

# A Novel Concept of a high Accuracy Calibration Rig

Accredited acc. to ISO/IEC  
17025 (mass flow rate)

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- Lower uncertainty, why?
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# The “Group” Endress+Hauser



- Holding company in Reinach, Switzerland
- 19 production facilities in 11 countries
- Endress+Hauser sales centers in more than 44 countries
- Representatives in over 70 other countries
- 8500 Employees worldwide

# Endress+Hauser Flowtec AG

The Flow Company of E+H

**Suzhou (CHIN)**



**Aurangabad(IN)**



- Established in 1977
- 1241 Employees
- Flowmeter development and production:  
Coriolis-, Vortex-, Ultra-Sonic-, Electromagnetic- and thermal mass flow- meters

**Cernay (FR)**



**Greenwood(US)**



**Reinach (CH)**



International Metrology Symposium,  
Moscow 2010



# High Precision Flowmeters

- Customer demand: higher accuracy flow meters for expensive fluids. The new E+H Promass 83/84F accuracy specification, with a  $\pm 0.05\%$  option, demanded more precise calibration rigs.
- Up until now, there had been no traceable production calibration rigs in the world, where this high level of accuracy could be proven and verified.
- Our own rigs ( $\pm 0.05\%$ ) were also not able to provide this verification end to end (turn down).

## Objective

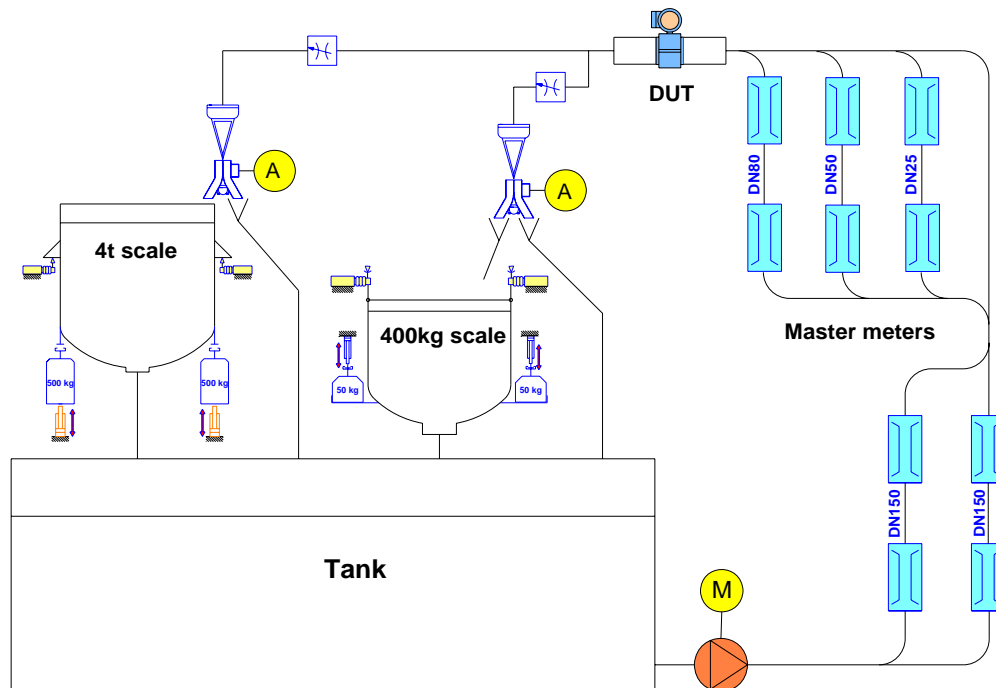
To develop rigs for the high-precision calibration of Promass 83/84F, 0.05% instruments, with the following properties:

- fully traceable
- accredited to ISO 17025
- suitable for production

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# The Rigs (PremiumCal)

Simplified rig drawing (FCP 7.1.5)



