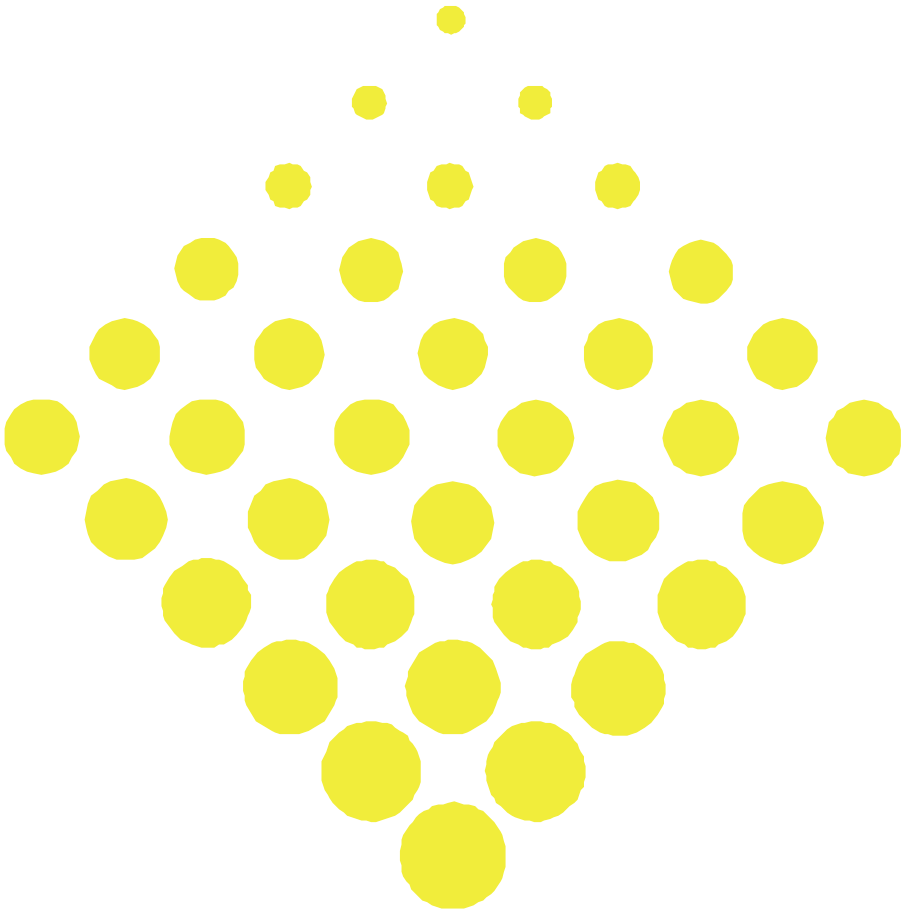


# TRZ



## Topics

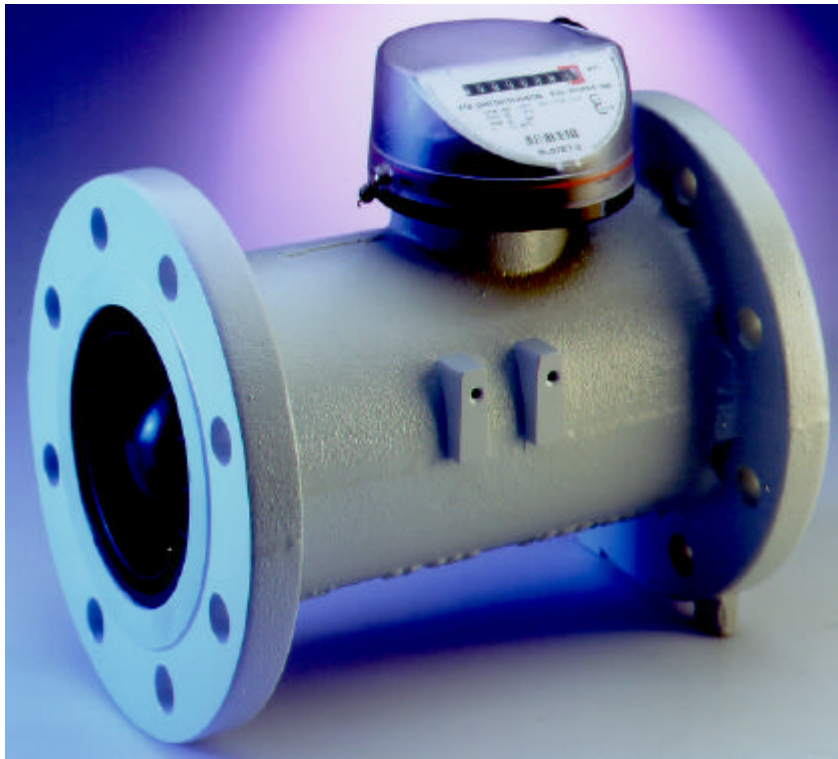
- Products
- History
- Features
- Quality
- Meter Comparison
- Calibration
- Installation
- Maintenance
- Summary

