Process Instrumentation Training

Temperature Measurement

Endress+Hauser
People for Process Automation

Why Temperature Measurement ?

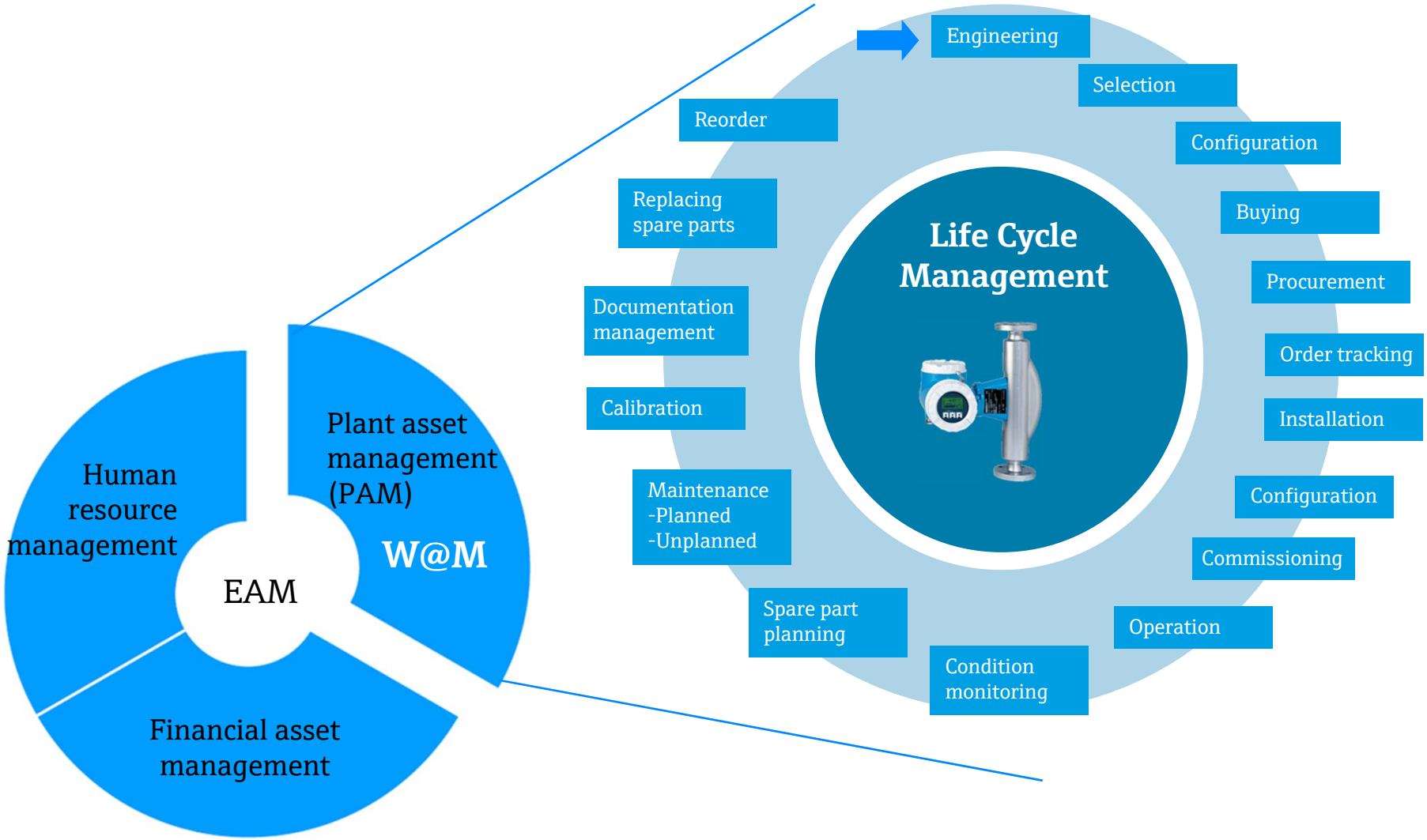
- Temperature is the most important parameter in the process industry

Temperature : Pressure	=	7 : 1
Temperature : Flow	=	14 : 1
Temperature : Level	=	2.3 : 1
Temperature : Conductivity	=	20 : 1

- Temperature is a **safety** relevant parameter

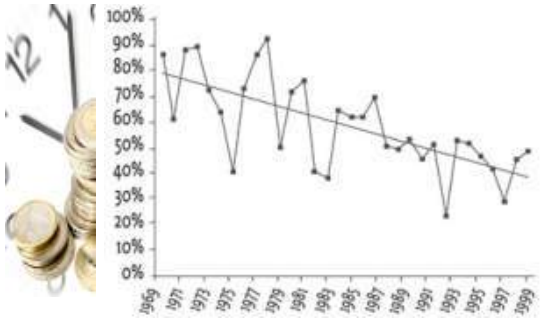
- Temperature is a **quality** relevant parameter

Why would you buy a temperature sensor from E+H?



Would you want this?

Improve the installed base management (time and costs)



Reduce internal workload and improve process quality

Information availability 24/7

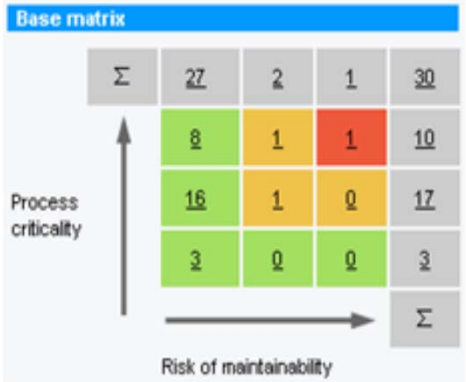
Easy and fast access to information and document 24/7

Would you want this?

Information traceability

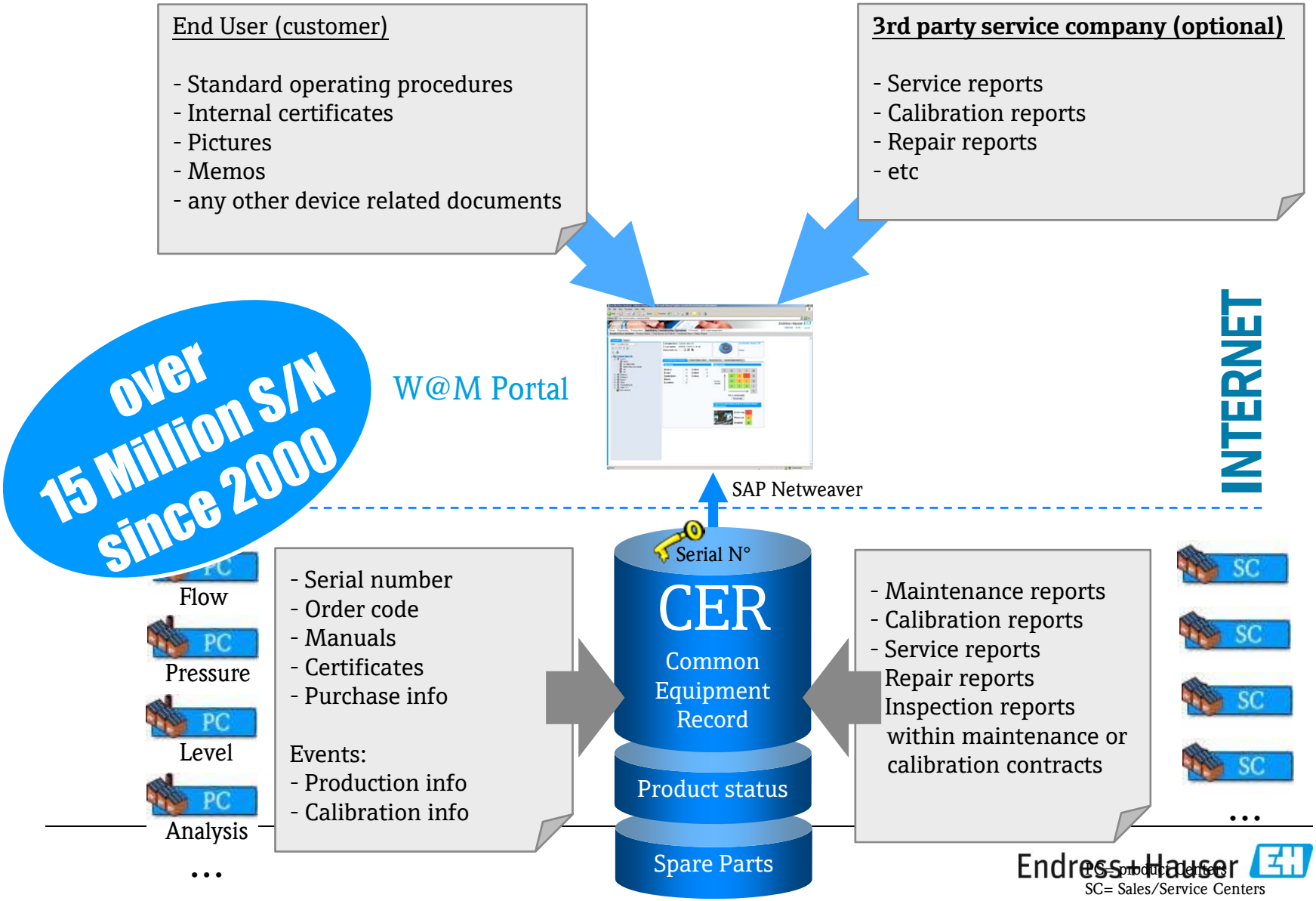
Logbook for traceability of calibration, repair and maintenance events

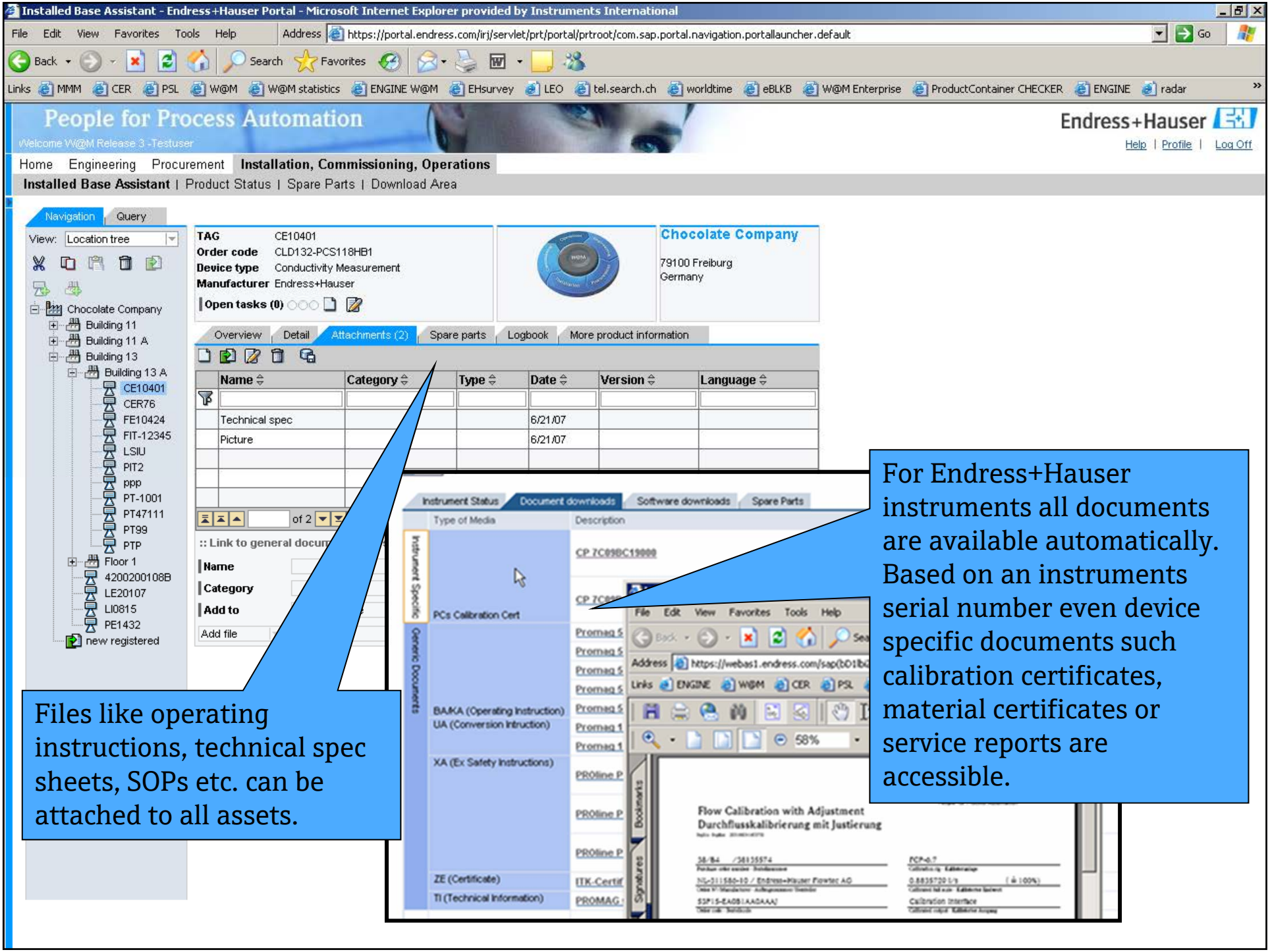
Quality Control



Analysis of critical measuring points and better spare part planning

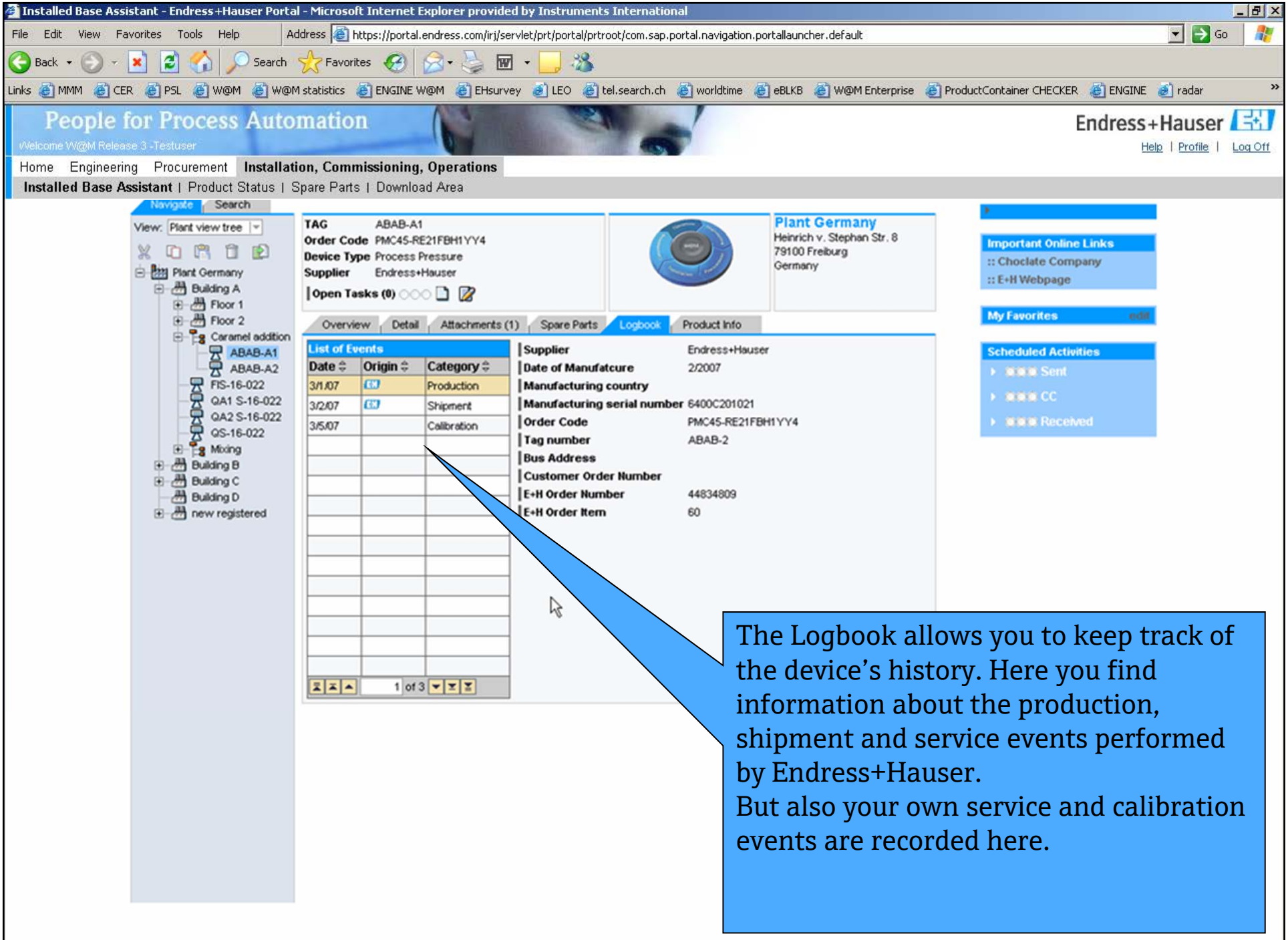
This is what you get out from E+H devices





Files like operating instructions, technical spec sheets, SOPs etc. can be attached to all assets.

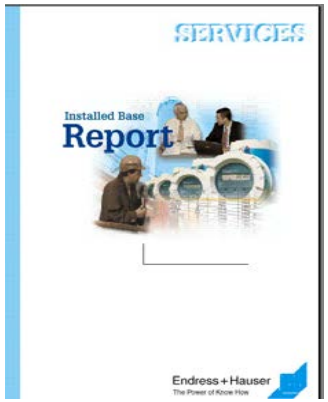
For Endress+Hauser instruments all documents are available automatically. Based on an instruments serial number even device specific documents such calibration certificates, material certificates or service reports are accessible.



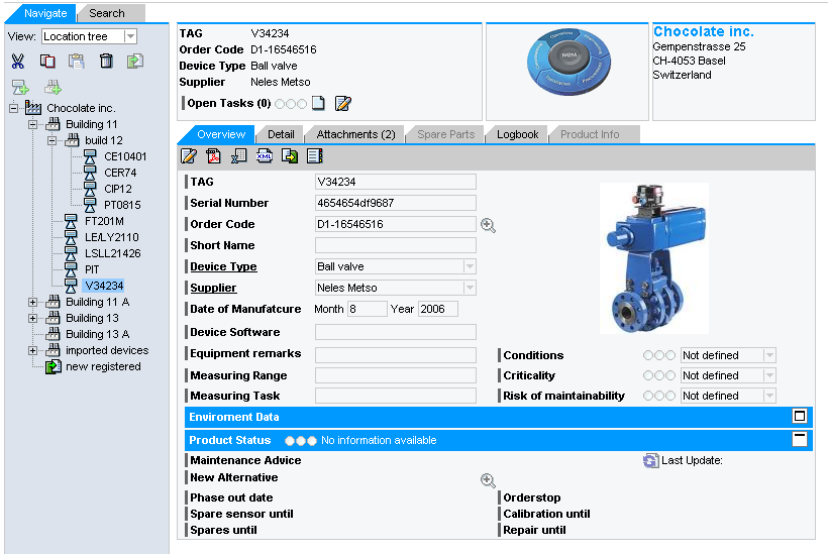
The Logbook allows you to keep track of the device's history. Here you find information about the production, shipment and service events performed by Endress+Hauser.
But also your own service and calibration events are recorded here.

W@M: Installed Base Audit

- Data is being presented in IBA report



- And data is made available in a W@M including 3rd party instruments.



Maintenance/Calibration Service

1

Creating service and calibration reports

2

Attaching documents to device in W@M

3

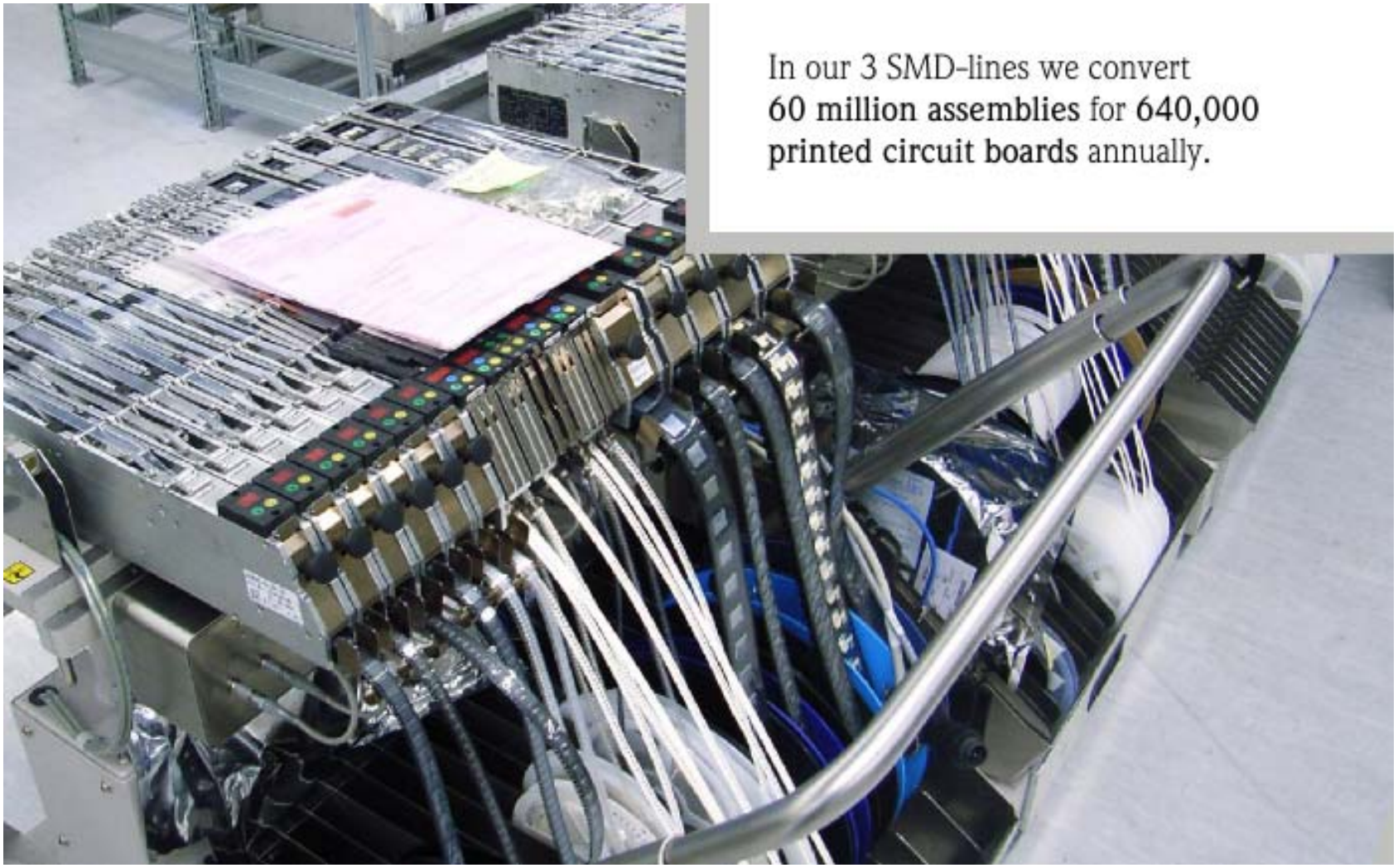
All data is available online

Introduction

Production Centers

Our Product Centers & Support Centers

Core Competence SMD Assembling



In our 3 SMD-lines we convert
60 million assemblies for **640,000**
printed circuit boards annually.

Core Competence Logistic

Kanban production:
Delivery performance >97%.
Order related production
2 to 4 working days.

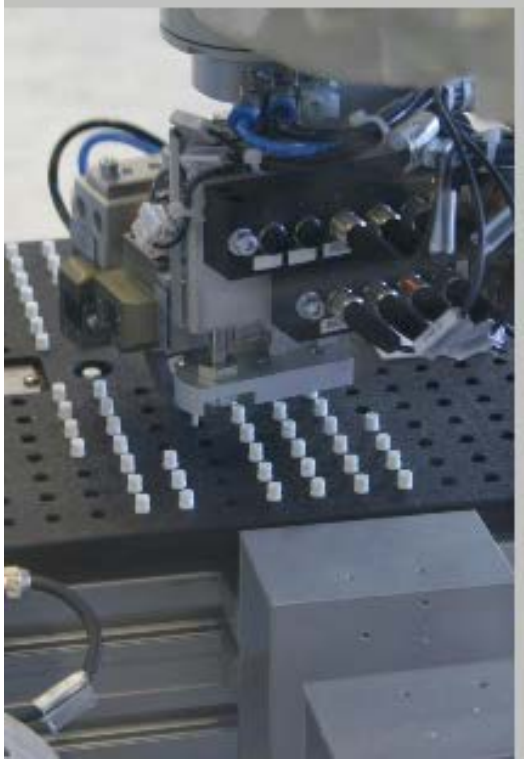
Core Competence Welding

Special welding procedures like oxyacetylene, WIG, plasma, MIG and MAG welding. **Certified welding experts and certified welding processes** ensure constant quality.