**A - flow diverters**

**M – frequency controlled pumps**

**DUT – Device Under Test**

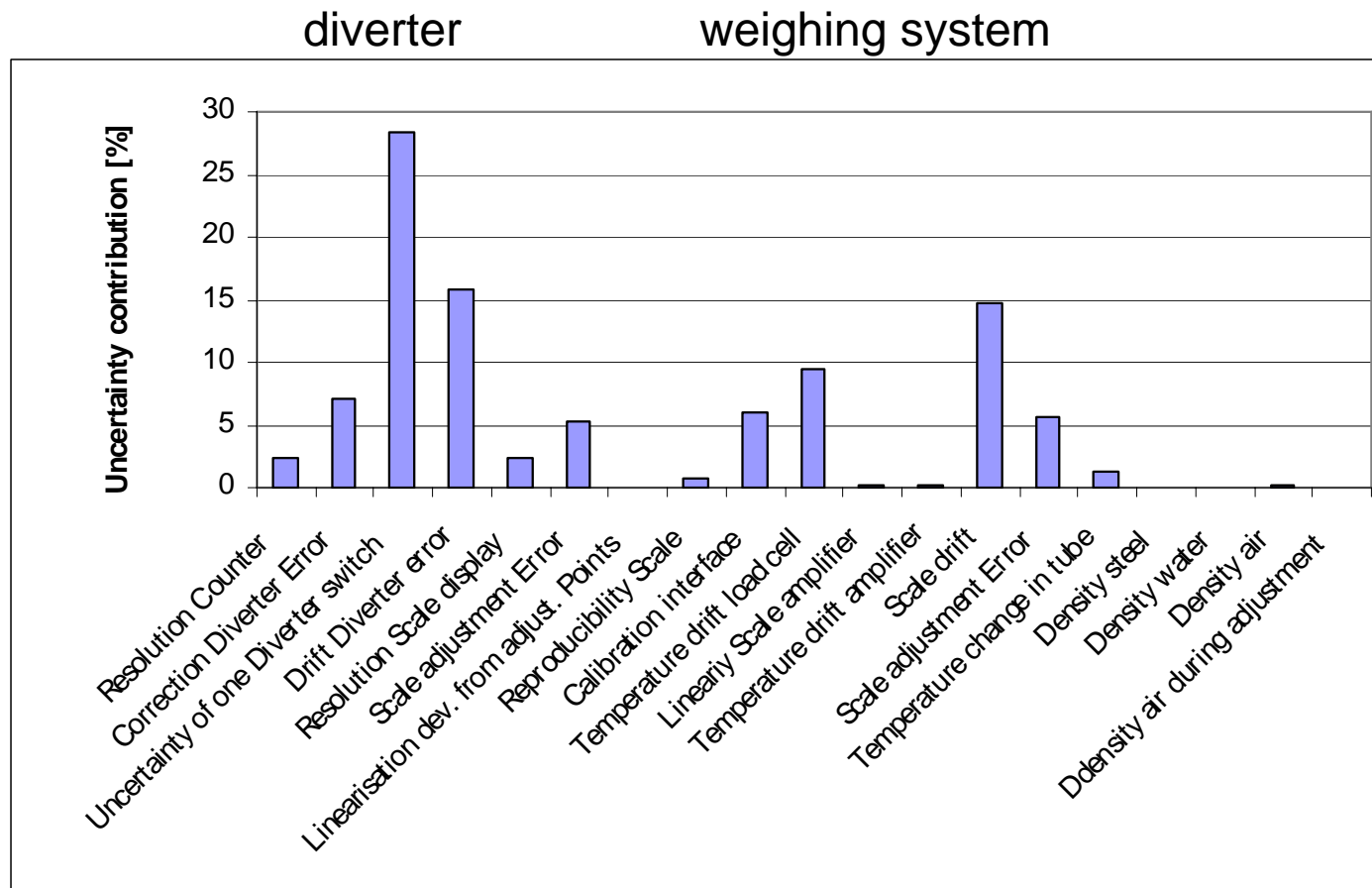
**Weighing systems: 400kg and 4000kg**

**Approved weights:  
7x50 kg and 9x500 kg  
suspended around tanks**

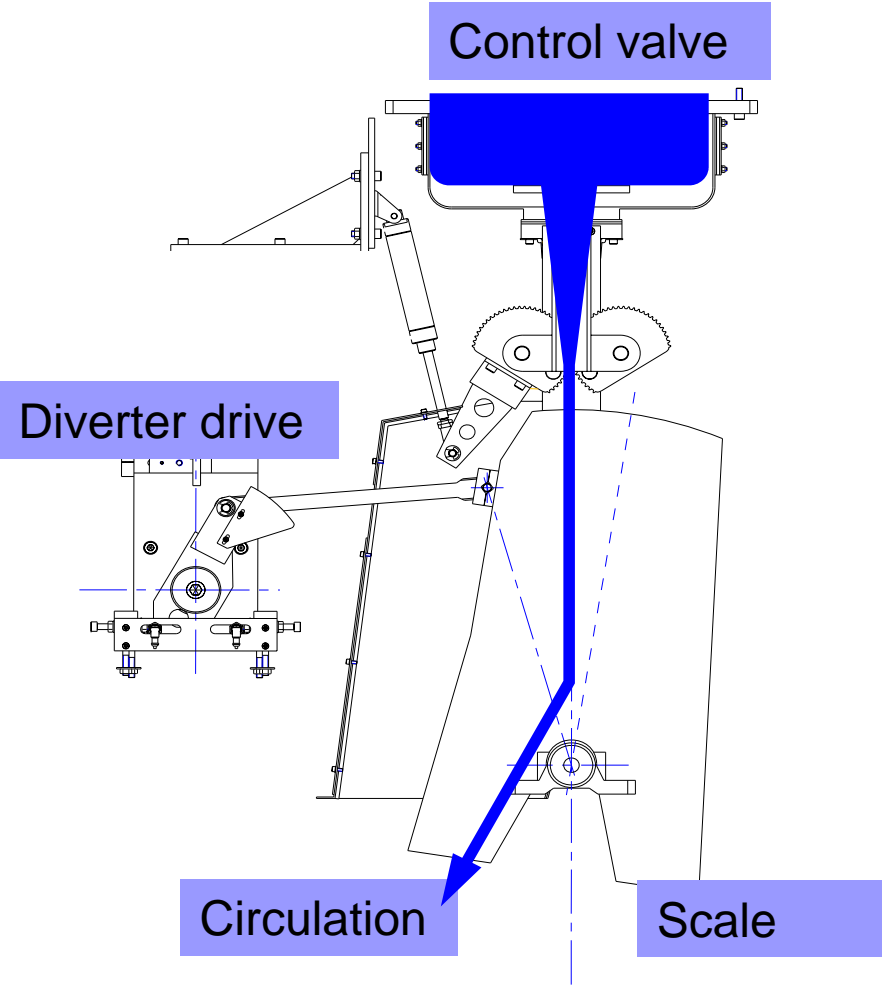
**2 large underground tanks with 300m<sup>3</sup>  
capacity each**