Dr. H. Dornauf  
Product Manager

## Products

- Custody Transfer
  - Turbine Meter      ETM  
                                 TRZ  
                                 TRZ-IFS
  
- In-Plant Measurement
  - Quantometer      Q  
                                 QA
  
- Special Application
  - Special Gases
  - Metrology Requirements

## Turbine Meter ETM



- Features
  - ELSTER Measuring Cartridge
  - Range G 100 DN80/3" - G 1600 DN 200/8"
  - PN 10 -16, ANSI 150
  - LF Pulser, Pressure Tap
  - Plastic Rotor
  - Permanent Lubricated Bearings
  - Outdoor Installation
  - Prepared for System with Volume Corrector
  
- Features
  - No special options
  
- Applications
  - Gas Distribution Network
  - Low Cost Applications

# Turbine Meters TRZ / TRZ-IFS

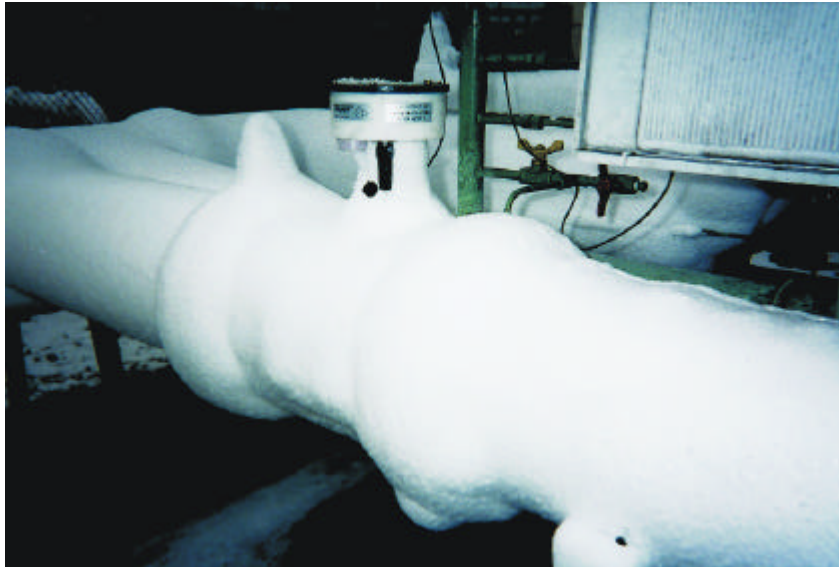


**IFS special features:**

- Integrated flow straightener
- Inlet pipe  $L \geq 2 \text{ DN}$  without any external flow straightener
- According to OIML R 32

- Features
  - Measuring Cartridge
  - Range G 65 - G 16.000
  - PN 10 - 100, ANSI 150 - 600
  - Totalizer S1 IP 67
  - 2 LF Pulsers + PCM
  - Aluminium Rotor
  - Permanent Lubricated Bearings
  
- Options
  - Oil Pump ( $\geq \text{DN } 200$  standard)
  - Integrated Flow Straightener IFS
  - Pressure Tap metrical or in inches
  - HF Pulsers A1S and A1R
  - Thermowell in Meter Housing
  