Core Competence Insert Production

Automated production of temperature measuring inserts

- >100,000 pieces per year
- Constantly high quality
- Extremely vibration resistant devices
- 100% traceability and individual testing



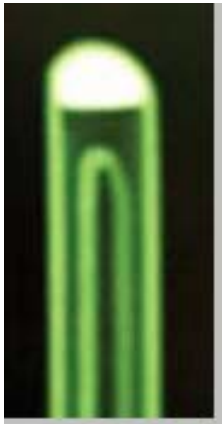
Core Competence Thermowell Production

Thermowells and process connections for industrial thermometers, custom-made and with very short delivery time.
We produce > **20,000 pieces/year**

Core Competence Test Center

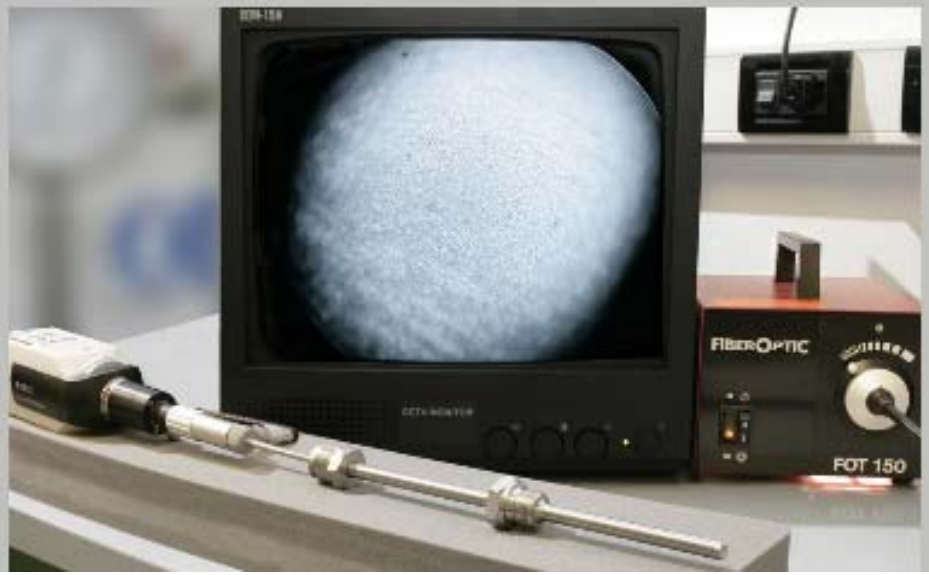
Extensive measurement and test **equipment** are available for safeguarding the quality and continuous optimization of the thermometers, thermowells and transmitters.

Core Competence Test Center



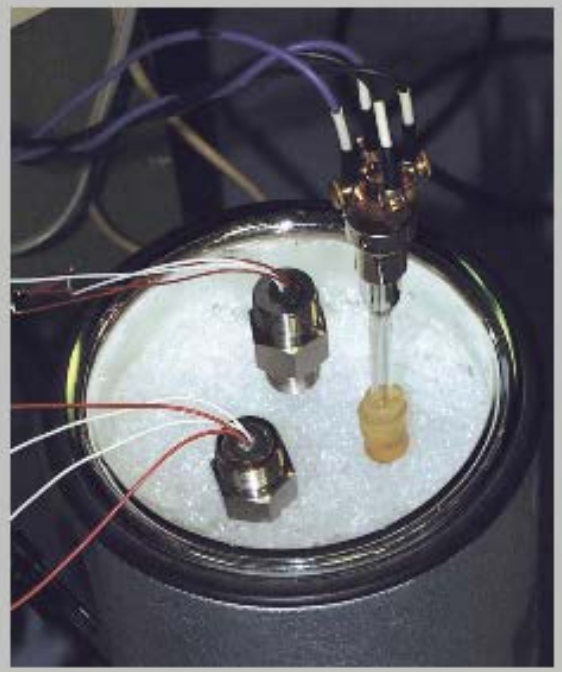
Metallurgical and non-destructive material testing

TEST TYPE	EQUIPMENT TYPE
PMI positive material identification	X-ray fluorescence type
Ferrite content analysis	Induction type (resolution 0.01%)
Helium leakage test	Mass spectrometry type
Endoscopic investigation	Optical fiber (minimum dia. 5mm)
X-Ray	3-D Inspection



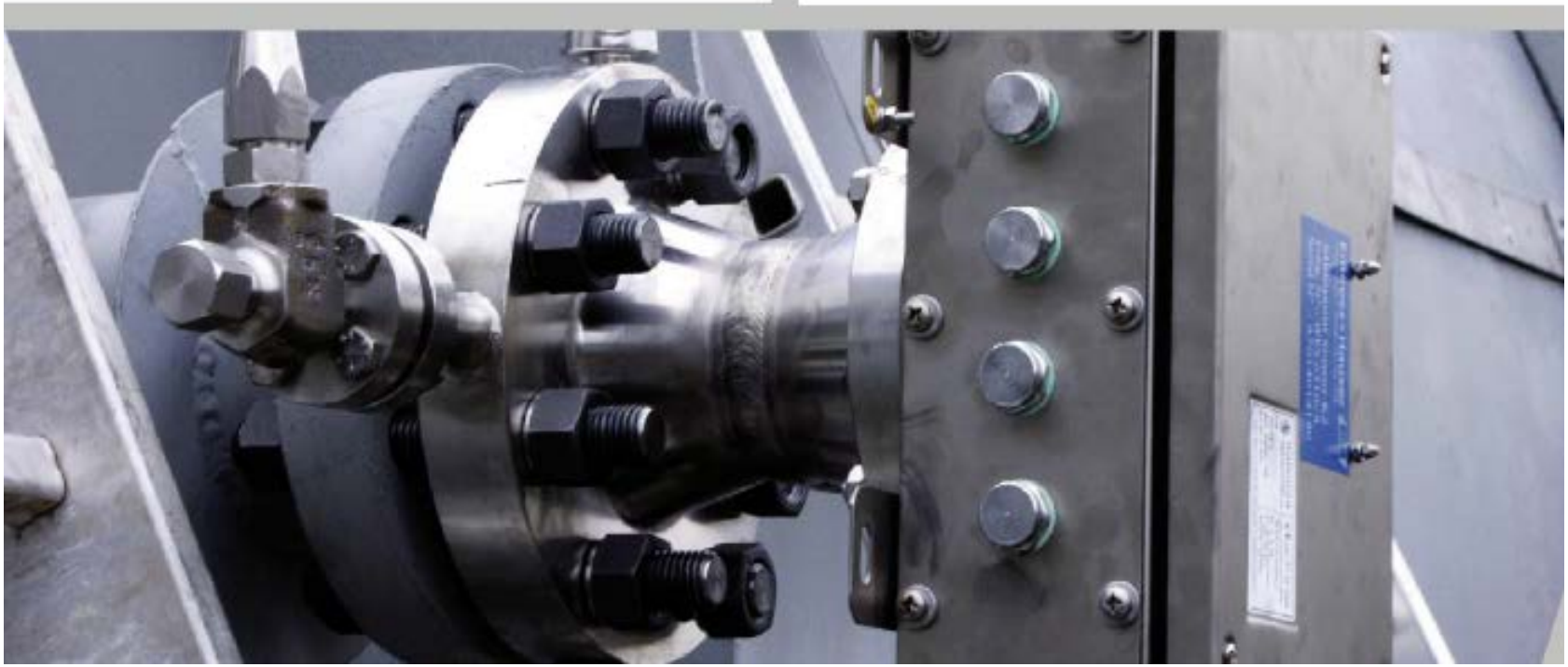
Core Competence Calibration Laboratory

DKD/SIT accredited laboratories for temperature allow for the calibration of contact thermometers at highest accuracy: **0.002 K**
Calibrations according to national standards and the international temperature scale ITS90.



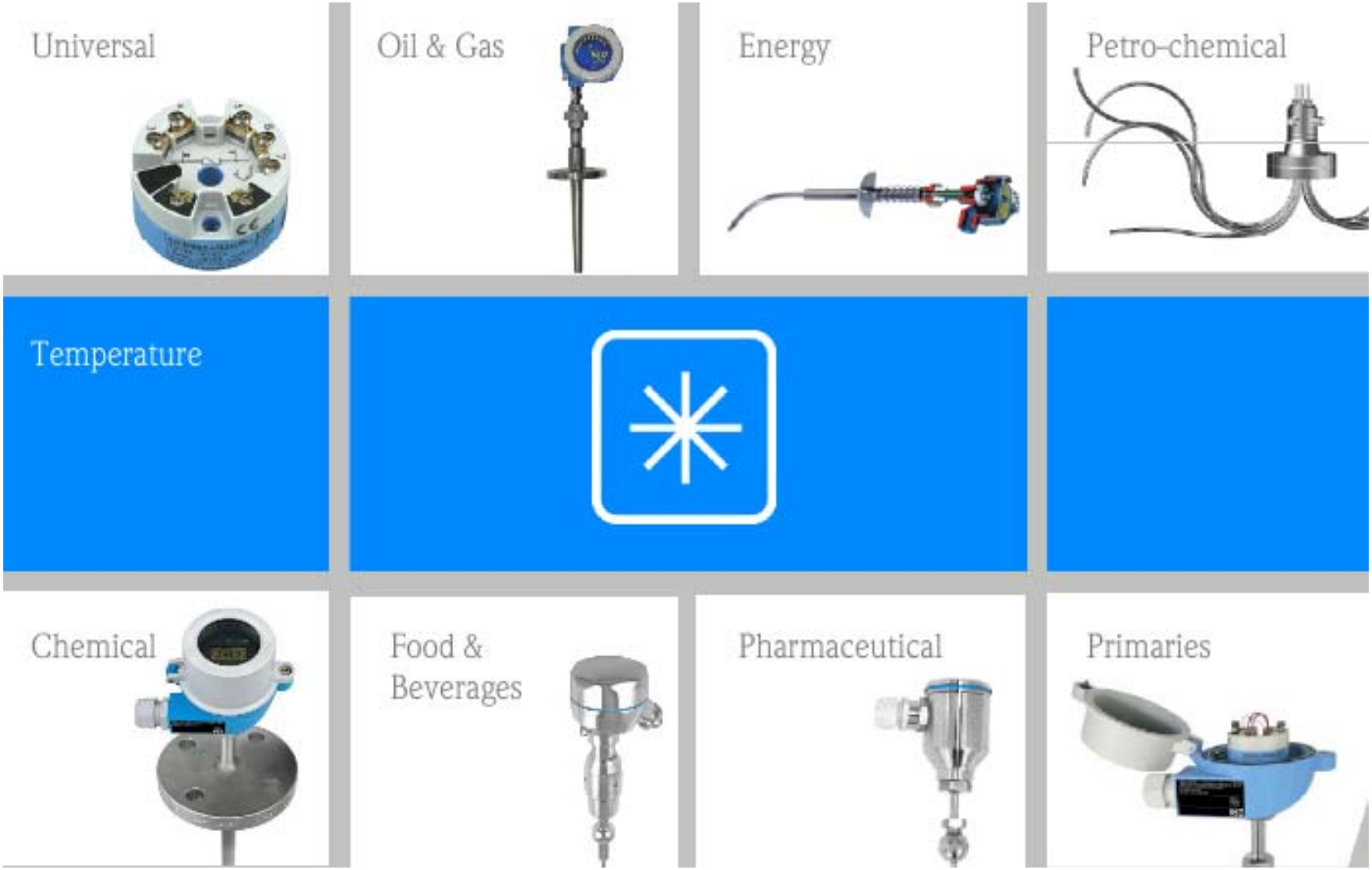
Core Competence Engineered Solutions for Temperature

A team of experts develops and maintains customized solutions from the offer to the installation – worldwide.



Temperature Transmitters & Thermometers

Temperature Transmitters & Thermometers - Industries



Data Managers, Recorders, Data Loggers & Software

Graphic Data Managers

Videographic Recorders

Hybrid Recorders

Paper Recorders

Recording

Data Loggers

Software OPC Server

Software ReadWin2000®

Visualizing Software FDM

Energy Managers & Components

Basic Principle

Temperature

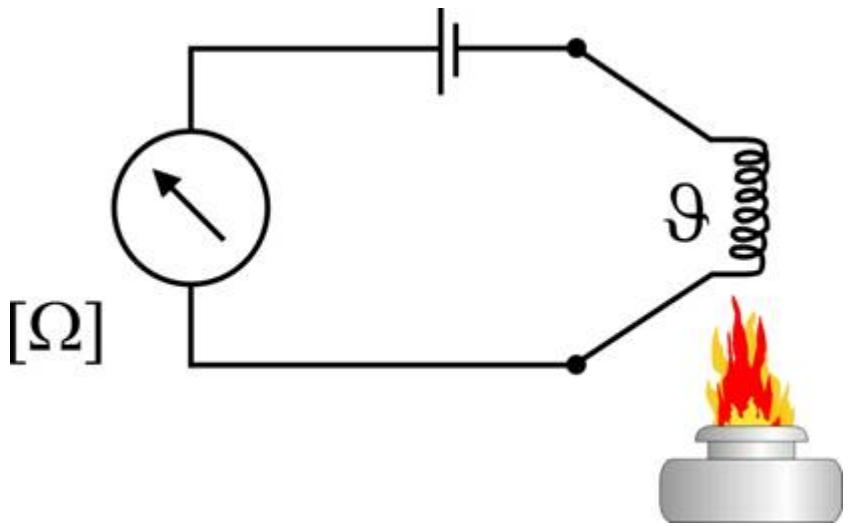
Basic physics

- What are the 2 most popular principles to measure temperature?
  - **R**esistance **T**emperature **D**etector
  - **T**hermo**c**ouples

- Other types of temperature sensors used in industry:
  - Thermistor
  - Infrared

Basic physics - Resistance Temperature Detector (RTD)

- RTD – Resistance Temperature Detector



- A RTD changes its resistance value proportional to the temperature!

- A Pt100 is a “PTC” resistance with “Positive Temperature Coefficient”

Basic physics - Resistance Temperature Detector (RTD)

What does **Pt100** mean?

“Pt“ means “Platinum”

“100“ means “100 Ω” at “0°C”

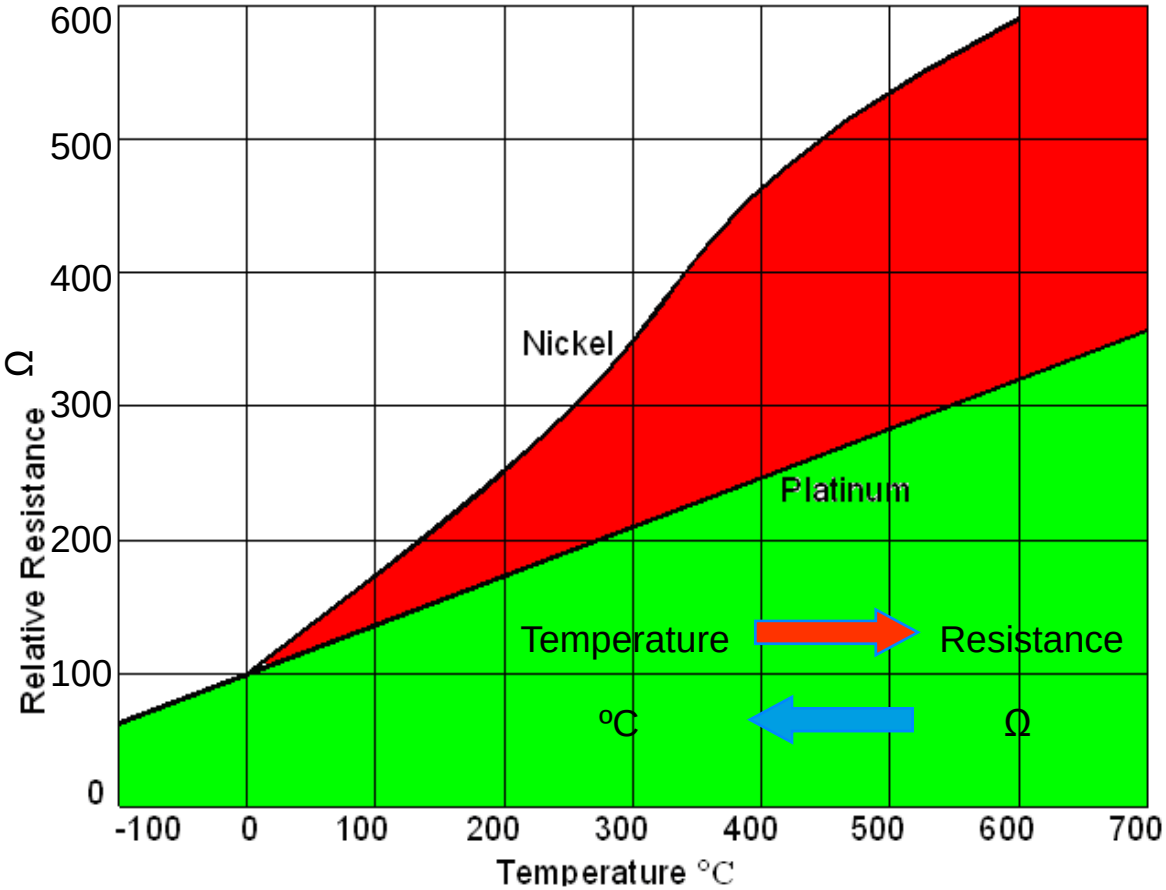
What does **Pt50** mean?

“50“ means “50 Ω” at “0°C”

Basic physics - Resistance Temperature Detector (RTD)

Reference standard for RTD: EN 60751 Temperature / Resistance relationship 1°C = 0.385 Ohm

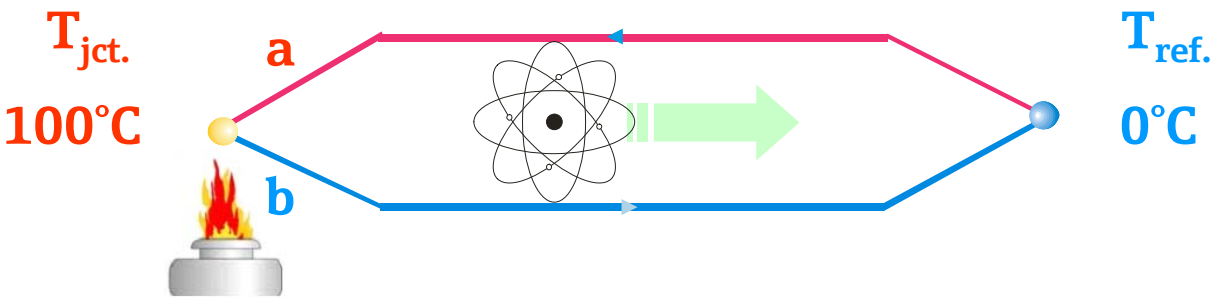
Copper or Nickel have restricted ranges because of non-linearities and wire oxidation problems in the case of Copper.



Basic physics – Thermocouple (TC)

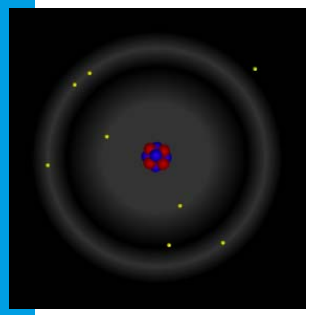
$T_{jct.} \neq T_{ref.}$ ⇒ **EMF** (Electromotive Force)

Metal a ≠ b

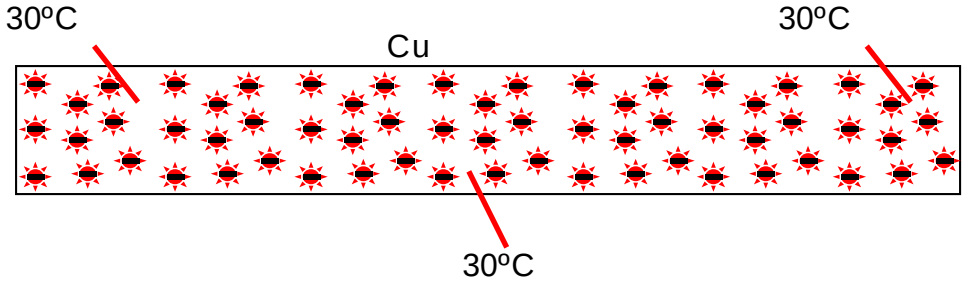


SEEBACK EFFECT
If the conductors' metal is not the same and if the two junctions are at different temperatures, between them a voltage is generated, and hence an electric current flows in the circuit.

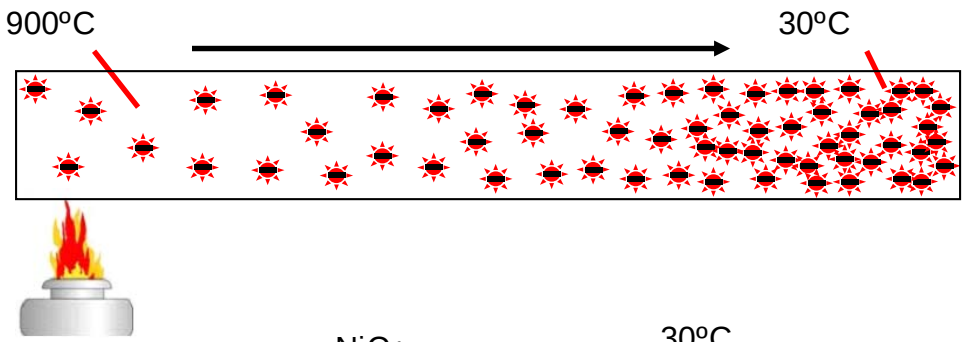
Basic physics – Thermocouple (TC)



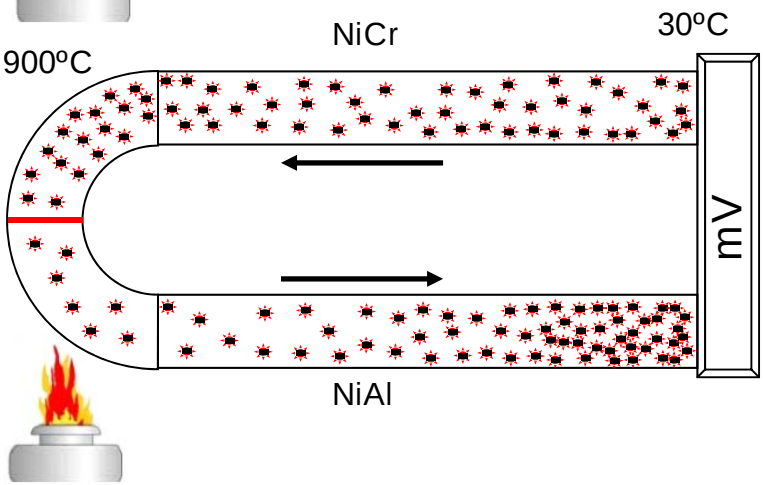
ATOM



Uniform electrons distribution for a homogeneous temperature distribution in a conductor



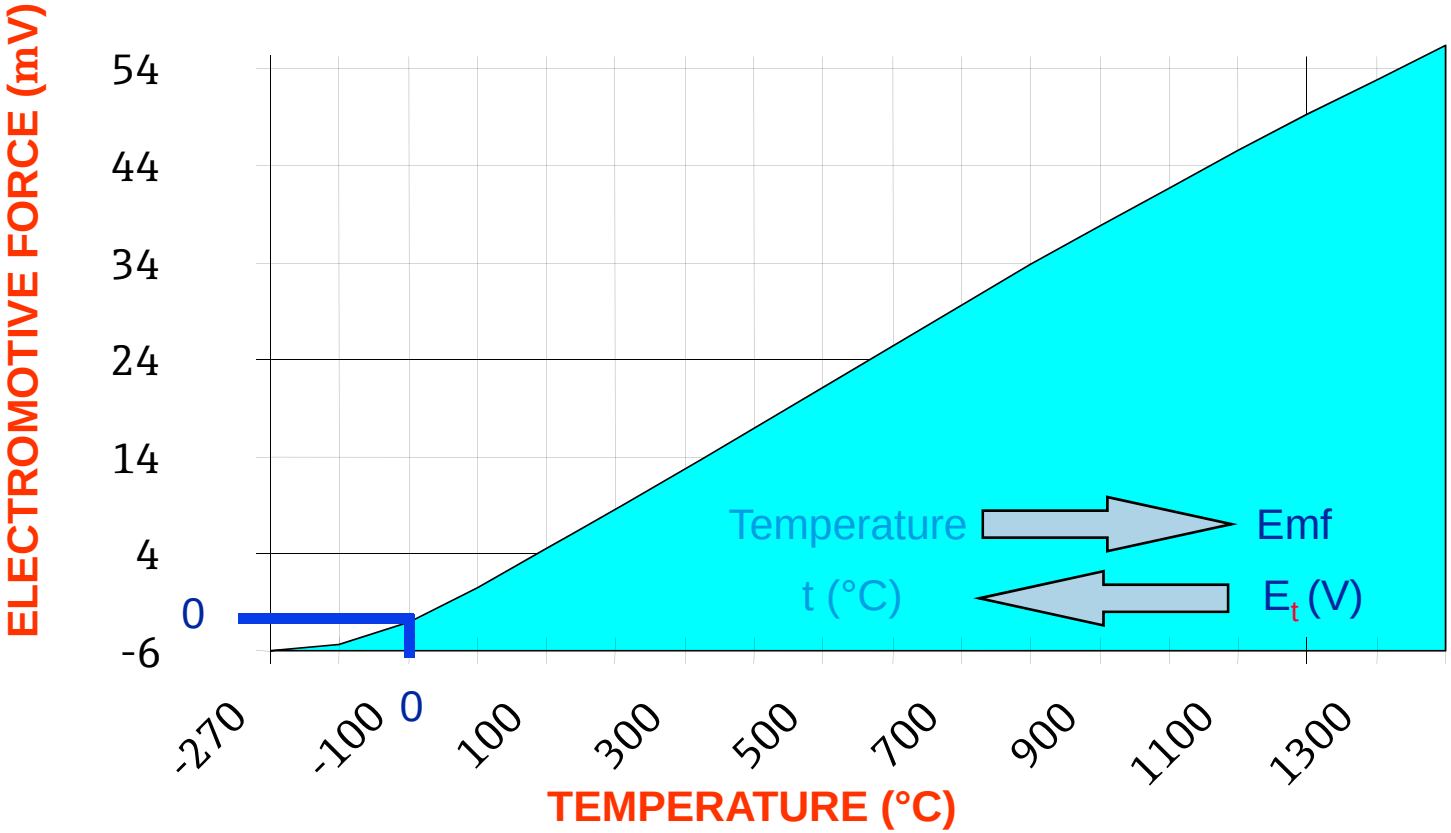
Electron depletion at the hot end



Dissimilar electron concentration in the circuit consisting of two different conductors

