

OPTITEMP TRA/TCA PLUS

Technical Datasheet

Industrial temperature assemblies with replaceable measuring inserts

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1.1 Temperature assemblies for industrial applications

Temperature assemblies for advanced requirements with replaceable measuring inserts can be used in various areas in industrial measuring technology. What sets them apart is the process connection and the thermowell version: multipart welded and one-piece bar stock.

- **Screw-in temperature assemblies without thermowells** can be screwed into existing, welded on thermowells or into machine housings. The range includes DIN variants with M18 x 1.5 mm connection threads and ANSI variants with ½" NPT thread connections.
- **Weld temperature assemblies with bar stock thermowells** are used in cases of high pressure and high flow velocities when the sealable pressure of a flange or union nut is no longer sufficient.
- **Screw-in temperature assemblies with bar stock thermowells** are used in the event of advanced requirements on the mechanical load capacity of the thermowell when the strength of multipart, welded thermowells is not sufficient.
- **Flanged temperature assemblies with bar stock thermowells** are also used in the case of advanced requirements on the mechanical load capacity of the thermowell. One advantage that flanged temperature assemblies have over screw-in temperature assemblies is that they may be coated to make them resistant to aggressive media.

All temperature assemblies feature a robust design, meticulous workmanship and dimensional accuracy. Certified materials, testing carried out throughout the production process and consistent final inspections guarantee the consistently high quality of our products.



① TRA/TCA-S50: Screw-in temperature assembly without thermowell according to ANSI
② TRA/TCA-T30: Weld temperature assembly according to DIN
③ TRA/TCA-TS54: Screw-in thermowell with offset tip according to ANSI
④ TRA/TCA-TF56: Flanged temperature assembly with conical thermowell according to ANSI

Highlights

- Temperature assemblies with replaceable measuring inserts with terminal blocks, flying wires or head-mounted OPTITEMP transmitters
- Intrinsically safe versions for use in potentially explosive atmospheres
- Quick-response versions with reduced thermowell tips
- Spring-loaded measuring inserts guarantee secure contact with the thermowell bottom, ensuring good heat transmission
- Wide range of measuring range
  - TRA -....: -200...+600°C / -328...+1112°F (temperature assembly with PT100)
  - TCA -....: -40...+1000°C / -40...+1832°F (temperature assembly with thermocouple)

Industries:

- Chemical and petrochemical
- Oil and gas
- Power generation
- Machinery
- Iron and Steel
- Pulp and paper

Applications

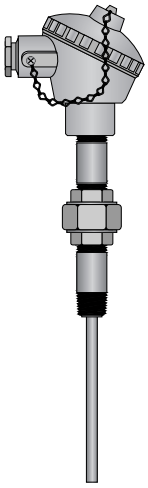
Due to the wide variety of process connections, the temperature assemblies for advanced requirements can be used in many areas:

- Screw-in temperature assemblies without thermowells, for example, can be installed in existing, welded thermowells or screwed into machines and system parts to measure storage temperatures and other similar measuring tasks.
- Weld temperature assemblies are used in power plants and other applications to create and distribute process steam. In addition, temperatures in cooling lines are often measured using weld-in thermometers when high demands are placed on the process connection in terms of tightness and safety.
- Screw-in temperature assemblies for general temperature measurements in pipelines and tanks, even under high pressures and flow velocities in all areas of industry. Bar stock versions are often used in the petrochemical industry as well as in the oil and gas industry, especially when temperature assemblies in compliance with ANSI standards are required.
- Flanged temperature assemblies with bar stock thermowells to measure temperatures in pipelines, tanks and reactors, typically found in the chemical and petrochemical industry as well as in oil and gas extraction with average and high operating pressures predetermined by the flange sizes.

1.2 Options and variants

Selected versions of temperature assemblies and process connections

The temperature assemblies shown here represent part of our range with the typical process adaptations: threaded, weld-in and flanged



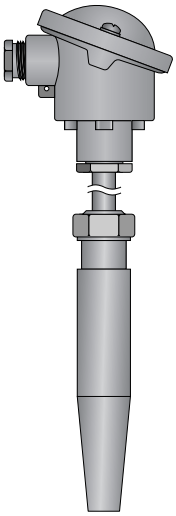
TRA-S50 / TCA-S50, screw-in temperature assembly without thermowell according to ANSI

Process connections:

- ½" NPT

Material and diameter:

- 1.4404: Ø SCH 40, Ø21.32 x 2.77 mm or Ø0.83 x 0.10"
- Nipple-Union-Nipple variant, NUN
- Nipple-Nipple variant, NN



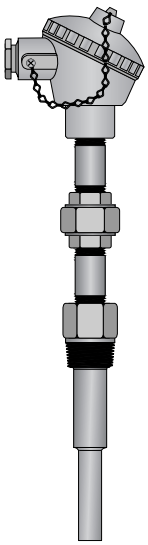
TRA-T30 / TCA-T30, weld temperature assembly with bar stock thermowell according to DIN

Process connections:

- Ø24 h7

Materials and diameters:

- 1.4571 / AISI 316 Ti
- 1.4404 / AISI 316 L
- 1.7335 / AISI F12
- 1.0460 / C 22.8



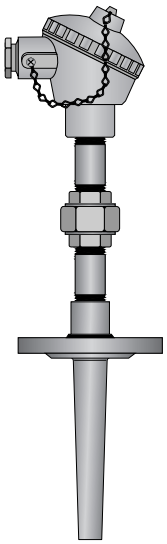
TRA-TS54 / TCA-TS54, crew-in temperature assembly with bar stock thermowell according to ANSI

Process connections:

- ½" NPT, ¾" NPT
- G ½, G ¾

Materials and diameters:

- 1.4571 / AISI 316 Ti: Ø16 and 22 mm or Ø0.62 and 0.86"
- 1.4404 / AISI 316 L: Ø16 and 22 mm or Ø0.62 and 0.86"



TRA-TF56 / TCA-TF56, flanged temperature assembly with bar stock thermowell according to ANSI

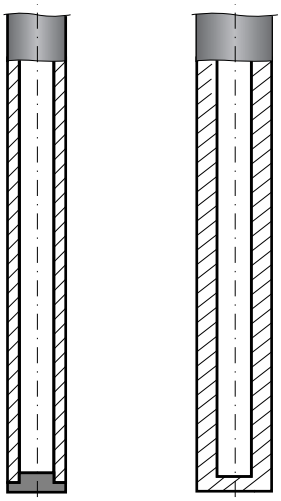
Process connections:

- 150 lbs: 1", 1 ½" and 2" acc. ANSI, RF, RTJ
- 300 lbs: 1", 1 ½" and 2" acc. ANSI, RF, RTJ
- 600 lbs: 1", 1 ½" and 2" acc. ANSI, RF, RTJ
- PN40: DN25 and DN50 acc. to DIN, B1

Materials and diameters:

- 1.4571 / AISI 316 Ti: Ø16 and 22 mm or Ø0.62 and 0.86"
- 1.4404 / AISI 316 L: Ø16 and 22 mm or Ø0.62 and 0.86"

Thermowell tip designs

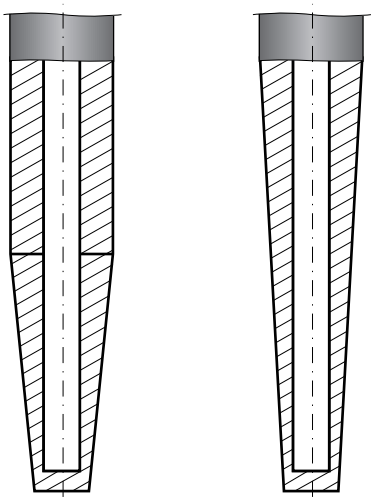


Straight thermowell tip
welded with TF32, TS33 and TS35 and bar stock for TS36, TS37, TS52, TF55 and TW58

