WIKA Company presentation

A strong group. For your success.

WIKA
Part of your business

All around the world - close to the customers

Global presence in over 43 countries

Our production locations: Germany (HQ), Brazil, China, India, Canada, Poland, Switzerland, South Africa, USA (f.l.t.r.)

Our local services

- Sales/stock
- Consultancy, service, customised solutions
- Calibration for pressure and temperature measurement
- Diaphragm seal assembly
- Temperature sensor assembly
- Production

Range of products

Unique breadth and depth of product range

Electronic
pressure measurement

Mechatronic
pressure measurement

Mechanical
pressure measurement

Diaphragm seals

Electrical
temperature measurement

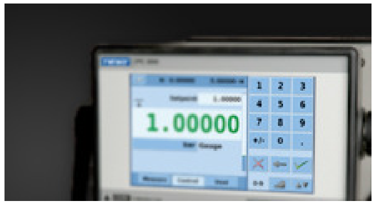
Mechatronic
temperature measurement

Mechanical
temperature measurement

Thermowells

Level measurement

Flow measurement



Calibration technology

Accessories

Competence

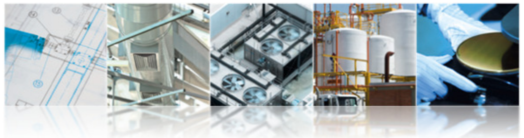
Able to meet any challenge

PROCESS

- Power engineering
- Chemical
- Petrochemical
- Oil & gas
- Water, waste water
- SF_6 gas excellence

INDUSTRIAL

- Machine building
- Heating, ventilation, air-conditioning
- Air handling
- Refrigeration
- Technical gases
- Semiconductor



HYGIENIC

- Food
- Pharmaceutical
- Beverage
- Biotechnology
- Cosmetics

Basic Training

Electrical Temperature Measurement

Content:

- Thermometer
- Thermowells
- Transmitter

Samples for industrial temperature measurement

Power engineering

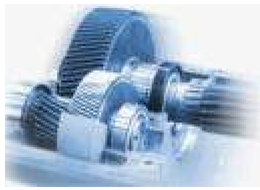
- As higher the process temperature, as better the efficiency of the plant

Chemical and petrochemical

- The temperature is responsible for the produced product

Food & Beverage

- Sterilization and cleaning of the process



Machine building

- Measuring of bearing temperature

Safety engineering

- Protection against fire and explosions

Measuring Principles

Temperature measurement is seperated in:

- Contact measuring (e.g.. inserting)
- Non contact measuring (e.g. optical IR thermometer)
- Special (acoustic, cristals)

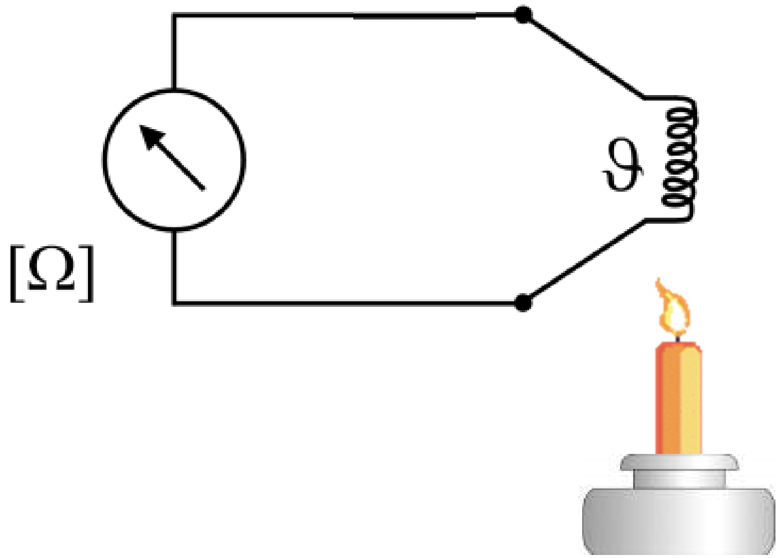
The contact electrical temperature measuring at WIKA will be done in two ways:

- Resistance sensors (e.g. Pt100)
- Thermocouples (e.g. Typ K)

Electrical resistance thermometer

The PT100 is a electrical device, which changes resistance with temperature.

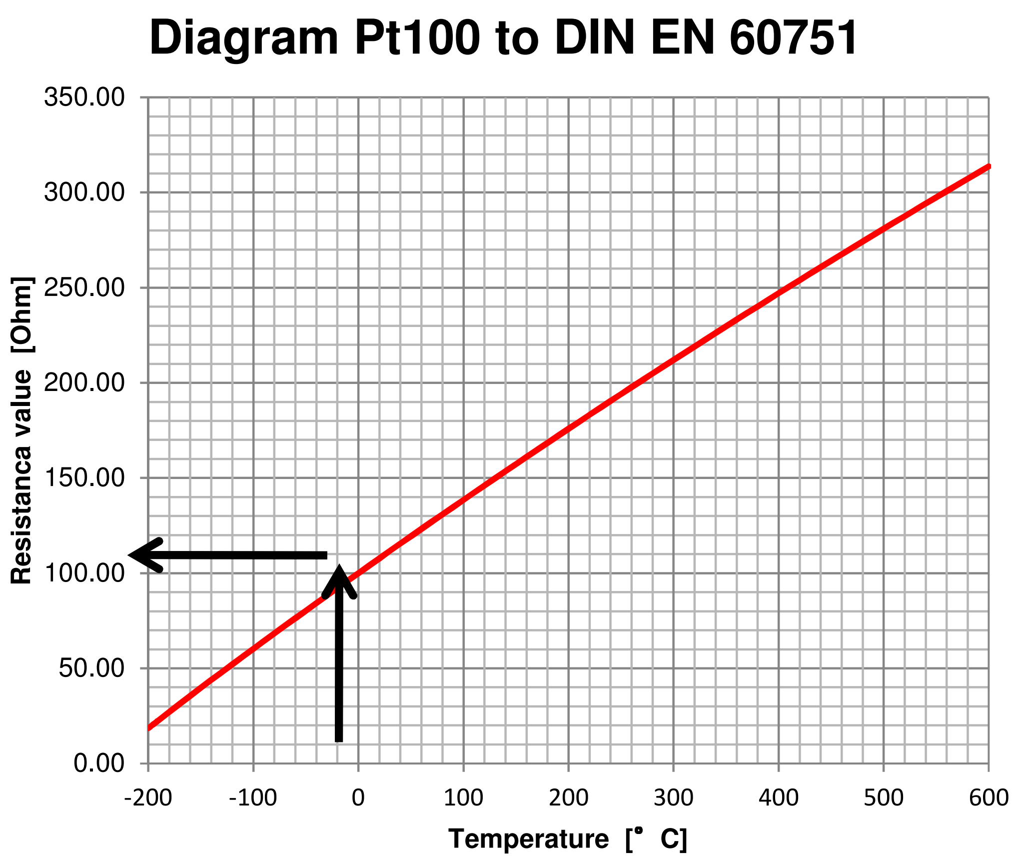
- The Pt100 is a „PTC“, a resistant with a „positive temperature coefficient“ (temperature is rising → resistance is also rising)
- There are also Pt1000, Pt500 etc. existing
- Another common name for PT100 is also RTD = Resistance Temperature Detector



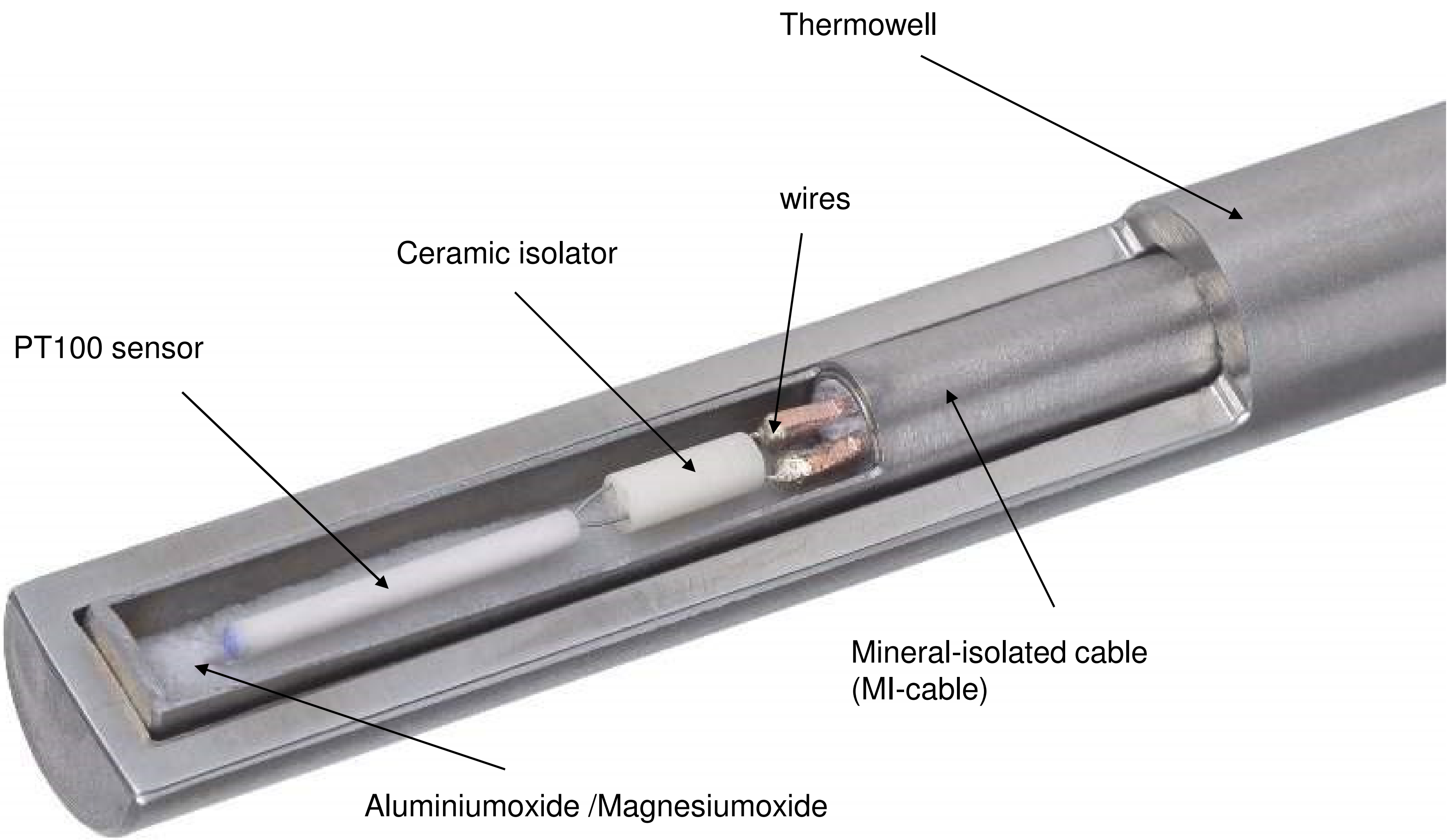
What means Pt100?

- **Pt** menas platinium, the main material of this sensors
- **100** means100 Ohm at 0° C to DIN EN 60751 (IEC 751)