Basic physics – Thermocouple (TC)

Reference standard: IEC 584
TC type K - Temperature / EMF relationship



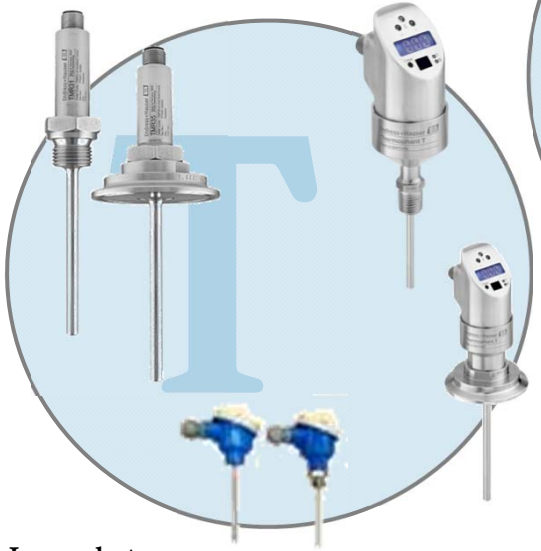
Operation

Temperature

Filled product basket

Measurement range and segmentation

The right portfolio for
- all industries
- all main process applications
- every budget



Low duty
Low cost, standard applications and models

Medium duty
Food & sanitary
Light chemical
Pipe thermowells (DIN std)
Head transmitters
Intrinsic safety

Heavy duty
Oil & Gas, Energy
Bar stock T-wells
Field TMT HART
Explosion proof

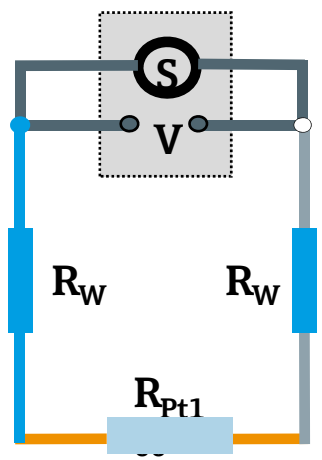
®

Wiring - Resistance Temperature Detector (RTD)

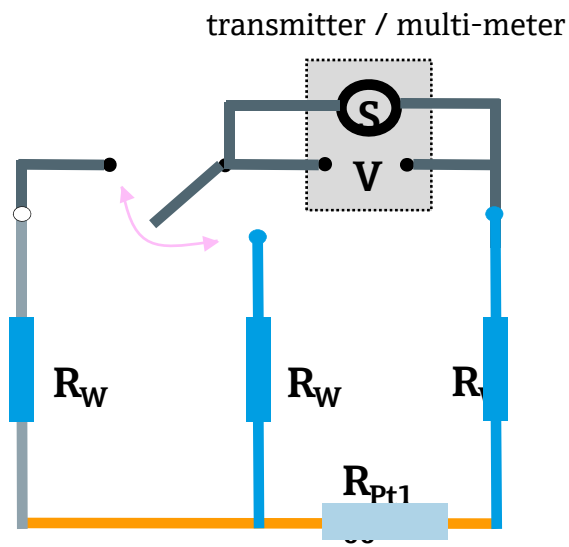
Used where lead length is short. There is no compensation for resistance of lead wires.

Most common type of RTD assembly. Typically connected to standard bridge circuit, which allows lead wire resistance to be compensated.

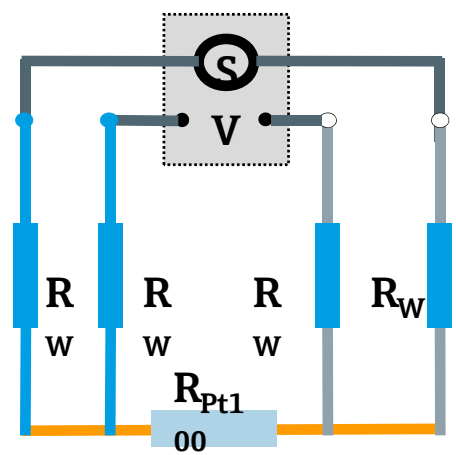
Where higher accuracy is demanded. Lead wire resistance errors are eliminated in this configuration by measuring the voltage across the RTD element supplied with a constant current.



2 wire configuration



3 wire configuration



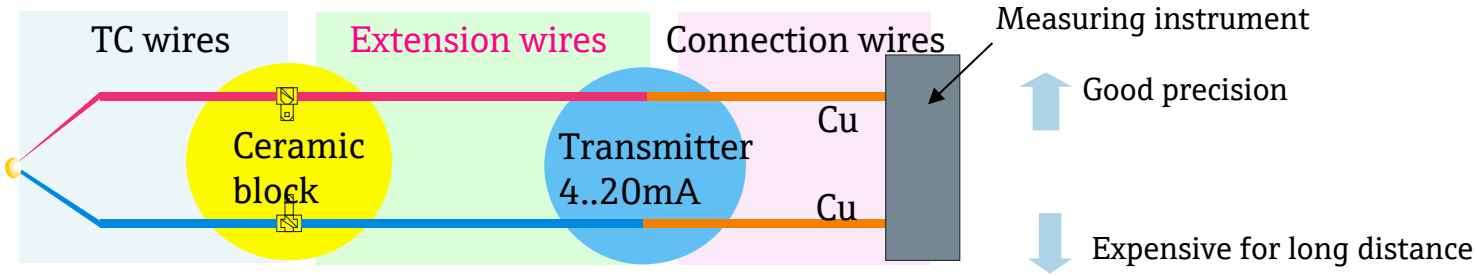
4 wire configuration

Basic physics - Resistance Temperature Detector (RTD)
Reference resistance value of Pt100

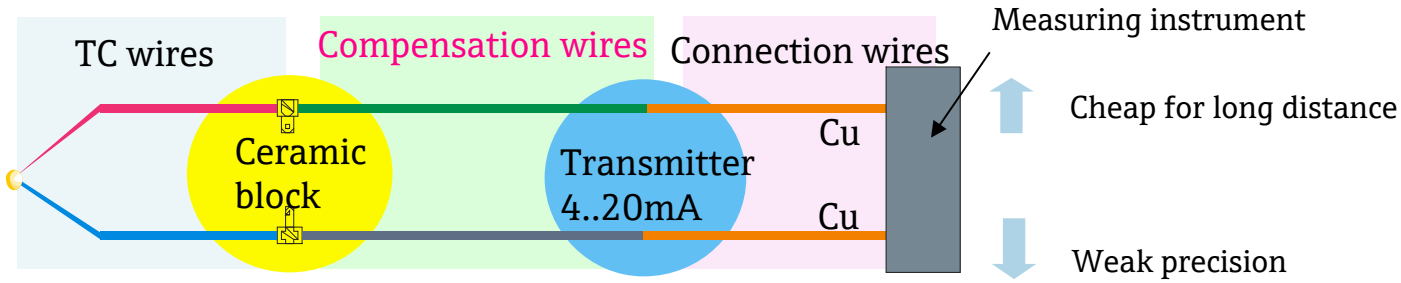
PT100 Resistance Table

°C	0	1	2	3	4	5	6	7	8	9	°C
-200.00	18.52										-200.00
-190.00	22.83	22.40	21.97	21.54	21.11	20.68	20.25	19.82	19.38	18.95	-190.00
-180.00	27.10	26.67	26.24	25.82	25.39	24.97	24.54	24.11	23.68	23.25	-180.00
-170.00	31.34	30.91	30.49	30.07	29.64	29.22	28.80	28.37	27.95	27.52	-170.00
-160.00	35.54	35.12	34.70	34.28	33.86	33.44	33.02	32.60	32.18	31.76	-160.00
-150.00	39.72	39.31	38.89	38.47	38.05	37.64	37.22	36.80	36.38	35.96	-150.00
-140.00	43.88	43.46	43.05	42.63	42.22	41.80	41.39	40.97	40.56	40.14	-140.00
-130.00	48.00	47.59	47.18	46.77	46.36	45.94	45.53	45.12	44.70	44.29	-130.00
-120.00	52.11	51.70	51.29	50.88	50.47	50.06	49.65	49.24	48.83	48.42	-120.00
-110.00	56.19	55.79	55.38	54.97	54.56	54.15	53.75	53.34	52.93	52.52	-110.00
-100.00	60.26	59.85	59.44	59.04	58.63	58.23	57.82	57.41	57.01	56.60	-100.00
-90.00	64.30	63.90	63.49	63.09	62.68	62.28	61.88	61.47	61.07	60.66	-90.00
-80.00	68.33	67.92	67.52	67.12	66.72	66.31	65.91	65.51	65.11	64.70	-80.00

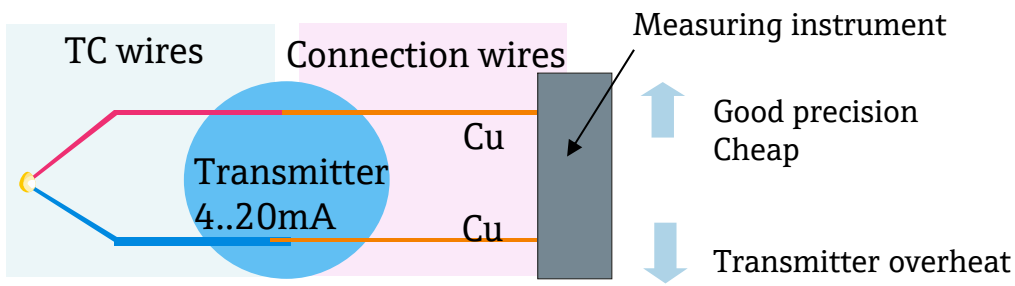
Thermocouple (TC) – Extension/Compensation Cables



Extension wires must be of the same alloy type as the TC



Compensation wires generate an EMF similar to TC (limited temp. range)

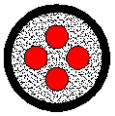
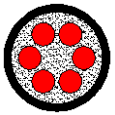


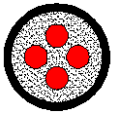
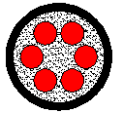
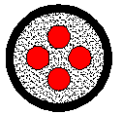
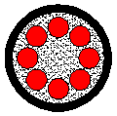
Thermocouple (TC) – Extension/Compensation Cables International Insulation Colour Codes

INSULATION COLOR CODES

	JAPAN JIS(DIV.2) C1610-1995	U.S.A ASTM E230	U.K. BS 1843-1961	GERMANY DIN 43714	FRENCE NF NFE 18001	INTERNATIONAL IEC 584-3 (JIS DIV.1)
B	Red + / White − / Gray	Gray + / Red − / Gray		Red + / Gray − / Gray		Gray + / White − / Gray
R & S	Red + / White − / Black	Black + / Red − / Green	White + / Blue − / Green	Red + / White − / White (Ex only)	Yellow + / Green − / Green (Ex only)	Orange + / White − / Orange
N		Orange + / Red − / Orange	Orange + / Blue − / Orange			Pink + / White − / Pink
K	KX: Red + / White − / Blue	KX: Yellow + / Red − / Yellow	KX: Brown + / Blue − / Red	KX: Red + / Green − / Green	KX: Yellow + / Purple − / Yellow	KX: Green + / White − / Green
	WX: Red + / White − / Blue				WX: Yellow + / White − / White	WX: Green + / White − / Green
	VX: Red + / White − / Blue		VX: White + / Blue − / Red		VX: Yellow + / Brown − / Red	VX: Green + / White − / Green
E	Red + / White − / Purple	Purple + / Red − / Purple	Brown + / Blue − / Brown	Red + / Black − / Black		Purple + / White − / Purple
J	Red + / White − / Yellow	White + / Red − / Black	Yellow + / Blue − / Black	Red + / Blue − / Blue	Yellow + / Black − / Black	Black + / White − / Black
T	Red + / White − / Brown	Blue + / Red − / Blue	White + / Blue − / Blue	Red + / Brown − / Brown	Yellow + / Blue − / Blue	Brown + / White − / Brown

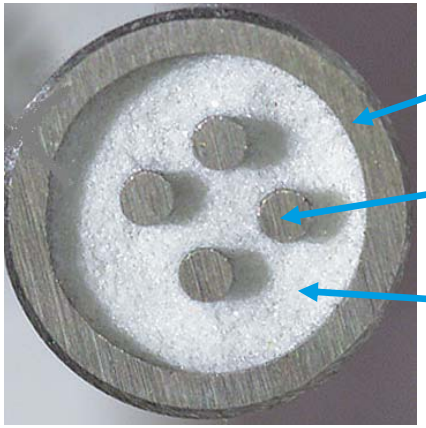
Number of Conductors (TC)/ Wires (RTD)

Thermocouple Number of Conductors		
Single Pair	2 Conductors	
Dual Pair	4 Conductors	
Triple Pair	6 Conductors	

RTD Number of wires			
Wiring System	Single	Double	Triple
2			✗
3			✗
4			✗

Ø8mm sheath (standard thickness, 1.02mm)

Ø8mm sheath (special thickness, 1.9mm)

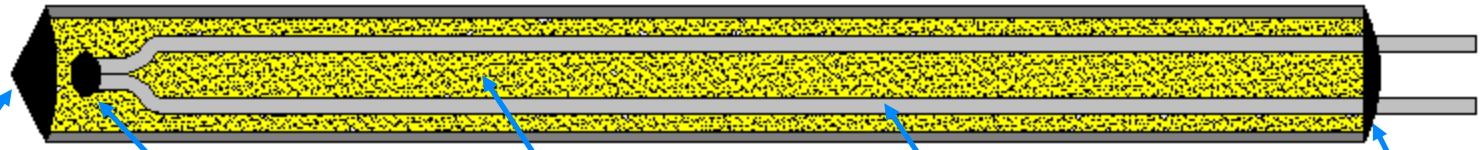


Advantages, Features & Benefits

Temperature

Mineral Insulated Cable (MgO) type Sensors – Basic Construction

THERMOCOUPLE



Tip Closing By Welding

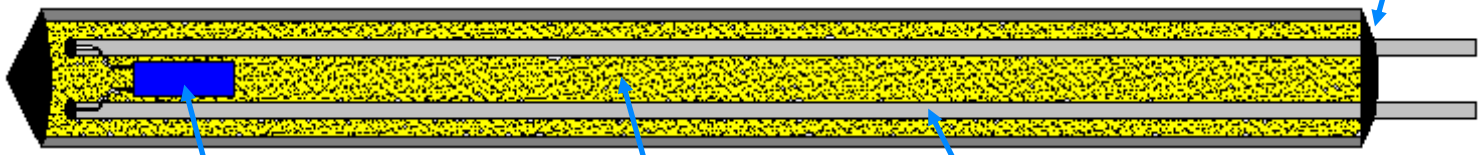
Hot Junction By Welding

MgO Powder For Insulation

Thermocouple Wire

Epoxy Seal

RTD



RTD Sensor Bulb Welded to Ni Wire

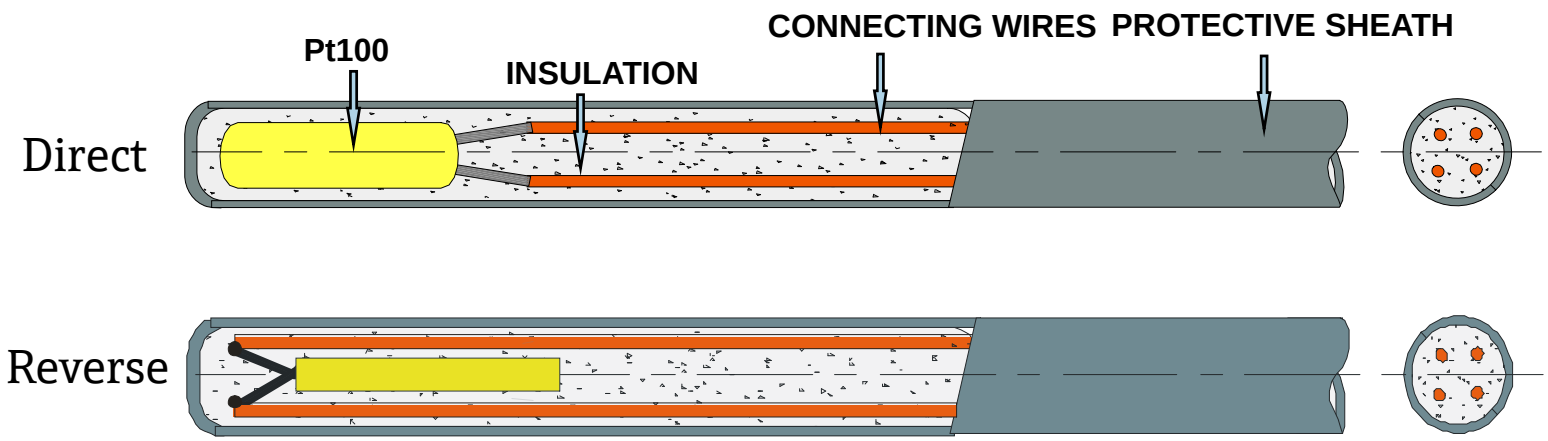
MgO Powder For Insulation

Lead wire, Nickel

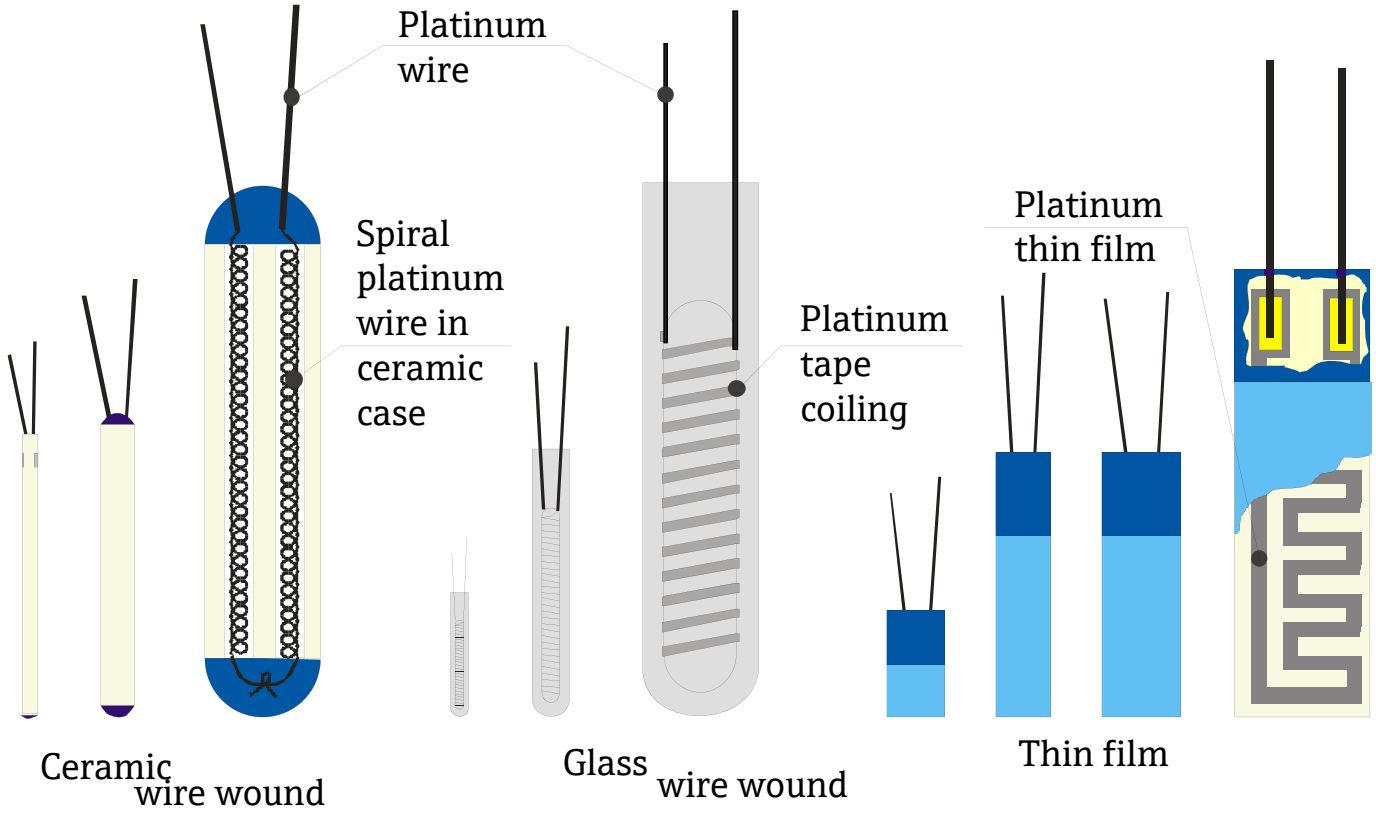
Temperature Sensor Assembly RTD – Inset

The inset:

protects from shocks and humidity
allows the insertion in the process
insulation **prevents** short circuits



RTD – PT100 Sensor Elements

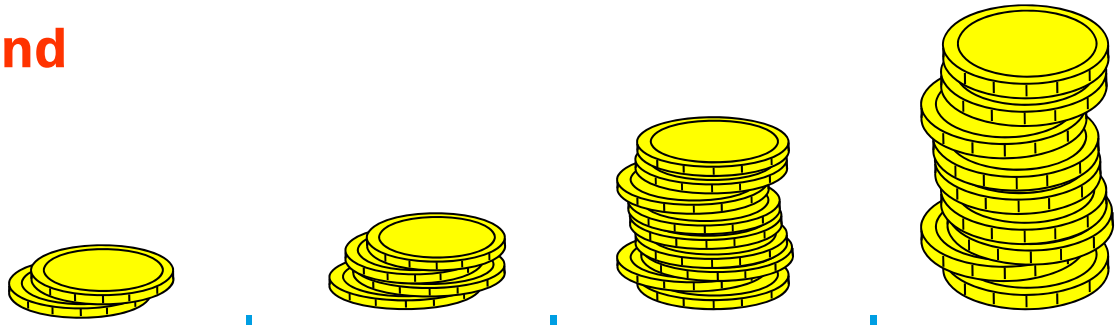


RTD – PT100 Sensor Elements

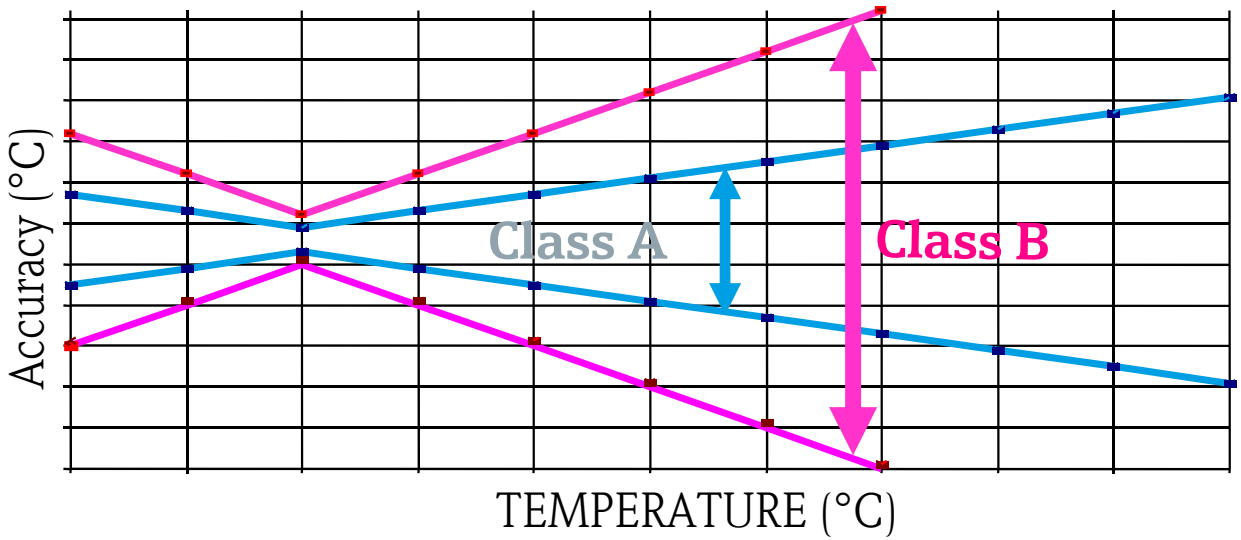
Type	Ceramic	Glass	Thin film
Temperature	-200..600°C	-50..450°C	-50..400°C