Materials and diameters, raw material:
- Material 1.4571 / 316 Ti: Ø 9 / 11 / 12 mm or Ø 0.35 / 0.43 / 0.47"
- Material 1.4404 / 316 L: Ø 10 / 12 mm or Ø 0.39 / 0.47"

Materials and diameters, bar stock:
- Material 1.4571 / 316 Ti: Ø17 mm or Ø 0.66"
- Material 1.4404 / 316 L: Ø16 / 17 / 19 and 23 mm or Ø0.62 / 0.66 / 0.74 / 0.90"

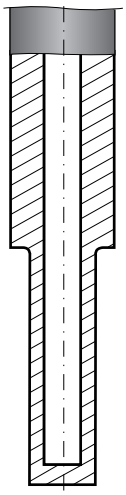
Special features:
- High load capacity



Conical thermowell tip
straight-conical for T30 and TF31 and conical for TS53, TF56 and TW59

Materials and diameters:
- Material 1.4571 / 316 Ti: Ø24h7 and 16 / 19 / 22 / 25 mm or Ø 0.62 / 0.74 / 0.86 / 0.98"
- Material 1.4404 / 316 L: Ø24h7 and 16 / 19 / 22 / 25 mm or Ø 0.62 / 0.74 / 0.86 / 0.98"
- Material 1.7335 / F12: Ø24h7
- Material 1.0460 / C 22.8: Ø24h7

Special features:
- Quick-response and high load capacity

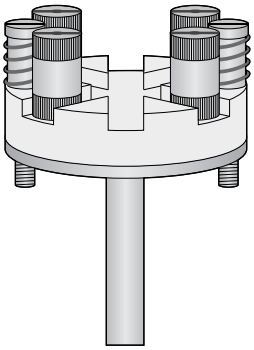


Offset thermowell tip
for TS54, TF57 and TW59

Materials and diameters:
- Material 1.4571 / 316 Ti: Ø 12 / 16 / 19 / 22 and 23 mm or Ø0.47 / 0.62 / 0.74 / 0.86 / 0.90"
- Material 1.4404 / 316 L: Ø 12 / 16 / 19/ 22 and 23 mm or Ø0.47 / 0.62 / 0.74 / 0.86 / 0.90"

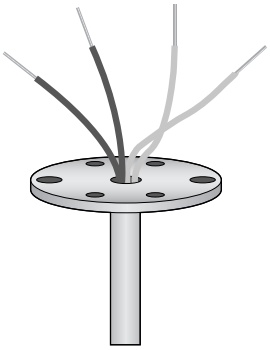
Special features:
- Very quick response with average loads

Measuring insert designs



Variant with ceramic terminal block

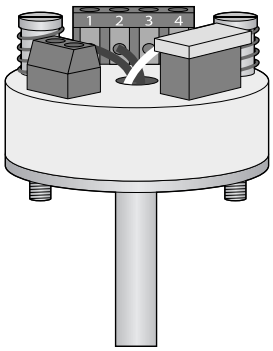
- Fully sealed solder joints
- Pt100 connection in 2, 3 and 4-wire connection
- Available with 2, 3, 4, 6 or 8 connection terminals
- Sheath diameter: 6 + 0 - 0.1 mm
- Washer disc with 2 screws, 2 springs and 2 retaining rings



Variant with flying wire ends

Excepting the following points, the features correspond to those of the version with ceramic terminals:

- Colour-coded, Teflon-insulated lead wires
- Lead wires measuring 50 mm / 1.97" in length for the first measuring point
- Lead wires measuring 100 mm / 3.94" in length for the second measuring point



Variant with head-mounted transmitter

The features correspond to those of the version with flying wire ends. A mounted temperature transmitter is also included in delivery:

- TT 10/11/20: analogue, Pt100 RTD without galvanic isolation
- TT 30/40: digital, Pt100/1000, Ni100, thermocouple
- TT 50 digital, HART®
- TT 51: digital, HART®, SIL2
- TT 60: Profibus PA

1.3 Measuring principle

All of the temperature assemblies described here belong to the class known as "contact temperature assemblies". Unlike "radiation temperature assemblies", these temperature assemblies come into direct contact with the medium whose temperature they are to measure.

The type of measuring principle depends on the measuring insert sensor that you combine with the transmitter. Two different sensor types are available. Their respective measuring principles are described in the following subsections.

1.3.1 Resistance temperature sensor

The measuring insert with a temperature-sensitive sensor made from a platinum(Pt) RTD, whose value at 0 °C / +32 °F is 100 Ω. That is where the name "Pt100" comes from.

It is generally valid that the electric resistance of metals increases according to a mathematical function as the temperature rises. This effect is taken advantage of by resistance temperature sensors to measure temperature. The "Pt100" temperature sensors features a measuring resistance with defined characteristics, standardised in IEC 60751. The same is true for the tolerances. The average temperature coefficient of a Pt100 is 3.85 x 10^{-3} K^{-1} in the range from 0...+100 °C / +32...+212 °F.

During operation, a constant current I (≤ 1 mA) flows through the Pt100 RTD, which brings about a voltage drop U. The resistance R is calculated using Ohm's Law (R=U/I). As the voltage drop U at 0 °C / +32 °F is 100 mV, the resulting resistance of the Pt100 temperature assembly is 100 Ω (100 mV / 1 mA = 100 Ω).

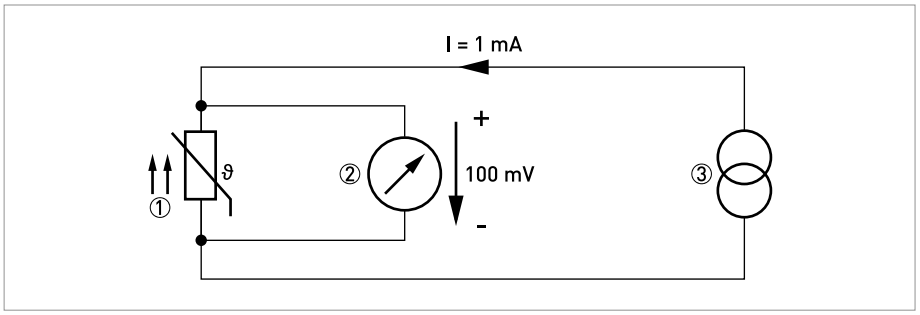


Figure 1-1: Pt100 resistance temperature sensor at 0°C / +32 °F, schematic

① Pt100 RTD
② Voltage meter
③ Current source

1.3.2 Thermocouples

The thermocouple features two electric conductors made from different metals, connected at one end. Each free end is connected to a compensation cable which is then connected to a millivolt meter. This circuitry forms a "thermal circuit". The point at which the two electric conductors connect is called the measuring point and the point at which the compensation cables connect to the conductors of the millivolt meter is called the cold junction.

If the measuring point of this thermal circuit is heated up, a small electrical voltage (thermal voltage) can be measured. If, however, the measuring point and the cold junction are at the same temperature, no thermoelectric voltage is generated. The degree of thermoelectric voltage, also known as electromotive force (EMF), depends on the thermocouple material and the extent of the temperature difference between the measuring point and the cold junction. It can be measured using the millivolt meter with no auxiliary power.

Simply put, the thermocouple behaves like a battery, the voltage of which also increases as the temperature rises.

The characteristic curves and tolerances of commercially available thermocouples are standardised in IEC 60584.