# Uncertainty Elements

Extract out of 30 uncertainty elements

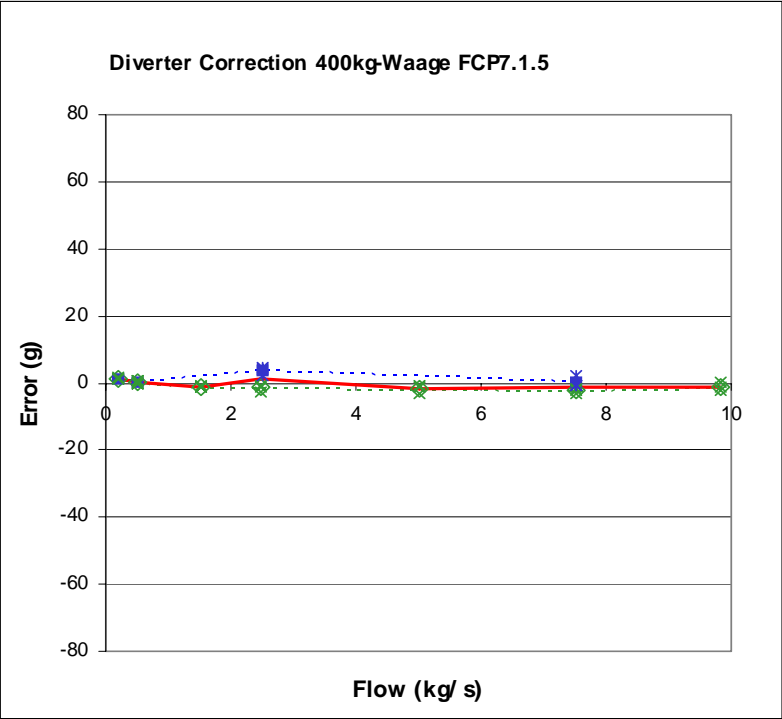


# Diverter Check

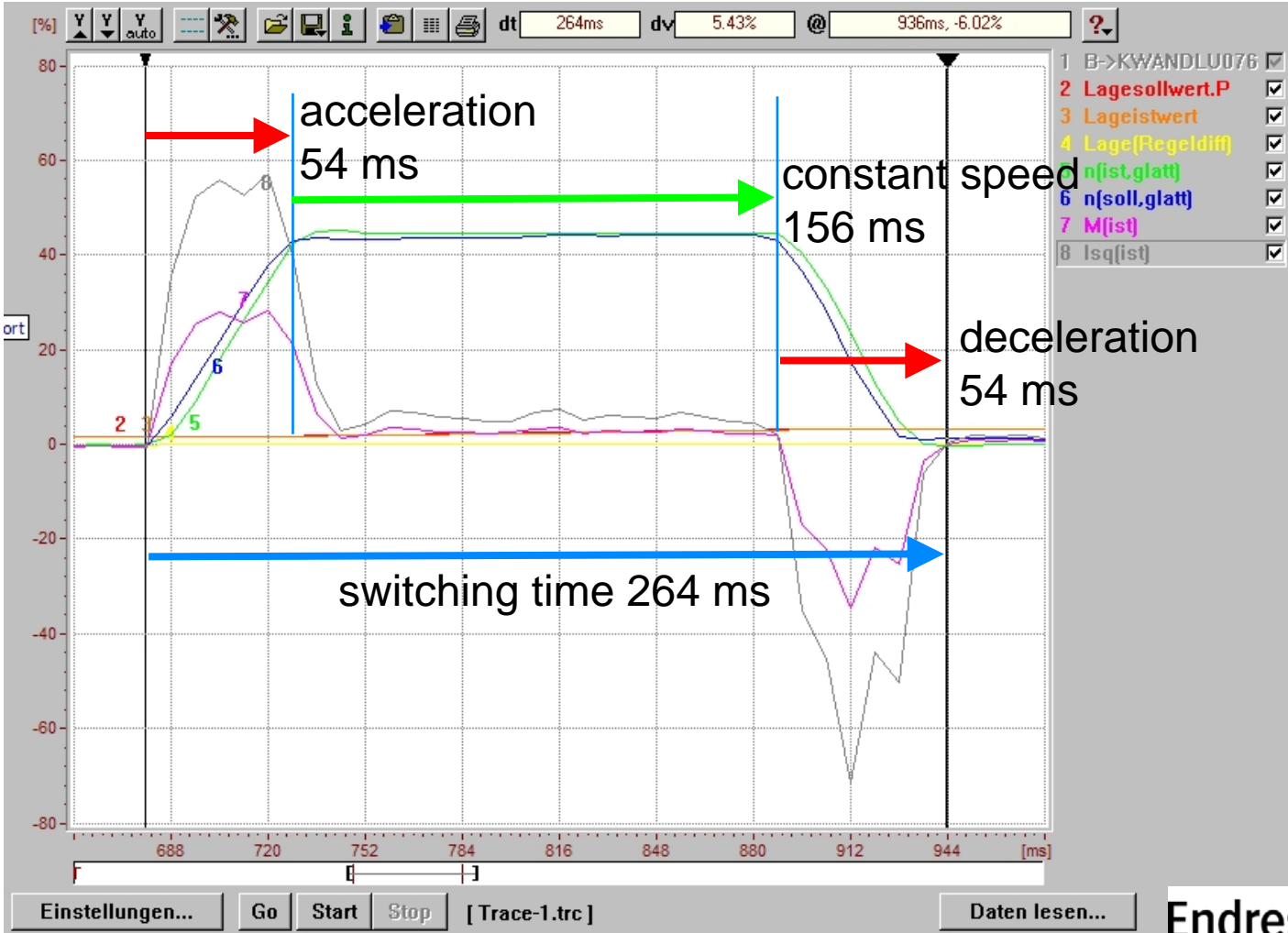


Every 2 weeks:  
Diverter-check

Linearisation of Diverter deviation curve

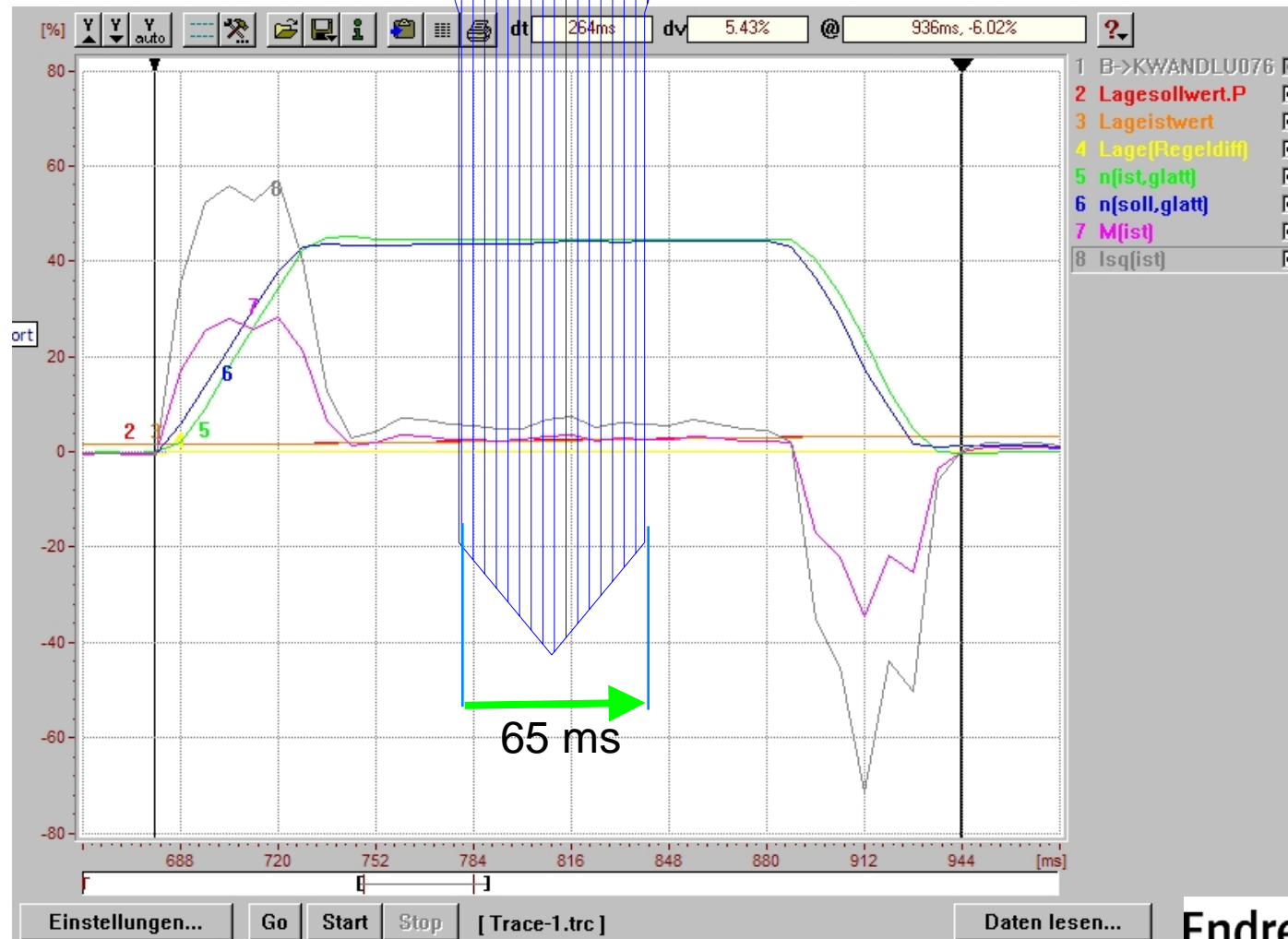


# Diverter Drive

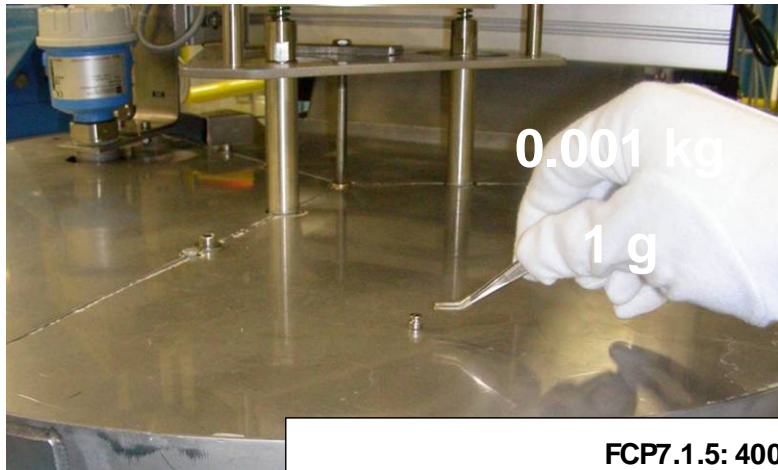


# Diverter Drive

Water jet (at 50 dm<sup>3</sup>/s) 22mm

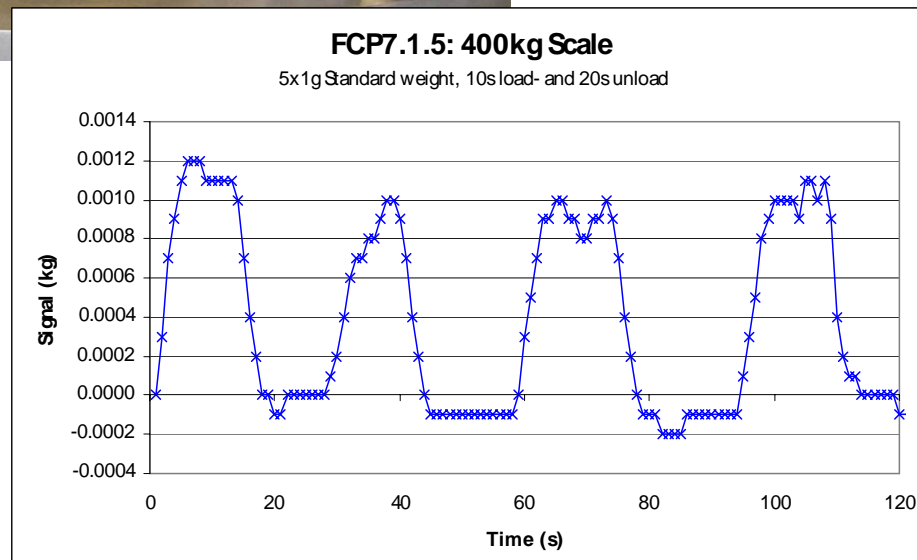


# Scale Resolution



## Check of scale resolution

Placing of a 1g certified weight on top of the 400kg weighing tank



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# Weights / Load Cells

## Certified weights F2



Weight [kg]	Standard		PremiumCal	
	OIML Classes	Tolerance	OIML Classes	Tolerance
20	M1	± 1 g		
50			F 2	± 0.8 g
500	M1	± 25 g	F 2	± 8 g

## Load cells C6

Typ	Standard	PremiumCal
	Z6FC4	Z6FC6
Pieces	1	3
OIML R 60 Class	C4	C6
Non-linearity [%]	< ± 0.0150	< ± 0.0110