  - Prepared for System with Volume Corrector
  
- Application
  - Distribution and Transmission
  - Pressures up to 100 bar

## TRZ Specials



- Features
  - Design Features & Options like TRZ and TRZ-IFS
- Options
  - Special Design according to customers requests e.g.:
  - Accuracy, Linearity, Repeatability
  - Master Meter for Test Rigs
  - Low Temperature Housing (Tmin -60° C)
  - Stainless Steel Housing
  - Special Painting
  - Additional p<sub>r</sub>-taps and HF-pulsers
- Applications
  - Transport pipeline e.g. border stations
  - Chemical industry
  - Low- and High Pressure Test Rigs

## Quantometer Q



- Features
  - Short Pattern Housing
  - also see TRZ
- Options
  - HF Pulsers A1S and A1R
  - LF pulsers IP 67 with 1 (IN-S11) or 2 (IN-S12) plugs
- Applications
  - In-Plant Measurement
  - Custody Transfer (UK)

## Quantometer QA/QAe



- Features
  - Short Pattern Aluminium Housing
  - Sandwich Design (No Flanges)
  - 7 digits index
  - LF and MF Pulser
  
- Options
  - QAe with electronic totalizer  
6 digits  
indicates volume in  $m^3$   
flow rate in  $m^3/h$
  - Data Transfer via M-Bus (special option)
  - DN 25 Stainless Steel Housing up to 40 bar
  
- Applications
  - Industrial, in-plant measurement  
e. g. burner control
  - Chemical Industry



## History (1)

- 1936 ELSTER Turbine Meter (*Schraubenradgaszähler*) for custody transfer  
Features: metal sheet housing,  $p_{\max}$  50 mbar, rotor blades handmade
- 1953 Patent *Schraubenradgaszähler*  
Range 1:12, Accuracy  $\pm 2\%$   
Top Mounted Design
- 1970 Housing Length 3 x DN according European Standard  
DN 50 - 1000,  $p_{\max}$  100 bar, Range 1:20, Accuracy  $\pm 1\%$
- 1975 ELSTER Patent "Measuring Cartridge"

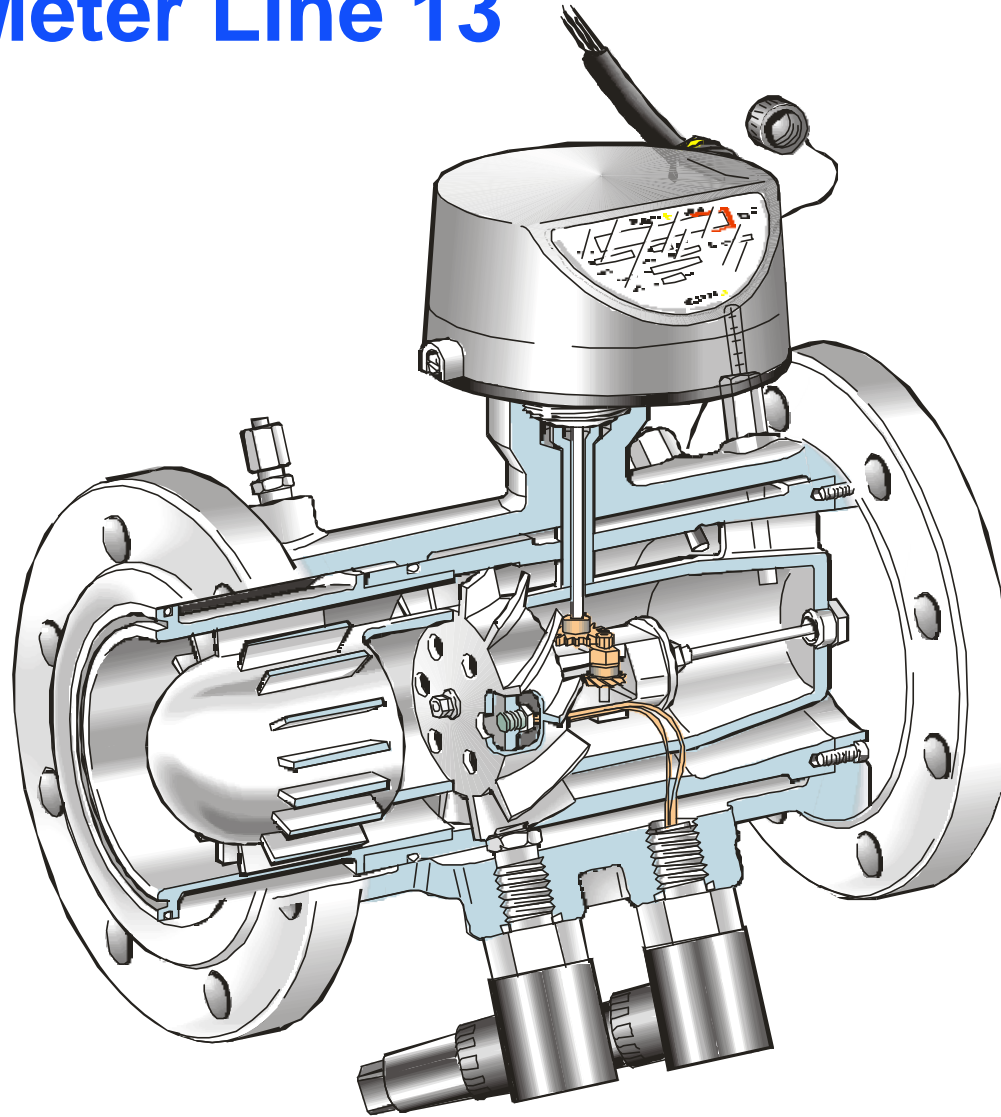
## History (2)