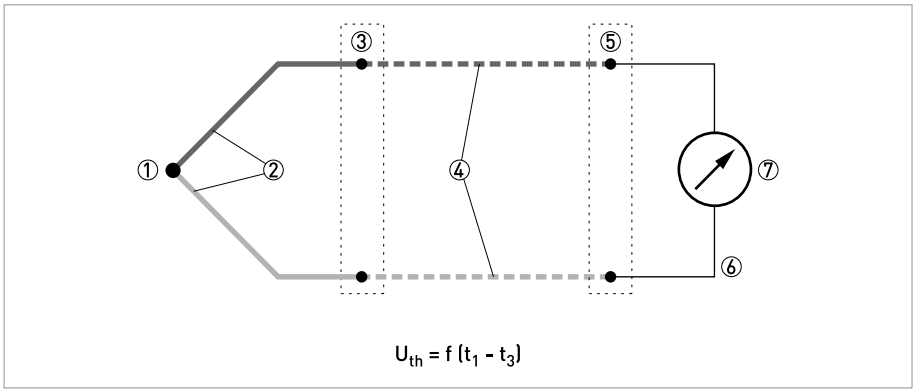


Figure 1-2: Thermocouple measuring circuit, schematic

① Measuring point t_1 (hot junction)
② Thermocouple
③ Transition junction t_2
④ Compensation cable / extension cable
⑤ Reference junction t_3 (cold junction)
⑥ Copper conductor
⑦ Voltage meter U_{th}

2.1 Technical data tables

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Application range	Temperature assemblies OPTITEMP TRA/TCA Plus for measuring the temperature of gases, liquids, vapours and solid bodies in industrial processes (e.g. high pressure and high flow velocities).
Measuring principle	Contact temperature assembly
Measured value	Temperature

Design

Modular design	Industrial temperature assemblies OPTITEMP TRA/TCA Plus consist of several components which, together, form a temperature assembly: • Measuring insert with temperature sensor • Transmitter (either inside on the measuring insert or outside) • Connection head • Separate extension tube • Thermowell
Signal converter	Digital temperature transmitter in the TT family as head-mount or rail-mount transmitter.
Sensor	Pt100 RTD as thin layer variant (TF) or as wire wound variant (WW) with a characteristic according to DIN EN 60751.
	Type "J" or "K" thermocouple with a characteristic according to DIN EN 60584.
Measuring range	Refer to "Operating conditions".
Display and user interface	
Display	Available in connection head "BUZ-HW","AXD-W", "SXD-W": 4...20 mA, LCD, loop powered indicator.
Operation	Available in connection head "BUZ-HW","AXD-W", "SXD-W": interior keys.
Display functions	Temperature, either as output signal (HART® penetrable) in mA or scaled to °C/°F.

Measuring accuracy

Reference conditions	Ambient temperature: +23°C / +73.4°F (Fluctuations due to air pressure and density have no impact on measuring accuracy.)
Maximum measuring error	More detailed information in the subsection "Measurement error" (also in the "Technical data" section). The maximum measurement error also depends on the type of sensor: • Measuring insert with Pt100 RTD: measurement error in accordance with tolerance classes AA, A, B, and 1/10 B according to DIN EN 60751. • Thermocouple: measurement error in accordance with tolerance class 1 according to DIN EN 60584.

Operating conditions

Load limits	The load limits depend on several factors (e.g. dimensions, design and material of thermowell). Other information can be found in the "Installation" section or in separate subsections of section "Technical data".
	Temperature assembly without thermowell: 0.8...1.2 bara / 11.6...17.4 psia.
Temperature	
Process temperature	-200...+600°C / -328...+1112°F, depending on measuring insert, design and material. Temperature assembly with thermocouple: Measuring inserts without thermowell can be used up to 1100°C / 2012°F
Ambient temperature	-40...+100°C / -40...+212°F, depending on connection head and measuring insert.
Storage temperature	-40...+70°C / -40...+158°F at 40...60% relative humidity.
Other conditions	
Protection categories	Depends on the connection head and the cable gland used: For more information, refer to chapter "Types of connection heads" in handbood of OPTITEMP TRA/TCA Plus

Installation conditions

Insertion angle	90° to the flow, directly against or diagonally against the flow.
Insertion length	10...15 x thermowell diameter, minimum 100 mm / 3.94" (shorter insertion lengths possible but they impair measuring accuracy).
Pipes with Ø ≤ 300 mm / 11.8"	The thermowell tip should project past the middle of the pipe.
Pipes with Ø > 300 mm / 11.8"	The thermowell tip may only project beyond the middle of the pipe when the mechanical load permits and the thermowell is not excited in its resonance; when in doubt, check the individual case again.
Bending radius	The immersion tubes on the measuring inserts can be bent but the smallest bending radius must be at least 3 times the diameter of the immersion tube. Note: Do not bend the bottom 50 mm / 2"!

Materials

Thermowells (including process connection)	The materials of the thermowells, flanges and threads as process connections are always identical:
	Standard:
	1.4571 / AISI 316 Ti (X6CrNiMoTi 17-12-2)
	1.4404 / AISI 316 L (X2CrNiMo 17-12-2)
Extension tube	**Standard:**
	1.4571 / AISI 316 Ti (X6CrNiMoTi 17-12-2)
Connection heads	Aluminium (powder coated), plastic or stainless steel
Measuring inserts	With Pt100 RTD: mineral insulated sheathed cable, sheath material 1.4404 / AISI 316 L (X2CrNiMo 17-12-2)
	With thermocouple: mineral insulated sheathed cable, sheath material Inconel 600®

Process connections and connection head thread

Weld temperature assembly with extension tube	Attached using welded sleeves; direct welding is possible starting at a wall thickness of 20 mm / 0.79".
Screw-in temperature assembly with extension tube	Weldable threaded sleeves are used to attach; it is possible to screw directly into the pipe with threads starting at a wall thickness of 20 mm / 0.8". Available threaded sleeves: • Thread according to DIN/ISO 228: G1/2", G3/4", G1" • Thread according to ASME/ANSI B1.20.1: 1/2" NPT, 3/4" NPT, 1"NPT • Other sizes: on request
Flanged temperature assembly	According to DIN EN 1092-1: B1-DN25 / PN40, B1-DN50 / PN40, other sizes on request.
	According to ASME B16.5: RF 1" / 150 lb, RF 1" / 300 lb, RF 1" / 600 lb, RF 1 1/2" / 150 lb, RF 1 1/2" / 300 lb, RF 1 1/2" / 600 lb, RF 2" / 150 lb, RF 2" / 300 lb, RF 2" / 600 lb, other sizes on request.
	Surface roughness of the flange raised face: R_z = 12.5...50 µm (DIN EN flanges), R_a = 3.2...6.3 µm (ASME flanges).
Connection head	There are two thread types available to connect to the extension tube: • Thread according to DIN: M24 x 1.5 mm • Thread according to ASME/ANSI: 1/2 NPT (NUN, NN)

Electrical connections

Power supply	Only necessary when using a temperature transmitter and depends on transmitter type (typically 24 VDC).
Power consumption	Only when using a temperature transmitter (typically 550 mW).
Cable entry (connection head)	Depends on the thread to connect to the extension tube: • For thread according to DIN: M20 x 1.5 mm • For thread according to ASME/ANSI: 1/2 NPT, no cable gland supplied here.
Current output	
Output range	Exists only when using a temperature transmitter and depends on transmitter type (typically 4...20 mA, HART®).
Error signal	According to NAMUR NE 43, selectable: upper value ≥ 21.0 mA, lower value ≤ 3.6 mA, the factory default is the upper value.
Load	Relevant only when using a temperature transmitter and then dependent on transmitter type (typically 250 Ω).
Other electrical characteristics	
Galvanic isolation	Relevant only when using a temperature transmitter (refer to transmitter handbook).
Time constant	More detailed information can be found in the subsection "Response times" of the section "Technical data".