Basic physics - Resistance Temperature Detector (RTD)

Tolerance Band



Class	B	A	1/3B	1/10B
Pt100	0.3+0.005*|t|	0.15+0.002*|t|	0.1+0.00167*|t|	0.03+0.0007*|t|



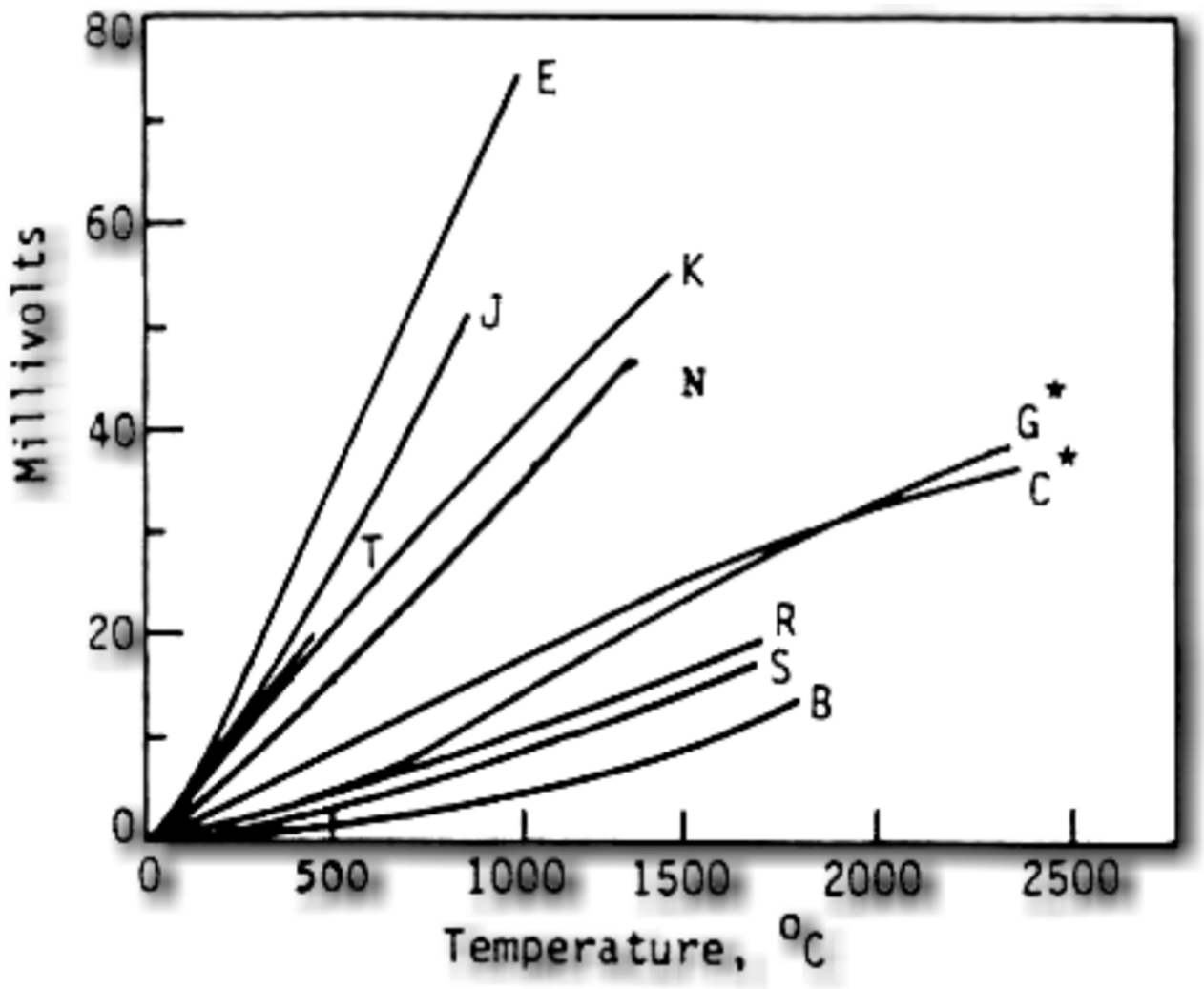
Thermocouple (TC) – Junction Types

Ungrounded
(Insulated)

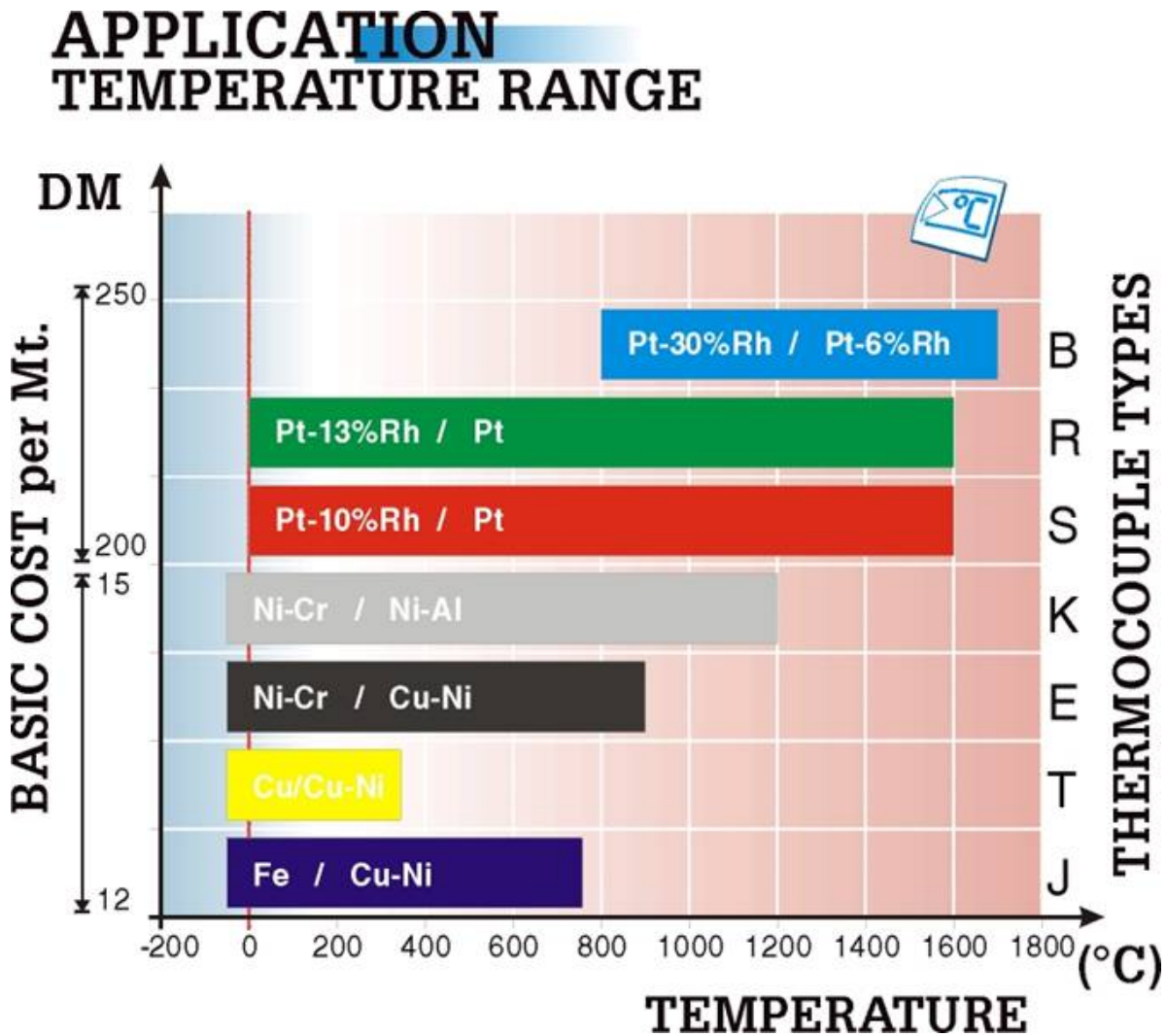
Grounded

Exposed

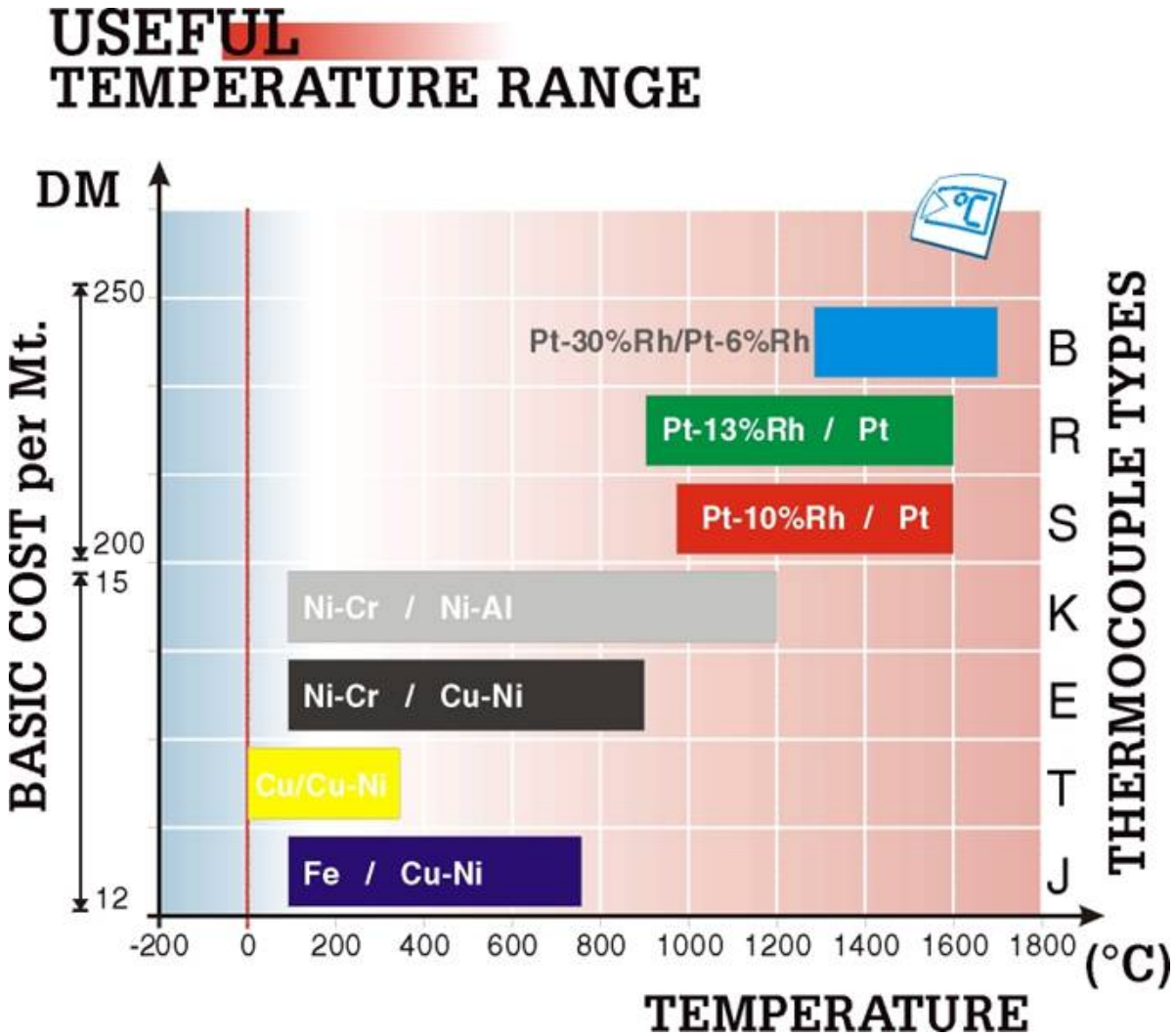
Thermocouple (TC) – Temperature / EMF Relationships



Thermocouple (TC) – Application Temperature Range



Thermocouple (TC) – Useful Temperature Range



Combination of Thermocouple Wires

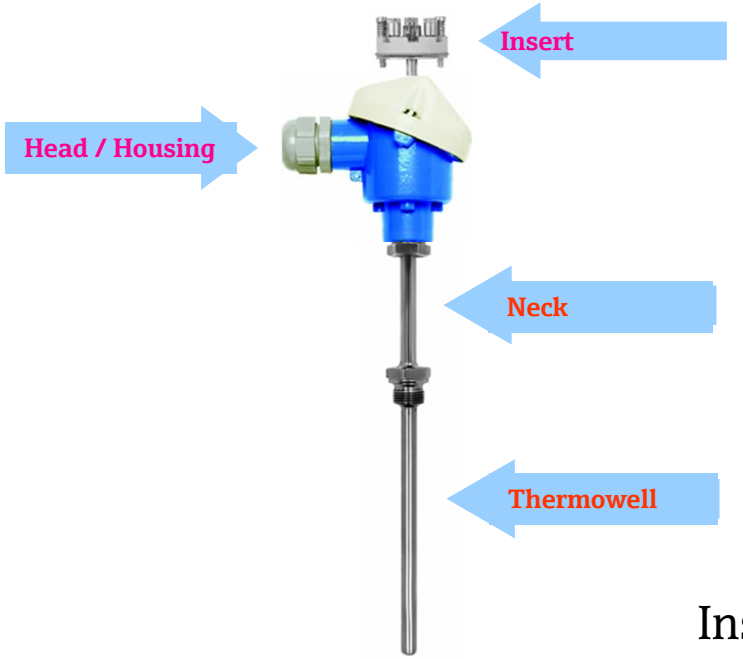
	Type	Old JIS Type	Combination of Element Wires	
			Positive (+) Leg	Negative (-) Leg
Noble Metals	B		70% Platinum * 30% Rhodium	94% Platinum * 6% Rhodium
	R		87% Platinum * 13% Rhodium	100% Platinum
	S		90% Platinum * 10% Rhodium	100% Platinum
Base Metals	K	CA	Chromel** (90%Ni * 10%Cr)	Alumel** (95%Ni * 2%Mn * 2%Al)
	E	CRC	Chromel** (90%Ni * 10%Cr)	Constantan (55%Cu * 45%Ni)
	J	IC	99.5% Iron	Constantan (55%Cu * 45%Ni)
	T	CC	100% Copper	Constantan (55%Cu * 45%Ni)
	N		Nicrosil (84%Ni * 14.2%Cr * 1.45%Si)	Nisil (95%Ni * 4.4%Si * 0.15%Mg)

Note:

** Chromel and Alumel are the registered trade marks by Hoskins Mfg., Co. USA.

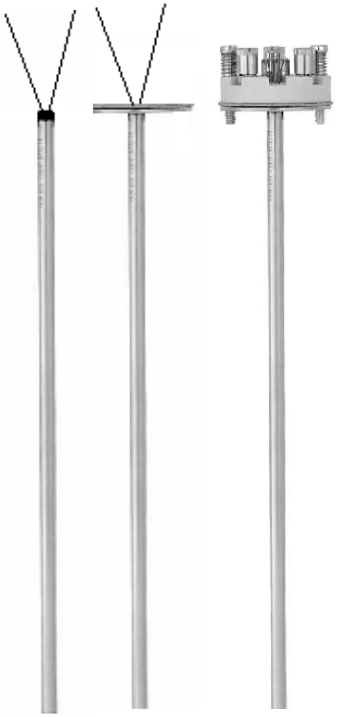
Temperature Sensor Assembly

Metallic Inset TC – RTD



Transmitter

Housing



Insert

Thermowell

T-class example: TMR3x - compact and economic

Outstanding price/performance ratio

Material SST 316L, roughness Ra < 0,8um

With or without integrated transmitter
accuracy 0.1 K

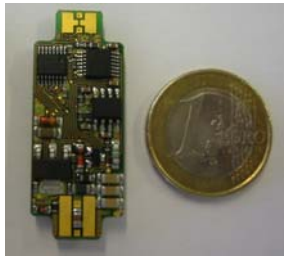
Sensor Pt100/4-wire class A to EN 60751

Versions: Without thread or 1/2”G, 1/4” NPT,
Clamp 1”, DIN11851, Varivent DN32, M/M)

Cost saving in stock keeping
PC programmable electronic
for Pt100 -50 to 200°C

Fast and precise setup by ReadWin2000
(M12 connector - no additional power supply)

Failure information to NAMUR NE 43



M-class example: TR4x - the hygienic line

Wide range of process connections

- Ingold, Varivent, SMS, ISO2852 clamp, Triclamp, Dairy DIN 11851/11864,...

Flexible dimensioning and material finishing

- Neck length, immersion length or pipe diameter
- SS316L / 1.4435 with Ra <0,4 um (electropolished)

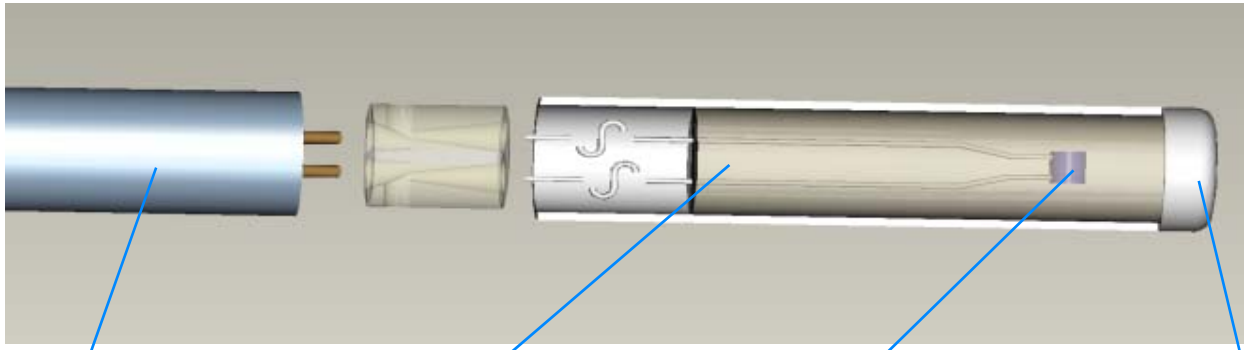
Different tip designs for fast response

- straight, reduced or tapered tip

Inset

- ATEX certification (1 GD)
- High accuracy: minimum Pt100 Class A acc. EN 60751
- Pt100 thin film: 3mm or 6mm

New Unique Insert – TS101



Specification:

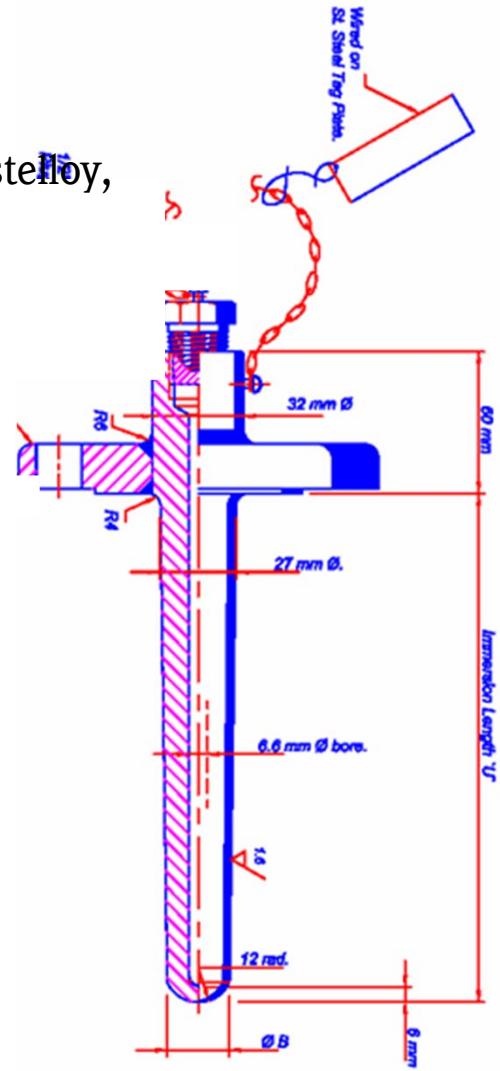
Diameter:	Ø6 mm
Sensor type:	1xPt100
Model:	Thin film (TF)
Range:	-50…500 °C
Accuracy:	class A, (450°C); class AA (250°C) acc. IEC60751
Wiring:	4-wire
Max. length:	970mm
Vibration:	60g acc. IEC
Response t90:	8s

TS101 – Advantages in a glance

Properties	Pros	Benefit
High vibration resistance 60g acc. IEC60751 with parallel wide temperature range	No damaging of the sensor element in a wide temperature range	Safe and reliable measurement result
Fast response time t_{90}= 8 s	Fast reaction at temperature changes	High process stability
100% traceability due to automated production	Reproduceable product properties	Stable product quality
Several improvements at the terminal block	Fix mechanical and electrical connection	Reliable connections and improved measurement performance

S-class example: TMT162x – rugged barstock thermowell

- Complete thermowell basket available as spare parts
- Wide range of steel grades available (e. g. Hastelloy, Duplex, Titanium, Tantalum, Zirconium,….)
- Stress calculation and individual thermowell design



Thermowell – Important differences

Bar stock Thermowells

- Weld in
- Threaded
- Flanged

Pipe Thermowells

- Flange with neck
- Threaded with neck
- Threaded without neck
- Thermowell with compression fitting

Thermowell (Tubular / Pipe)- Tip Profile

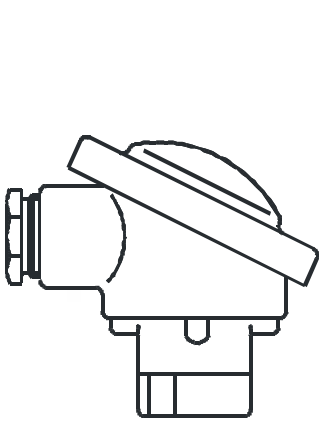
Straight

Tapered

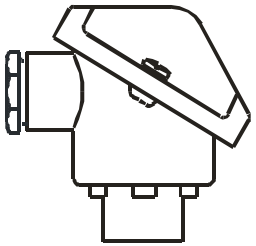
Reduced

Form	Manufacturing	Inset replaceable	Pressure resistance	Insert length
Tapered	formed	yes	high	> 65mm
Reduced	**welded**	yes	low	> 30mm