Mathematical Interrelation

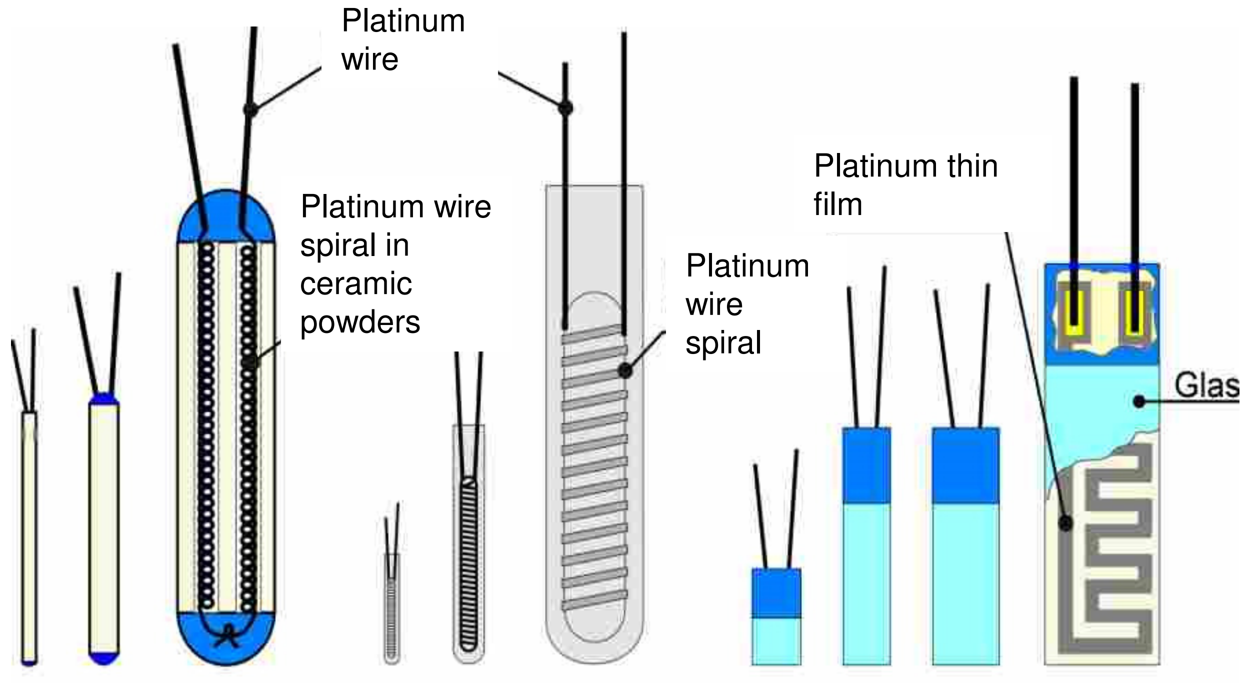


Construction of a industrial RTD

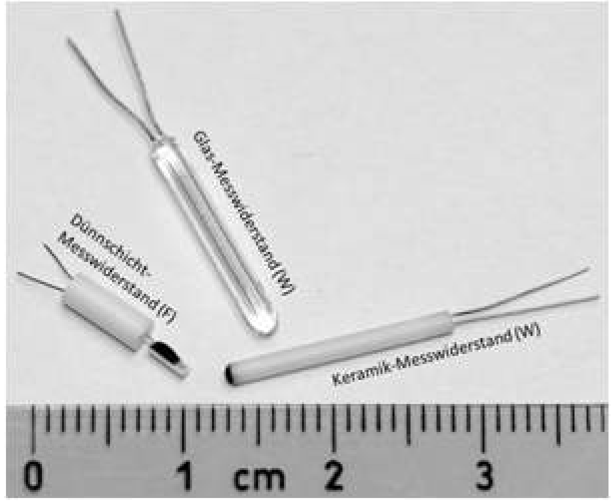


WIKA
Part of your business

2 principles and 3 versions



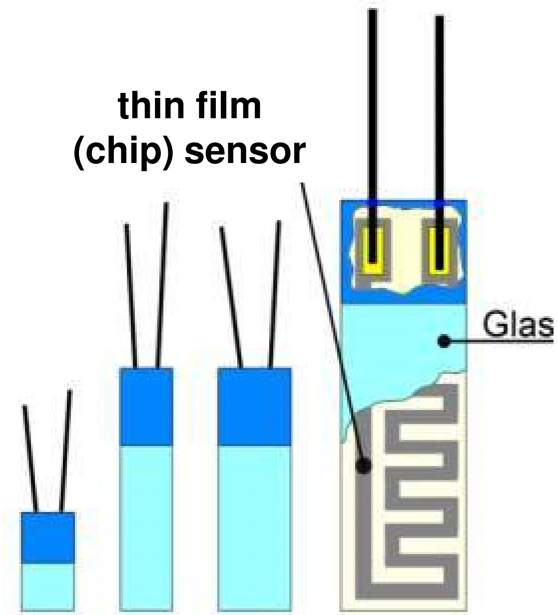
Ceramic sensor **Glass sensor** **Thin Film (chip) sensor**



Thinfilm (chip) sensor

- High Vibration resistance
- Good price/benefit ratio
- Small size

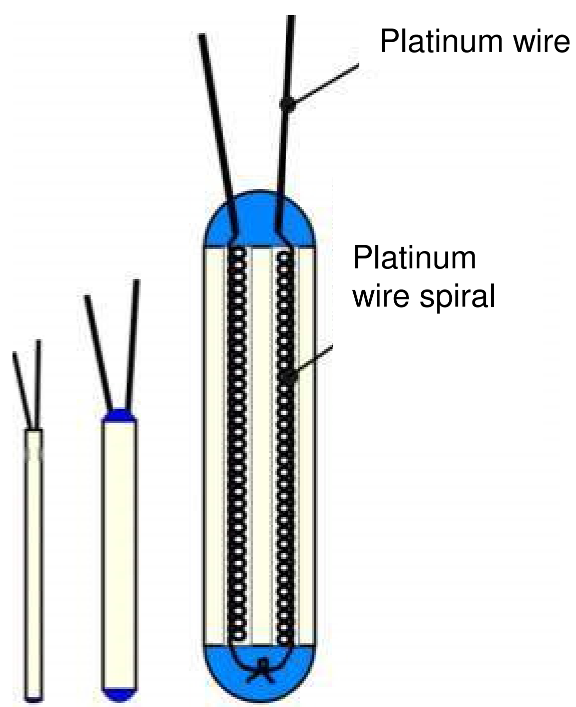
- Temperature range : -50... +500 ° C (class B)
- Not fully accepted by chemical industry



Ceramic sensor (platinum wire)

- Full temperature range -200 … +600 °C (class B)
- fully accepted by all customers

- Limited vibration resistance
- High price



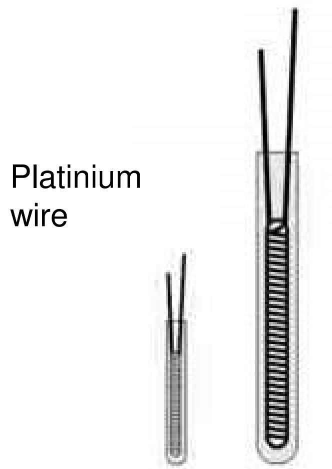
Glass sensor (wire)

+

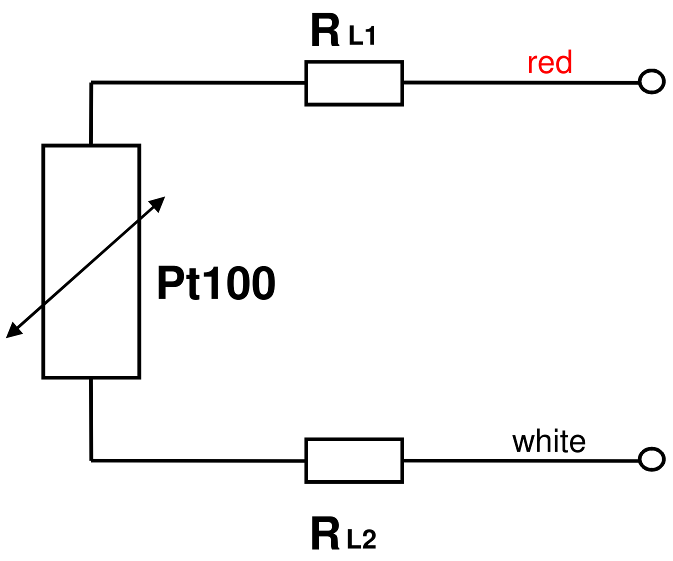
- High vibration resistance
- Fully accepted by all customers

-

- Temperature range: -200 ... +400 ° C (class B)
- High price



2-wire-circuit



Easy and cheap

- For short distance
- Measuring error because of wire resistance

Sample:

Length of wire: 100m
cross section: 0,5mm² (40 Ohm□/1000 m)

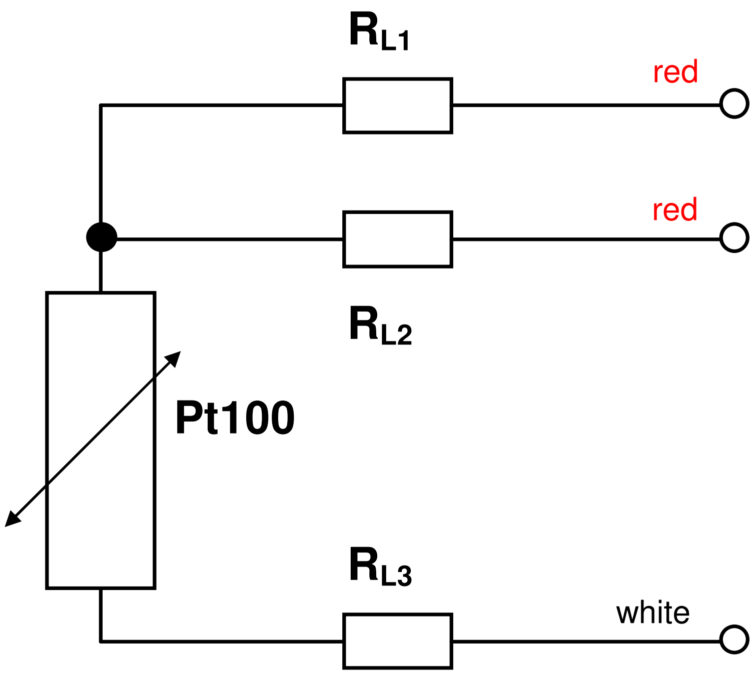
$$2 * R_{line} = 2 * 100\ m * \frac{40\ Ohm}{1000\ m} = 8\ Ohm$$

This leads to an error of approx. **20 ° C (!)**

(Widerstand in Ω)

	0	1	2	3	4	5	6	7	8	9	10
-10	96,086	96,478	96,870	97,261	97,653	98,044	98,436	98,827	99,218	99,609	100,000
0	100,000	100,391	100,781	101,172	101,562	101,953	102,343	102,733	103,123	103,513	103,903
10	103,903	104,292	104,682	105,071	105,460	105,849	106,238	106,627	107,016	107,405	107,794
20	107,794	108,182	108,570	108,959	109,347	109,735	110,123	110,510	110,898	111,286	111,673

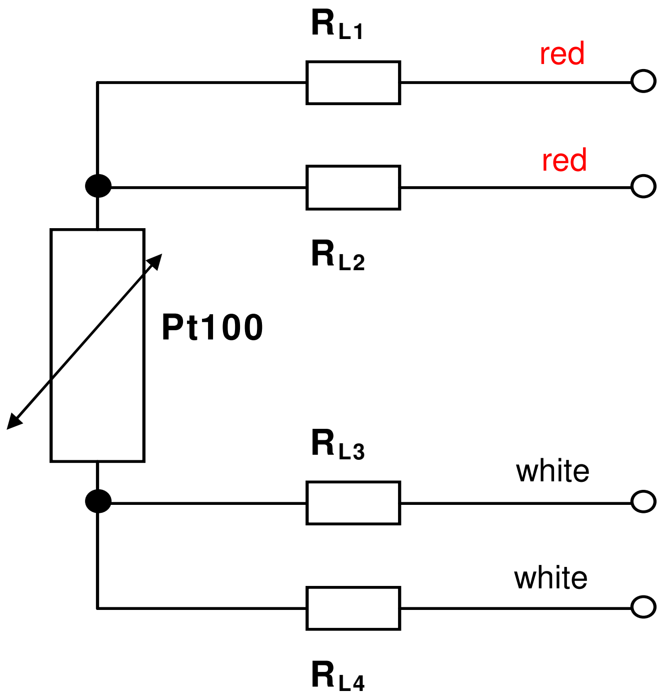
3-wire-circuit



Good cost/benefit ratio

- No measuring error if the resistance of all wires are identical
- Recommended wire length up to 30 meter
- Standard in electrical measurement
- Suitable for standard trandmitter configuration

4-wire-circuit



No influance of wire resistance

- Wire resistance is fully compensated
- Recommended for wire length over 100 meter

Applications

- Calibration and high accuracy measurement
- For accuracy class A or AA
- For SIL - applications

Pro & Cons of Resistance Thermometer‘s

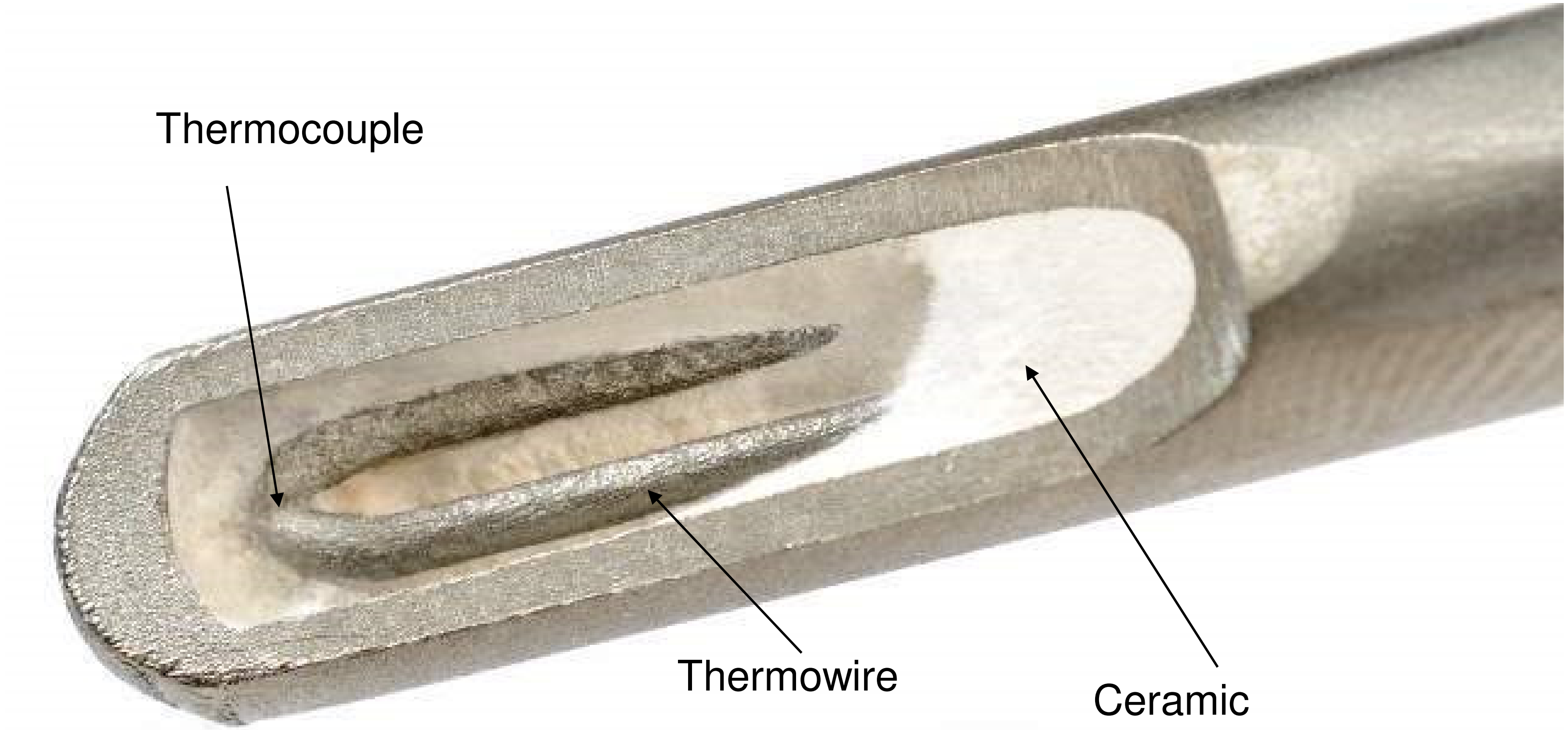
+

- Linear signal output
- No compensation circuit required
- In low temperature applications better accuracy then a thermocouple

-

- Limited up to 600 °C
- In comparison to TC‘s longer response time
- Possible error by self-heating
- More expensive than a TC
- Mechanical strength not as high as a TC

Thermocouples



How a thermocouple works ?