- 1978 1. German High Pressure Test Rig in Darmstadt in Co-operation with SHGW, test pressure 10 -15 bar, meter accuracy at high pressure improved to  $\pm 0.5\%$
- 1987 High Pressure Test Rig in Recklinghausen/GER 35 - 50 bar
- 1988 Celebration of 150.000 Turbine Meter for custody transfer
- 1997 Manufacturing of more than 11,000 Turbine-/Quantometers  
Introduction of ETM Economical Turbine Meter - and  
QAe - Quantometer with electronic totalizer
- 1998 Introduction of TRZ-IFS Integrated Flow Straightener

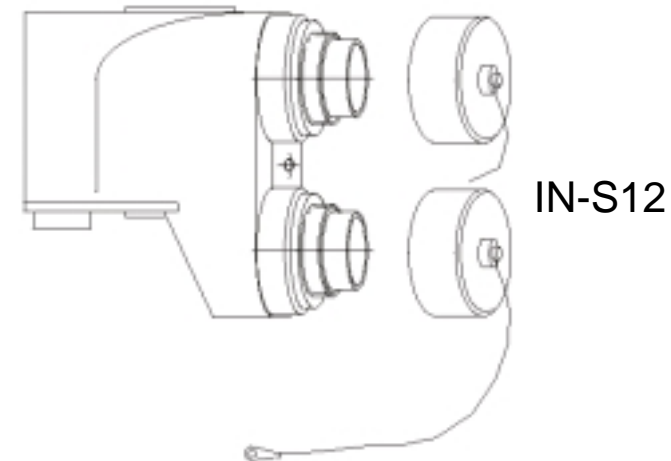
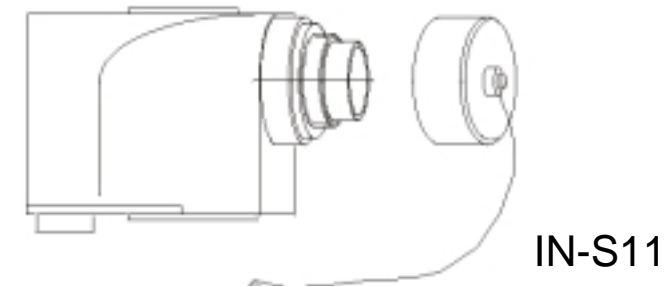
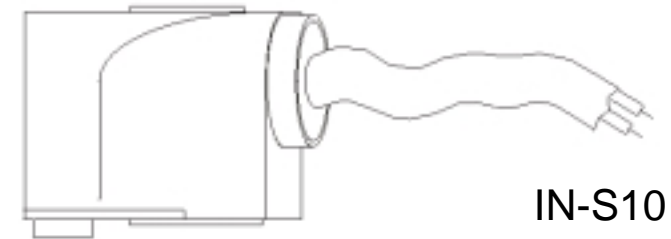
## Approvals & Standards