Approvals and certificates

Electromagnetic compatibility	See handbook for temperature transmitter used.
ATEX, IECEx, UKEX...	See appropriate supleremtry instructions for intrinsically safe or flameproof certified products.
Functional safety	SIL2 with temperature transmitter TT51 C/R

2.2 Dimensions

2.2.1 Cable entry threads

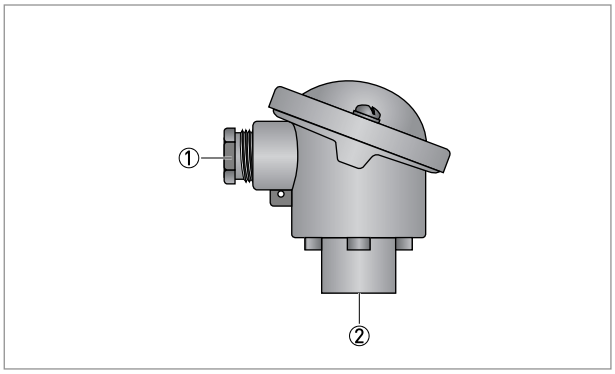


Figure 2-1: Cable gland

① Cable gland
② Process connection (inner thread)

Connection head	Process connection	Cable thread
BA	M24 x 1.5 mm	M20 x 1.5 mm
BUZ-T	M24 x 1.5 mm or 1/2 NPT	M20 x 1.5 mm or 1/2 NPT
BUZ-S	M24 x 1.5 mm	M20 x 1.5 mm
BUZ-H	M24 x 1.5 mm or 1/2 NPT	M20 x 1.5 mm or 1/2 NPT
BUZ-HW		
BGK		
BKK	M24 x 1.5 mm	M20 x 1.5 mm
BVA		
AXD	M24 x 1.5 mm or 1/2 NPT	M20 x 1.5 mm or 1/2 NPT

Table 2-1: Dimensions in mm and inch

For connection heads with 1/2 NPT threads, there are process connections and cable glands in 1/2 NPT thread versions. Connection heads with 1/2 NPT threads are supplied without cable gland. There are no plans for a combination of M24 x 1.5 mm and 1/2 NPT thread.

2.2.2 Extension tubes

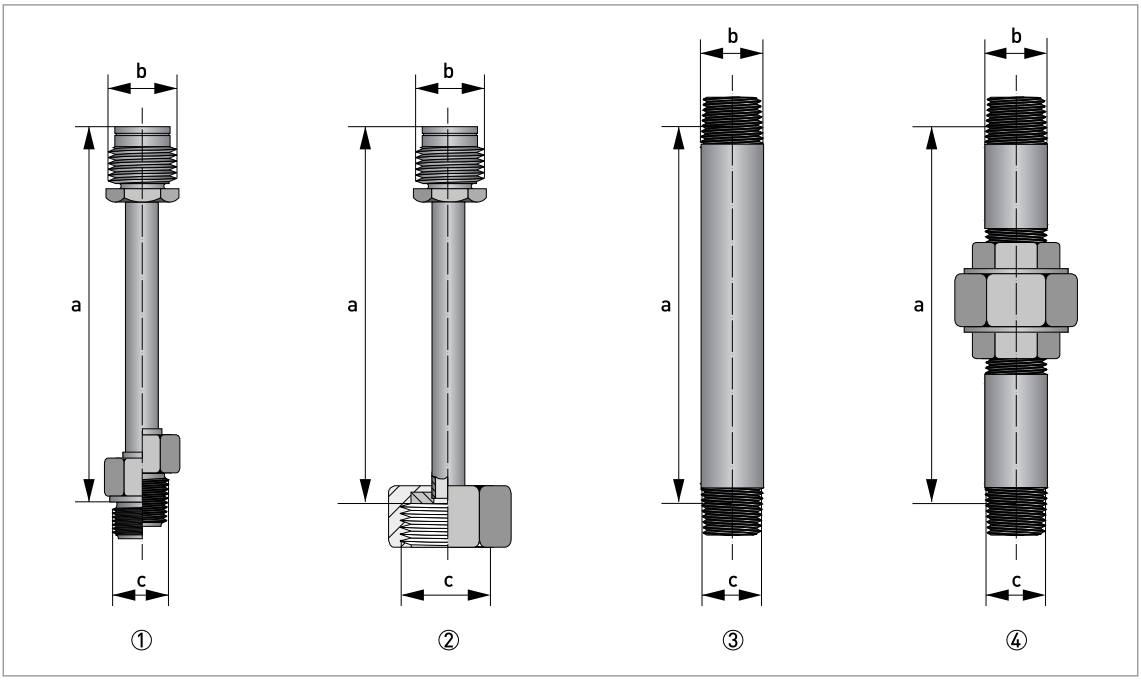


Figure 2-2: Extension tubes

① DIN extension tube with metric screw-in thread (left) and NPT thread (right)
② DIN extension tube with union nut
③ ASME extension tube with NN connection (Nipple-Nipple)
④ ASME extension tube with NUN connection (Nipple-Union-Nipple)

Type of extension tube	"a" (extension tube length)		"b" (thread for connection head)	"c" (process connection)
	[mm]	["]		
①	80	3.15	M24 x 1.5 mm	Thread M18 x 1.5 / G1/2 / 1/2 NPT
	145	5.71		
	165	6.50		
	200	7.87		
②	80	3.15	M24 x 1.5 mm	Union nut G1/2 or G3/4
	145	5.71		
	165	6.50		
	200	7.87		
③	76	3	1/2 NPT	Thread 1/2 NPT
	102	4		
④	152	6		

Table 2-2: Dimensions in mm and inch

2.2.3 Lengths of thermowells

The dimensions for the thermowells and measuring inserts given in the following subsections are standard measurements. Upon request the manufacturer can supply devices with other dimensions. All industrial temperature assemblies OPTITEMP TRA/TCA Plus require a measuring insert with a diameter of 6 mm / 0.24".

2.2.4 Screw-in temperature assembly

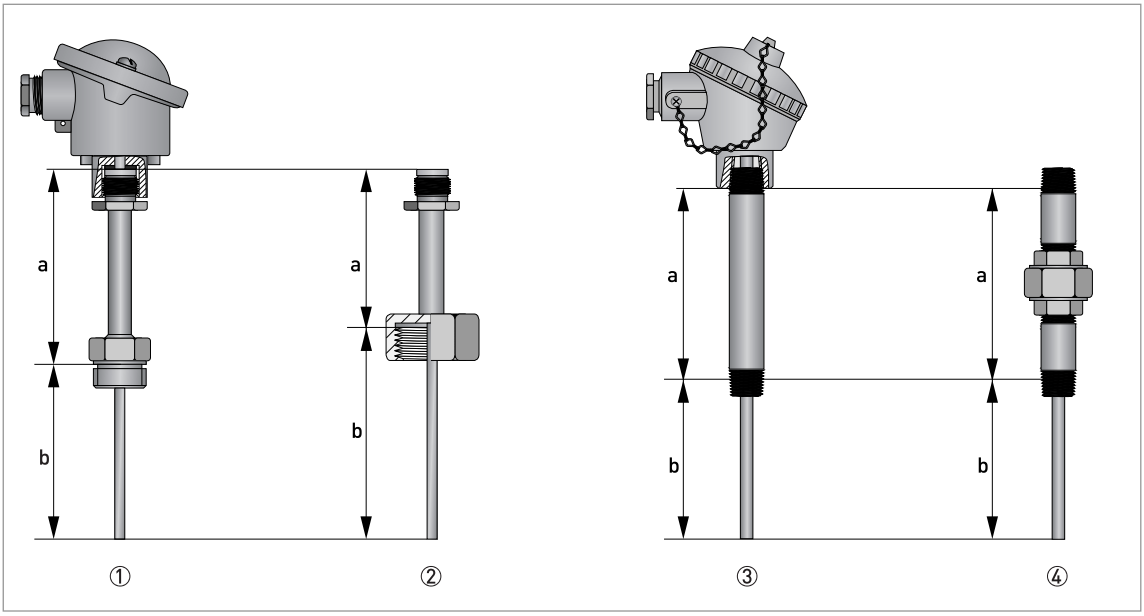


Figure 2-3: Screw-in temperature assembly without thermowell

① TRA/TCA-S34 (process connection: thread)
② TRA/TCA-S34 (process connection: union nut)
③ TRA/TCA-S50 (process connection: NPT thread with NN connection)
④ TRA/TCA-S50 (process connection: NPT thread with NUN connection)