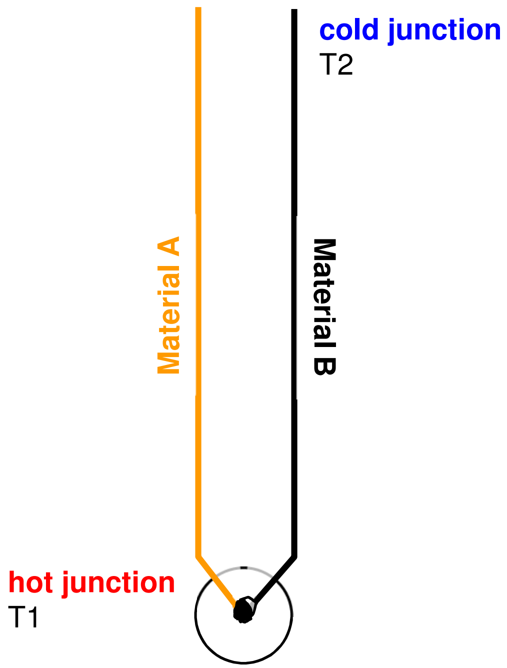
The thermo-electric effect (Seebeck effect)

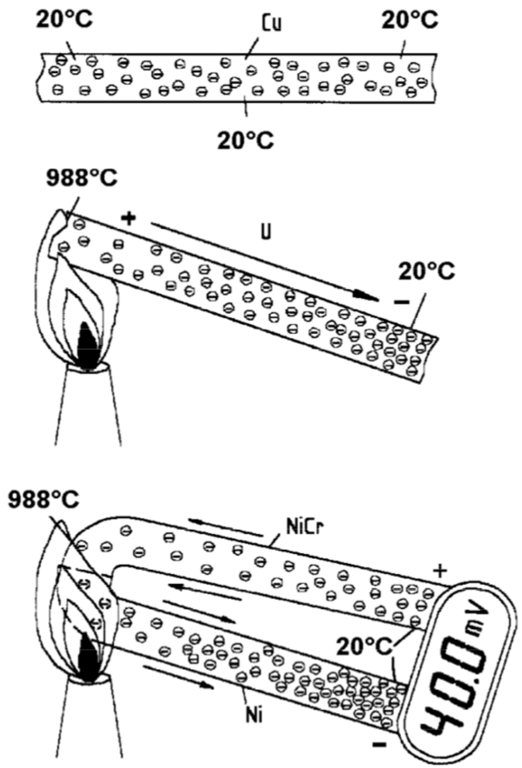
A thermocouple never measures the absolute temperature, but always the difference between:

- **T1**: the measuring point (hot junction) and
- **T2**: the basis point (cold junction)

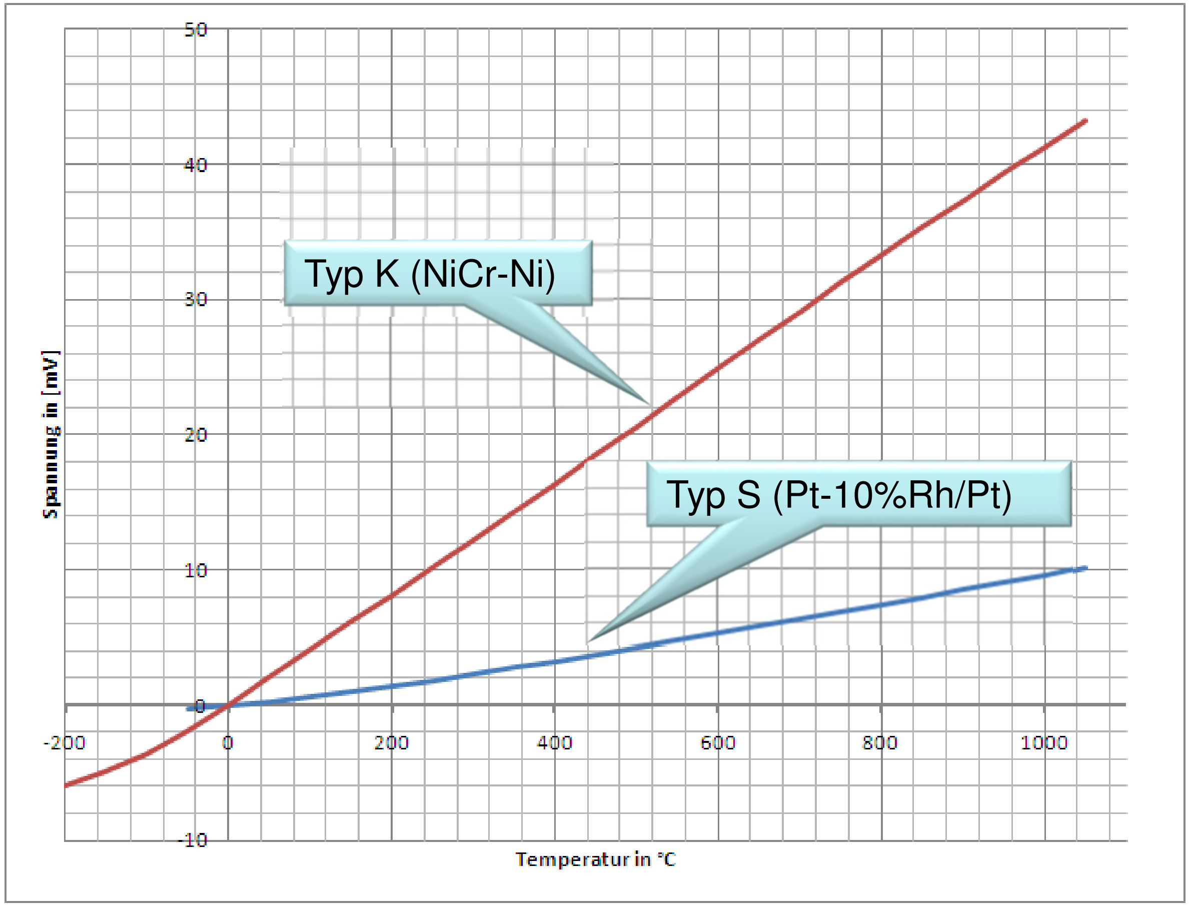
Ungrounded Junction

Grounded Junction





Characteristic curve of TC's



- Each thermocouple has a different characteristic
- the caracteristic is not linear
- The voltage of the seebeck effect is really small, approx. 0.04 Volt

(The Voaltage of a normal batterie is 40 times stronger)

Accuracy of thermocouples

The standard EN 60584-2

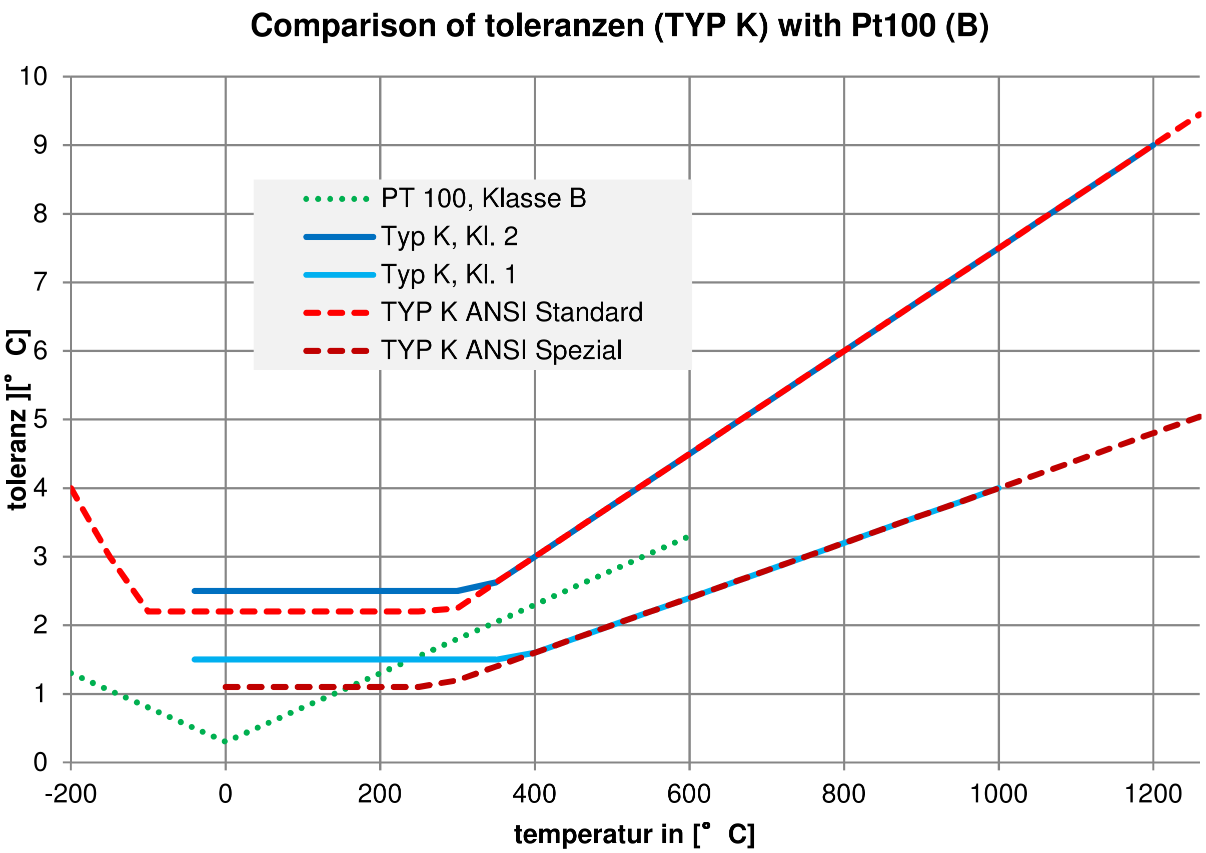
separate thermocouples into different classes

- class1
- Class 2

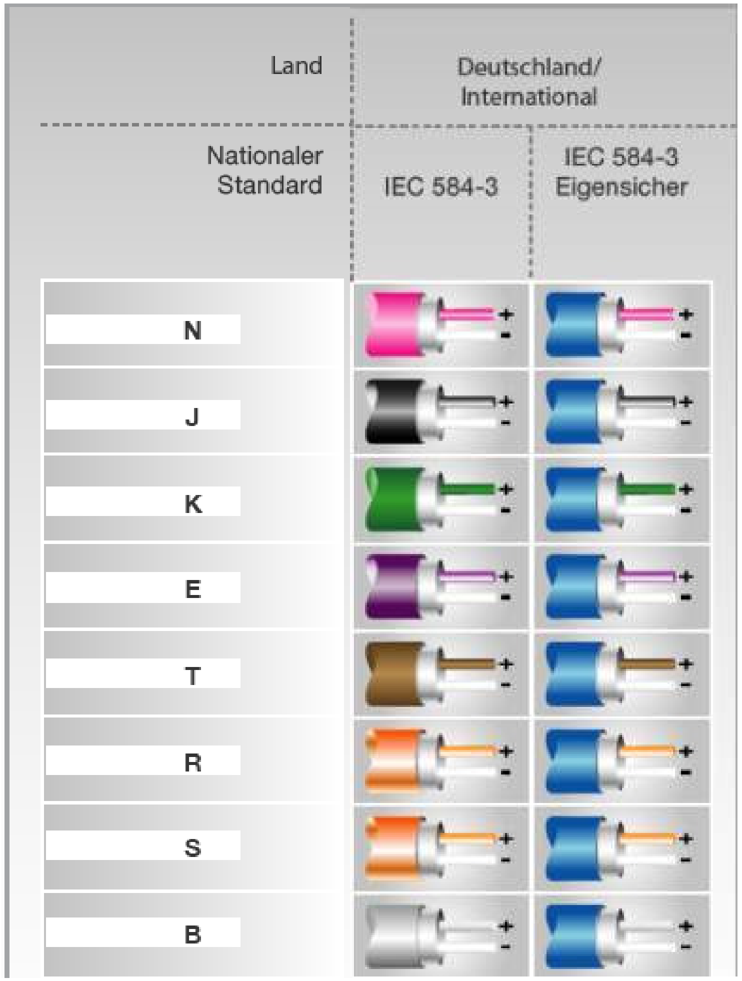
ASME 230

Northamerican standard

- Standard
- Spezial



Colour codes of thermo- and compensation cables



The most popular cable arecodeable and listed in the WIKA equipment catalouge.