- European Approvals by PTB
  - D 87 7.211.05,    D 93 7.211.13,    D 97 7.211.15,    D 97 7.211.17
  - (6 fins)            (13-17 fins)            (ETM)            (IFS)
  
- Russia, Eastern Europe
  
- Company Approvals
  - BRITISH GAS / U.K.
  - DISTRIGAZ / Belgium
  - DONG / Denmark
  - GASUNIE /Netherlands
  - GAZ DE FRANCE / France
  - RUHRGAS / Germany
  - SNAM / Italy
  - TRANSGAS / Portugal
  
- Standards
  - ISO 9951            OIML R 6            prEN 12261            DIN 33800
  - OIML R 32            AGA Report No.7    DIN EN 12261            DIN 19234

# Turbine Meter Line 13



# Index and retro-fittable LF options

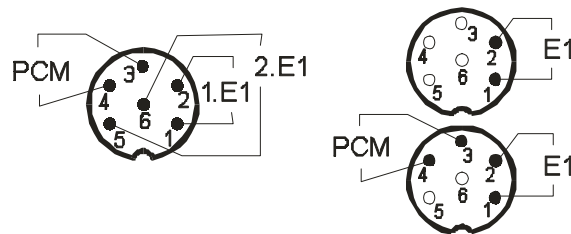


IN-S10

IN-S11

IN-S12

- 1. E1: white - brown
- 2. E1: green - yellow
- PCM: gray - pink



View on soldering side of female plug

## Features & Benefits (1)

- Measuring Cartridge - unique ELSTER Design
  - Stressfree Measuring Unit
  - Quick Replacement
  - Isolated from Housing - independent from ambient temperature changes
  - ELSTER Patent since 1975
- Flow Straightener
  - Reference Pressure detected with 4 holes
  - Design creates uniform Pressure Measurement
  - Almost independent from dust and dirt
  - Concentric Mounting guarantees Accuracy
- Temperature Pocket integrated in Meter Housing
  - Compact System with Volume Corrector
  - Pre-Assembly possible
  - Optimized Position for Temperature Measurement
  - Welding in Pipe not necessary

## Features & Benefits (2)

- Precision Ball Bearings
  - Swiss made Quality
  - Oversized Design guarantees reliability
  - Bigger than competitors equivalent parts
  - Overload up to 160%
- Rotor Bearing Position
  - Centre of Gravity
  - No Torque on Bearings: Reliability
- Lubrication
  - Permanently lubricated Bearings: Maintenance free
  - Oil Pump (manual operated; option): Heavy Duty Operation
- Pressure Recovery
  - Outlet Flow Channel Design Low Pressure Loss

## Features & Benefits (3)

- Fireproof Design
  - Safety in Operation - tested at 650 °C
  - German DVGW Certification
  
- Painting
  - Corrosion Resistant, Two-Layer Painting
  - Conform to prEN 12261
  - Customized Painting possible
  
- Totalizer S1
  - Protection class IP 67, turnable 355°
  - 2 LF Pulsers + PCM
  - IN-S10                    2.5 m cable with open ends
  - IN-S11                    one 6 pin connector
  - IN-S12                    two 6 pin connectors
  - "Ice Box"                Extreme Condition



## Quality

- Quality System
  - ISO 9001/ 9002 Approval
  
- Safety
  - Strength Test with  $1.5 p_{\max}$                       Housing only
  - Tightness Test with  $1.1 p_{\max}$                       Complete Meter
  - Materials with 3.1B Certificate
  - Fireproof Housing (no Aluminium on pressurized parts)
  
- Continuous Improvement
  - Operation:                      Digital Switching Characteristic of HF-Pulsers
  - Design/Look:                      2-Layer Painting before assembling  
  Totalizer Head S1 IP 67
  - Experience:                      more than 180.000 Turbine Meters
  