Insertion length "b"		Measuring insert length	
[mm]	["]	[mm]	["]
100	3.9	278	10.9
140	5.5	318	12.5
200	7.9	378	14.9
260	10.2	438	17.2
300	11.8	478	18.8
350	13.8	528	20.8
400	15.8	578	22.8

Table 2-3: Dimensions for TRA/TCA-S34 with DIN extension tube (extension tube length: 165 mm / 6.5")

Insertion length "b"		Measuring insert length	
[mm]	["]	[mm]	["]
100	3.9	281	11.1
150	5.9	331	13.0
200	7.9	381	15.0
250	9.8	431	17.0
300	11.8	481	18.9
350	13.8	531	20.9
400	15.7	581	22.9

Table 2-4: Dimensions for TRA/TCA-S50 with ASME extension tube (extension tube length: 152 mm / 6.0")

You can determine the length of the measuring insert for screw-in temperature assembly without thermowell as follows:

- *TRA/TCA-S34 with DIN extension tube: Measuring insert length = insertion length of the temperature assembly + 178 mm / 7.0"*
- *TRA/TCA-S50 with ASME extension tube: Measuring insert length = insertion length of temperature assembly + 181 mm / 7.1"*

- *Tolerances of all thermowell and insertion lengths: ±1 mm / 0.04"*
- *Tolerances of all measuring insert lengths: +2 mm, -0 mm / +0.08", -0"*

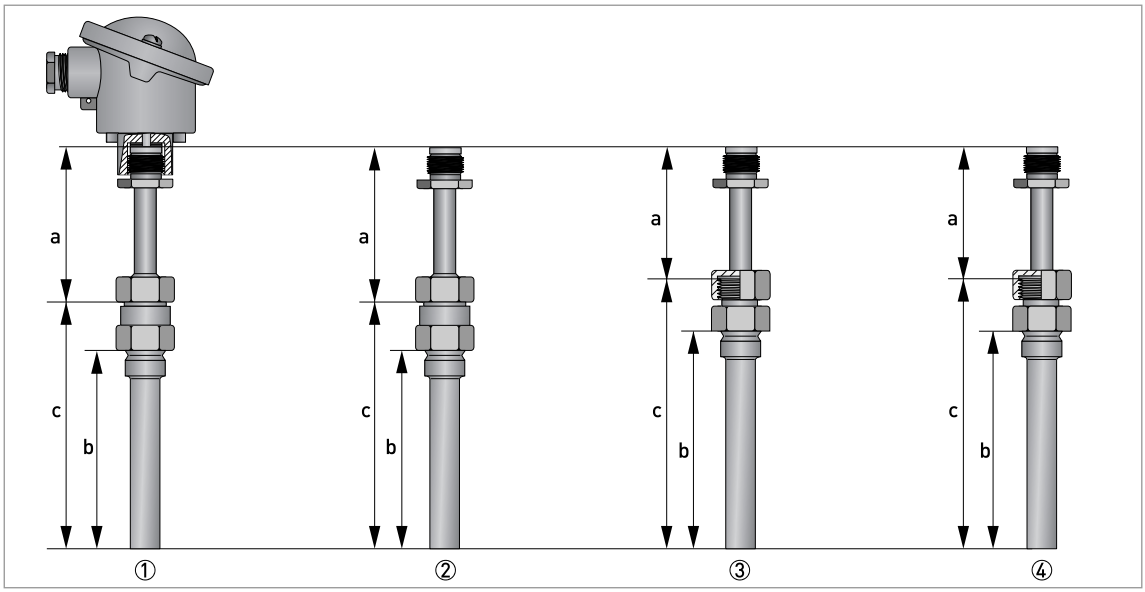


Figure 2-4: Screw-in temperature assembly with thermowell according to DIN 43772

① TRA/TCA-TS32 (similar to Form 5 as per DIN 43772, with external and internal thread, multipart, welded
② TRA/TCA-TS36 (similar to Form 6/7 as per DIN 43772, with external and internal thread, one-piece, bar stock)
③ TRA/TCA-TS35 (similar to Form 8 as per DIN 43772, with two external threads, multipart, welded)
④ TRA/TCA-TS37 (similar to Form 9 as per DIN 43772, with two external threads, one-piece, bar stock)

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	82	3.2	110	4.3	287	11.3
		142	5.6	170	6.7	347	13.7
		232	9.1	260	10.2	437	17.2
		382	15.0	410	16.1	587	23.1

Table 2-5: Dimensions for TRA/TCA-TS32 (similar to Form 5)

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	82	3.2	110	4.3	284	11.2
		142	5.6	170	6.7	344	13.5
		232	9.1	260	10.2	434	17.1
		382	15.0	410	16.1	584	23.0

Table 2-6: Dimensions for TRA/TCA-TS36 (similar to Form 6/7) (bar stock)

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	110	4.3	138	5.4	314	12.4
		170	6.7	198	7.8	374	14.7
		260	10.2	288	11.3	464	18.3
		410	16.1	438	17.2	614	24.2

Table 2-7: Dimensions for TRA/TCA-TS35 (similar to Form 8)

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	110	4.3	138	5.4	311	12.2
		170	6.7	198	7.8	371	14.6
		260	10.2	288	11.3	461	18.1
		410	16.1	438	17.2	611	24.1

Table 2-8: Dimensions for TRA/TCA-TS37 (similar to Form 9) (bar stock)

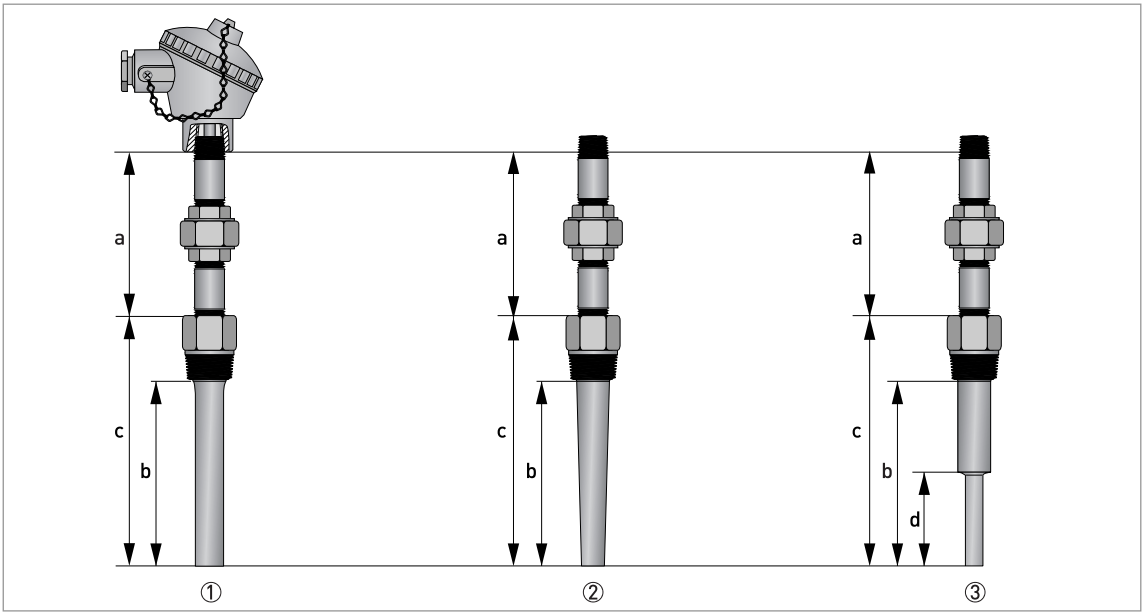


Figure 2-5: Screw-in temperature assembly with thermowell according to ASME

① TRA/TCA-TS52 (straight, with external and internal thread, one-piece, bar stock)
② TRA/TCA-TS53 (conical, with external and internal thread, one-piece, bar stock)
③ TRA/TCA-TS54 (reduced, with external and internal thread, one-piece, bar stock)

The length of the reduced tip "d" is always 65 mm / 2.56".