# Certified Weights



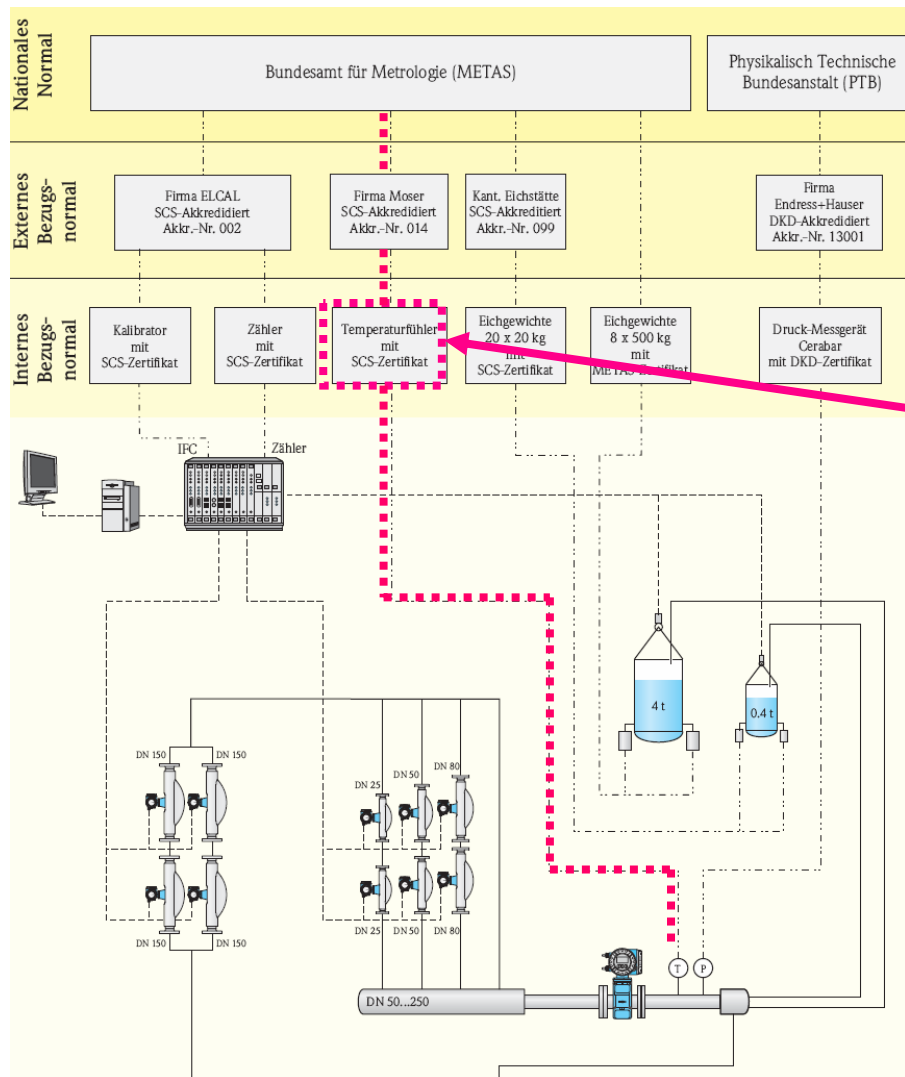
**Certified weights OIML class F2.**

**Polished stainless steel**

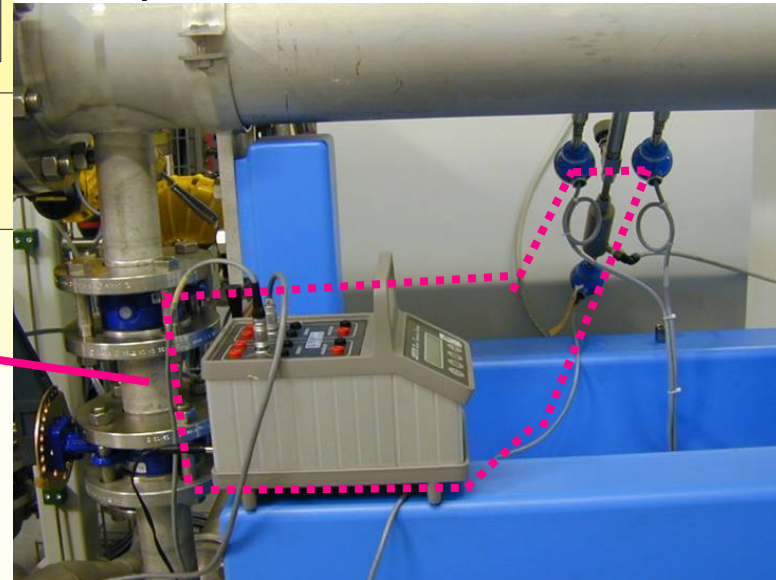