Thermocable:

Are made of **identical** material as the thermo couple:
\+ accuracy
\- cost

Compensation cable

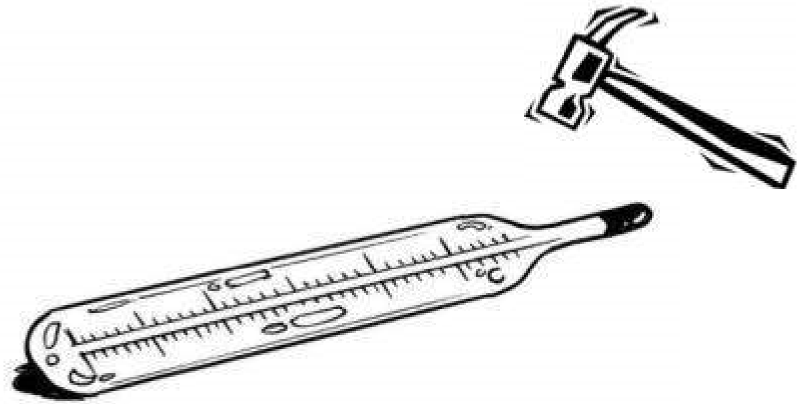
Are made of **similar** material as the thermo couple
\+ cost
\- accuracy

Leitungsmantel und Ausführung

- **Material**: PVC, silicon, teflon, fibreglas
- **Armour**: yes / no

Why to use thermowells?

- Protection of the temperature sensor
- Protection of the workers and the enviroment
- Replaceability of the sensor during running process



WIKA Thermowell's

Construction of Thermowells

Shank design of solid drilled thermowells

- Tapered: strong root and fast respone time
- Straight: for highest pressure loads
- Stepped: fast response time

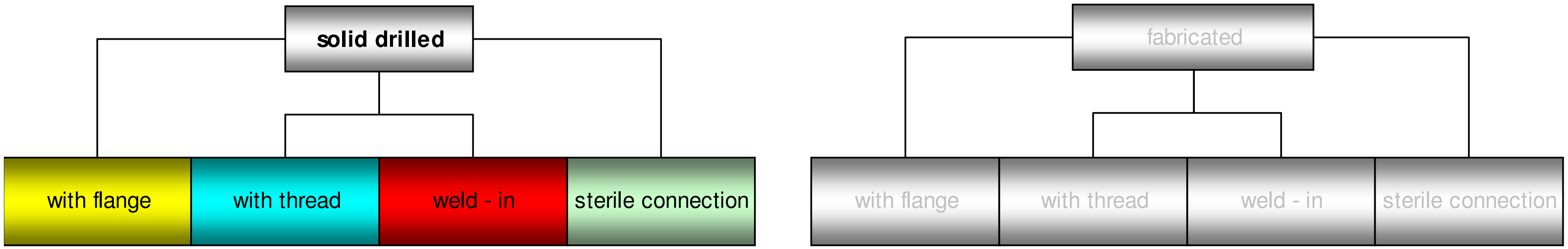
Shank design of fabricated thermowells

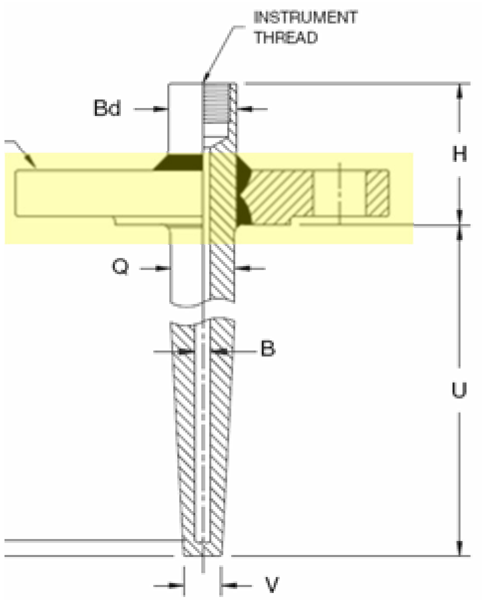
- Straight tube (standard)
- Tapered tube 12x2,5 mm to 9 mm for fast response time

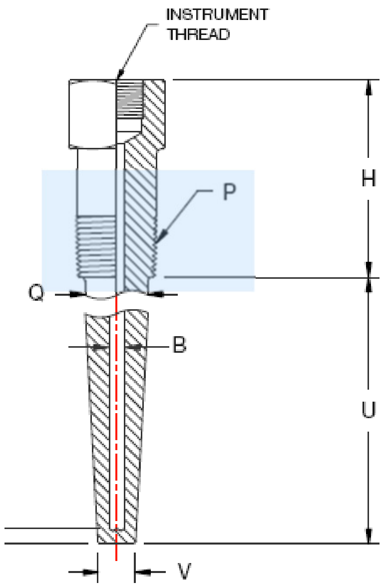
Thermowell Lunch and Learn

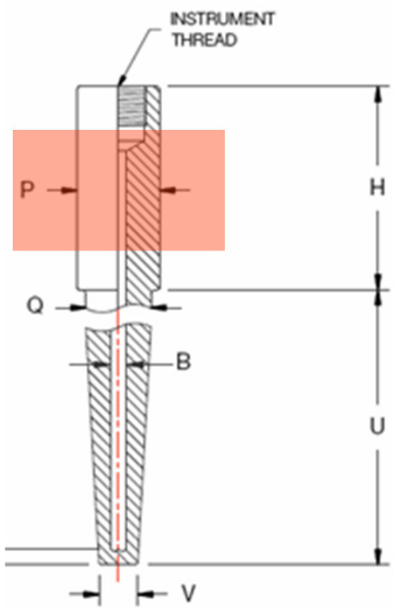
Process Connections

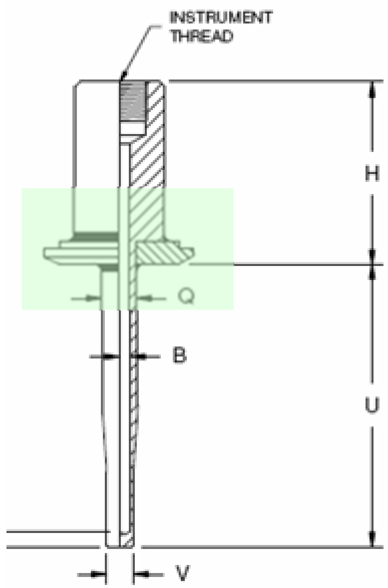
WIKA Part of your business



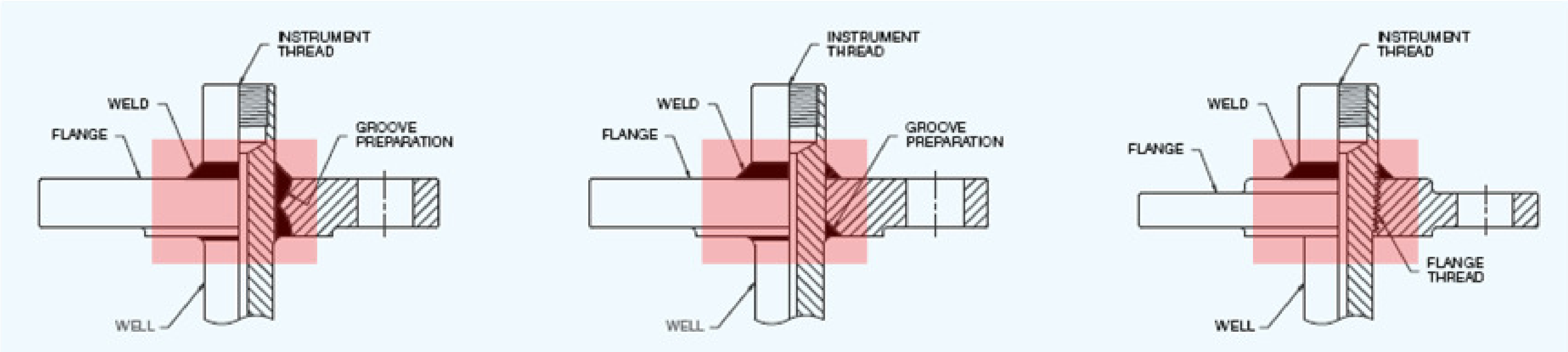








Construction of Thermowells



Full Penetration Welding

- global acceptance
- use of blind flanges

Partial Penetration Welding

- use in Europe / Germany
- use of blind flange

Screwed & Welded construction

- roots in asian market
- threaded flange with hub

TW40: Special construction for exotic materials

TANTALUM:

- removeable cover
- 12 x 0,4 mm with tube 11 x 2 mm
- 16 x 0,4 mm with tube 15 x 3 mm

EXOTIC MATERIAL

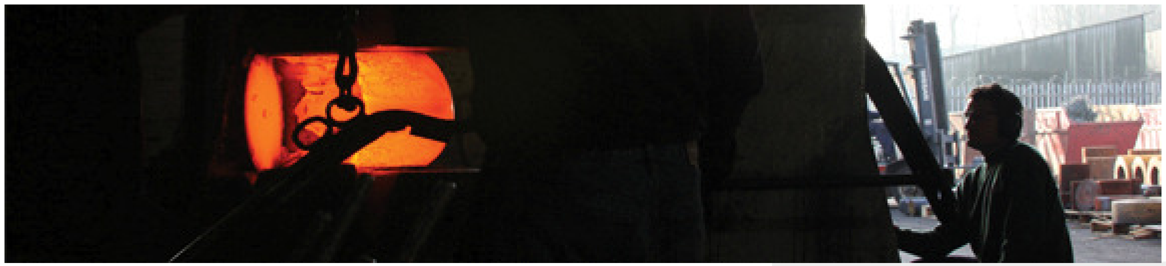
- Washer disc construction (also TW10)
- Wetted parts made of exotic material
- Flange body made of stainless steel

WIKA
Part of your business

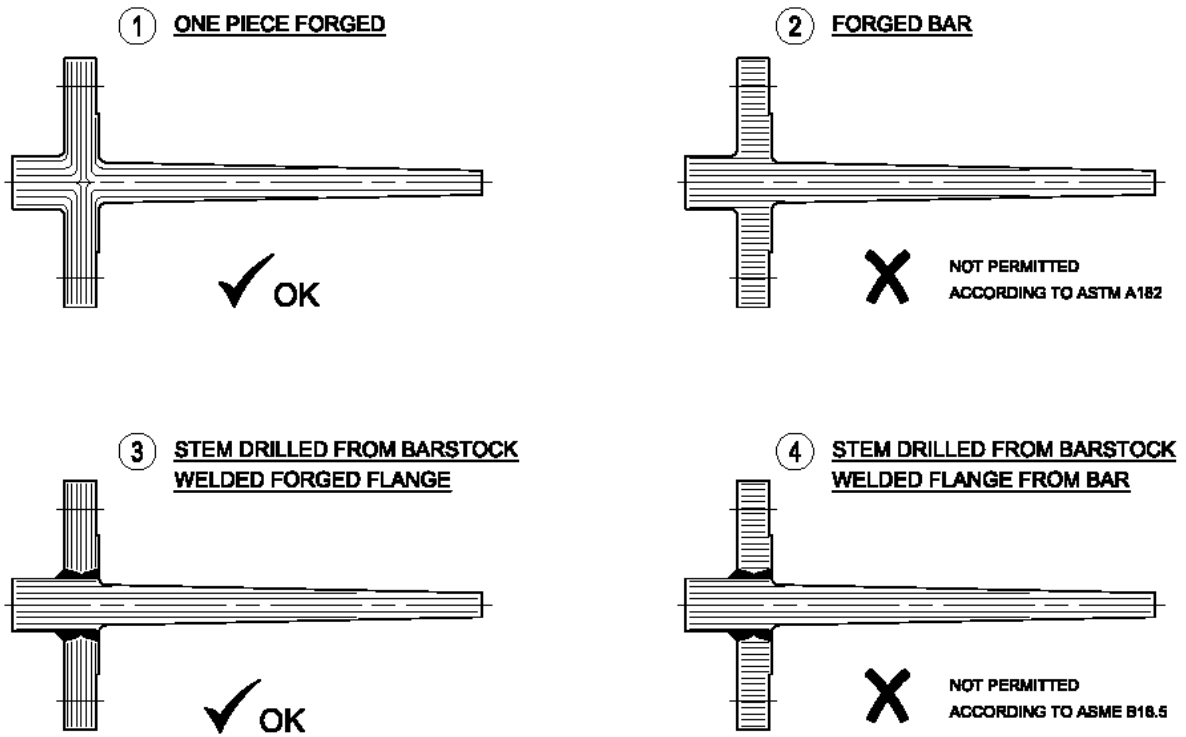
Focus on Oil & Gas

TW31 - The manufacturing of solid forged Thermowell's

Flanged & single piece Thermowells machined from forged blanks…full adherence to ANSI B16.5 & essence of ASTM A182….