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	100	3.9	145	5.7	318	12.5
		150	5.9	195	7.7	368	14.5
		200	7.9	245	9.6	418	16.5
		250	9.8	295	11.6	468	18.4
		300	11.8	345	13.6	518	20.4
		350	13.8	395	15.6	568	22.4

Table 2-9: Dimensions for TRA/TCA-TS52, -TS53, -TS54 with DIN-extension tube

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
76	3	100	3.9	145	5.7	243	9.6
		150	5.9	195	7.7	293	11.5
		200	7.9	245	9.6	343	13.5
		250	9.8	295	11.6	393	15.5
		300	11.8	345	13.6	443	17.4
		350	13.8	395	15.6	493	19.4

Table 2-10: Dimensions for TRA/TCA-TS52, -TS53, -TS54 with ASME-extension tube

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
152	6	100	3.9	145	5.7	319	12.6
		150	5.9	195	7.7	369	14.5
		200	7.9	245	9.6	419	16.5
		250	9.8	295	11.6	469	18.5
		300	11.8	345	13.6	519	20.4
		350	13.8	395	15.6	569	22.4

Table 2-11: Dimensions for TRA/TCA-TS52, -TS53, -TS54 with ASME-extension tube

2.2.5 Flanged temperature assembly

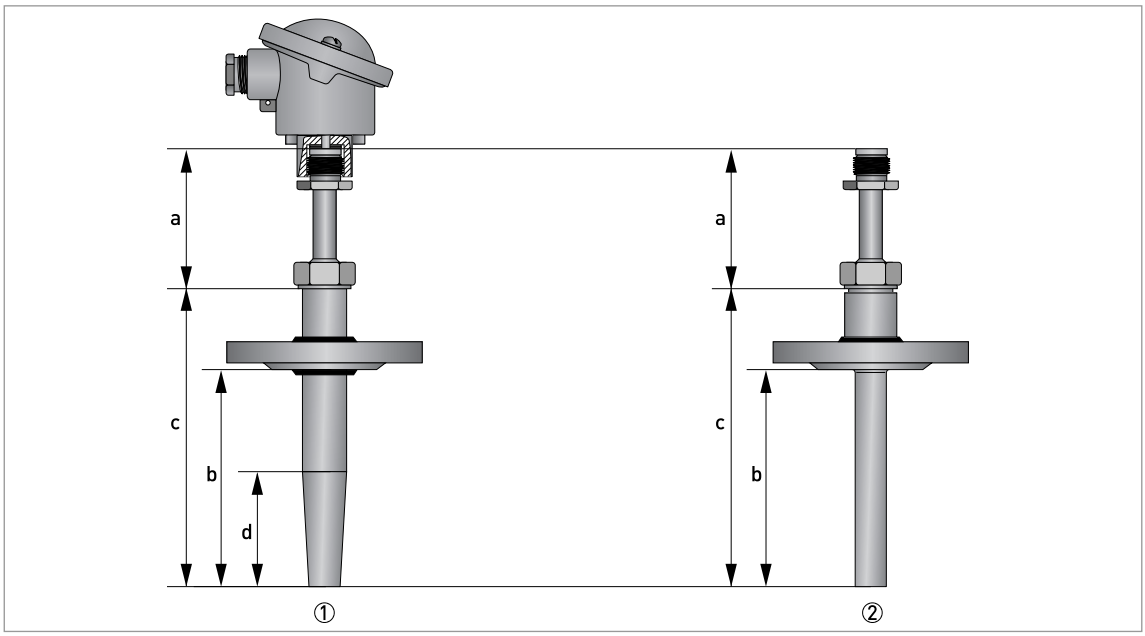


Figure 2-6: Flanged temperature assembly according to DIN 43772

① TRA/TCA-TF31 (conical thermowell, one-piece, bar stock)
② TRA/TCA-TF33 (straight thermowell, multipart, welded)

Extension tube length "a"		Insertion length "b"		Cone length "d"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	130	5.1	65	2.6	200	7.9	375	14.8
		190	5	125	4.9	260	10.2	435	17.1

Table 2-12: Dimensions for TRA/TCA-TF31

Extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	110	4.3	200	7.9	322	12.7
		170	6.7	260	10.2	382	15.0
		260	10.2	350	13.8	472	18.6
		410	16.1	500	19.7	622	24.5

Table 2-13: Dimensions for TRA/TCA-TF33

- *Tolerances of all thermowell and insertion lengths: ±1 mm / 0.04"*
- *Tolerances of all measuring insert lengths: +2 mm, -0 mm / +0.08", -0"*

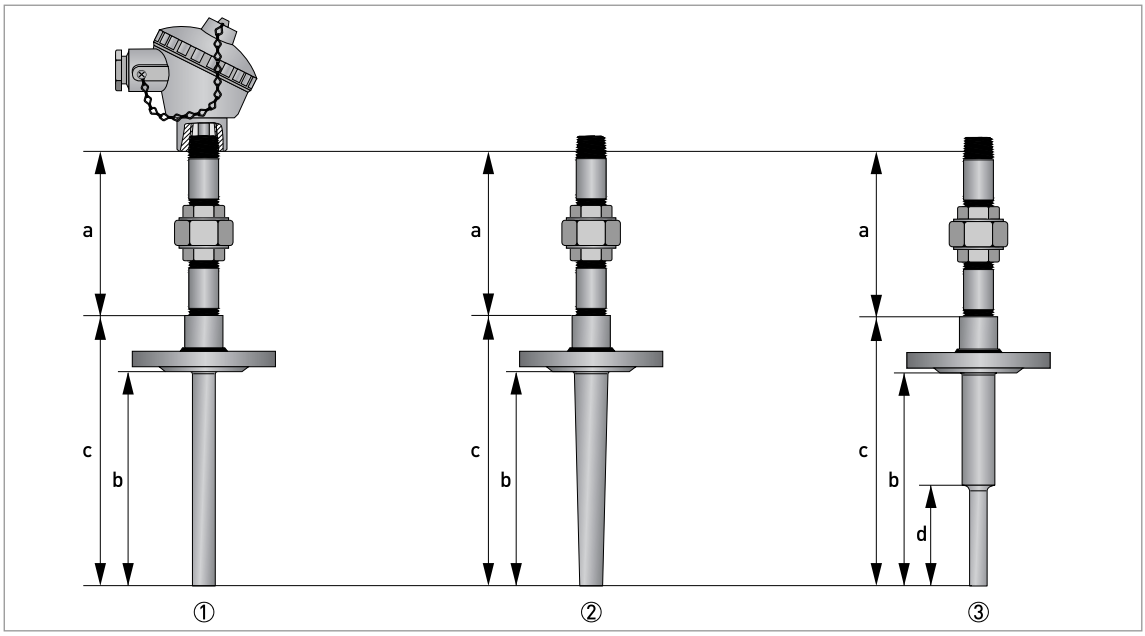


Figure 2-7: Flanged temperature assembly according to ASME

① TRA/TCA-TF55 (straight thermowell, one-piece, bar stock)
② TRA/TCA-TF56 (conical thermowell, one-piece, bar stock)
③ TRA/TCA-TF57 (reduced thermowell, one-piece, bar stock)

The length of the reduced tip "d" is always 65 mm / 2.56".