**500 kg +/- 8g.**

**Sitting on mobile carriers to be hitched to the side of the Tank.**

# Traceability (Temperature)



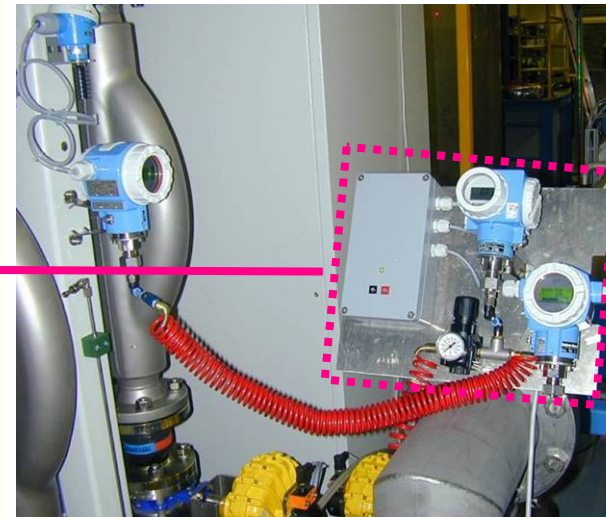
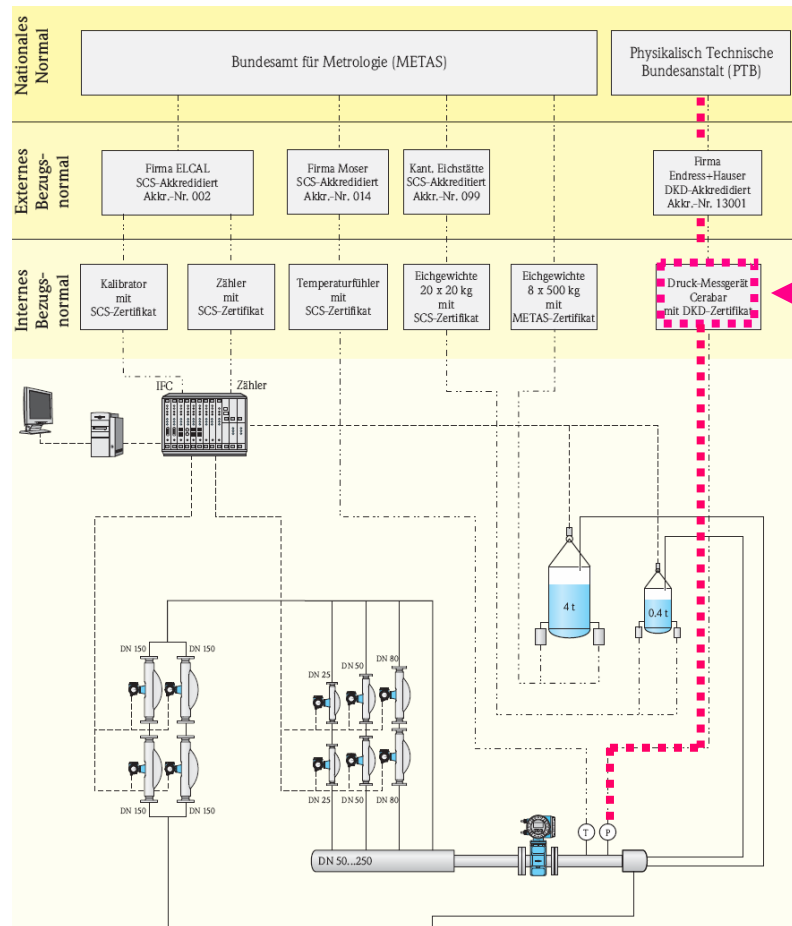
Temperature sensor check