- Accuracy
  - Individual 6 (3) Point Calibration for TRZ (Q/QA)
  - Tests on ELSTER owned High Pressure Test Rigs
  - High Pressure Calibration with Natural Gas on Request

## Meter Comparison

	Turbine Meter TRZ / TRZ-IFS / ETM	Quantometer Q / QA
Application	Custody Transfer Meas. Transport & Distribution	In-Plant Measurement
Sizes	DN 50/2" – 600/24"	DN 25/1" – DN 400/16"
Pressure	ETM: max. 20 bar TRZ: max. 100 bar	QA: max. 20 bar Q: max. 100 bar
Flow Range	5 – 25.000 m <sup>3</sup> /h	1 – 16.000 m <sup>3</sup> /h
Housing	ductile cast iron (ETM, TRZ) cast steel (TRZ) welded steel (TRZ)	Aluminium (QA)  Q see TRZ
Length	3 DN	1.5 DN
Accuracy	± 1%	± 1.5%
Range	1:20 (1:30 for 10 types) up to 1:200 (High Pressure)	1:20

## Comparison ETM – TRZ

ELSTER Turbine Meters	ETM	TRZ
Accuracy	•	•
Reliability	•	•
Safety	•	•
2 LF pulsers	•	•
HF pulser (optional)		•
Integrated temperature pocket (optional)		•
System with volume corrector	• <sup>1)</sup>	•
Volume corrector (pre-assembled)	•	•
Outdoor installation	•	•
EU approval (German PTB)	•	•
Accuracy $\pm 1\%$ ( $\pm 2\%$ )	•	•
Improved accuracy $\pm 0.5\%$ ( $\pm 1\%$ )		•
Installation with 2 D upstream piping	•	•

ELSTER Turbine Meters	ETM	TRZ
Maintenance-free bearings	•	•
Oil pump (optional)		•
Turbine wheel (synthetic)	•	
Turbine wheel (aluminium)		•
Pressure rate PN 10, 16, ANSI 150	•	•
Pressure rate PN 25, 40, 64, 100		•
Pressure rate ANSI 300, 600		•
Fire resistant	•	•
Custom meter		•
Low temperature housing		•
Special housing material, e. g. stainless steel		•
<sup>1)</sup> temperature measurement in downstream piping		

# Calibration (1)

- Calibration of Turbine Meters

- standard: 6 flow rates at atmospheric pressure with air
- option additional high pressure test
- option exclusive high pressure calibration
- option additional test points

- Operation

- Comparison of volumes between test meter and master meter
- Low Pressure air with atmospheric conditions sucked through test- and master meter
- High Pressure use of natural gas network  
pressures between 5 - 60 bar  
calibration depends on gas supply

- Low Pressure

■ Test Facility	p bar	DN	Q Sm <sup>3</sup> /h	Company
Mainz (GER)	0	50-400	12.000	Elster
Dortrecht (GER)	0	50-400	16.000	NMI

## Calibration (2)

- High Pressure

■ Test Facility	p bar	DN	Q Sm <sup>3</sup> /h	Company
Darmstadt (GER)	10-14	50-300	12.000	SHGW/Elster
Dorsten (GER)	14-50	80-400	350.000	Ruhrgas
Recklinghausen (GER)	25-50	80-400	200.000	VEW/ELSTER
Stuttgart (GER)	4-20	50-300	80.000	TWS
Bergum (NL)	8-50	50-600	132.000	NMI
Westerbork (NL)	60	200-600	> 420.000	NMI
Bishop Aukland (UK)	28-70	100-900	1.400.000	British Gas

## Calibration (3)

- Course of High Pressure Meters
  - Specification Check
  - Organisation HP Test Date
  - Meter Manufacturing
  - Low Pressure Calibration #1
  - High Pressure Test #1 on Elster HP-Test Rig
  - Possibly Optimisation
  - Low Pressure Calibration #2
  - High Pressure Test #2 on Elster HP-Test Rig
  - Official High Pressure Calibration
  - Low Pressure Calibration #3 if new adjustment
  - Dispatch