ASME extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
152	6	100	3.9	157	6.2	331	13.0
		150	5.9	207	8.1	381	15.0
		200	7.9	257	10.1	431	17.0
		250	9.8	307	12.1	481	18.9
		300	11.8	357	14.1	531	20.9
		350	13.8	407	16.0	581	22.9

Table 2-14: Dimensions for TRA/TCA-TF55, -TF56, -TF57 with DIN or ASME flange

ASME extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
76	3	100	3.9	157	6.2	255	10.0
		150	5.9	207	8.1	305	12.0
		200	7.9	257	10.1	355	14.0
		250	9.8	307	12.1	405	15.9
		300	11.8	357	14.1	455	17.9
		350	13.8	407	16.0	505	19.9

Table 2-15: Dimensions for TRA/TCA-TF55, -TF56, -TF57 with DIN or ASME flange, ASME extension tube length "a"

DIN extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	100	3.9	157	6.2	331	13.0
		150	5.9	207	8.1	381	15.0
		200	7.9	257	10.1	431	17.0
		250	9.8	307	12.1	481	18.9
		300	11.8	357	14.1	531	20.9
		350	13.8	407	16.0	581	22.9

Table 2-16: Dimensions for TRA/TCA-TF55, -TF56, -TF57 with DIN or ASME flange DIN extension tube length "a"

2.2.6 Weld temperature assembly

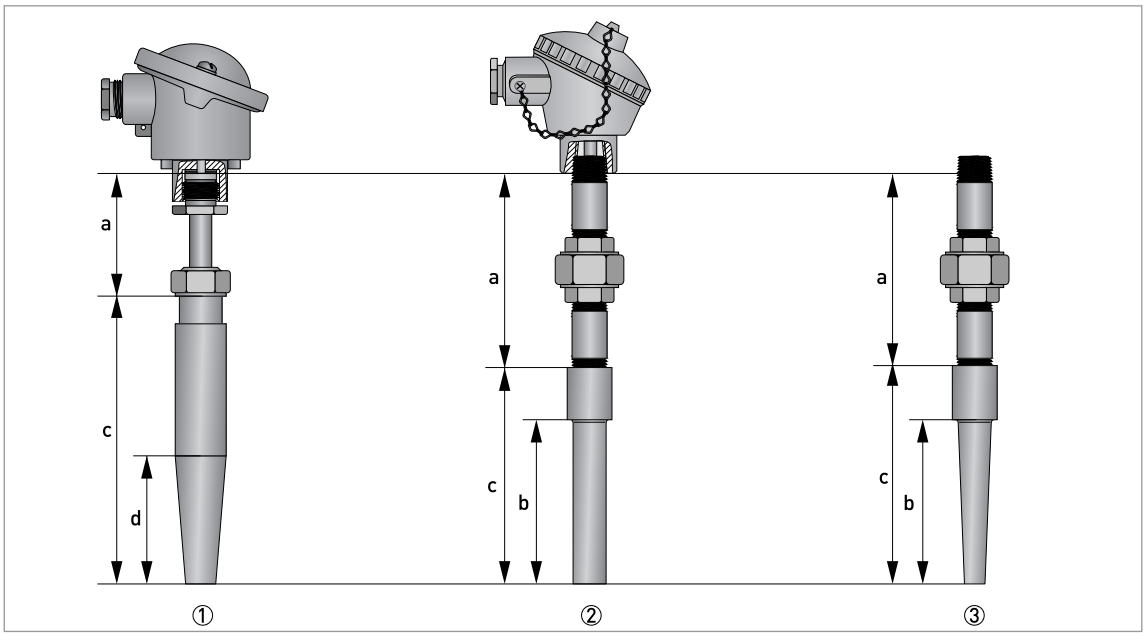


Figure 2-8: Weld temperature assembly according to DIN 43772 and ASME

① TRA/TCA-T30 (conical thermowell with internal thread, one-piece, bar stock)
② TRA/TCA-TW58 (straight thermowell with internal thread, one-piece, bar stock)
③ TRA/TCA-TW59 (conical thermowell with internal thread, one-piece, bar stock)

DIN extension tube length "a"		Thermowell length "c"		Cone length "d"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
165	6.5	140	5.5	65	2.6	315	12.4
		200	7.9	65	2.6	375	14.8
		200	7.9	125	4.9	375	14.8
		260	10.2	125	4.9	435	17.1

Table 2-17: Dimensions for TRA/TCA-T30 (similar to Form 4)
DIN extension tube length "a"

ASME extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
76	3	100	3.9	145	5.7	243	9.6
		150	5.9	195	7.7	293	11.5
		200	7.9	245	9.6	343	13.5
		250	9.8	295	11.6	393	15.5
		300	11.8	345	13.6	443	17.4
		350	13.8	395	15.6	493	19.4

Table 2-18: Dimensions for TRA/TCA-TW58 and -TW59

ASME extension tube length "a"		Insertion length "b"		Thermowell length "c"		Measuring insert length	
[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
152	6	100	3.9	145	5.7	319	12.6
		150	5.9	195	7.7	369	14.5
		200	7.9	245	9.6	419	16.5
		250	9.8	295	11.6	469	18.5
		300	11.8	345	13.6	519	20.4
		350	13.8	395	15.6	569	22.4

Table 2-19: Dimensions for TRA/TCA-TW58 and -TW59

2.2.7 Thermowells: Diameter, wall thickness, tips

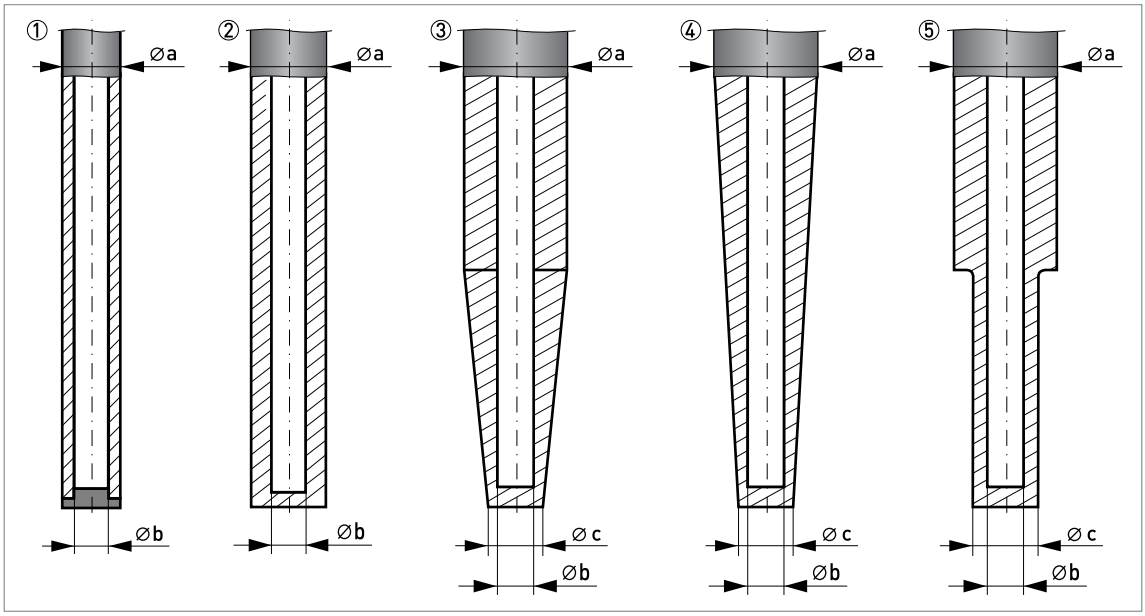


Figure 2-9: Thermowell designs

① Straight thermowell, multipart, welded
② Straight thermowell, one-piece, bar stock
③ Conical-straight thermowell, one-piece, bar stock
④ Conical thermowell, one-piece, bar stock
⑤ Reduced thermowell, one-piece, bar stock