Annually:  
Comparison with SCS reference sensor (calibrator + temp. sensor)

Every 2 weeks:  
Sensor cross-check

# Traceability (Pressure)



**Pressure sensor check**

Annually:  
Comparison with SCS reference sensor (calibrator + pressure sensor)

Every 2 weeks:  
Sensor cross-check

# Traceability – Flowmeter / Rig



±0,000001%

Standard kilo at (BIPM) Paris  
Measuring uncertainty = +/- 0.000001%  
+/- 10 microgram



±0,0001%

National Standard kilo of METAS  
Measuring uncertainty = +/- 0.0001%  
+/- 0.5g/500 kg, duplicate No 38



±0,0016%

Gravimetric scale of E+H Flowtec  
Traceable weights of OIML class F2  
+/- 0.8g/50 kg = 0.0016%



±0,015%

PremiumCal rigs in Reinach and Greenwood

Measuring Uncertainty +/- 0.015%  
accredited acc. to ISO 17025

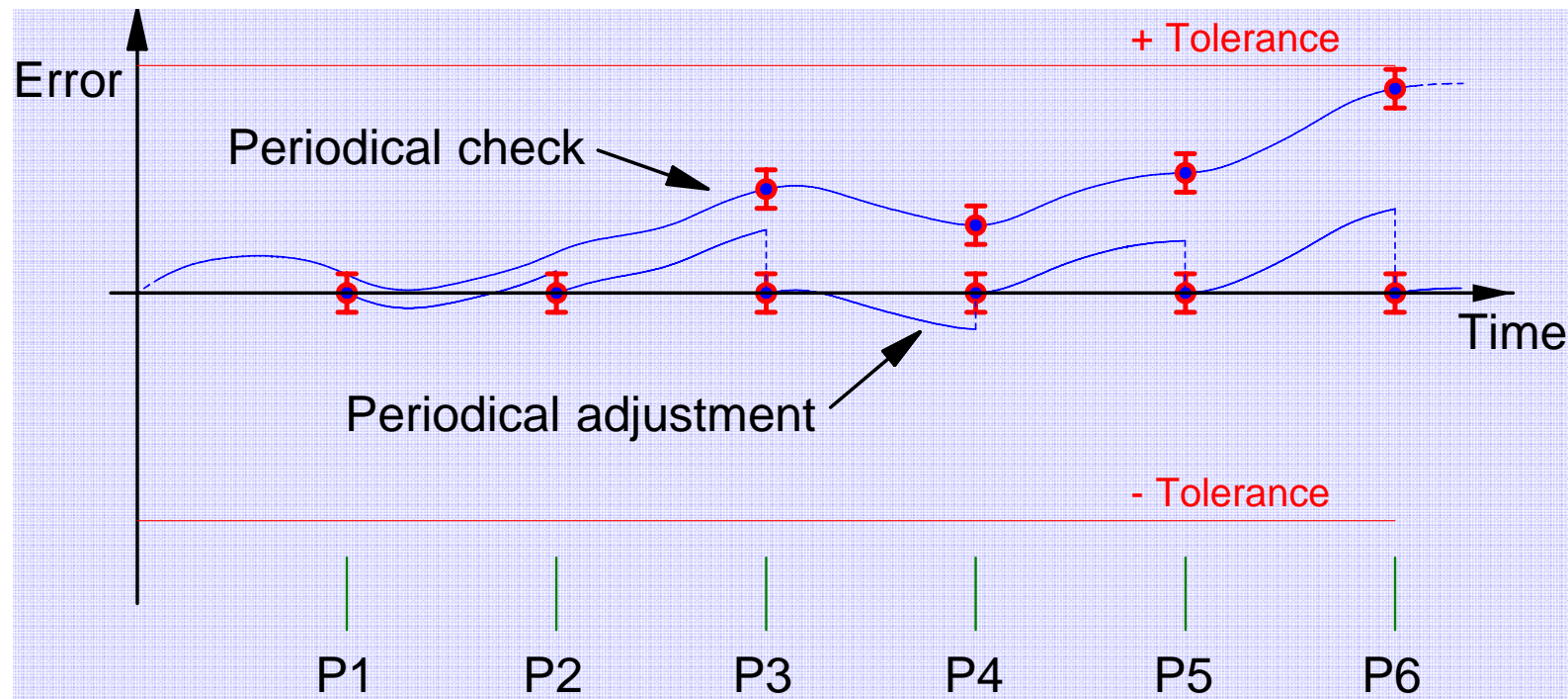


±0,05%

Promass 83/84F DN 08 – 250  
Option 0.05%

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# Narrow Tolerances



Change from “Periodical check“ to “Periodical adjustment“  
Time span from P to P = 2 weeks (diverter check)