Forged Grain Structure



Non Destructive Testing

Standard → Special

Hydrostatic pressure test:
- outside pressure for flanged thermowells
- inside pressure for screwed and weld-in thermowells

Dye penetration test / Liquide penetration test:
- surface defects of welding connections

Positive material identification (PMI):
- verification of alloy content
- spectral analysis (OES) oder X-ray Fluorescence (XRF)

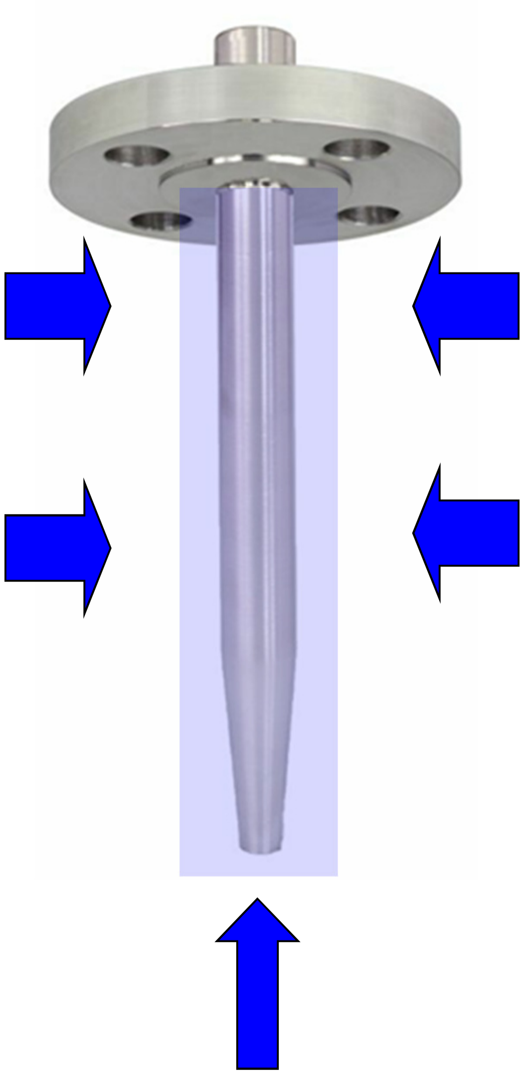
Ultrasonic testing and X-ray :
- defect inside welding connections
- check of bore concentricity

Helium leak test:
- leak test of themowells

Thermowell Lunch and Learn

Outside pressure testing

WIKA Part of your business



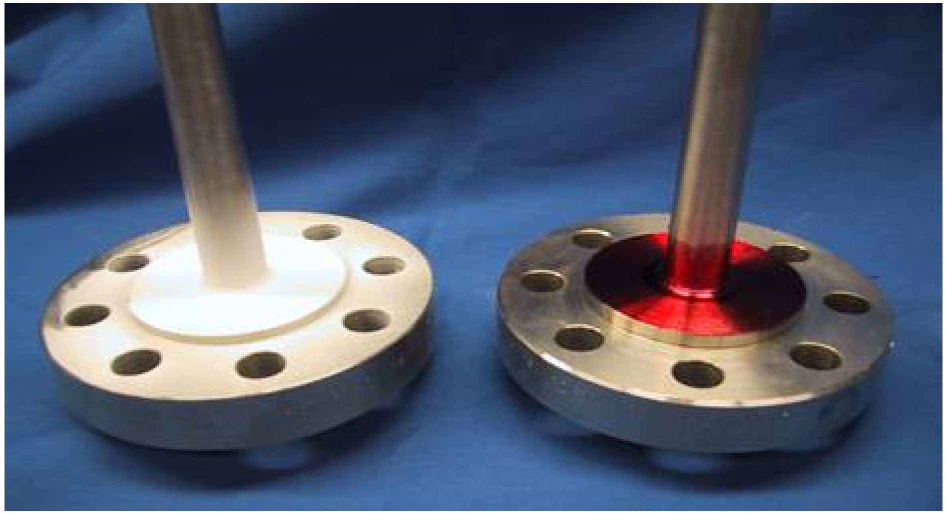
Flange to ASME B16.5:	
pressure rating	test pressure in bar
150#	30
300#	85
600#	160
1500#	390

Flange to DIN / EN:	
pressure rating	test pressure in bar
PN 16-40	60
PN 63/64	100
PN 100	150

inside pressure testing

- Standard test for threaded and weld-in thermowells
- Special for flanged thermowells
- Testing time: 3 min
- Testing pressure: 400 bar

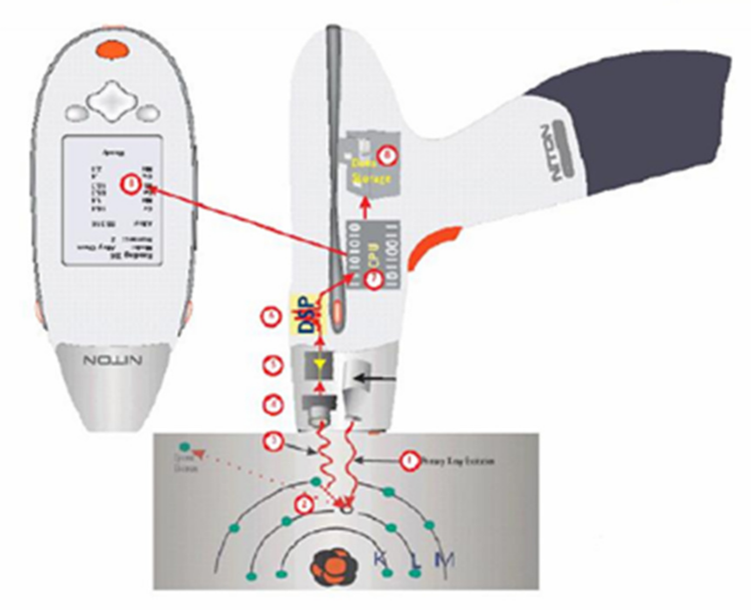
Dye Penetration Test (DPI)
Liquide Penetration Test (LPI)



Surface defect on welding connections

- Methode red/white („Mat'l Check")
- Methode with ultraviolet light

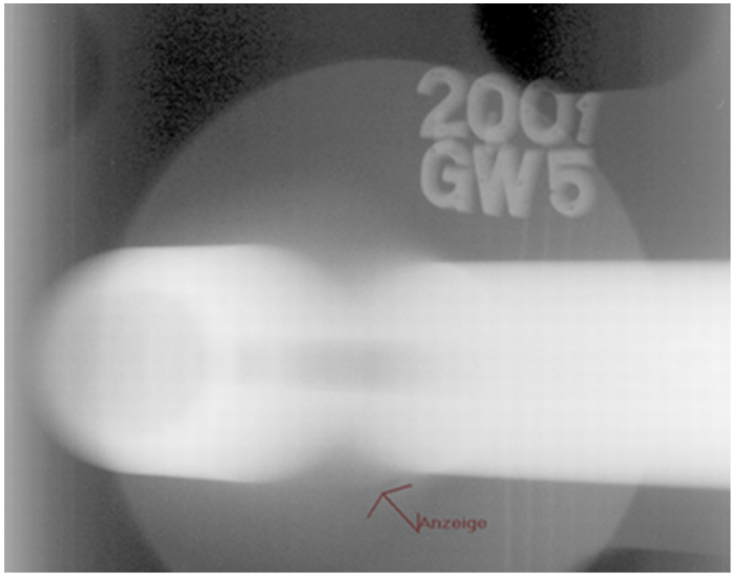
X-ray Fluorescence (RFA)



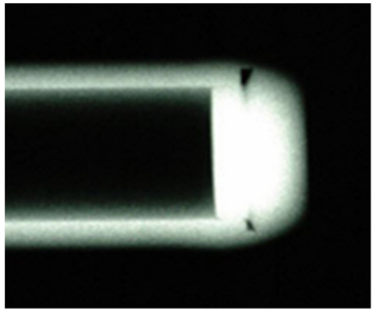
- X-Ray = high energy radiation
- Energy of X-ray stimulate atomes
- Atome radiate a specific radiation
- Specific radiation = Indicator about alloy element in probe

Thermowell Lunch and Learn

X-Ray examination



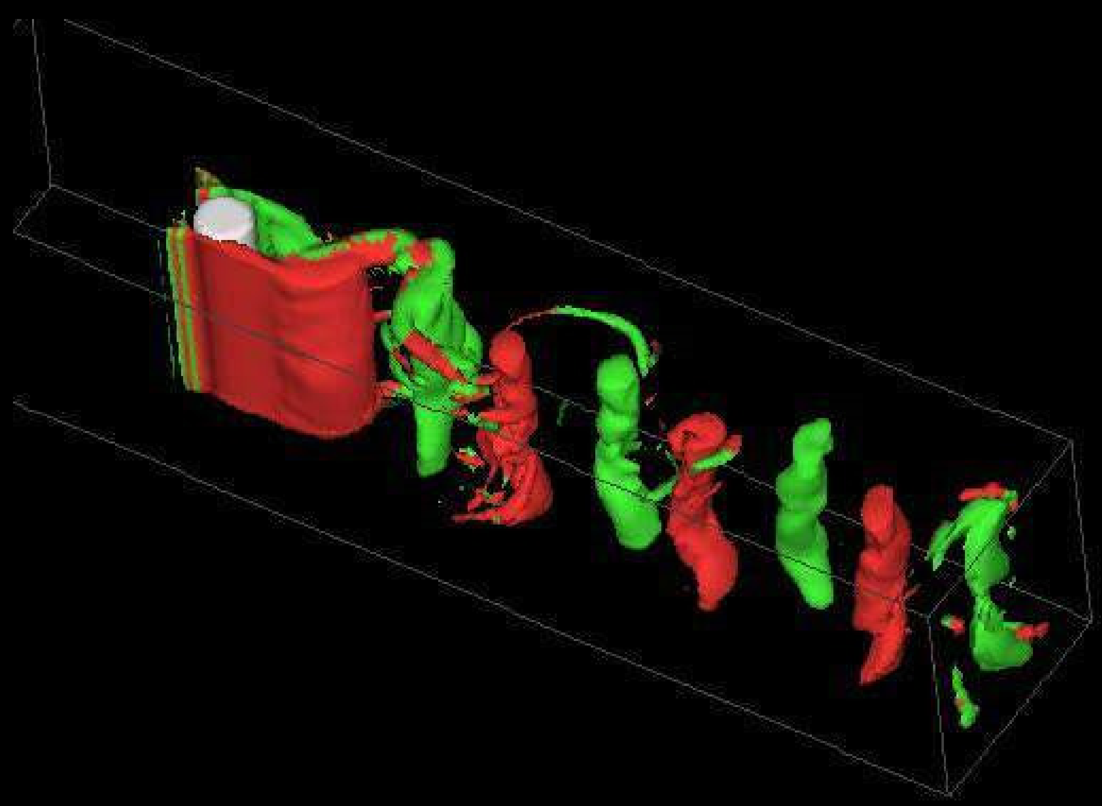
- Internal defect of welding connections
- Full Penetration Welding
- Welds of end caps of fabricated thermowells
- Concentricity of bore

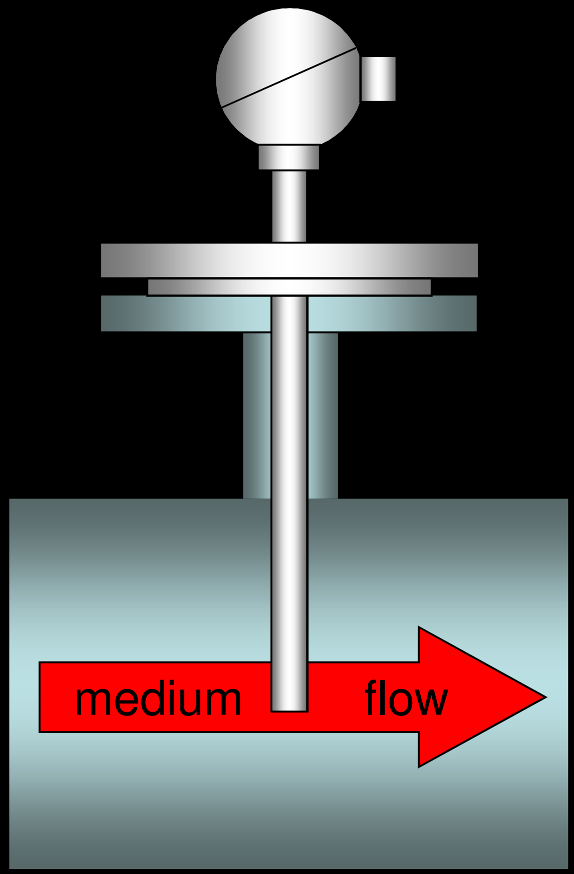


What this pictures have in common?

