter table		
1.4	Impurities and contaminants in % (sedimentation, crystallization)		
1.5	Temperature range	min.      °C, norm.      °C, max.      °C	
1.6	Average viscosity (indicate units in, mPas, mm <sup>2</sup> /s)		
<b>2. Materials</b>			
2.1	Which materials are corrosion resistant?		
2.2	Which materials are not corrosion resistant?		
2.3	Which materials may not be used must be avoided?		
<b>3. Operating values</b>			
3.1	Installation location	<input type="checkbox"/> Pipe <input type="checkbox"/> Container <input type="checkbox"/> Bypass	
3.2	Process connection	DIN / ANSI <input type="checkbox"/> Flange <input type="checkbox"/> Swagelok <input type="checkbox"/> Sanitary threads	
3.3	Operating overpressure at the installation location (indicate in bars)	max.      min.	
<b>4. Type of System</b>			
4.1	Use for	<input type="checkbox"/> Internal measur. <input type="checkbox"/> Fiscal measure. (Only PV)	
4.2	Type of System	<input type="checkbox"/> Pump <input type="checkbox"/> Pressure gradient exists <input type="checkbox"/> Centrifugal pump <input type="checkbox"/> Other	
4.3	Filter, gas separator	<input type="checkbox"/> Suction line <input type="checkbox"/> Pressure line	
<b>5. Description of the Measuring Task</b>			
5.1	Measuring of the ..	<input type="checkbox"/> Operating density <input type="checkbox"/> Reference density <input type="checkbox"/> Concentration <input type="checkbox"/> Other	
5.2	Purpose of the measurement	<input type="checkbox"/> Quality assurance <input type="checkbox"/> Mass measurement (conversion) <input type="checkbox"/> Process control <input type="checkbox"/> Process regulation	



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