## Error calculation of a gas meter

- For calculating a gas meters measuring error the test meter (**P**rove device) is compared with a master meter (**N**ormal) with known measurement error.
- Following the continuity condition in a closed tube the flowing normal volume is by definition equal in test meter and master meter independant from actual pressure and temperature.
- Continuity condition:  $V_{Pn} = V_{Nn}$ 
  - $V_{Pn}$  volume measured by the test meter under normal or standard conditions in  $m^3$
  - $V_{Nn}$  volume measured by the master meter under normal or standard conditions in  $m^3$
- Formula for calculating the error of the test meter:

$$f_P = \left[ \frac{V_P \cdot p_P \cdot T_N}{V_N \cdot p_N \cdot T_P} \cdot \left( 1 + \frac{f_N}{100} \right) - 1 \right] \cdot 100\%$$

Legend:

- |  |  |
|--|--|
| ■ $f_P$ error of test meter in %                 | ■ $f_N$ error of master meter in %                 |
| ■ $V_P$ volume of test meter in $m^3$            | ■ $V_N$ volume of master meter in $m^3$            |
| ■ $p_P$ pressure of test meter in mbar           | ■ $p_N$ pressure of master meter in mbar           |
| ■ $T_P$ temperature of test meter in $^{\circ}C$ | ■ $T_N$ temperature of master meter in $^{\circ}C$ |

# Meter Performance

- Meter Lifetime

- Over Range Operation
 

Permanent overload	120%
Overload * 2 h	160%
Short-time (5 min)	200%
  
- Ramp Rates
 

Maximum pressure increase depending on volume downstream	
slow increase ≤	350 mbar/s
  
- Process Limitations
 

Pressure shocks	
H <sub>2</sub> S contents (contact ELSTER)	
Dust, dirt or liquids	

- Measuring Accuracy

- Installation
 

Upstream operation of pulsating devices e. g. compressor, rotary gas meter or pulsating regulator may cause measuring errors	
--	--
  
- Operation
 

Intermittent operation (on-off switch of gas flow) in short cycles causes positive error	
---	--



## Installation Requirements

according German TR G13

Inlet: Straight Pipe of length L with Nominal Diameter DN

	Approval D 87 7.211.05 Type TRZ model <sup>3</sup> 1987	Approval D 93 7.211.13 Type TRZ	Approval D 97 7.211.17 Type IFS	Approval D 97 7.211.15 Type ETM
<b>Low level perturbations</b>  - Single elbow - Double elbow - Expander	$L \geq 2 \text{ DN}$  1 perforated plate BLN 1	$L \geq 2 \text{ DN}$  DN 50 - 150: no plate  DN 200 - 600: 1 plate BLN 1  $L \geq 5 \text{ DN}$ : no plate	$L \geq 2 \text{ DN}$  no perforated plate	$L \geq 2 \text{ DN}$  1 perforated plate BLN 1
<b>High level perturbations</b>  - Throttling Devices e.g. regulators	$L \geq 2 \text{ DN}$  2 perforated plates BLN 2	$L \geq 2 \text{ DN}$  1 perforated plate BLN 1	$L \geq 2 \text{ DN}$  no perforated plate	$L \geq 2 \text{ DN}$  1 perforated plate BLN 1

Outlet: Length  $\geq 2 \text{ DN}$

## Installation (1)

- 1 Prior to the installation, the turbine flowmeter must be checked to ensure that there are no damages caused by the transportation and that all accessories (e.g. plugs, oil) are completely available.
- 2 Remove the adhesive tape from the inlet and outlet flanges.
- 3 The flow direction is indicated on the housing by an arrow.
- 4 The preferred installation position is horizontal with the totalizer on top. In case of a vertical installation, the flow through the meter should be from top to bottom (Attention: If existing, the oil pump must be turned by 90°).