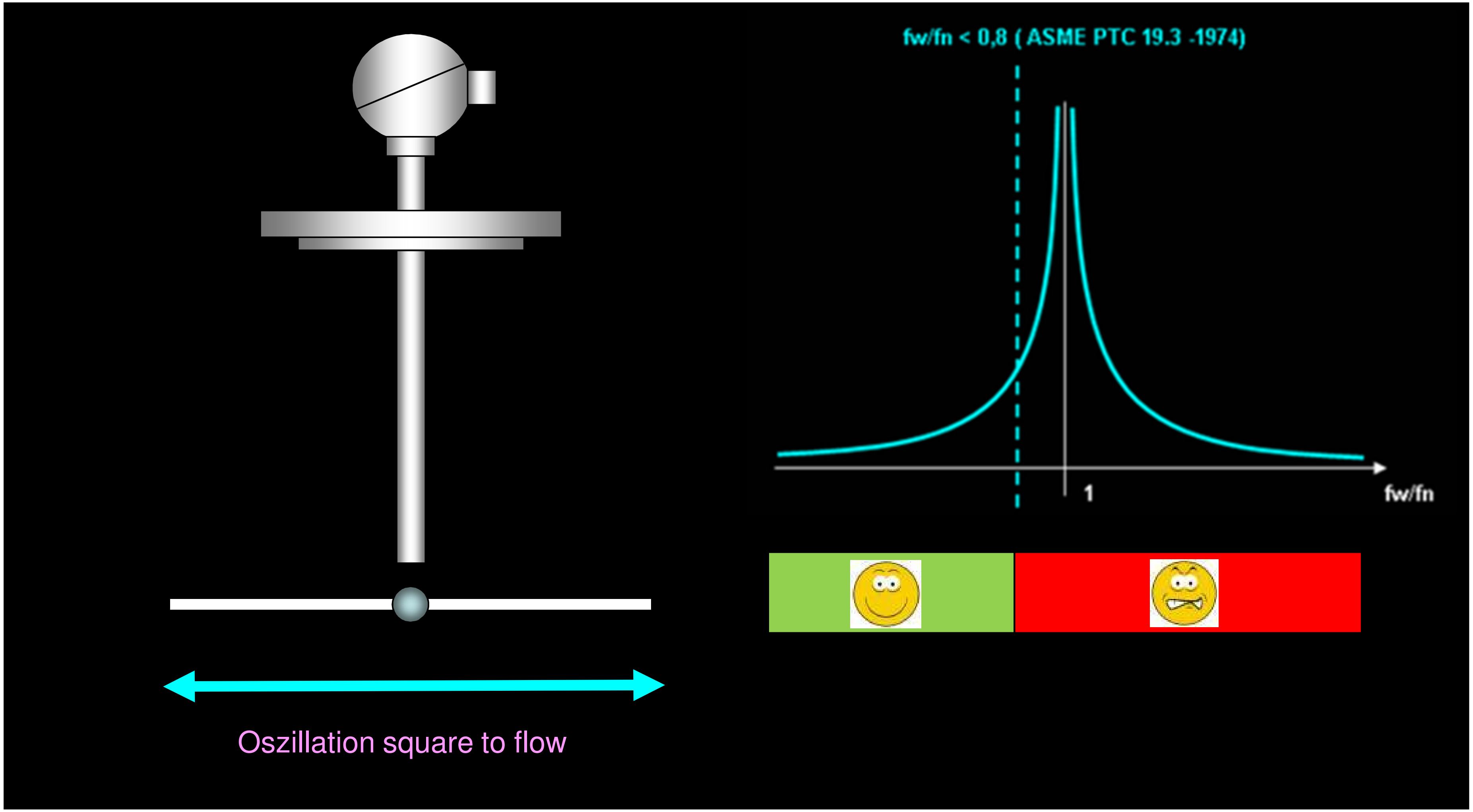
Kármán Vortex Street

Principle of VORTEX shedding





Oszillation to ASME PTC 19.3-1974



What happend 1995 in the fast breeder reactor in Monju, Japan ?

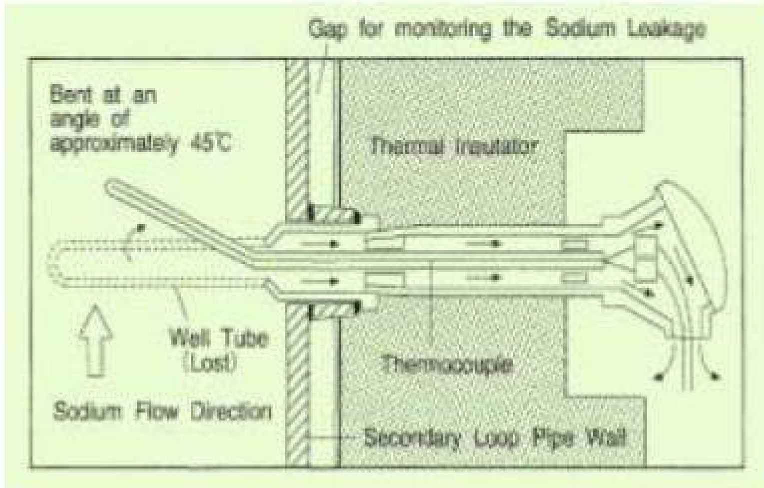
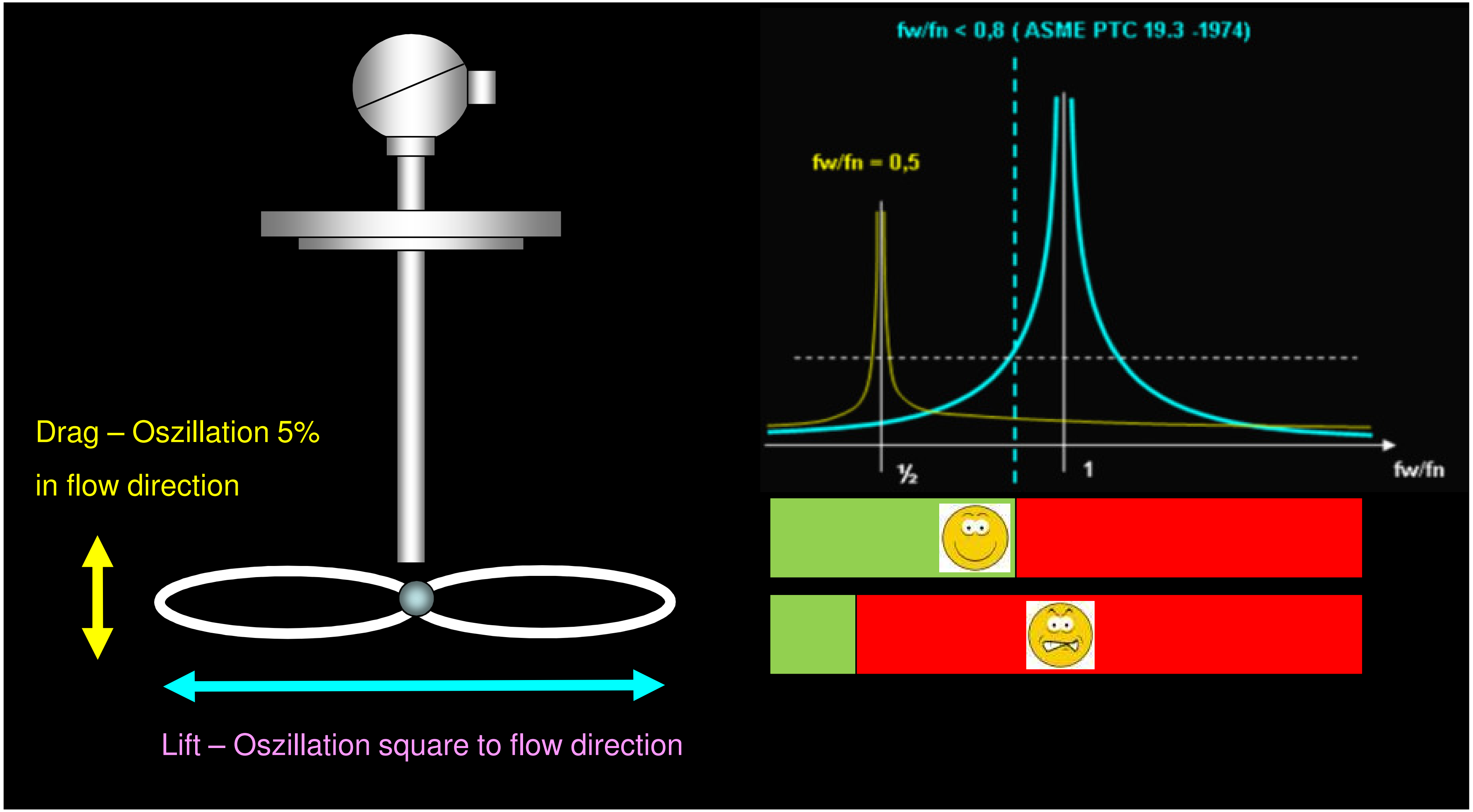


Fig.3 MONJU reactor thermowell after failure

Osolation to ASME PTC 19.3-TW2010

WIKA
Part of your business



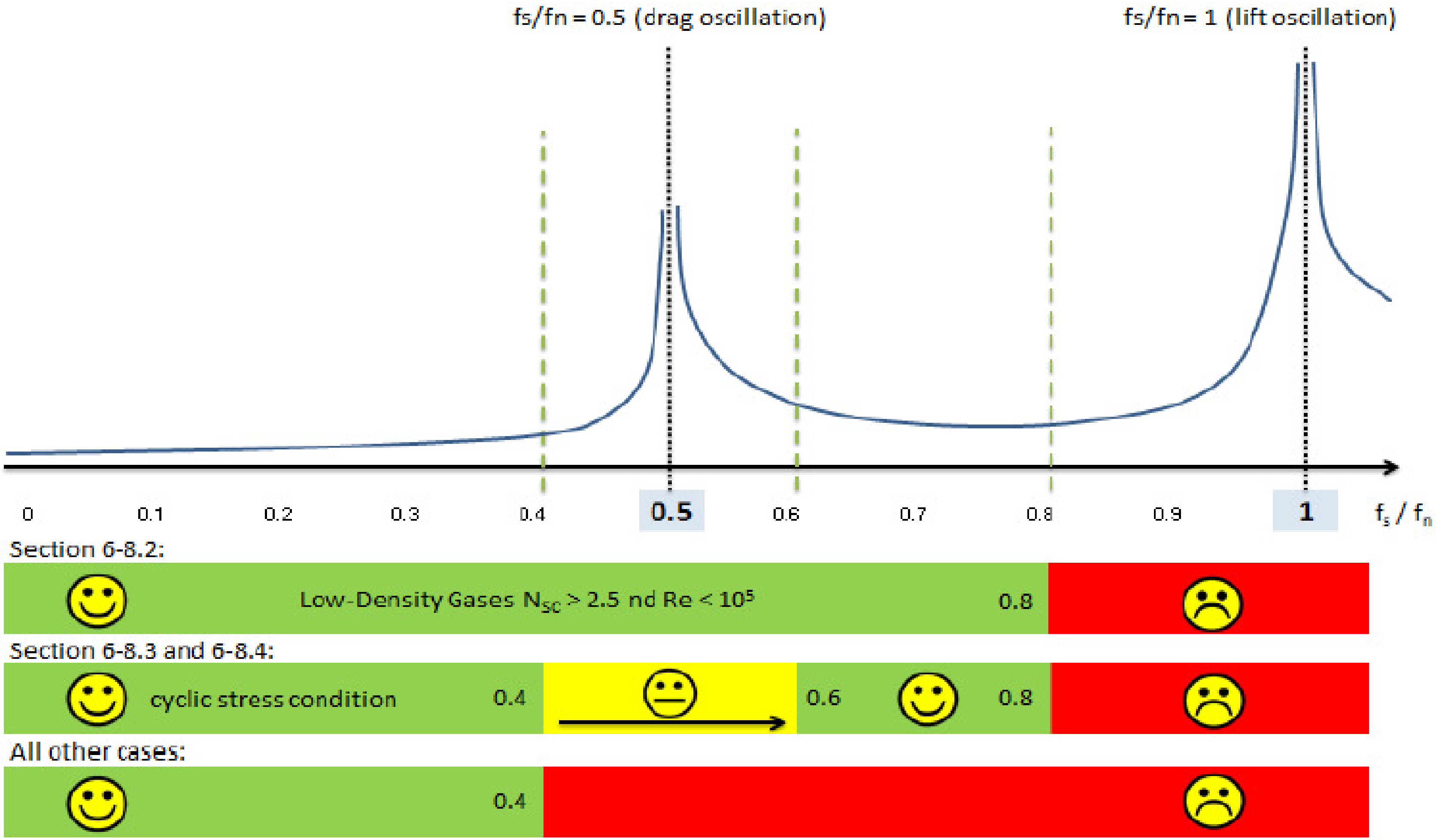
Wake Frequency Calculation program PTC 19.3- TW2016

		Process data							Thermowell data										Calculation result							
Selection	Display detail TAG-No	Temperature	Pressure	Max. velocity	Med. density	Inner diameter	Dyn. viscosity	Shielded length	WIKA TW Type	Insertion length	Stepped length	Step radius at B	Root radius at A	Bore diameter	Root diameter	Tip diameter	Tip thickness	TW material	Safety fatigue	Safety bending	Safety pressure	Ratio limit fwfnc	Frequency ratio	Result	Optimized length (--> 0,7/0,35 ... < rmax_)	Note code
All	WIKA description ASME description	T	P	v	rho	Di	my	Sl Lo	/	U L	U_s Ls	R_s rB	R_a rA	B db	Q A	V B	Tt	mat	dyn	stat	Sp	rmax_	r	Eval.	Uopt Lopt	/
☑	Choose units --->	°C	bar	m/s	kg/m3	mm	mPa s	mm	/	mm	mm	mm	mm	mm	mm	mm	mm	name	x	x	x	/	/	/	mm	/
☑	sample	343	9.80665	8.01	11.46		0.003		TW30	500	90			6.6	30	14	5	316L	35.5308	173.403	23.17	0.80	1.14	✗	390	Ri
☑	sample	160	9.80665	8.078	680.85				TW20	255				6.6	30	14	5	316L	2.63584	17.4873	28.39	0.40	0.34	✓		
☑	sample	370	3.43233	90.099	654.57				TW10	84				6.6	30	18	7	316L	0.344	0.94811	80.00	0.40	0.43	✗	75	RFB
☑	sample	370	3.43233	45.05	654.57				TW10	115				6.6	30	18	7	316L	0.79733	2.02335	80.00	0.40	0.37	✗		F
☑	sample	465	167.694	8.493	510.68				TW10	255				6.6	30	16	5	316L	3.15619	14.3582	1.40	0.40	0.34	✗		T
☑	sample	370	3.43233	66.46	0.1				TW10	110				6.6	30	18	7	316L	1724.47	3043.66	80.00	0.80	0.48	✗	130	Di
☑	sample	370	300	66.46	0.1				TW10	110				6.6	30	18	7	316L	1724.47	39.1631	0.92	0.80	0.48	✗	130	DPi
☑	sample	315	3.43233	0.973	650.91				TW10	230				6.6	30	14	5	316L	582.546	1212.86	67.51	0.40	0.03	✓		

- Process data
- Thermowell data
- results

Results to PTC 19.3- TW2016

WIKA
Part of your business



WIKA Thermowell Wake Frequency Calculations

Error Codes for PTC 19.3- TW2016

Capital letters indicate a critical value at the root of the thermowell root.
Stepped thermowells are calculated at the root and at the position of the step diameter. Note codes in small letters indicate that a critical value was reached at the position of the step diameter.