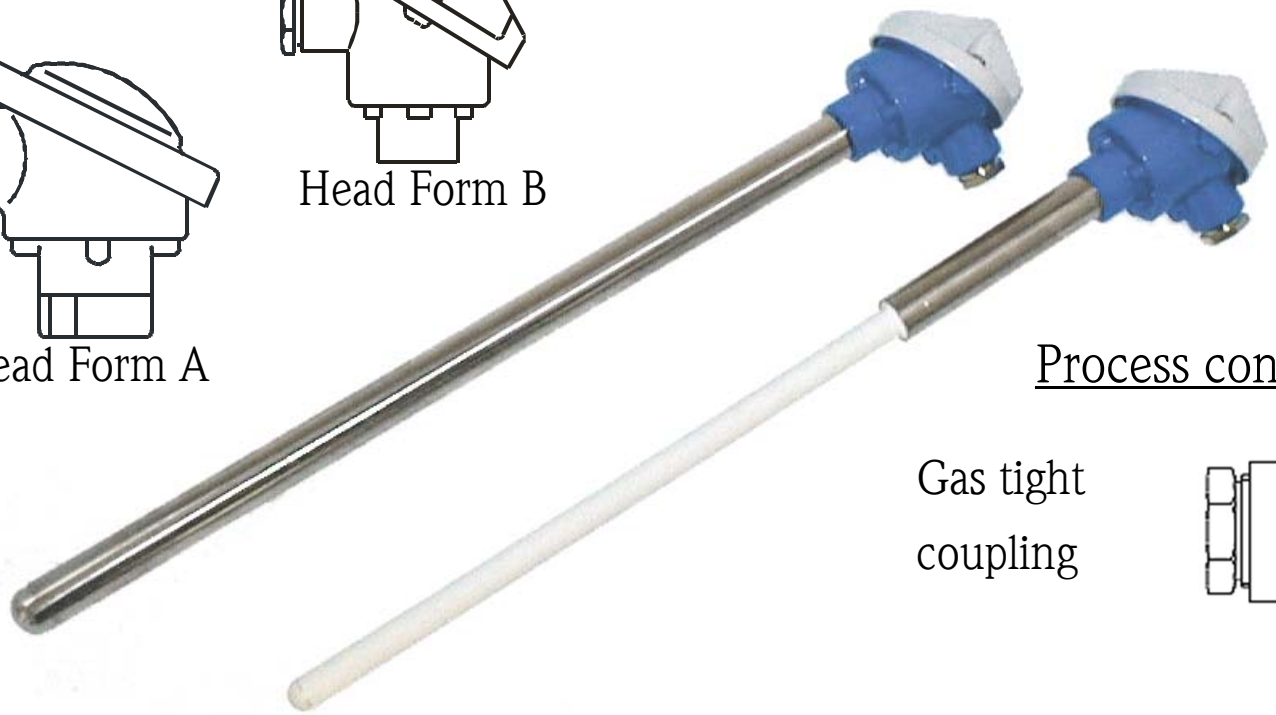
TC for high temperatures



Head Form A

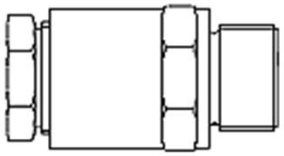


Head Form B

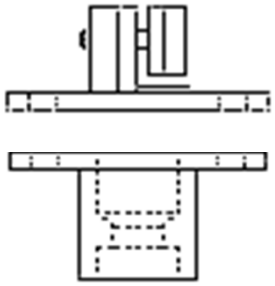


Process connection

Gas tight coupling



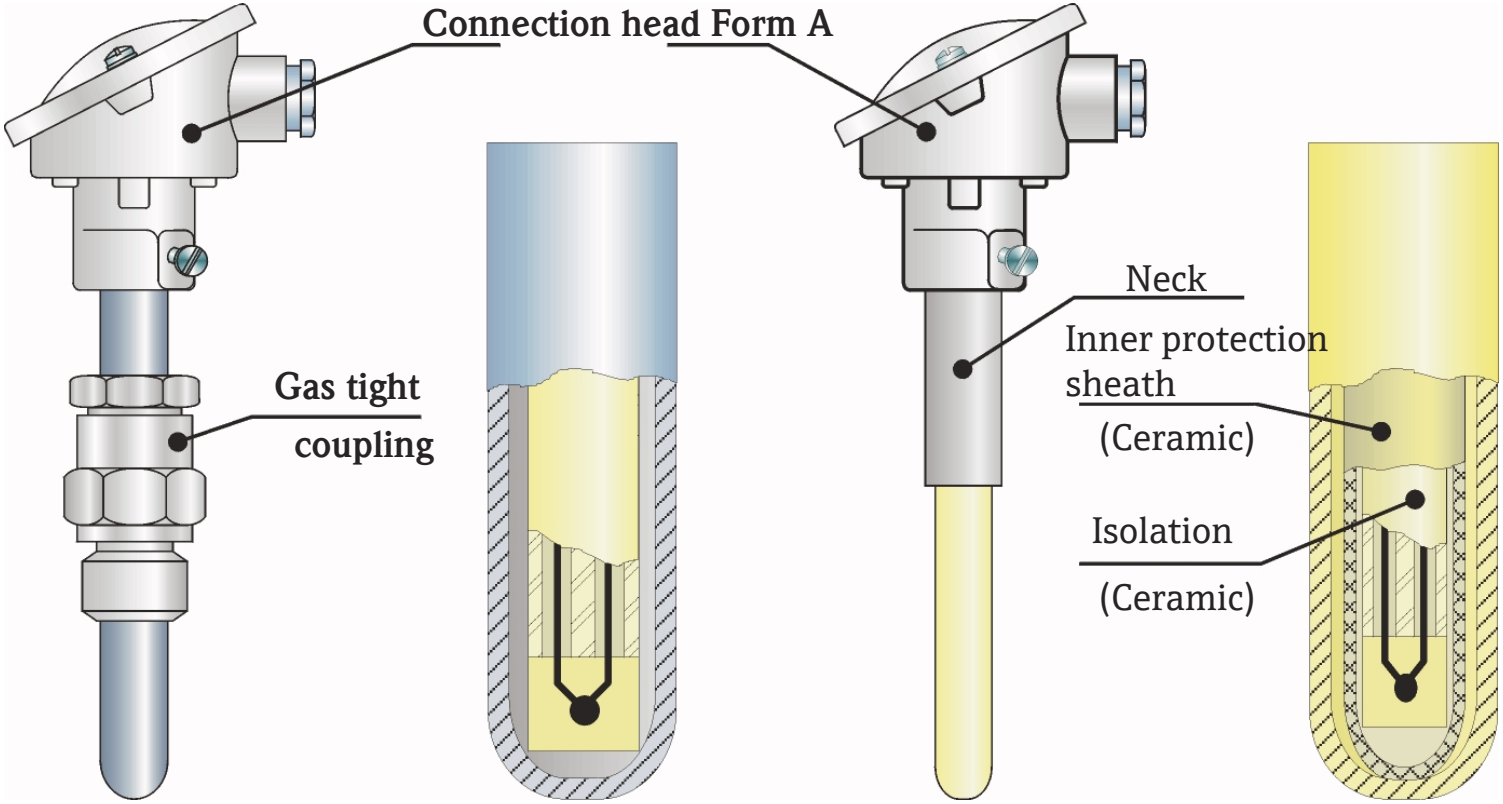
Flange



In different ceramic materials

KER 610, KER 710,....

TC for high temperatures



Heat resistant
Steel and ceramic

Ceramic

Temperature measurement up to 1600°C

Why use transmitters?

- Reduce wiring costs
- Eliminate plant noise (EMI)
- Increase accuracy
- Reduce control systems costs
- Allow sensor flexibility
- Avoid ground loops
- Make maintenance easier/Advanced diagnostics

Eliminates plant noise

Electromagnetic Interference (EMI) are present in almost all factories due to electrical and electronic systems (motors, power lines, radio….), as well as natural phenomena such as lightning occurring in the same area.

Their effects on extension wires are important and obviously affect the measured value.

All Endress+Hauser transmitters are electro magnetically compliant to IEC 61326-1 and NAMUR NE21. However EMI source can still affect the signal but within the nominal transmitter accuracy specification.

Good reasons for temperature electronics?

- **Safety**
  - Galvanic isolation in the transmitter prevents short cut loops and safes interface cards from over voltage
  - Compensation cables are much more sensible against mechanical stress or noise influence than 4-20mA copper cables
  - Control System suppliers are no temperature experts - development and diagnostics are not their focus
  - SIL2 can only be reached with temperature transmitte

- **Flexible programming**
  - offset, change of sensor, output simulation can be done local without touching the process control system
  - Additional displays, recorders or contactors can be added easily

Good reasons for temperature electronics?

- **Costs**
  - even in Ex-zones the transmitters are more cost effective
  - compensation cables are really expensive
- **Accuracy**
  - long sensor cables result in reduced accuracy
  - complete measurement point can be calibrated in a loop (transmitter and sensor together)
  - setup can be easily adjusted via software

Current temperature transmitter basket - overview

iTEMP® Family

HART COMMUNICATION PROTOCOL | PROFIBUS PROCESS FIELD BUS | FOUNDATION


TMT142


TMT162


TMT162


TMT162

Fixed range


TMT127


TMT128

RTD

Thermo-couples


TMT187


TMT188

TMT1x7 Ex

TMT1x8 Ex

PC-Programmable


TMT111/121

Pt100

universal


TMT180


TMT181

TMT1x0 Non Ex

TMT1x1 Ex


TMT112/122

universal


TMT182

TMT 1x2 Ex

New


TMT22

2-channel universal

New


TMT82

Multi-Input


TMT84

2-channel universal

8-channel


TMT125

2-channel universal


TMT85

New Features iTEMP TMT82

Overview: iTEMP® TMT82 head transmitter

- 2 sensor inputs
- Support of all common sensor types
- High accuracy (0.1 K Pt100)
- HART6 protocol
- Advanced diagnostic functionality
- Optional with display (TID10)
- International Ex approvals
- Screw- or spring loaded terminals

New

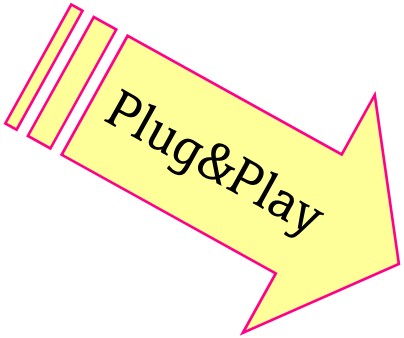
- SIL acc. IEC61508 (SIL2, SW SIL3) (available Q2/12)
- Status/diagnostic messages – NE107

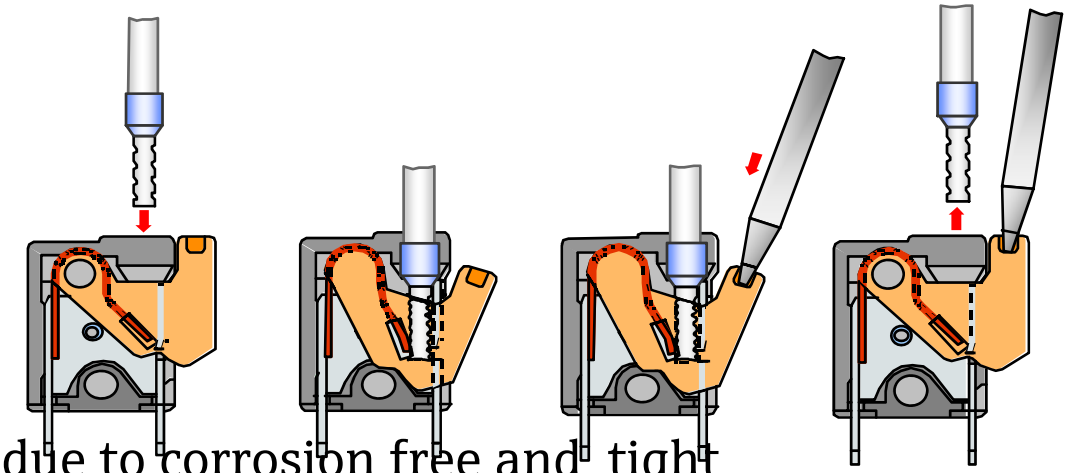
New temperature head transmitter platform

- Spring terminals or screw terminals
- Basis for new transmitter generation
- Optional display

Spring clip version

Spring terminal





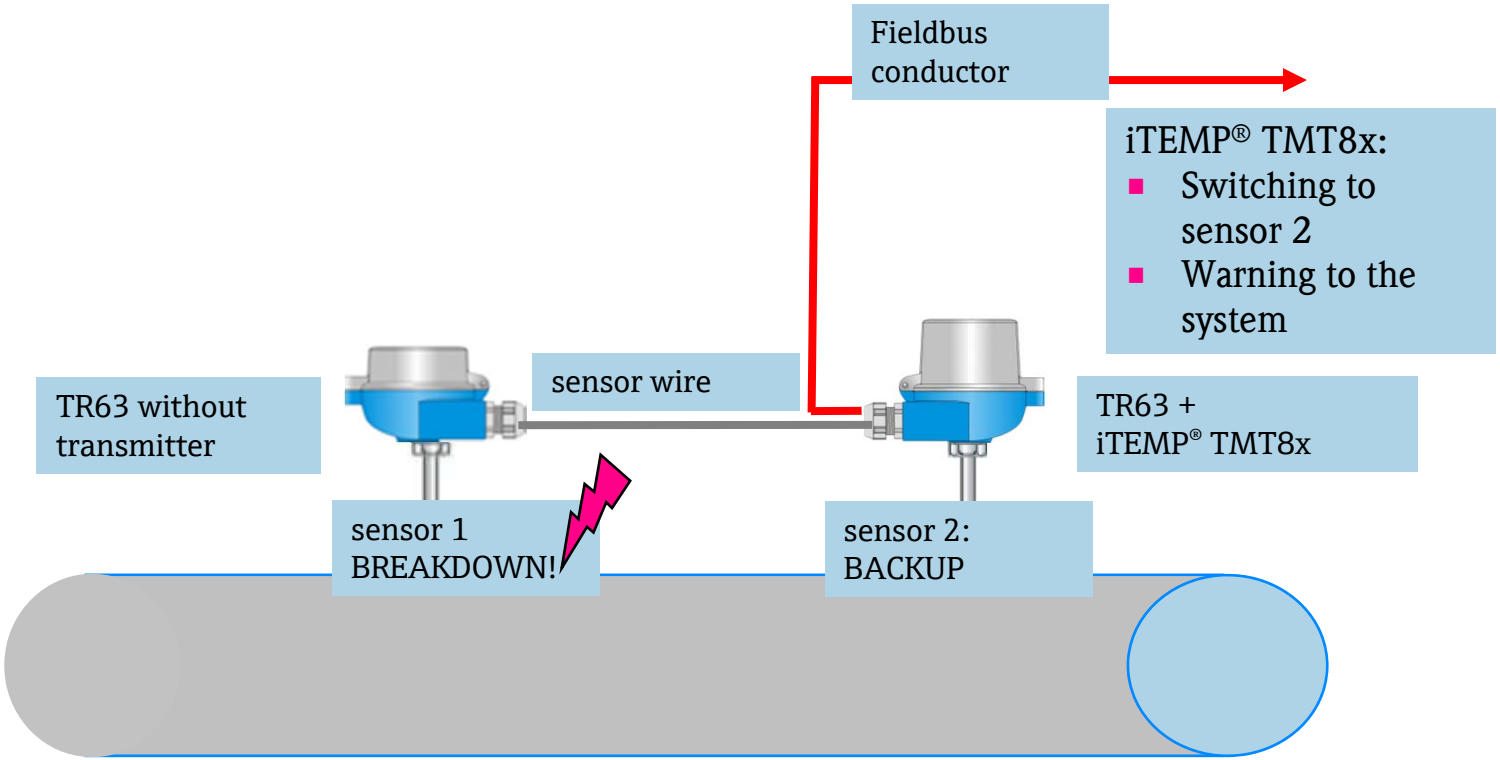
Advantages:

- High reliability due to corrosion free and tight clamp-connection
- Reduced wiring time – Plug in of rigid and flexible wires with wire-end ferrules without any tools
- Easy releasing of the connection with a screw driver

Sensor Backup Functionality

Sensor backup: at breakdown of the sensor

- automatic switch to the residual sensor.
- alarm to control system via HART.
- function can be realized also with an insert 2xPt100.

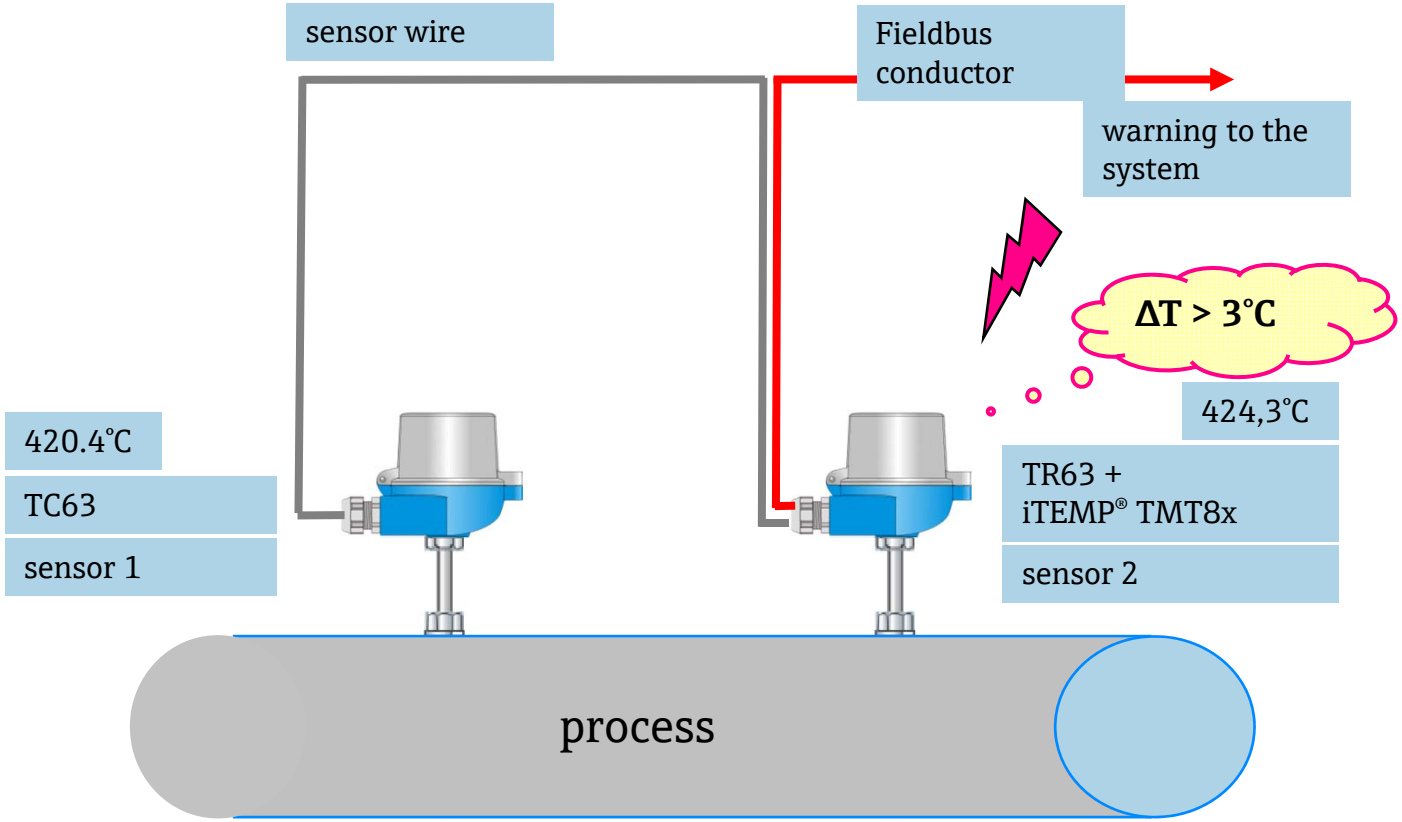


Sensor Drift Detection

Another application example:

Temperature difference between sensor 1 and sensor 2 must not exceed 3°C otherwise a warning signal shall be output.

Application makes sense if 2 different sensor types are used!



Display module

- Display of the measured value
  - TAG – Information of the measuring point
  - Measured value and unit of each channel

- Display of an error
  - Inverse display of a specified error number and the error inducing channel
  - Alternating indication of the error number and the measured value

Food & Beverage – New hygienic thermometer

Key features & customer values:

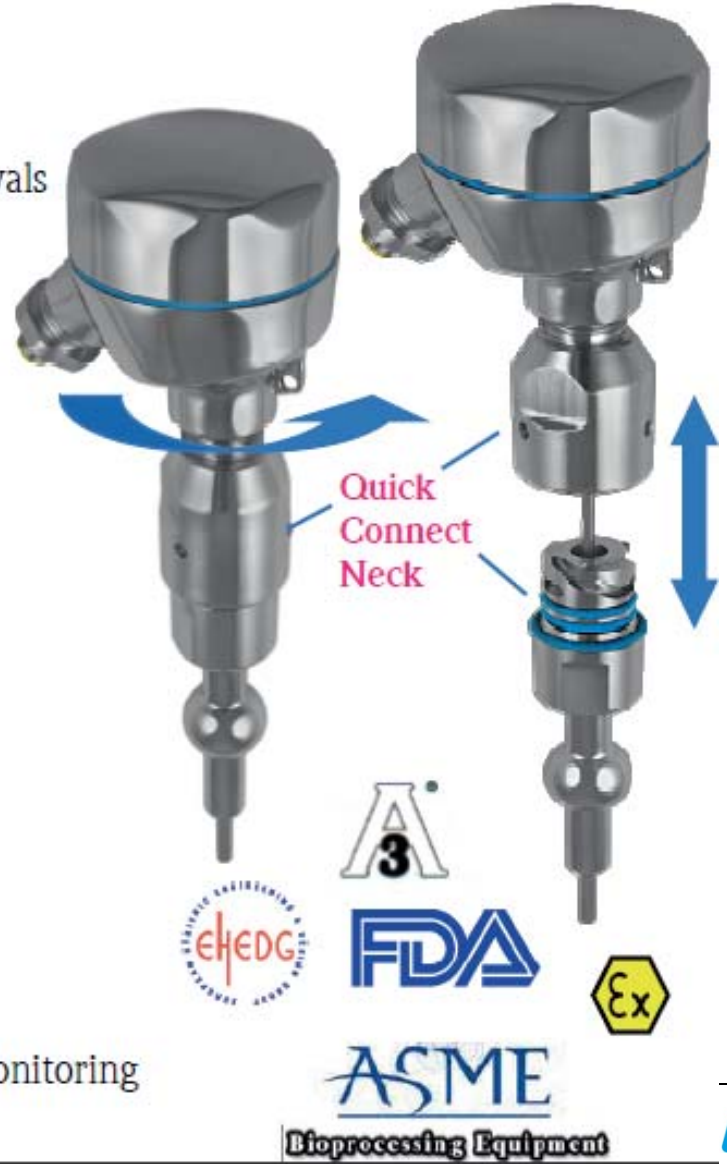
- **One** global portfolio with international approvals
  → global availability of all versions for simple standardization and duplication of production processes of global customers

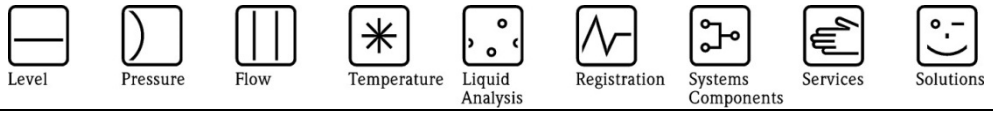
- Consistent product **segmentation**
  → fast and easy product selection

- Patented **Quick Connect Neck**
  → cost savings through simplified recalibration

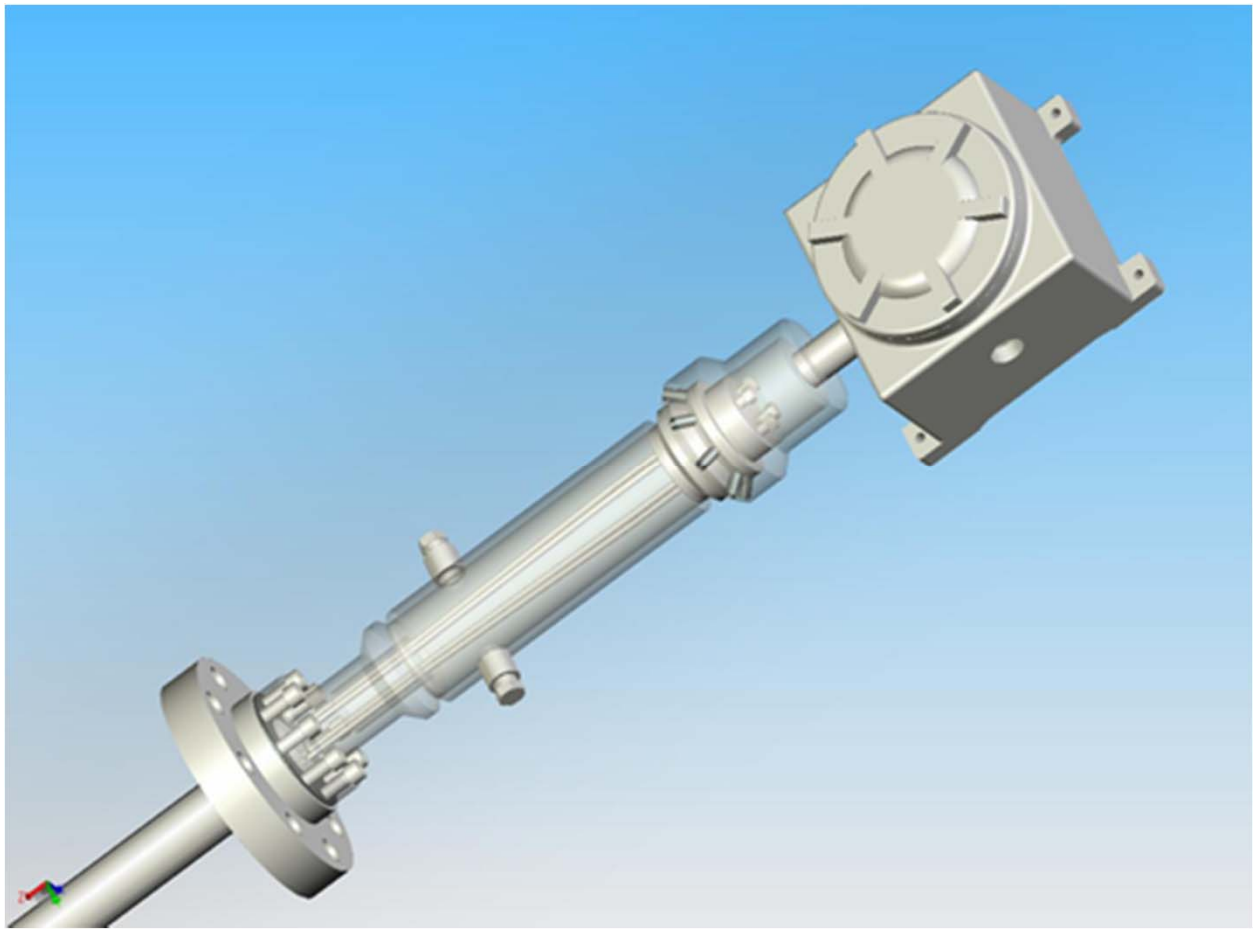
- New inserts **TS101** with outstanding performance → see TS101 (following page)

- New hygienic heads **TA30R** (316L):
  → IP69K suitable for pressure washer
  → cost savings through simple and fast wiring
  → optional display TID10 for on-site process monitoring

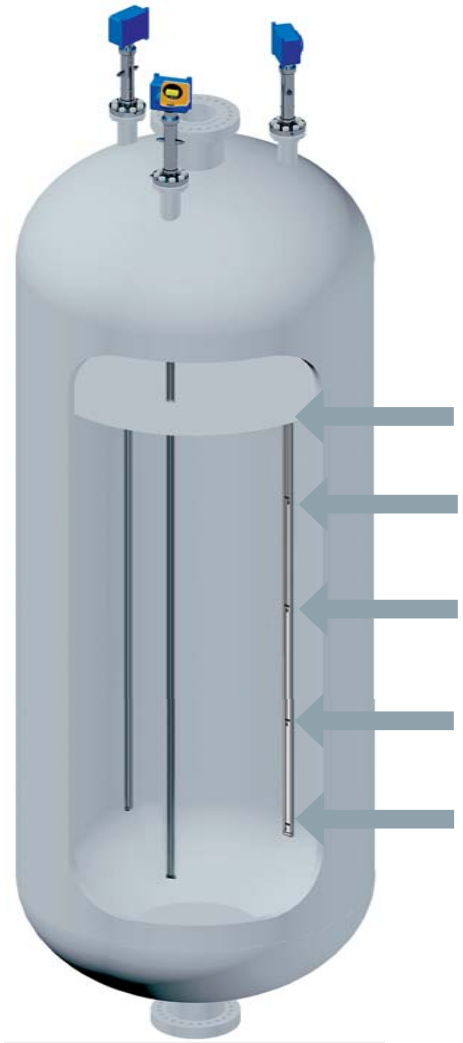




Standardized Straight Multipoint



What are we talking about?