## Installation (2)

- ⑤ In case of new systems, the temporary installation of a filter or a cone screen (mesh width: 0.5 mm) is recommended in order to protect the meter. The cone screen should be removed after approximately four weeks.
- ⑥ The lengths of the inlet and outlet piping is  $L \geq 2 \times DN$ . The diameter must correspond to the nominal width of the meter (Inlet: straight pipe)
- ⑦ All approved types of flat packings can be used as gaskets. The gaskets must be aligned concentrically and must not project into the inside of the pipe.

## Commissioning

- ① Meter equipped with an oil pump (Meter without oil pump start at 3)
- ① Fill oil tank with supplied oil.
- ② Operate oil pump according to maintenance instructions.
- ③ Fill section to be measured slowly (pressure rise  $\leq 350$  mbar per second) until the operating pressure of the meter has been reached. To fill the pipe section, it is recommended to use a bypass line with a diameter of 12 mm.
- ④ Open shut-off valves slowly (duration: at least 1 minute).
  - Attention: Pressure surges and/or inadmissibly high speeds may damage the meter.
- ⑤ Carry out leak test.

## Maintenance

- Turbine flowmeters without oil pump are maintenance-free.
- Turbine flowmeters which are equipped with an oil pump must be lubricated at least every four (4) months.
  - Lubrication Instructions:

DN 80 - DN 150	DN 200 - DN 600
Oil pump with push button	Oil button with lever
Open union nut by at least three turns	
push button 10 strokes	operate lever 4 strokes
- Please refill oil into the oil tank on time to ensure that no air gets into the piping system.
- Oil pump must be sheltered against water

## Start-Up-Procedure: Hand Lever Oil Pump

- Hand Lever Type (DN200-600)
  - LINCOLN Quicklub Oilpump Type HPO
  - Max Pressure: 250 bar
  - Volume per stroke: 1.5 cm<sup>3</sup>  
Important: Pump must be installed vertically
  
- Filling:
  - Open the cap on top of the oil pump
  - The sieve must be in position when filling the oil container
  - Clean sieve regularly
  
- Commissioning:
  - Fill oil container
  - Open locknut which fixes breather/ventilation screw
  - Unscrew breather screw at most one (1) turn
  - DO NOT REMOVE BREATHER SCREW
  - Operate hand lever until oil runs out
  - Screw tight breather screw
  - Screw tight lock nut

## Volume Corrector Installation

- 1 Pockets for temperature sensors have been provided for in the housing of the turbine flowmeter or should be installed downstream of the meter at a distance of 1 DN.
- 2 To enable the connection of a volume corrector, each TRZ and ETM meter has a standard screw connection (6 mm pipe, ERMETO 6 L) serving as pressure tap pr/pm.  
Note: NPT 1/4" on request (standard feature from III/1998)
- 3 Open valve between pressure tap and pressure sensor.
- 4 Connect pulser with volume corrector (check pulse factor  $c_p$ )

Check Meter and Volume Corrector for indicating the same volume

## Fifteen reasons for ELSTER Turbine Meters

1.	Measuring cartridge – unique ELSTER design <i>accuracy independent from housing no forces on measuring unit</i>
2.	Cartridge not sensitive to ambient temperature changes <i>accuracy over the whole temperature range</i>
3.	Flow straightener with 4 reference pressure points <i>not sensitive to dirt</i>
4.	Flow straightener concentric to measuring unit <i>guarantees high accuracy</i>
5.	Temperature pocket integrated <i>optimized position</i>
6.	Precision Swiss made ball bearings <i>oversized design</i>
7.	Overspeed safety up to 160 % <i>safety in operation</i>
8.	Rotor bearing in the centre of gravity <i>assures reliability</i>

9.	Pressure recovery due to outlet design <i>keeps pressure loss low</i>
10.	Fire resistant meter <i>safety in operation</i>
11.	Permanent lubrication <i>maintenance free – no maintenance costs</i>
12.	Corrosion resistant 2-layer painting <i>meets European standard CEN of the future</i>
13.	Index head S1 suitable for outdoor installation <i>protection class IP 67</i>
14.	Index head version IV (icebox) for extreme conditions <i>both extreme cold and extreme hot</i>
15.	Customized design <i>e. g. special painting, low temperature housing (-20 °C), stainless steel housing for chemical applications etc. Type IFS: integrated flow straightener plate</i>