Message T: Temperature
- The requested temperature of the application exceeds the allowed temperature range of the selected material.
- Counteraction: Select a material suitable for higher temperatures

Message R: frequency ratio
- A dangerous vibration of the thermowell that cannot be excluded.
- Counteraction: The resonance frequency of the thermowell can be affected by every design element of a thermowell. The most effective way to reduce the frequency ratio is to increase the natural frequency of the thermowell by reducing the insertion length. In the case of failing

Message F: fatigue strength
- The dynamic stress at design conditions caused by the vibration could reach a dangerous level.
- *Counteraction*: Increase the shank dimensions for root and tip to the direction of a stronger thermowell

Message B: static stress
- The static stress at the root of the thermowell, caused by bending and pressure, could reach a dangerous level.
- *Counteraction*: Increase the shank dimensions for root and tip to the direction of a stronger thermowell.

Message P: pressure limit
- The operation gauge pressure is higher than the pressure limit of the requested design.
- *Counteraction*: Increase the tip diameter and thickness of the thermowell.

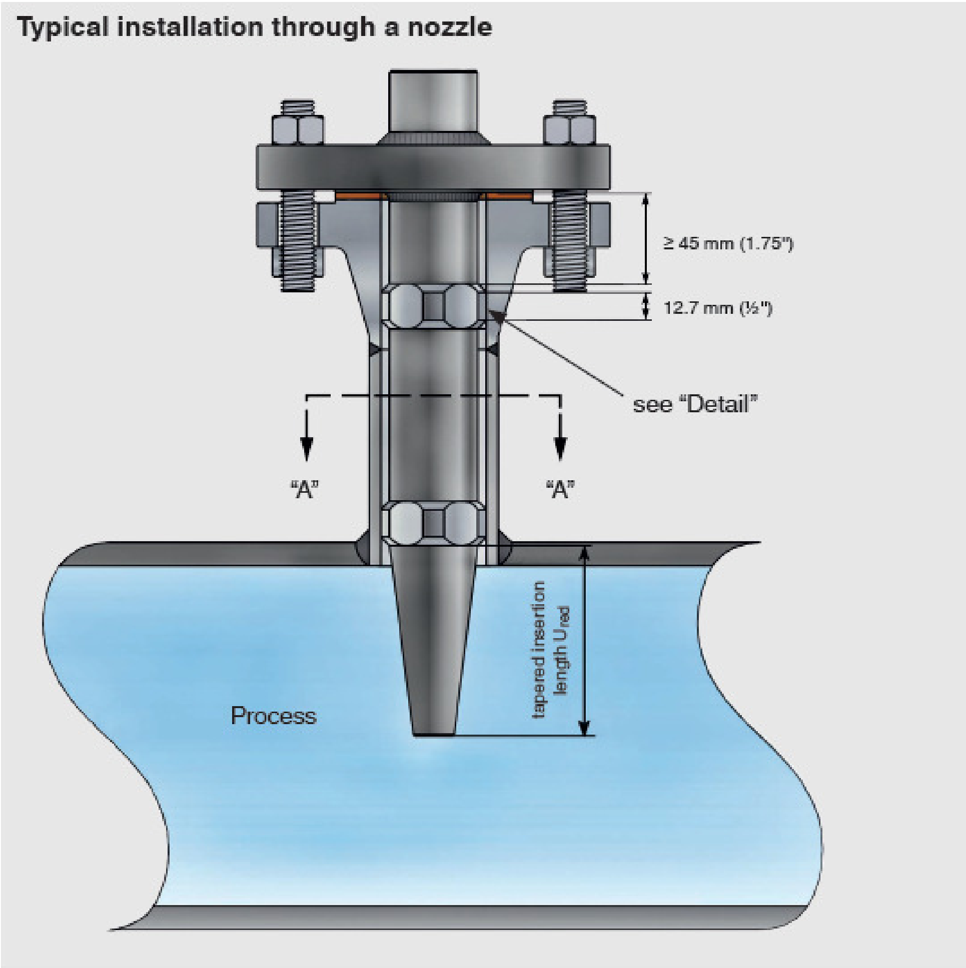
Message X: tip and wall thickness
- The tip thickness or the wall thickness is smaller than 3.0 mm
- For step style thermowells the wall thickness is outside the range of 3.0 to 6.0 mm
- *Counteraction*: Correct the design data into the given ranges

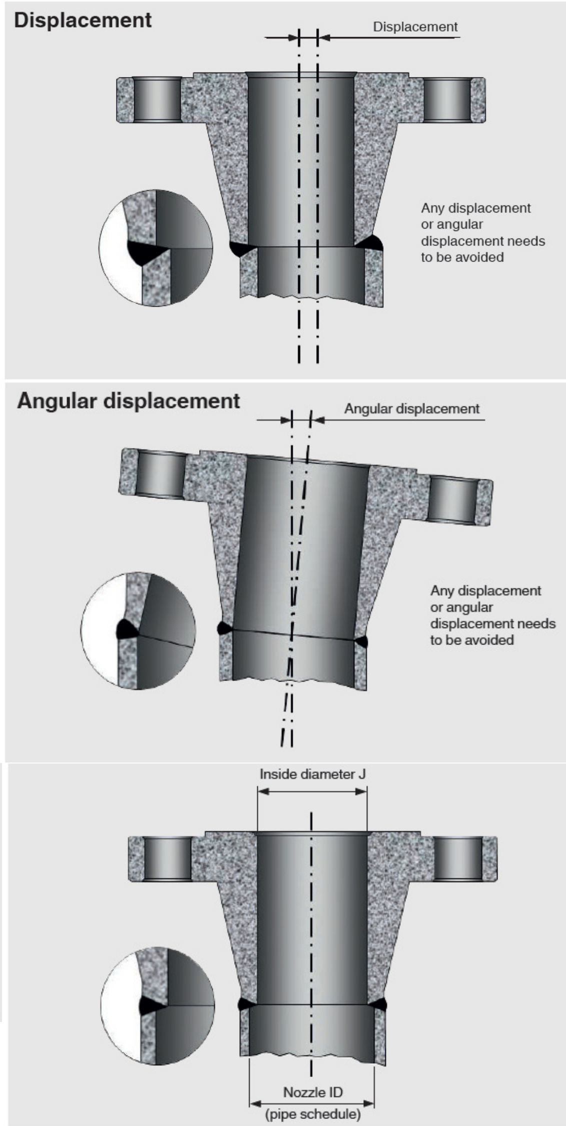
Message D: In-line (drag) resonance
- For frequency ratio fw/fnc = 0.4<x<0.6 if Nsc < 2.5 or Re > 105
- *Counteraction: Increase the thermowell insertion length U up to* fw/fnc = 0.6 …0.8
- *Or shorten the thermowell insertion length U up to* fw/fnc < 0.4

Message N: pipe nozzle length (shielded length)
- The insertion length U is smaller than the pipe nozzle length (=shielded length). This means, the thermowell shank is not immersed into the process.
- *Counteraction*: Increase the insertion length U or reduce the length of the pipe nozzle

Message M: Free material input
- There is a mistake in the free material input (e.g. missed material values for youngs modul in mat2)
- *Counteraction:* Check the free material input table

Options…Velocity Collars (interference fit)





WIKA ScrutonWell ®

Thermowell ScrutonWell® design

WIKA - Part of your business

WIKA ScrutonWell ®

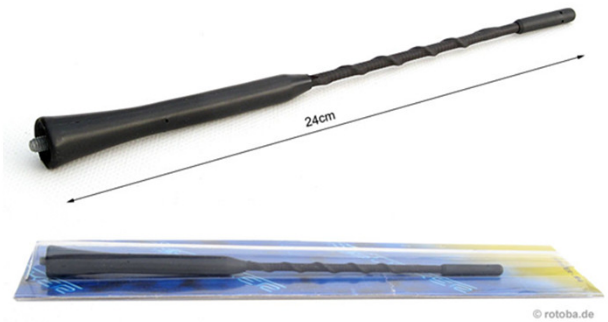
Thermowell ScrutonWell® design

WIKA ScrutonWell ®

Sample for helical design in other technical applications:

The helical design is state of the art in different technical applications:

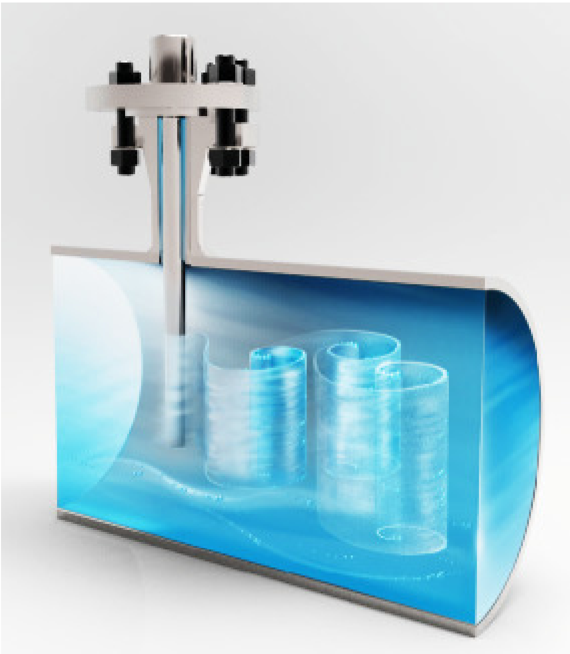
- Industrial chimneys
- Offshore platform
- Car antenna



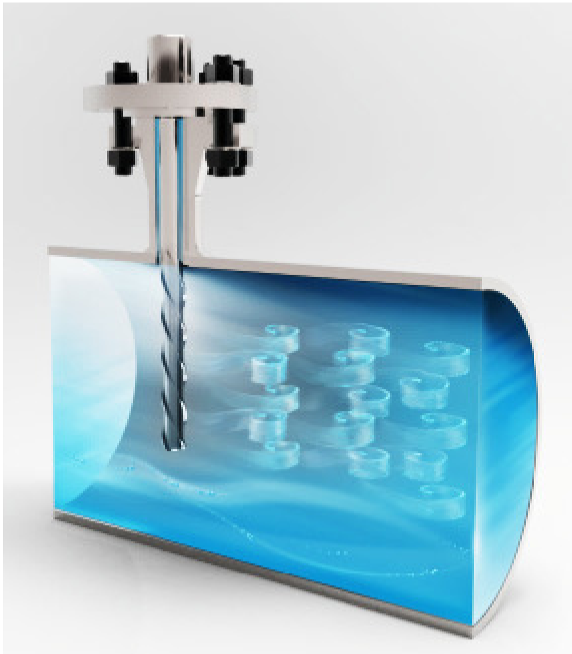
WIKA Part of your business

How does the ScrutonWell® work?

- Kármán vortex street behind the thermowell stem
- This initiates the vibration of the stem in resonance



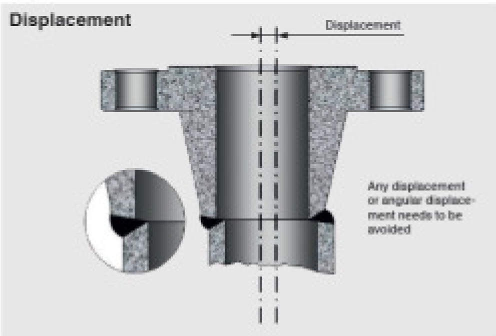
- The ScrutonWell® design avoids the formation of a Kármán vortex
- The vortex behind the thermowell stem gets diffuse
- The amplitude of the vortex can be reduced by more than 90%
- **→ NO RESONANCE – NO VIBRATION**

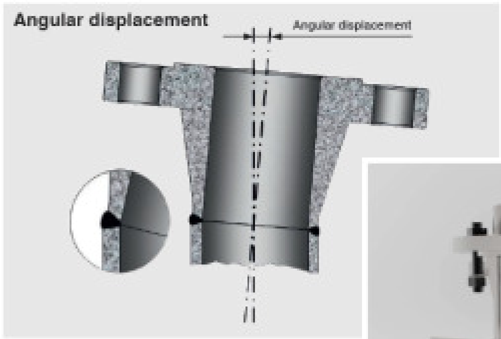


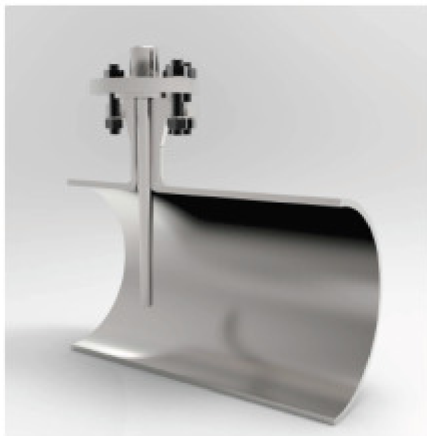
Advantages of the ScrutonWell® design for the customer

ScrutonWell installation
Installing a thermowell with ScrutonWell® design is identical to installing a comparable standard thermowell.
No time-consuming and expensive rework at the nozzle or thermowell adjustment is required for assuring an interference fit, as is the case with the installation of a thermowell with support collar.