Several measuring points

on different levels

Inside of a reactor or tank

Using only one process nozzle

Straight Multipoint
Sensor TM911

Field of Applications

- High variety of applications in Oil & Gas and Petrochemical Plants such as:
  - **Desulphurization reactors**
  - **Gas treatment**
  - **Fractionating columns**
  - **Hydro Cracking process**
  - **Storage tanks**

- Typical process design conditions
  - **Design pressure: atm < Pd < 250 bar**
  - **Design temperature: -40 °C < Td < 580 °C**
  - **Highly corrosive media**

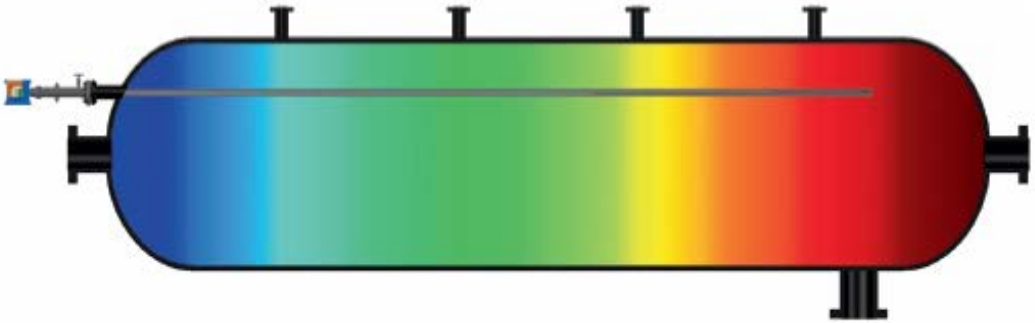
Oil & Gas – Straight Multipoint TM911

Key Features and Customer Value:

- Unmatched safety concept with 3 process barriers
  → safe operation also in fault condition

- Adherence to the pressure equipment directives (PED/CRN) and Ex-d certification of the whole device (ATEX, FM, CSA, IEC)
  → simplified plant certification

- Completely standardized product with consistent order structure and complete technical documentation → simple and easy product selection, configuration and ordering process – also for non-experts!



Temperature

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Temperature Engineering

Classification:
INTERNAL

2007

Endress+Hauser
People for Process Automation

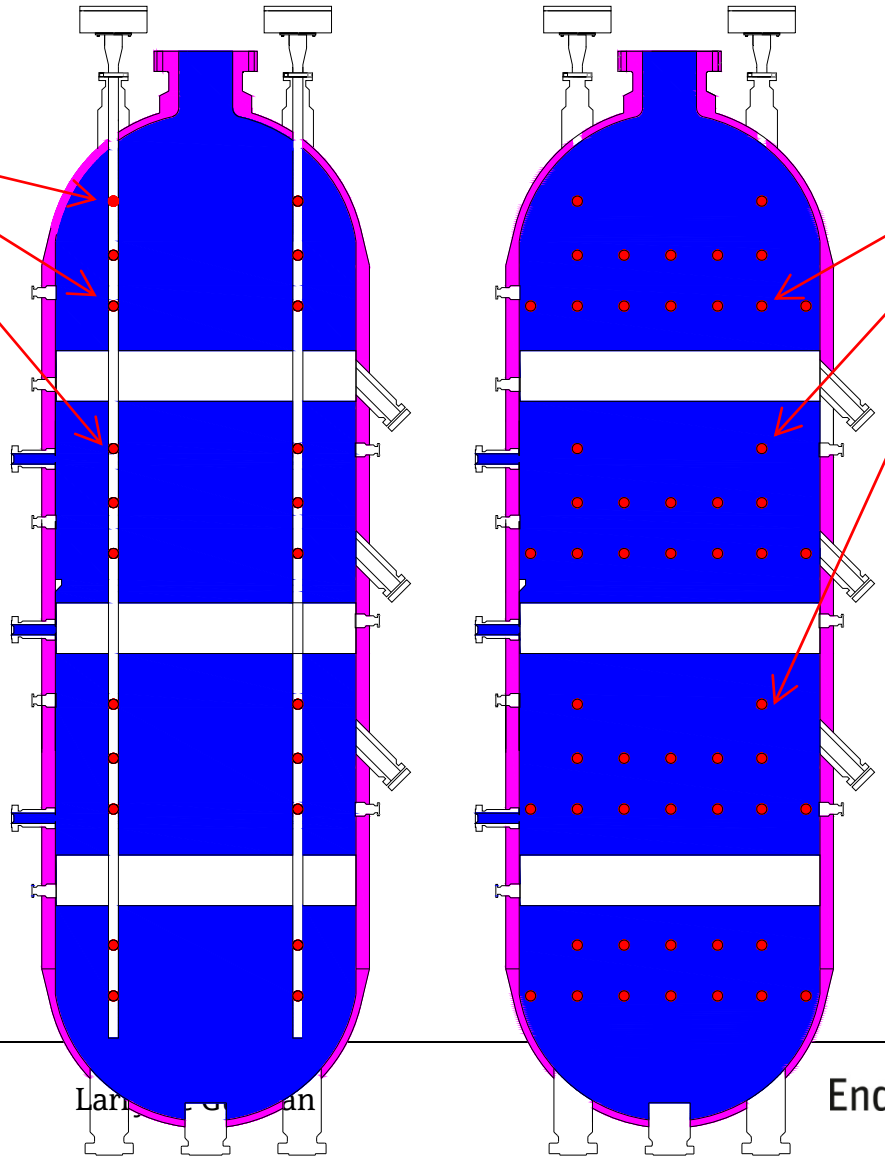
Larry De Guzman

Multi-point Temperature Sensor Measurement

Temperature Sensor Top Entry

Possible temperature measurement points

With Themowell System



Possible temperature measurement points

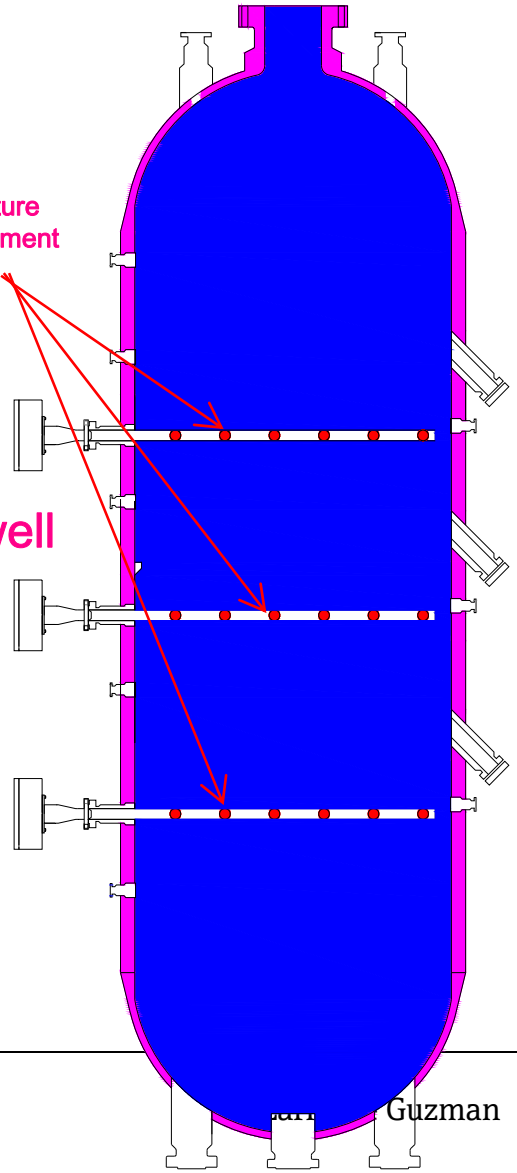
Octopus and/or Radial Fixed System

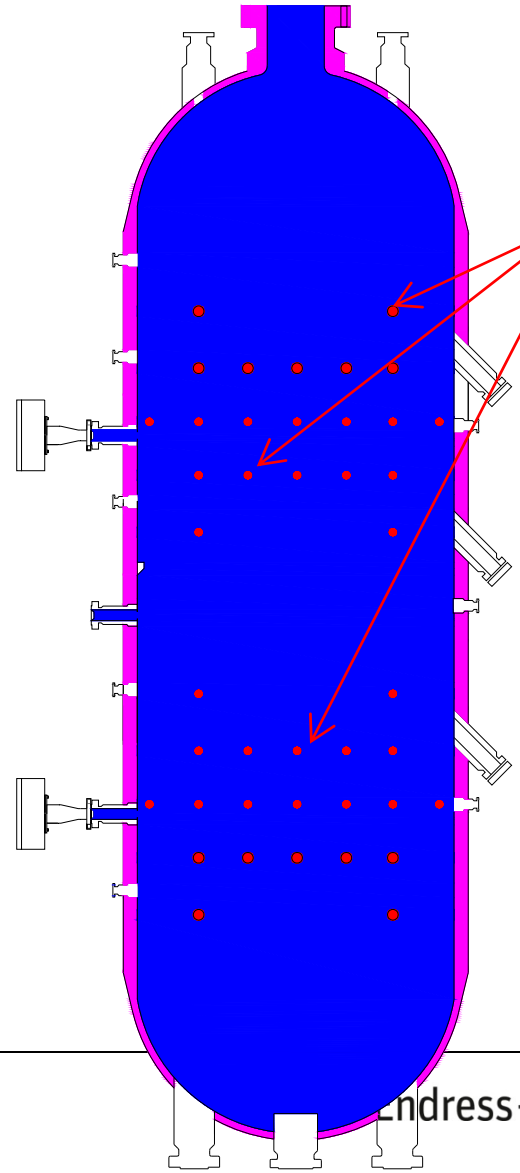
Multi-point Temperature Sensor Measurement

Temperature Sensor Side Entry

Possible temperature measurement points

With Themowell System

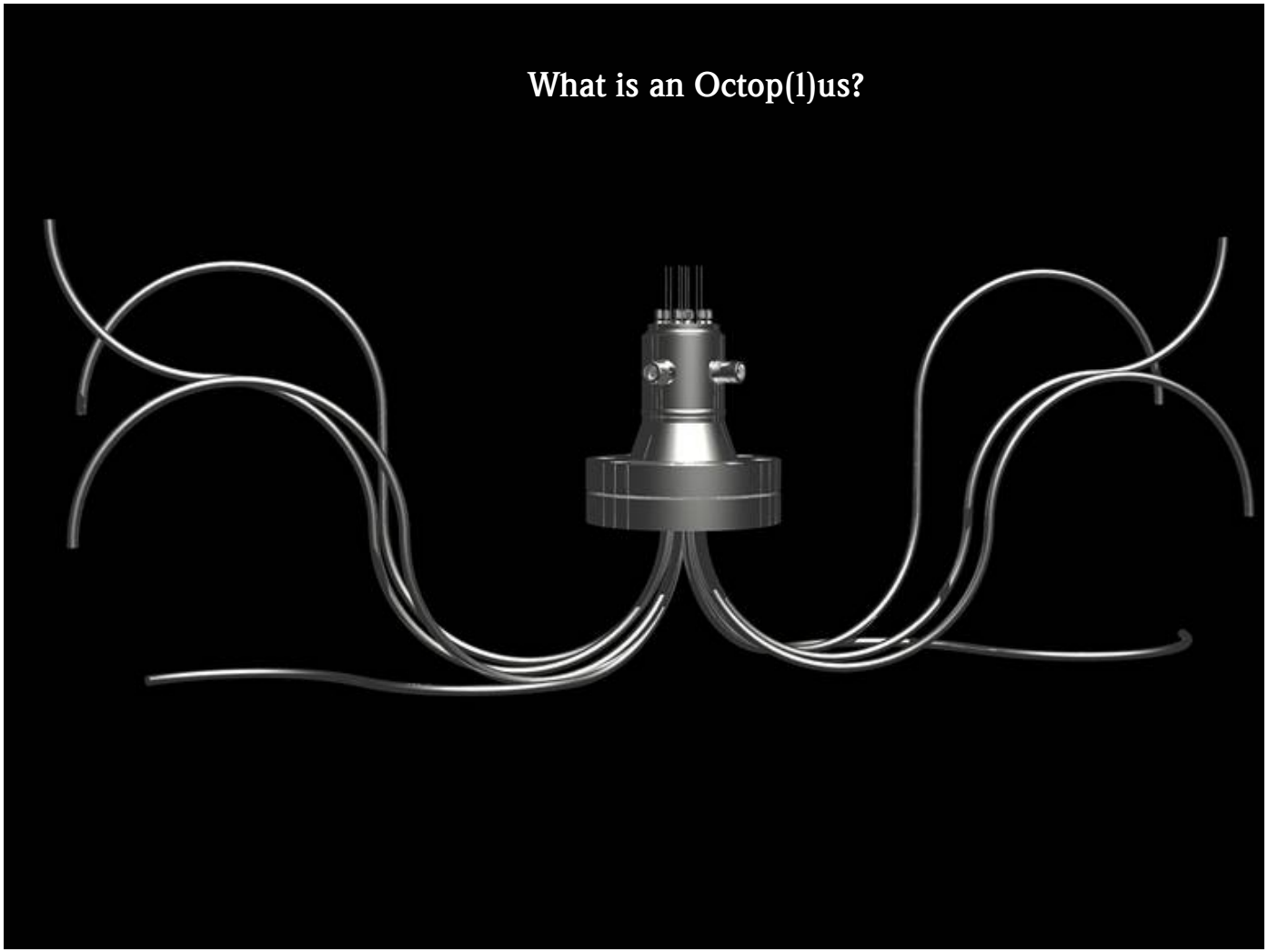




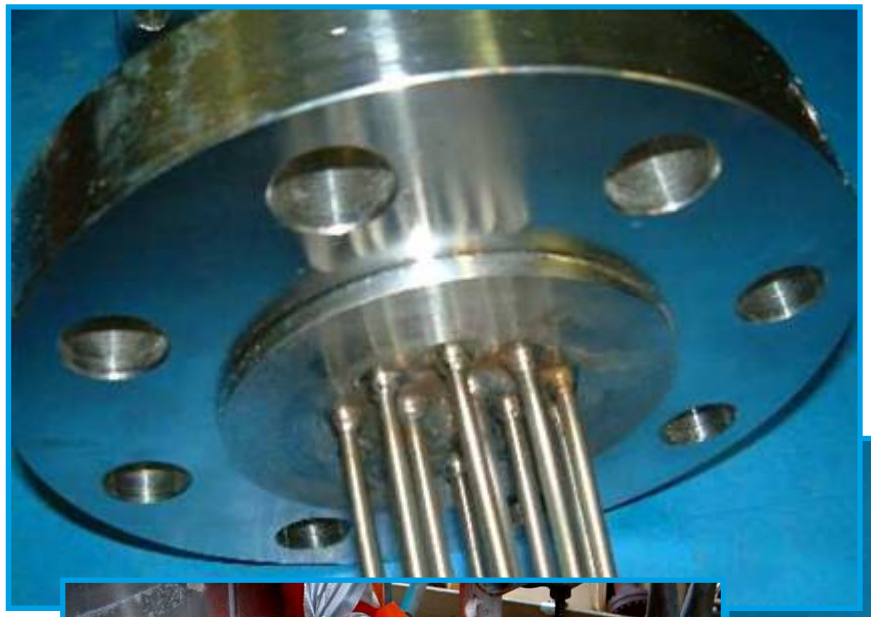
Possible temperature measurement points

Octopus and /or Radial Fixed Type System

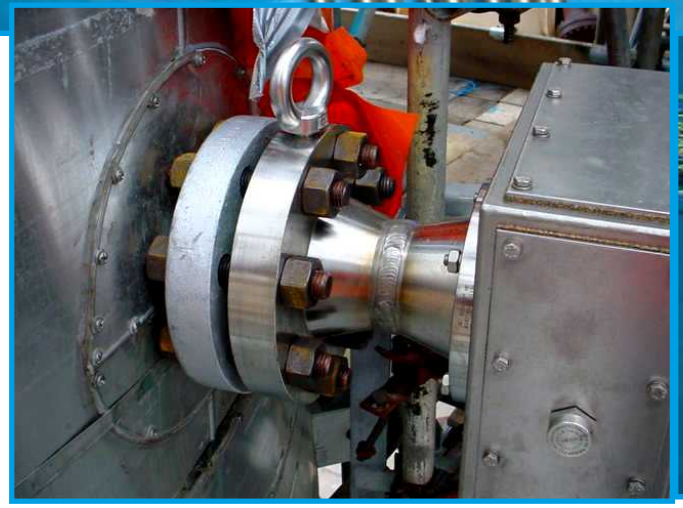
Octoplus multipoint measurement



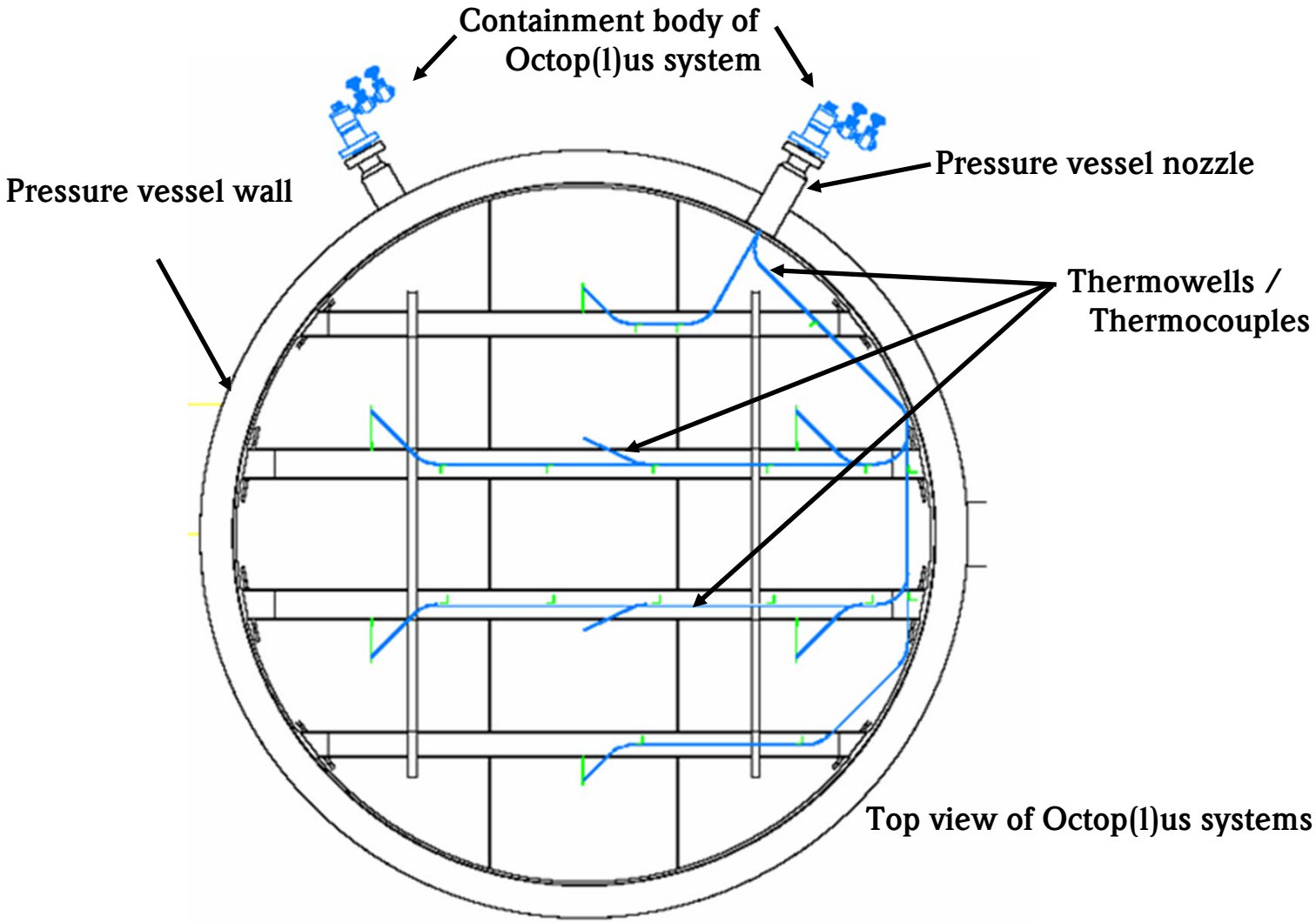
Desulphurization - Thermocouple Multi-point Sensor (15 points)