# Calibration Intervals

- Very narrow tolerances for the whole system
- To be on the safe side, and until we have enough data to be sure how long we can finally extend calibration intervals, we remain within the two weeks.
- One calibration cycle takes between 6 and 8 hours
- Calibration, fully automatically over weekends



# Summary

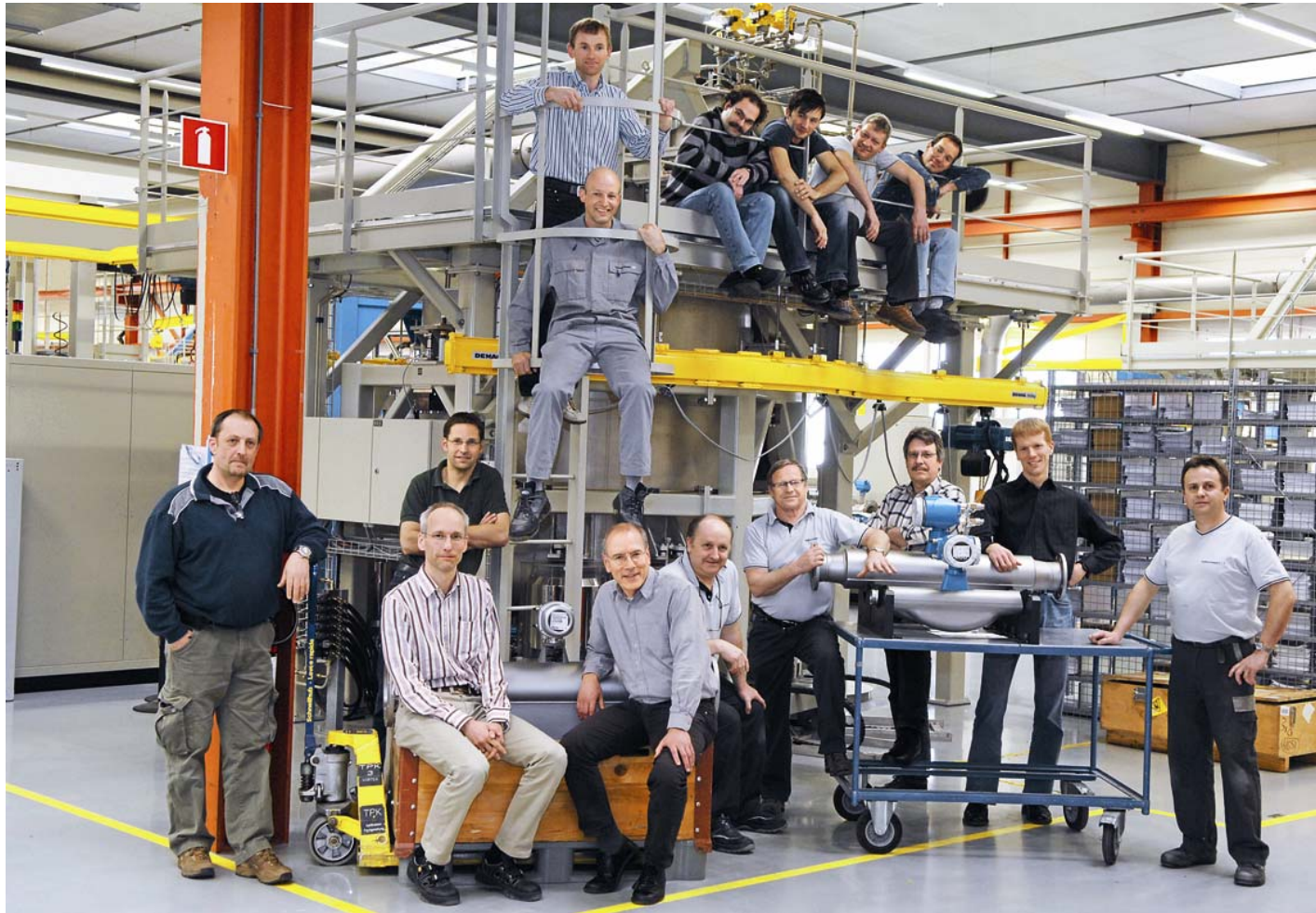
- Uncertainty of  $\pm 0.015\%$  is very demanding and ambitious
- Requirement of technical know how is high
- Calibration time of a flow meter (PremiumCal / Promass 83/84F +/- 0.05%), is twice as long as under standard calibration regime
- To guarantee the uncertainty over time is cost and time consuming
- The added value for the customer, **backed by standards**, justifies the big investment

# Endress+Hauser in Russia



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# Thanks for your attention!



**The  
Team!**

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