Even flange nozzles with an axial or angular displacement have no influence on the installation of a thermowell with ScrutonWell® design.





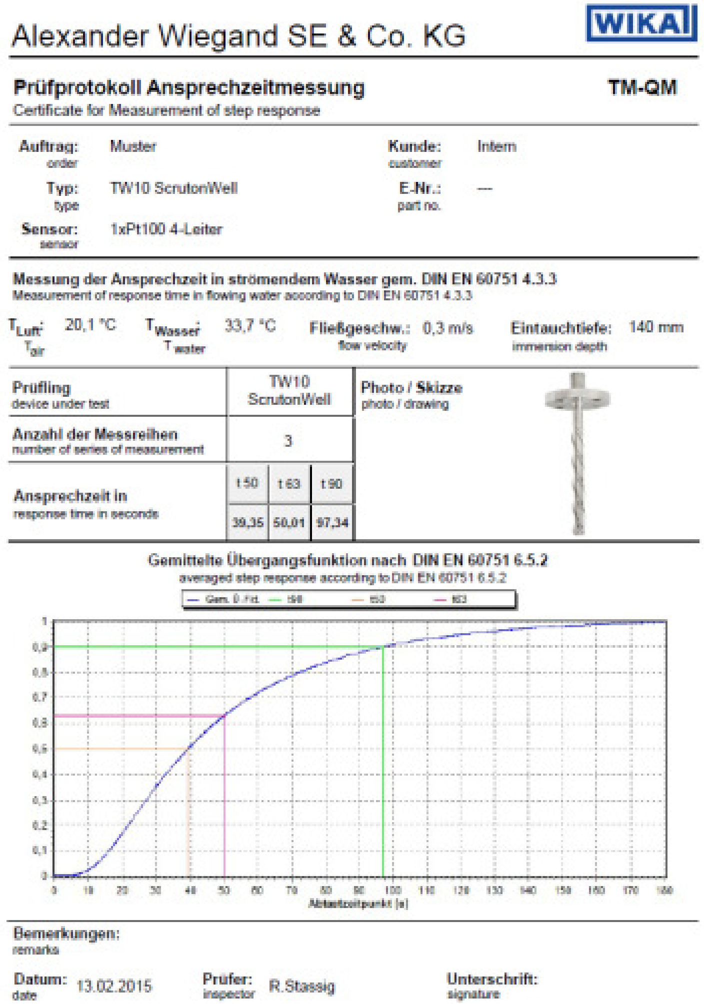


WIKA ScrutonWell ®

Reduced response time

- Reduced response time in comparison to a standard thermowell stem design
- The increased surface by the helical strake structure reduces the response time of the thermometer

Response time [s]	t50	t90
Standard thermowell	40.98 s	101.65 s
ScrutonWell®	39.35 s	97.34 s



Alexander Wiegand SE & Co. KG

Prüfprotokoll Ansprechzeitmessung — TM-QM
Certificate for Measurement of step response

Auftrag: order	Muster	Kunde: customer	Intern
Typ: type	TW10 ScrutonWell	E-Nr.: part no.	---
Sensor: sensor	1xPt100 4-Leiter		

Messung der Ansprechzeit in strömendem Wasser gem. DIN EN 60751 4.3.3
Measurement of response time in flowing water according to DIN EN 60751 4.3.3

T_{Luft} / T_{air}: 20,1 °C — T_{Wasser} / T_{water}: 33,7 °C — Fließgeschw.: / flow velocity: 0,3 m/s — Eintauchtiefe: / immersion depth: 140 mm

Prüfling / device under test	TW10 ScrutonWell		
Anzahl der Messreihen / number of series of measurement	3		
Ansprechzeit in / response time in seconds	t 50	t 63	t 90
	39,35	50,01	97,34

Photo / Skizze
photo / drawing

Gemittelte Übergangsfunktion nach DIN EN 60751 6.5.2
averaged step response according to DIN EN 60751 6.5.2

Bemerkungen:
remarks

Datum: date 13.02.2015 — Prüfer: inspector R.Stassig — Unterschrift: signature

WIKA
Part of your business

Advantages of the ScrutonWell® design for the customer

- Damping of the oscillation can be reduced by more than 90% in comparison to a standard thermowell stem design.
- Easy, fast and trouble-free installation of the thermowell without rework
- Implementation of a globally established technical solution for thermowells
- Optimized response time of the thermometer compared to the conventional thermowell design through enlarged surface
- Eliminating the use of support collars and their disadvantages such as additional costs or rework
- Easy dismounting comparable to maintaining a standard thermowell
- The effectiveness of the ScrutonWell® design for thermowells has been verified by independent laboratory testing of TU Freiberg
- Dimensioning and calculation of the thermowells based on the static results of ASME PTC 19.3 TW-2016

WIKA ScrutonWell ®

Technical data

- Versions
  - *Solid-machined version with 3 strakes*
  - *Solid-machined version with 3 filler rods, welded*

- Materials
  - *Stainless steel 304/304L, 316/316L*
  - *Carbon steel A105*
  - *Special alloys - Monel 400 or Inconel 600*
  - *Other materials available on request*

- Process connection
  - *Flanges to all standards (e.g. ASME, API, EN, DIN, JIS, GOST)*
  - *Vanstone design for 1", 1 ½" and 2" nozzle*
  - *Threaded connections with 1" NPT, 1 ¼" NPT, 1 ½" NPT or 2" NPT on request*
  - *Weld-in connection for socket or direct welded thermowells on request*

WIKA ScrutonWell ®

Technical data

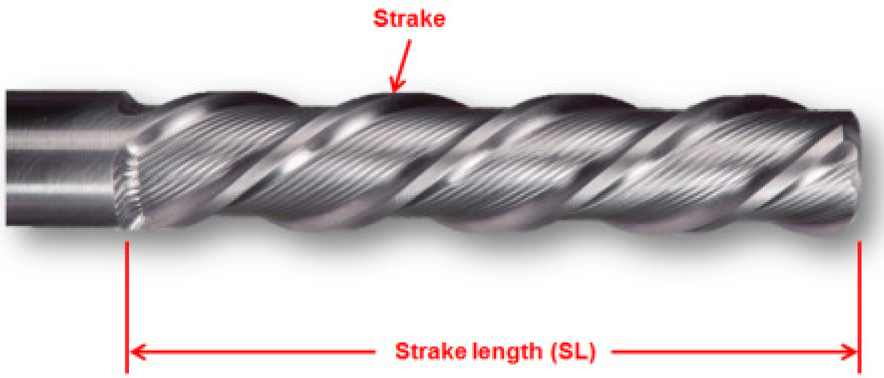
ScrutonWell® (solid-machined) for flanged and Vanstone thermowells

Dimensions in mm (inch)	Outer diamter OD	Tip diameter V	Strake height Sh	Strake depth Sw	Scruton length (max) SL	Insertion length (max) U
1" nozzle schedule 5 ... 80	22 (0.866")	17 (0.669")	2.5 (0.098")	2.5 (0.098")	305 mm (12")	610 mm (24")
1 ½" nozzle schedule 5 ... 160	25 (0.984")	20 (0.787")	2.5 (0.098")	2.5 (0.098")	305 mm (12")	610 mm (24")
2" nozzle schedule 5 ... 160	25 (0.984")	20 (0.787")	2.5 (0.098")	2.5 (0.098")	305 mm (12")	610 mm (24")

ScrutonWell® (welded design) for flanged and Vanstone thermowells

Dimensions in mm (inch)	Outer diameter (approx.) OD	Tip diameter V	Rod diameter R	Scruton length (max) SL	Insertion length (max) U
1" nozzle schedule 5 ... 80	22 (0.866")	17 (0.669")	2.4 (0.094")	800 mm (31.5")	1,000 mm (39")
1 ½" nozzle schedule 5 ... 160	25 (0.984")	20 (0.787")	2.4 (0.094")	800 mm (31.5")	1,000 mm (39")
2" nozzle schedule 5 ... 160	25 (0.984")	20 (0.787")	2.4 (0.094")	800 mm (31.5")	1,000 mm (39")

pitch angle $\alpha = 58°$



WIKA ScrutonWell ®

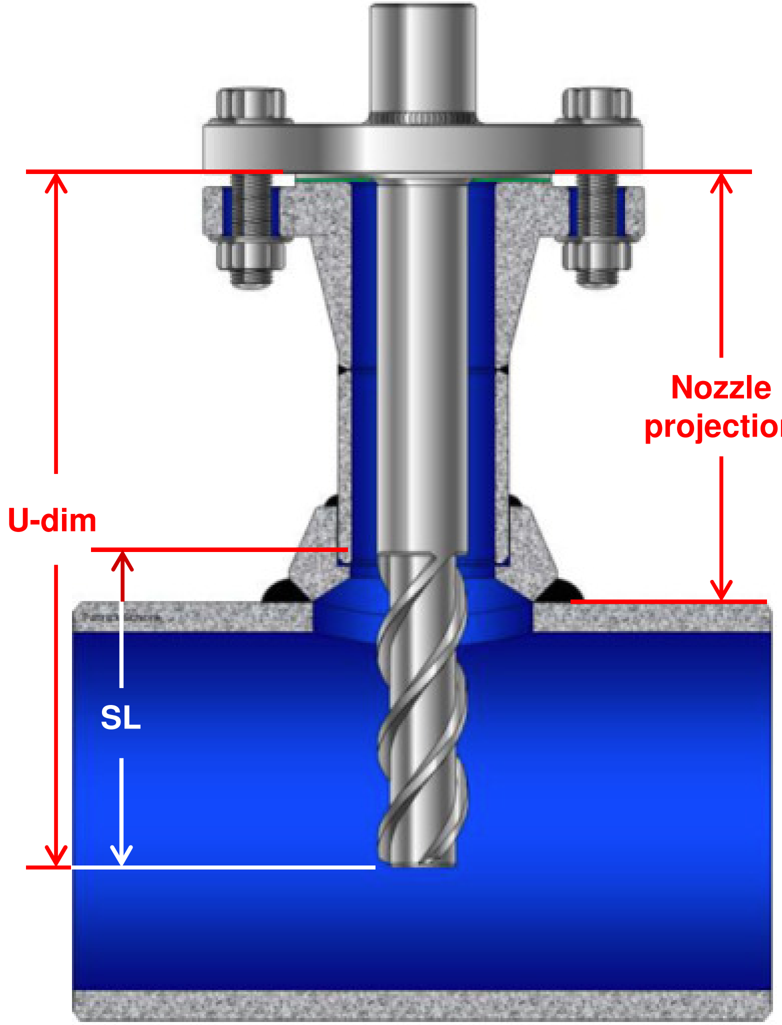
How to define the Scrutonwell length ?

Insertion Length (U-dim)

- Where possible use customer original specifications
- When not specified use a general rule of 1/3 to 1/2 of the pipe ID + nozzle projection

Strake Length (SL)

- Minimum length = U-dim - nozzle projection



Stress calculation

Calculation of ScrutonWell® design based on ASME PTC 19.3 TW-2016

- Maximum permissible pressure load with original stem dimensions
- Maximum permissible bending load with modified stem dimensions
- The dynamic part of the thermowell calculation is not calculated, as it does not fall within ASME PTC 19.3 TW-2010 scope. Based on an ASME article the damping of the oscillation is reduced by more than 90% when helical strakes are used. *"Helical strakes in suppressing vortex-induced vibrations" (ASME report 11/2011 Vol. 113).*

WIKA ScrutonWell ®

Type testing summary

WIKA
Part of your business

TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG
The University of Resources. Since 1765.

imfd

Report on the

High-speed visualization of flow structure resonance of thermocouple wells

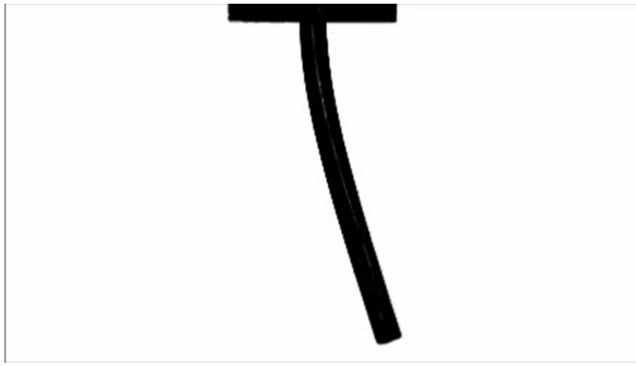
Institute for Mechanics and Fluiddynamics
Technical University of Freiberg

Humberto Chaves
Franziska Hegner
Laura Kamps
Mario Köhler
Stefan Ostmann
Benjamin Ponitz

Freiberg,
July 2014

High-speed visualization video (click on the picture to start the video):

- BackLit methode (Left: standard / Right: ScrutonWell®)



- LED-IF methode (Left: standard / Right: ScrutonWell®)