TEXACO UK
Pembrokeshire
Refinery

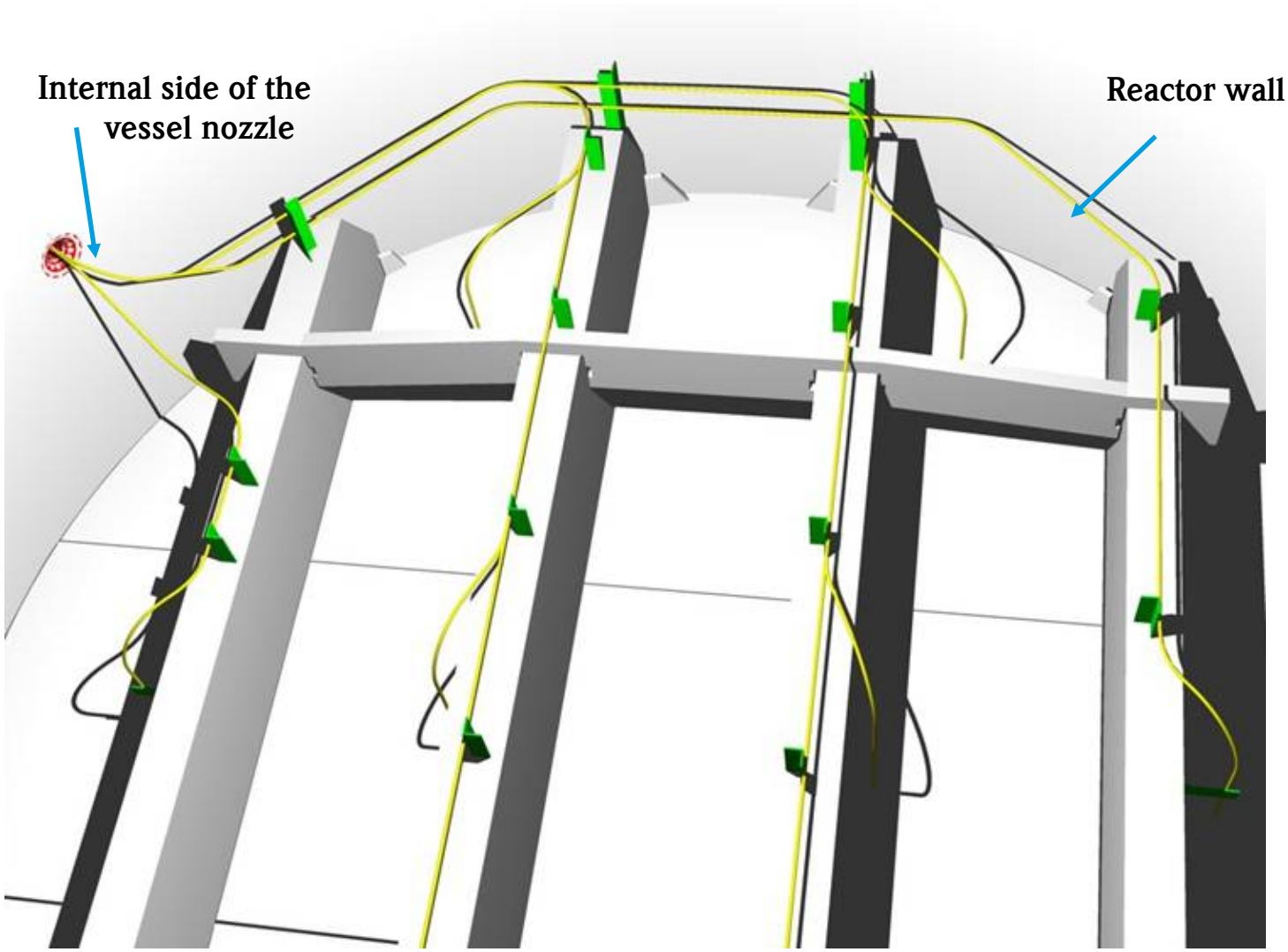


ENGINEERED SOLUTIONS: MULTIPOINT – 3D MEASUREMENT DISTRIBUTION

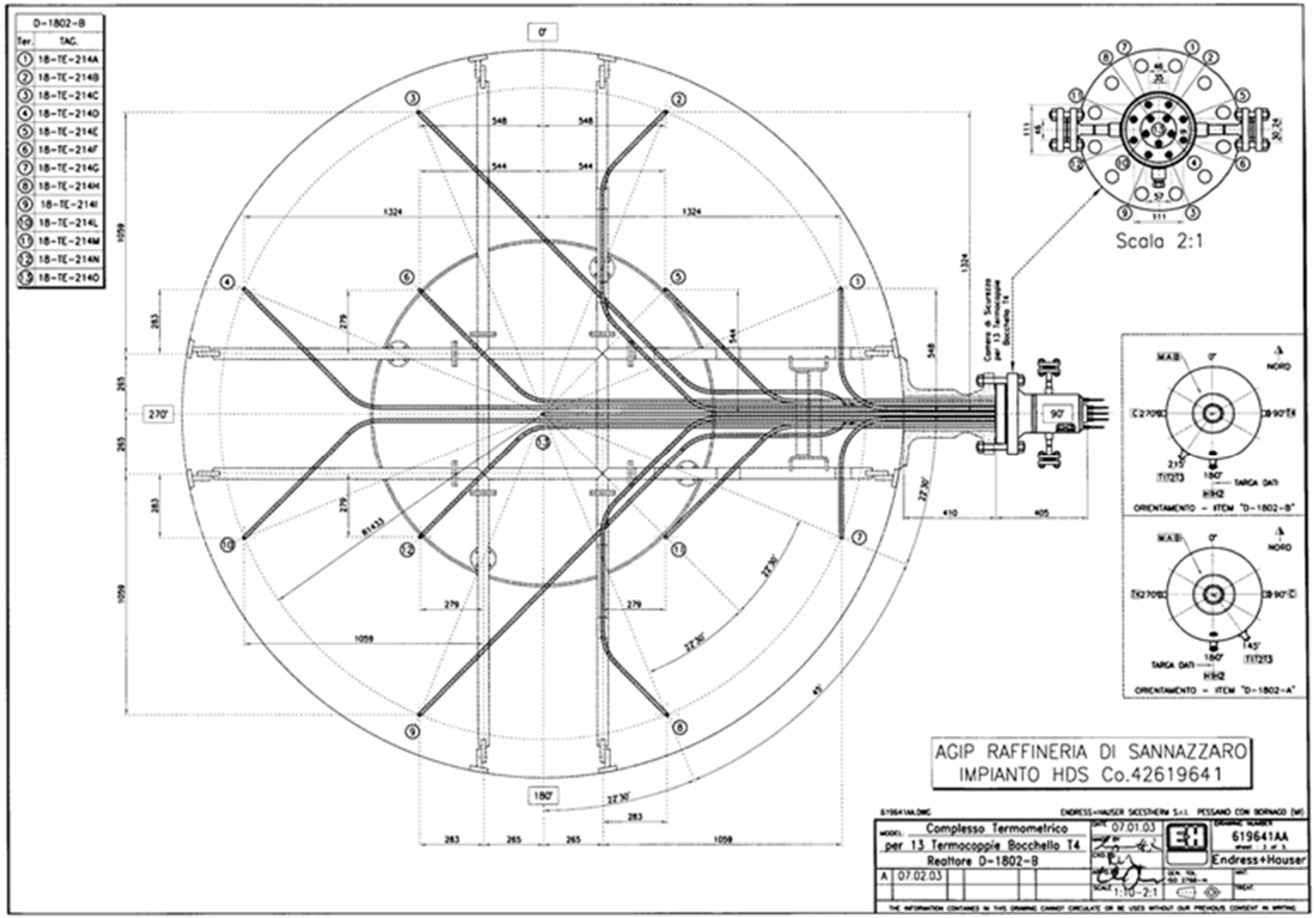


- Material of fixed internals: ISI 347, 321, 316L
- Corrosion allowance on each exposed surface:

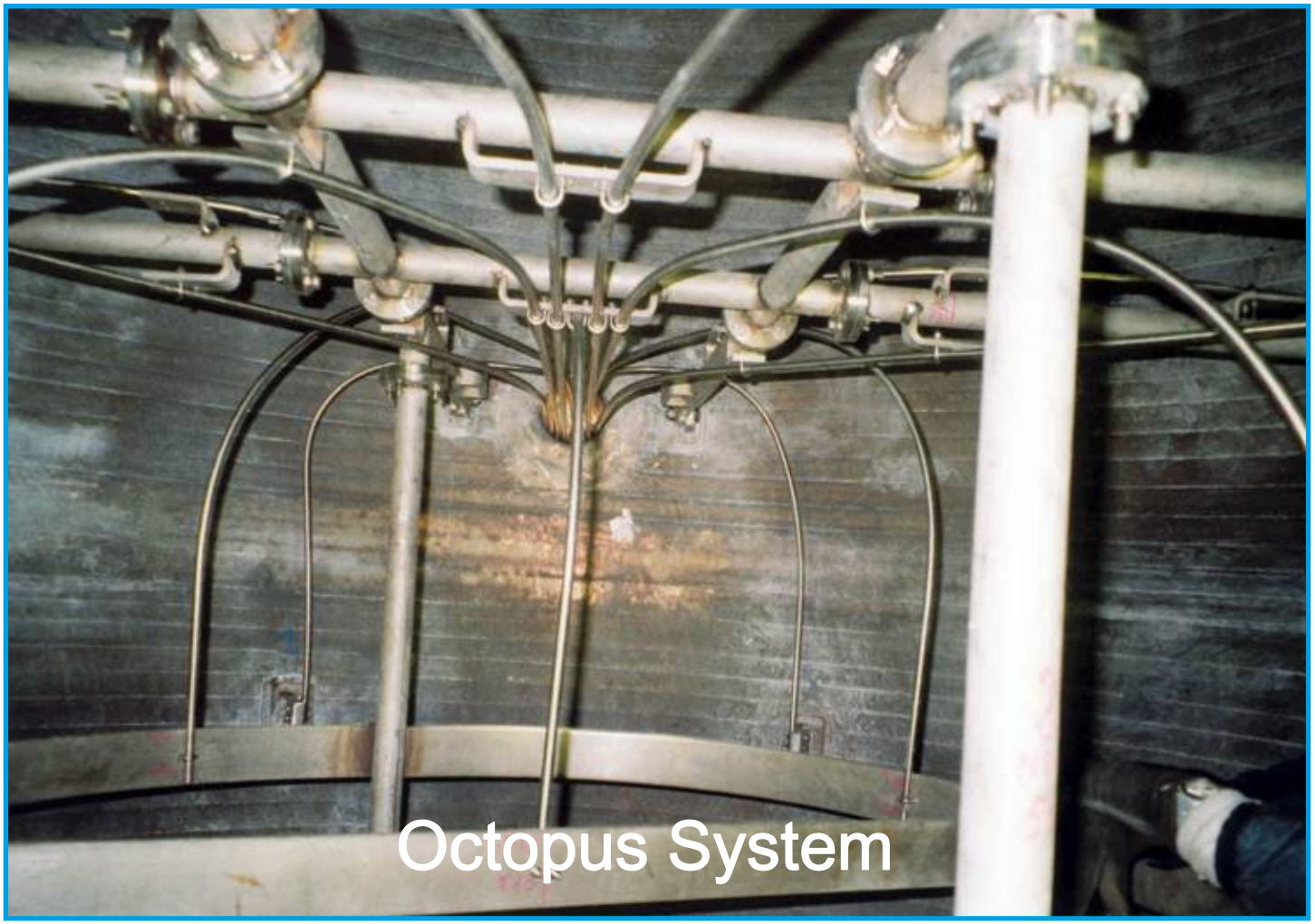
ENGINEERED SOLUTIONS: MULTIPOINT – 3D MEASUREMENT DISTRIBUTION



Desulphurization - Thermocouple Multi-point Sensor (13 points)



Desulphurization – Thermocouple Multi-point Sensor



Heater Tube Skin Thermocouples

E+H Solution - Hast 'X' Pad & Knife Edge Thermocouple

TSK100 technical characteristics

Hole in heater wall

Spring

Heater wall

Protection tube (to shield thermocouple from direct heat)

Air from outside ambient cools the thermocouple and sweeps it clean, thus preventing the deposition of damaging combustion products

Skin thermocouple

Thermocouple hot joint (knife edge)

Thermal radiation

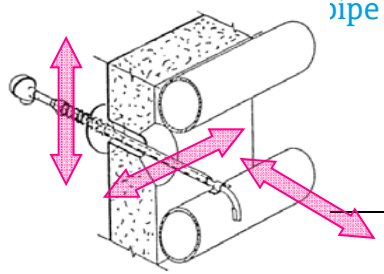
Cool air (air 'intake' due to low pressure in the heater)

Closure disk (it's pressed against heater wall by a light spring to avoid undesirable air infiltrations through the hole)

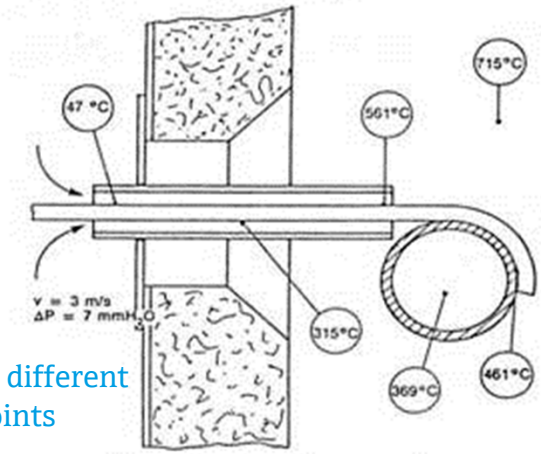
Heater radiant section - low pressure -

Process pipe

With this solution the thermocouple can follow the thermal expansion of the process pipe freely in all 3 directions and it's completely free from mechanical stresses deriving from process pipe movements



Temperatures in different thermocouple points

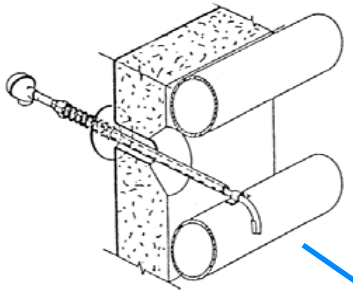


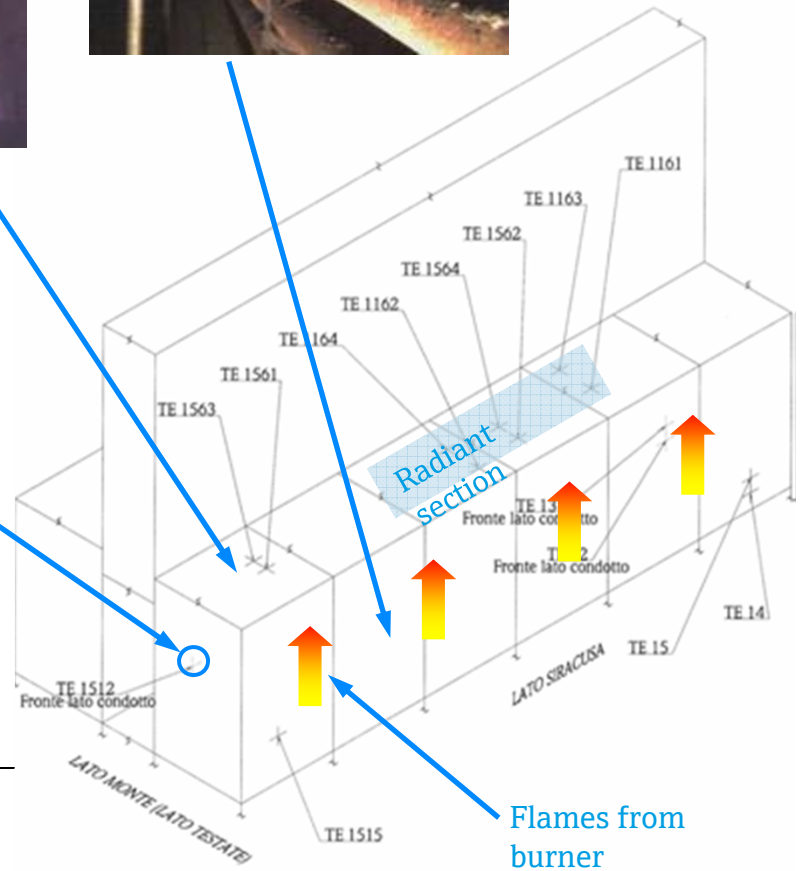
Customer references - Italy

2005 – Ergmed, North Plant - Siracusa Refinery

Nr. 56 skin points mod. TSK 100 ATEX certified for direct fired process heater (2 heaters CR-30 plant)

Techincal data:
T = -20 ÷ +400 °C
Heating surface: pipe Ø 6” Sch 40 material A335 – P5
Skin point material: Hastelloy X
Process heaters fuel: oil/gas
Agip Petroli Patent





Applications

Temperature

Temperature Measurement in Food & Beverages

TM4xx – New modular hygienic thermometers for Food & Beverages and Life Sciences industry.
Extensive variety ranging from basic thermometers to advanced technology thermometers – completely standardized

iTHERM® QuickNeck – Neck with quick release for fast and easy recalibration

iTHERM® QuickSens – Sensors with unmatched response times for high-precision measurements and accurate process control

Temperature Measurement in Beverage Industry

Compact thermometer with short immersion length and fast response time in the Beverage industry

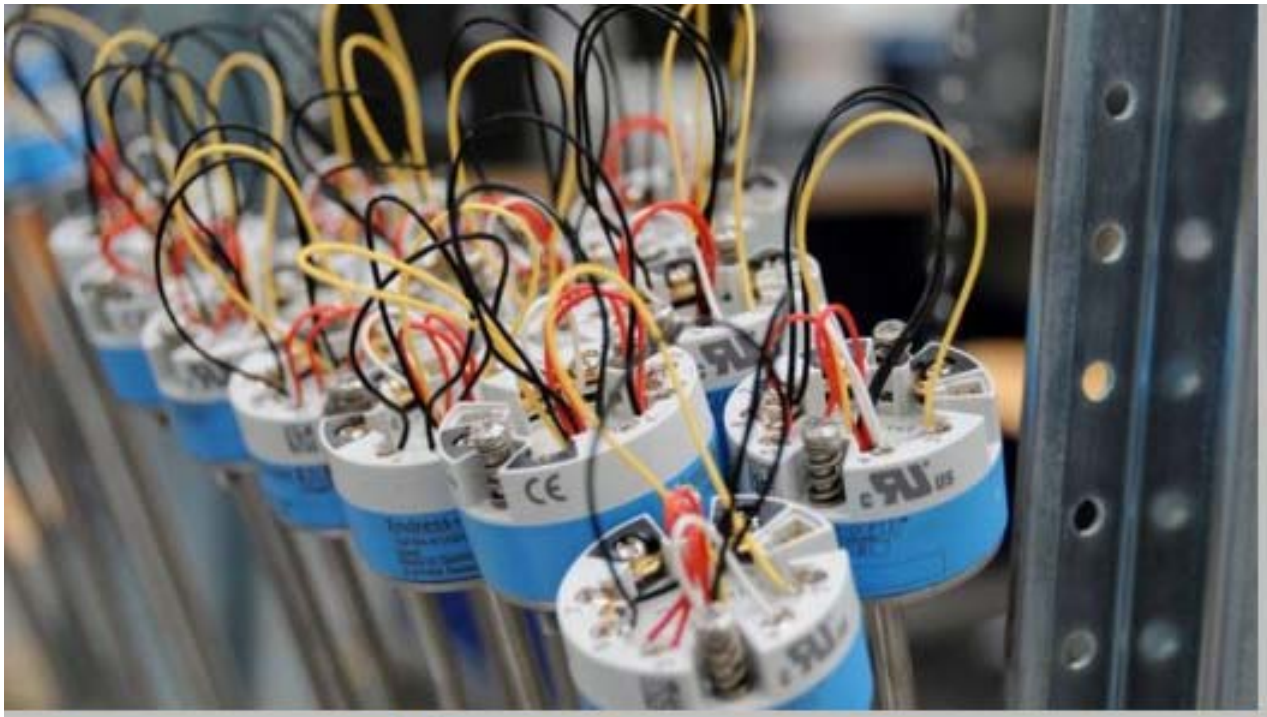
Field transmitter with dual Pt100 mounted in a “glove-box” in the Pharmaceutical industry

Temperature Measurement in Oil & Gas Industry

Temperature measurement via PROFIBUS® PA in the Chemical industry

Multipoint thermometer with safety chamber for the Oil & Gas industry

Temperature Measurement in Chemical Plant



Head transmitters mounted on inserts for an application in an ethylene plant

Robust thermometer with quick fastener neck for safety relevant applications

RTD - Summary

- Definition RTD and PTC
- Power source required
- Ceramic Pt 100 (WW), -200°C...600°C
- Glass Pt 100, -50°C...450°C
- Thin film Pt 100 (TF), -50°C...400°C
- Accuracy class B, A, 1/3B, 1/5 DIN B, 1/10 DIN B
  Endress+Hauser Standard: Class A
- 2-,3-,4- wire configuration
- Endress+Hauser Standard: Pt100-Reverse (MgO- insulation)

TC - Summary

- EMF – no power supply required
- Junction types
- TC types:

T	-185.....300°C
J	+ 20.....700°C
E	0.....800°C
K	0...1100°C
N	0...1100°C
S	0...1550°C
R	0...1600°C
B	0...1600°C

- Class 1,2
- Compensation/Extension wires

Any Questions?

Temperature

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Product Selection

Standard E+H Temperature Products

Classification:
INTERNAL

2007

Endress+Hauser
People for Process Automation

Typical Construction of a Thermometer

Metric-Style

TERMINAL HEAD

The terminal is fitted to the thermowell or the neck of the thermometer.

- Protection and installation for terminal block or transmitter
- Cable entry and wiring

NECK / EXTENSION

The neck is the connection between terminal head and process connection / thermowell.

- Protection of the head transmitter from over-heating
- Guarantees access to the terminal head in the case of pipe insulation.

PROCESS CONNECTION

The process connection is the connection between the process and the thermometer.

- Threads Weld-in connections
- Flanges

THERMOWELL

The thermowell is the process wetted component of the thermometer

- Increases the life cycle of the measurement insert through protection against influence.
- Possible measurement insert exchange under process conditions.

US-Style

Quick Guidelines

Process Connection

PROCESS CONNECTION	SENSOR + THERMOWELL		THERMOWELL ONLY		SENSOR ONLY	
	TUBE / PIPE	BAR-STOCK	TUBE / PIPE	BAR-STOCK		
THREADED CONNECTION	TST414	TR66 TC66	TA414	TA550 (3/4" NPT Process conn., max. OD 30mm Single bore)	TTR31	TMT142R TMT142C
	TR10 TC10		TW10	TA555 (1" NPT Process conn., max. OD 34mm. With double bore)	TMR31	TMT162R TMT162C
	TR11		TW11	TA556 (1" NPT Process conn., max. OD 35mm, graduated)	TR25	
	TST90- (1 pair)		TW251	TA557 (1" NPT Process conn., max. OD 35mm. With Single bore)	TST40M	
	TST187 (Tube 89mm max.)		TA535	TA560 (3/4" NPT Process conn., Hexagonal ex SW27. With Single bore, Tapered)	TST41M	
	TR61 TC61		TA540	TA562 (1/2" or 3/4" Process Conn, Hexagonal ext. SW27. With Single bore, Straight or Stepped)	TR62 TC62	
	TR63 TC63		TA541	TA565 (1" NPT Process conn., Hexagonal ext. SW36. With Single bore, Tapered)	TR65 TC65	
				TA566 (1" Process Conn, Hexagonal ext. SW21 With Single bore, Straight or Stepped)	TR## TC##	

Quick Guidelines

Process Connection

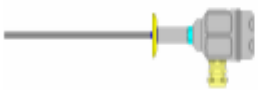
PROCESS CONNECTION	SENSOR + THERMOWELL		THERMOWELL ONLY		SENSOR ONLY
	TUBE / PIPE	BAR-STOCK	TUBE / PIPE	BAR-STOCK	
FLANGED CONNECTION	TR13 TC13	TR15 TC15	TW13	TW15	--
	TR61 TC61	TR66 TC66	TA540	TA550 (Threaded Flange, max. OD 30mm)	
	TR63 TC63		TA541	TA555 (Threaded Flange, max OD 34mm. With double bore)	
				TA556 (Threaded Flange, max. OD 35mm, single bore, graduated)	
				TA557 (Threaded Flange, max. OD 35mm. With Single bore)	
				TA575 (Welded Bathride of flange; Lagging Ø30*34mm)	
				TA576 (Welded Bathride of flange, Lagging Ø25*29mm)	

Quick Guidelines
Process Connection

PROCESS CONNECTION	SENSOR + THERMOWELL		THERMOWELL ONLY		SENSOR ONLY	
	TUBE / PIPE	BAR-STOCK	TUBE / PIPE	BAR-STOCK		
WELD CONNECTION	--	TR15 TC15 	TW251 	TW15 	TR43 	
		TR47 		TW47 		
				TA570 (Weld-in Ø35 * 49mm) 		
				TA571 (Weld-in Ø30 * 35mm) 		
				TA572 (Weld-in Ø25 * 29mm) 		

Quick Guidelines

Process Connection

PROCESS CONNECTION	SENSOR + THERMOWELL		THERMOWELL ONLY		SENSOR ONLY	
	TUBE / PIPE	BAR-STOCK	TUBE / PIPE	BAR-STOCK		
SANITARY CONNECTION	TR45 	--	TW45 	--	TTR35 	TR46 
					TMR35 	
					TR44 	

Quick Guidelines

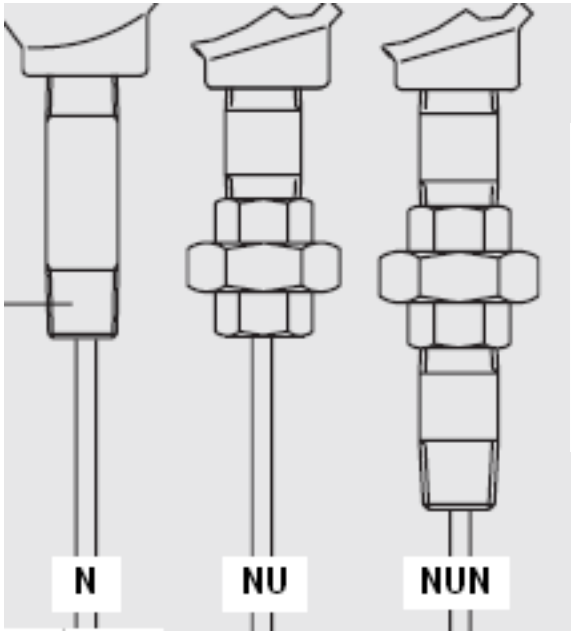
Process Connection

PROCESS CONNECTION	SENSOR + THERMOWELL		THERMOWELL ONLY		SENSOR ONLY	
	TUBE / PIPE	BAR-STOCK	TUBE / PIPE	BAR-STOCK		
NO CONNECTION (WITH OPTIONAL COMPRESSION FITTING OR LOOSE FLANGE)	TR12 (1) TC12 (1)	--	TW12 (1)	--	TST310 (1) TSC310 (1)	GPTC (1)
	TR61 (1) TC61 (1)		TA540 (1)		TST602 (1)	GPTL (1)
	TAF11 (1)(2)		TA541 (1)		TST410 (1)	TEC300
	TAF12S (1)(2)				TST414	TET90, TET300, TPR100, TPC100, TPR300, TPC300
	TAF12D (1)(2)				TST434 (wall mounted) TYPE A	
	TAF12T (1)(2)				TR24 (1)	
	TAF16 (1)(2)				TEC420	

Quick Guidelines

Sensor Extension / Neck

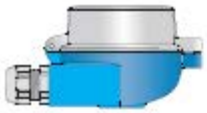
Neck (Metric style)



US style Neck

No Extension Neck

Terminal heads

TA30A	IP	TA20B	IP	TA30D	IP	TA20W	IP
 Form B Standard (also with display)	66/67	 Form BUK	65	 Form BUZH	66	 Form BUS	66
TA20J	**IP**	**TA20R**	**IP**	**TA21E**	**IP**	**TA30H**	**IP**
 (also with display)	66/67		66/67		65	 (also with display)	66/67

Terminal head with display, hinged cover and display window

iTEMP®, temperature transmitters

	Head and DIN rail transmitters					Field transmitters		
Type	ReadWin 2000 iTEMP PCP	ReadWin 2000 iTEMP PCP	HART COMMUNICATION PROTOCOL	PROFIBUS		HART COMMUNICATION PROTOCOL / PROFIBUS	HART COMMUNICATION PROTOCOL	
Model	TMT180	TMT181 TMT121/111	TMT182 TMT122/112	TMT84	TMT85	TMT162	TMT142	TMT125
Design						 		
DIN rail								

System Components

Robert Zeller

Outlook – System Components

State of the art System Components - The "Solutions for the Loop"

Field | Cabinet






Whatever Sensor

	Field + Process	Panel + Infrastructure
Supply	X	X
Isolation	X	X
Indication	X	X
Protection	X	X
Limits + Alarms	X	X
Recording + Batch	X	X
Calculation	X	X

Robert Zeller

Process Meters/Indicators: Portfolio

Process meters with control unit

RIA45

RIA46

Loop powered indicators

RIA14

RIA16

RIA15

Process indicator with pump control

RIA452

Fieldbus indicators

RID14

RID16

Complete and state-of-the-art process meters and indicators portfolio with all kinds of housings and various communication protocols!

Loop Powered Indicator RIA15

- Loop powered indicator for hazardous areas
- LCD backlight can be activated -> excellent readability even in environments with poor lighting helps increased safety

NEW Feature HART® Communication

Key feature: Master functionality

- HART® is a protocol which works according to the master slave method. This means the communication activity comes from the master.
- In the HART® loop there can be two masters: A primary master and a secondary master.
- RIA15 can be set up as primary or secondary master (default is secondary master).
- The indicator can actively interrogate and display the process values of a HART® sensor.

✓ The sensors/actuators can be directly addressed by RIA15, also inside a multi-drop network

✓ Cost saving for the customer since no other master is required

✓ RIA15 as a HART® master can evaluate the status byte of the sensor/actuator

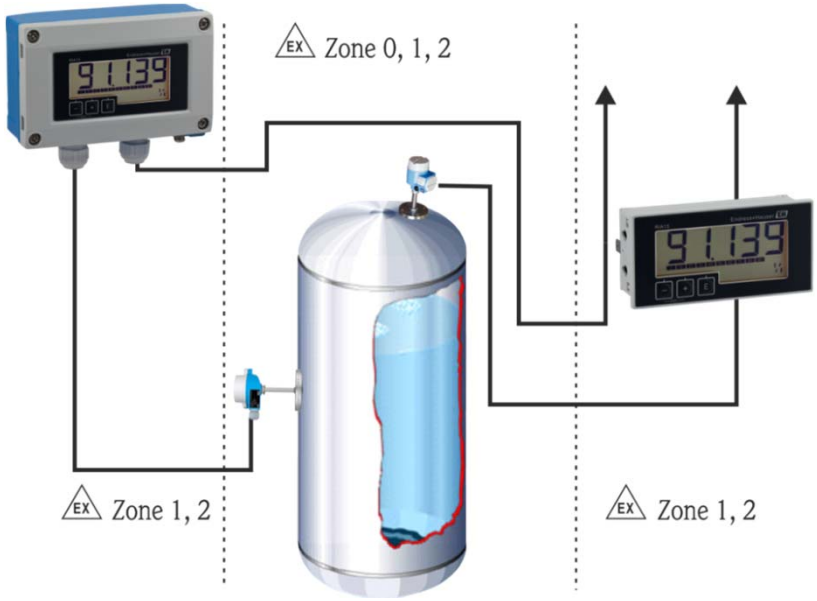
NEW Feature HART® Communication

Key feature: Low voltage drop

- Also with HART® communication RIA15 is powered from the loop
- The voltage drop of RIA15 with HART® is still very low at ≤ 1.9 V

✓ No additional power supply is needed!

✓ More than one display can be integrated into one loop!



Endress+Hauser

Loop Powered Indicator RIA15 HART®

Key features & added values:

- Increased process safety
  –> loop powered & low voltage drop means no additional power supply needed even in Ex applications with reduced voltage

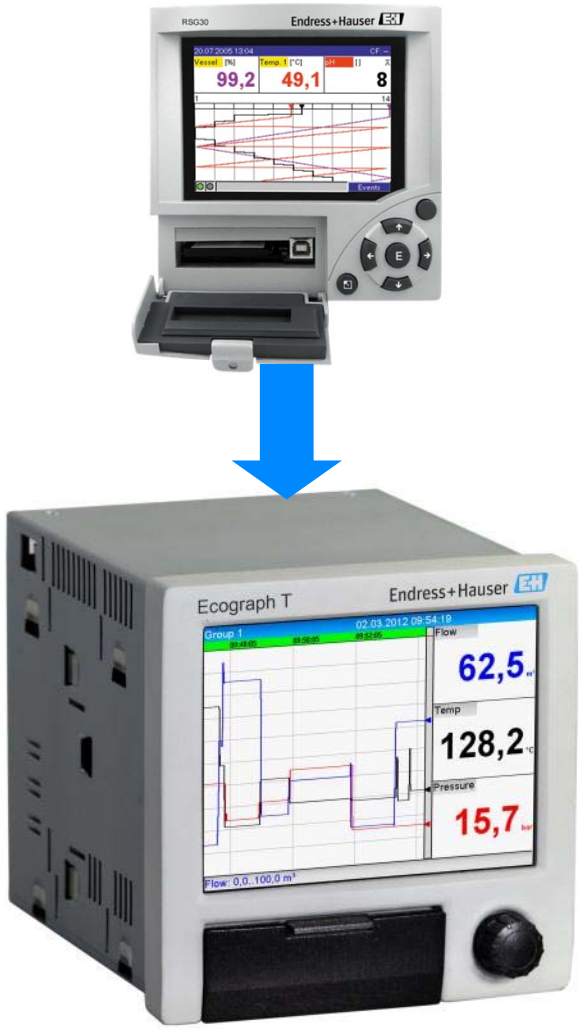
- Cost saving for the customer since no other master is required
  -> RIA15 can be HART® master and actively inquire values from the measurement devices

- Time-saving with easy commissioning from the pushbuttons

HART® COMMUNICATION PROTOCOL

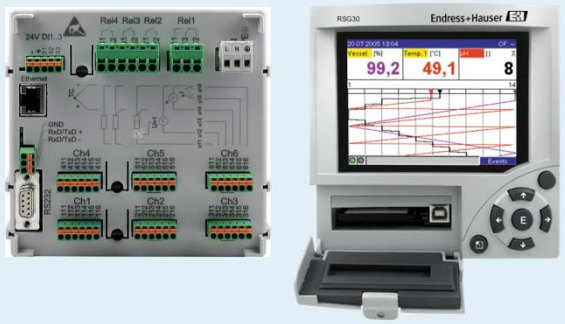
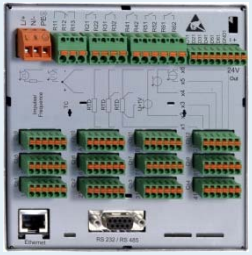
Smart Recorder - Ecograph T RSG35

- Completely new enhanced webserver
  -> easy visualization and parameterization
- Up to 12 input channels and 4 freely adjustable display groups
  -> increased flexibility
- SD card for Ecograph T and Memograph M
  -> same data storage media for both devices
- Four virtual math channels for universal calculation
  -> increased application flexibility for the customer



Robert Zeller

Overview: RSG30 vs. RSG35

	RSG30	RSG35
		 
Universal analog inputs	3/6	4/8/12
Signal types	Current, voltage, RTD, TC	Current, voltage, RTD, TC, frequency, pulse
Digital inputs	3	6
Alarm set points/relays	16/4	30/6
Signal analysis	Totalization (optional)	Totalization (standard)
Mathematics	5 math channels (optional) Every used math channel reduces the number of analog channels +, -, *, /, constants, average	4 math channels (optional) Virtual Formula editor for individual calculations
Communication protocols	-	Modbus RTU slave, Modbus TCP slave
Interfaces	USB, RS232/RS485 (standard) Ethernet (optional)	USB RS232/RS485 (optional) Ethernet (standard)

Overview: RSG30 vs. RSG35

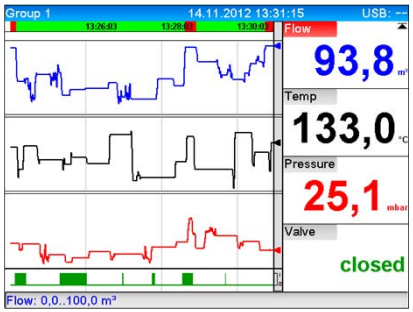
	RSG30	RSG35
		
Display	4,7”, 320 x 240 pixel	5.7”, 640 x 480 pixel
Display groups	-	4 groups with up to 8 channels
Size of internal memory	2 MB	128 MB
External storage medium	CF card	SD card, USB stick
Set-up	On-site via keys ReadWin® 2000	On-site via navigator Integrated web server FieldCare
E-mail	-	Yes, in case of limit value infringements/alarms
Readout	ReadWin® 2000, Field Data Manager Software	Field Data Manager Software
Front material	Fiberglass reinforced plastic	Zinc diecast
Protection class	IP54 (front)	IP65 (front)
Others	Various language packages	One firmware for all languages Remote access on current and stored data via webserver

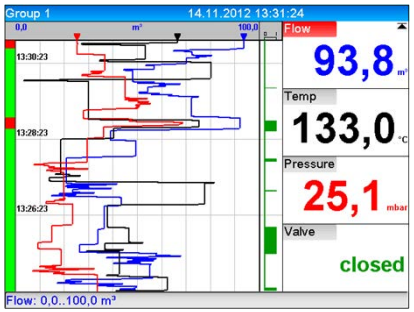
Features and Added Values

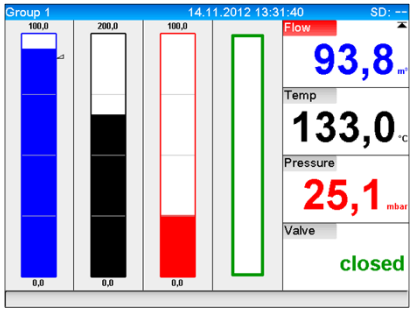
Informative

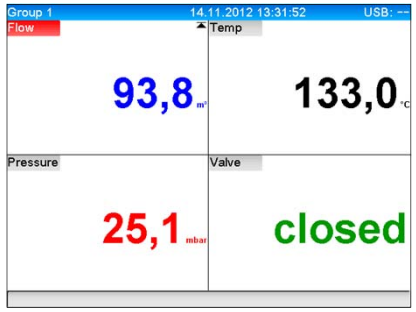
Flexible display possibilities

- Indicate **curves, waterfall, bargraph or digital values** dependent on the specific process and data
- Display of curves and waterfall in ranges gives an improved overview









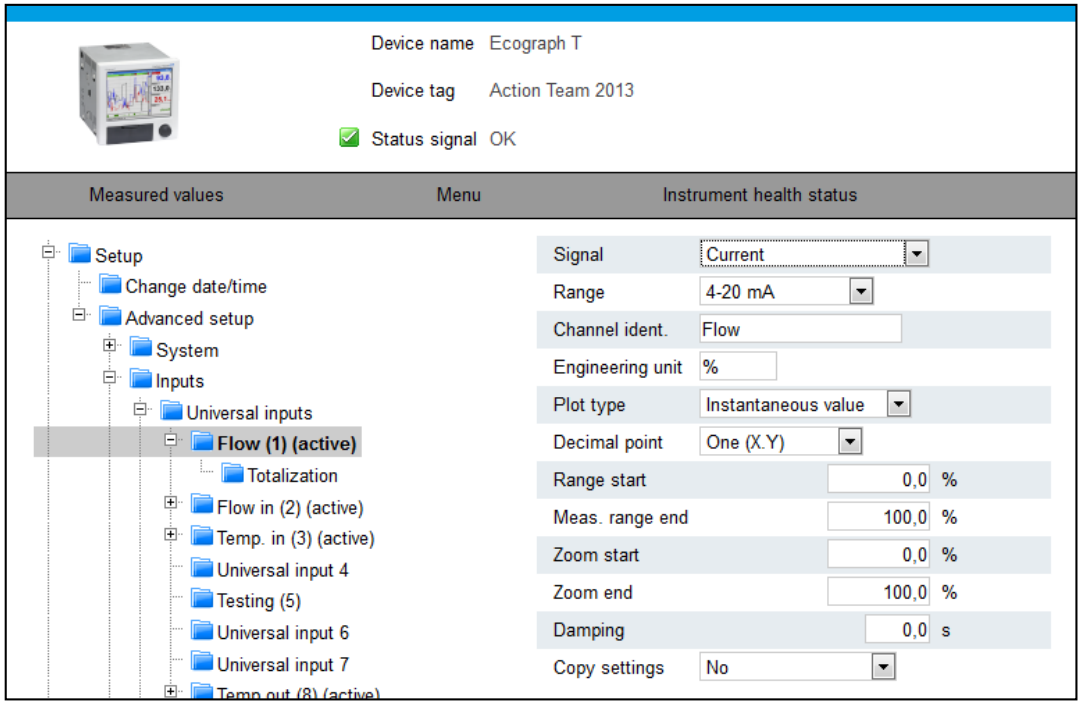
Feature	Benefit	Added Value
▪ Flexible display possibilities	▪ Indication as required for the specific process	▪ Quick process overview ▪ Wide range of applications

Web Server - Parameterisation

New web server – worldwide access

Integrated web server

- Timesaving set-up of the RSG35 via standard web browser
- Changes of the set-up are immediately transferred to the device
- Three password protected user levels with various user rights

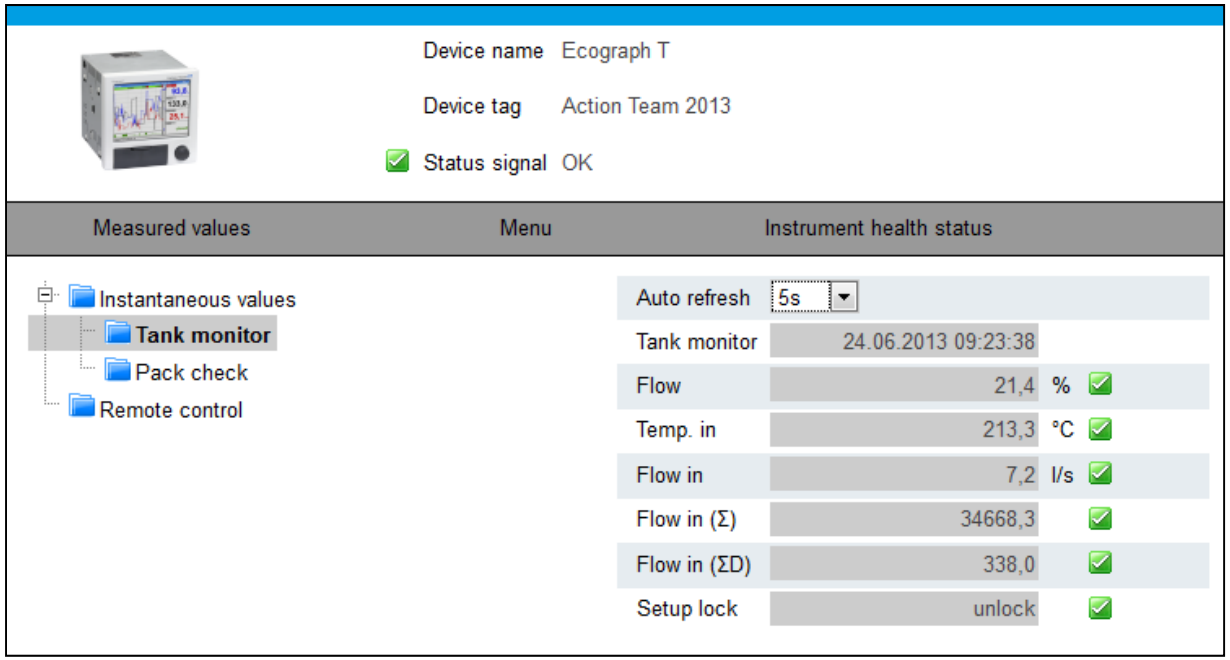


Web Server – Instantaneous Values

New web server – worldwide access

Integrated web server

- Indication of instantaneous values of the RSG35 as digital values
- Indication of limit value infringements
- Easy device identification
- Information on the device status in the header



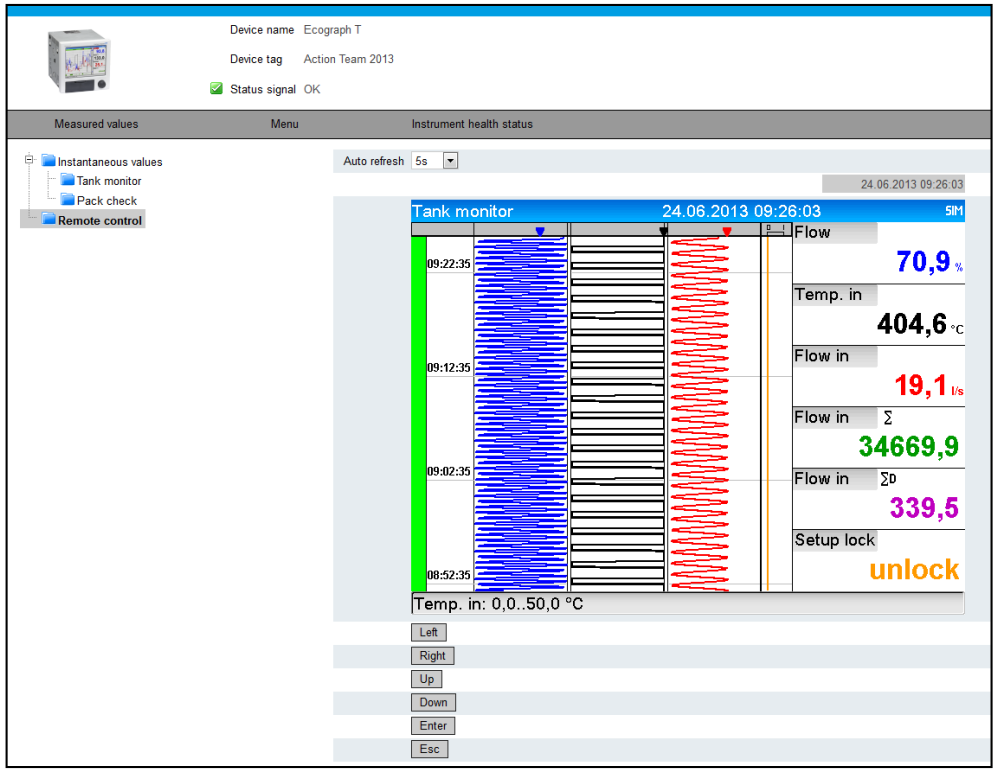
Endress+Hauser

Web Server – Historical Data & Remote Access

New web server – worldwide access

Integrated web server

- Remote access on and control of the device
- Display the current values and historical data as indicated on the device



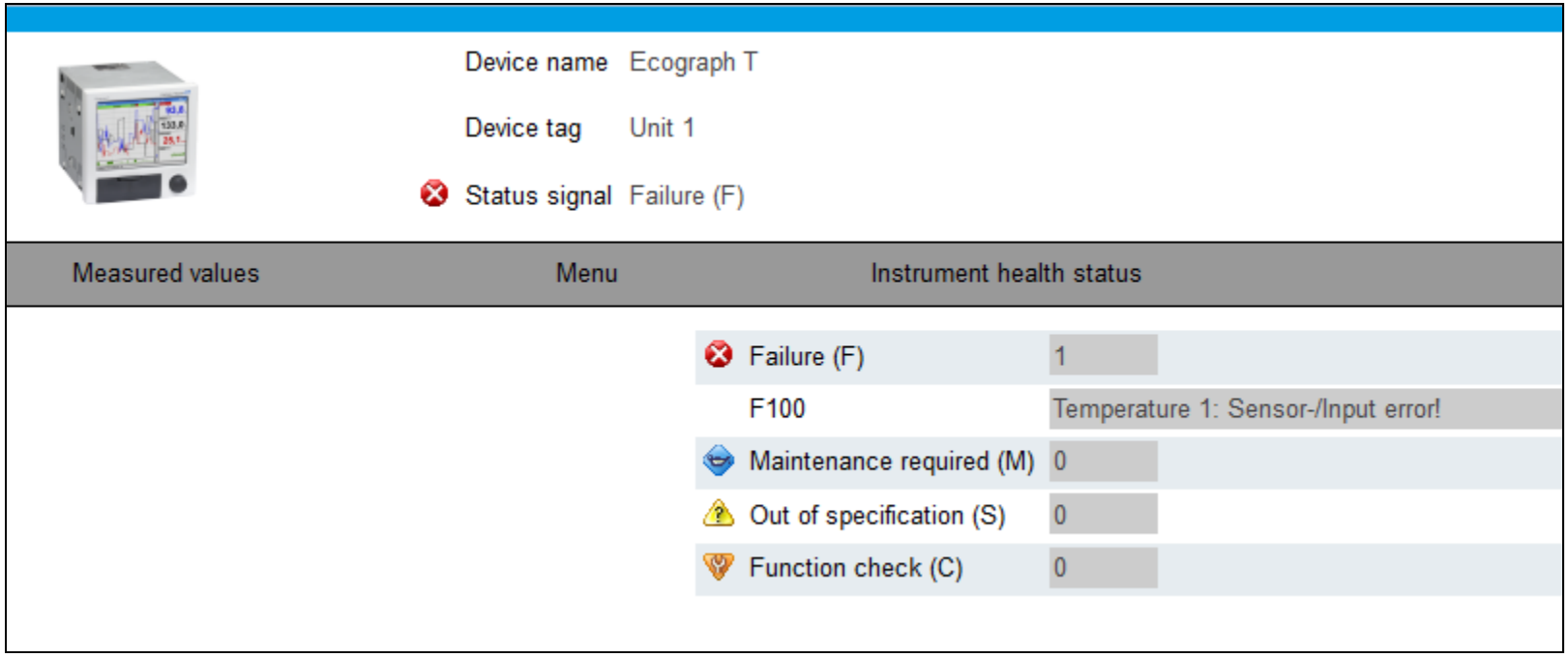
Endress+Hauser

Web Server – Diagnostics Messages

New web server – worldwide access

Integrated web server

- Indication on the health status of the Ecograph T RSG35 from all over the world!



Smart Scale Solution - Memograph M RSG40

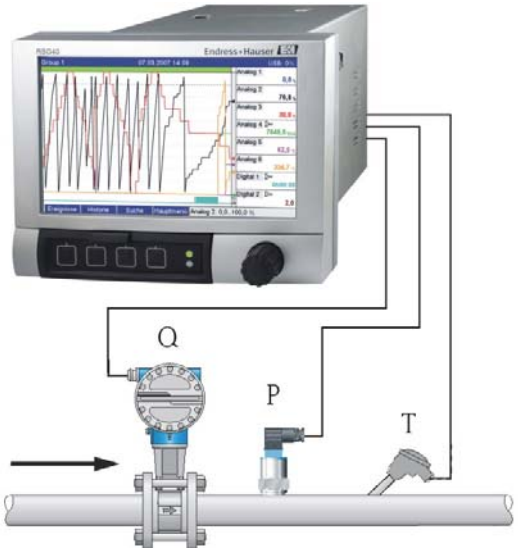
- Process related graphic
- USB printer interface (PCL V5.0)
- USB keyboard
- Additional functionality
  - Telealarm
  - Energy package
  - Water/wastewater package

Energy package

Mass- and Energy calculation

- Water
- Steam
- Water / Glycol mixtures

- Calculation standards
  - Accurate Water- and steam calculations due to the usage of the IAPWS97 Standards (International Association for the Properties of Water and Steam Version 1997)
  - Water / Glycol applications according EN1434



Telealarm Package

- Monitoring of remote stations such as pumping stations, water treatment plants etc.
- Unmanned plants
- Plants with no connection to centralized systems
- Where regular visits to check remote sites made
- Monitoring critical parameters which require immediate action
- Inventory monitoring

Telealarm – Modes

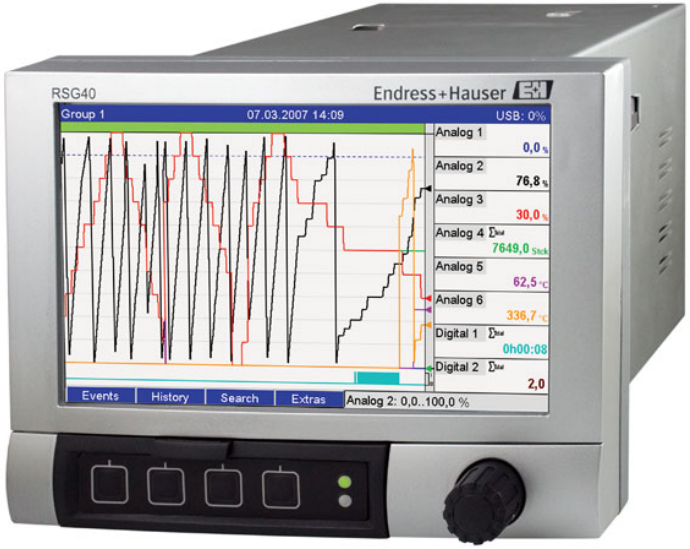
- Automatic alarm in case of limit violations
  - via SMS
  - via email
- Receiving of instantaneous values on demand on a cell phone
- Remote control of relays
- Confirmation of incoming alarms
- Alarm forwarding (with 4 escalation levels)

Telealarm functions – retrieving values remotely

- Instantaneous values or counter values can be retrieved as a text message from Memograph M
  - Analog values
  - Digital values (counters)
  - Math channels
- Values from a single channel or a whole signal group can be retrieved
- Syntax:
  - GETA;8;1 or
  - GROUP4

Benefit of water / wastewater software option

- Monitoring of remote stations such as pump stations, water treatment plants, storm water tank overflow etc.
- Remote monitoring and remote control of waste water and water plants
- Increased security due to fast alarm forwarding via SMS/text message or email



Water/ Wastewater Package

- Storm water tank overflow monitoring
- Analogue channel peak and low value recording
- Quantity floating peak and low value recording
- Seepage water monitoring
- Tele alarm included
- Math included
- Alarm statistic