Type	Design	Ø a		Ø b (Hole)		Ø c	
		[mm]	["]	[mm]	["]	["]	["]
TRA/TCA-T30	3	24 h7	0.94	7	0.28	12.5	0.49
TRA/TCA-TF31							
TRA/TCA-TS32, TRA/TCA-TF33, TRA/TCA-TS35	1	9 x 1	0.37 x 0.04	7	0.28	-	-
		10 x 1	0.41 x 0.04	8	0.31		
		11 x 2	0.45 x 0.08	7	0.28		
		12 x 2	0.49 x 0.08	8	0.31		
		12 x 2.5	0.49 x 0.10	7	0.28		
TRA/TCA-TS36	2	17	0.67	7	0.28		
TRA/TCA-TS37	2	17	0.67	7	0.28		
TRA/TCA-TS52	2	16	0.63	6.5	0.26		
TRA/TCA-TS53	4	16	0.63	6.5	0.26	13	0.51
		22	0.87	6.5	0.26	16	0.63
TRA/TCA-TS54	5	16	0.63	6.5	0.26	13	0.51
		22	0.87	6.5	0.26	13	0.51
TRA/TCA-TF55	2	19	0.75	6.5	0.26	-	-
TRA/TCA-TF56	4	22	0.87	6.5	0.26	16	0.63
		25	0.98	6.5	0.26	19	0.75
TRA/TCA-TF57	5	12	0.47	6.5	0.26	9	0.35
		19	0.75	6.5	0.26	13	0.51
		23	0.91	6.5	0.26	13	0.51
TRA/TCA-TW58	2	19	0.75	6.5	0.26	-	-
		23	0.91	6.5	0.26		
TRA/TCA-TW59	4	19	0.75	6.5	0.26	16	0.63
		25	0.98	6.5	0.26	19	0.75

Table 2-20: Dimensions in mm and inch

2.2.8 Sleeves

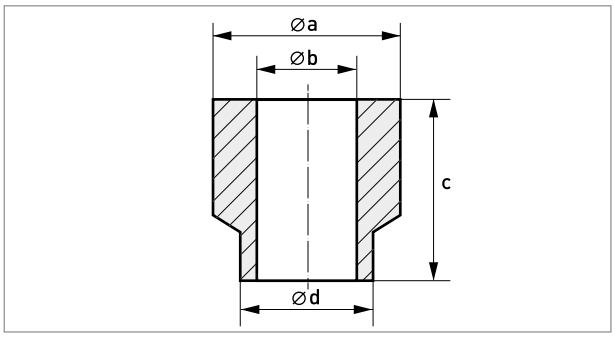


Figure 2-10: Weld-in sleeve for TRA/TCA-T30

	[mm]	["]
a	48	1.89
b	24 G7	0.94
c	50	1.97
d	30	1.18

Table 2-21: Dimensions in mm and inch

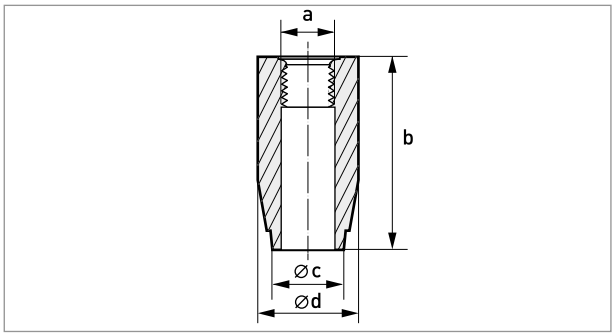


Figure 2-11: Threaded sleeve for process connections with G1/2 thread

	[mm]	["]
a (thread)	12.7	G1/2
b	50 / 100	1.97 / 3.94
c	29	1.14
d	40	1.57

Table 2-22: Dimensions in mm and inch

2.2.9 Flanges

Upon request the manufacturer can supply flanges with dimensions other than those specified here.

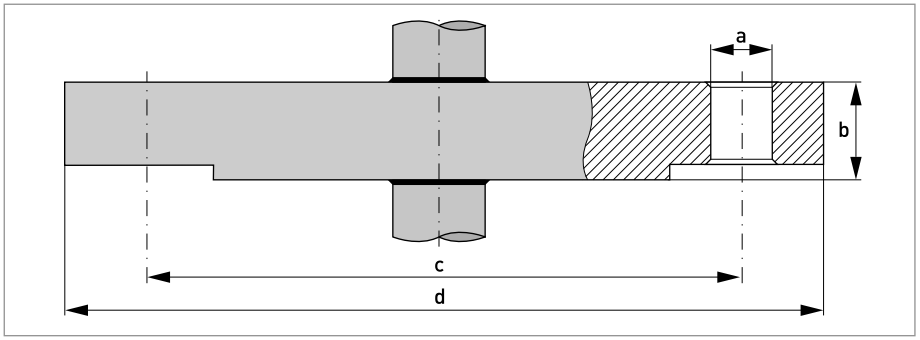


Figure 2-12: Dimensions of flange

Type of flange	a		b		c		d	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
B1-DN25 / PN40 (EN 1092-1)	14	0.55	18	0.71	85	3.35	115	4.53
B1-DN50 / PN40 (EN 1092-1)	18	0.71	20	0.79	125	4.92	165	6.50

Table 2-23: Dimensions of flange according to DIN EN 1092-1, raised face B1

Type of flange	a		b		c		d	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
RF 1" / 150 lb (ASME B16.5)	15.9	0.63	14.7	0.58	79.4	3.13	110	4.33
RF 1" / 300 lb (ASME B16.5)	19.1	0.75	17.9	0.70	88.9	3.50	125	4.92
RF 1" / 600 lb (ASME B16.5)	19.1	0.75	24.5	0.96	88.9	3.50	125	4.92
RF 1½" / 150 lb (ASME B16.5)	15.9	0.63	17.9	0.70	98.4	3.87	125	4.92
RF 1½" / 300 lb (ASME B16.5)	22.3	0.88	21.1	0.83	114.3	4.50	155	6.10
RF 1½" / 600 lb (ASME B16.5)	22.3	0.88	29.3	1.15	114.3	4.50	155	6.10
RF 2" / 150 lb (ASME B16.5)	19.1	0.75	19.5	0.77	120.7	4.75	150	5.91
RF 2" / 300 lb (ASME B16.5)	19.1	0.75	22.7	0.89	127	5.00	165	6.50
RF 2" / 600 lb (ASME B16.5)	19.1	0.75	32.4	1.28	127	5.00	165	6.50

Table 2-24: Dimensions of flange according to ASME/ANSI 16.5, raised face RF

2.3 Measuring accuracy

The measuring accuracy depends largely on the following factors:

- The version of the measuring insert (type of sensor, type of circuit, measuring range).
- The correct dimensions (diameter, wall thickness) and insertion length of the thermowell for good thermal coupling to the process temperature (insufficient insertion depth often results in measurement errors).
- The type of temperature transmitter used.

Please consult the appropriate handbook for further information regarding the accuracy of the measuring inserts and the temperature transmitters.

	Accuracy (% of the measuring range or °K)
TT 10 C/R (analogue, standard, 4...20 mA)	± 0.15%
TT 11 C/R (analogue, 3- or 4-wire circuit: 0...10 VDC)	± 0.15%
TT 20 C/R (analogue, 4...20 mA)	± 0.10%
TT 30 C/R (digital, 4...20 mA, standard)	± 0.10%
TT 31 R (3-wire-circuit, 4...20 mA)	± 0.10%
TT 32 R (4-wire circuit, 0/4...20 mA: 0/2...10 VDC)	± 0.20%
TT 40 C/R (digital, 4...20 mA, precise)	± 0.05%
TT 50 C/R (digital, 4...20 mA, HART®)	± 0.10%
TT 51 C/R (digital, 4...20 mA, HART®, SIL2)	± 0.05%
TT 60 C/R (digital, Profibus-PA)	± 0.10°K

Table 2-25: Measuring accuracy of temperature transmitter

2.4 Process connections

Process connection	Materials	Ø of extension tube	
		[mm]	["]
Thread M18 x 1.5 mm	1.4571	12 x 2.5	0.47 x 0.1
Thread G1/2, G3/4			
Union nut G1/2, G3/4			
Thread 1/2 NPT (NN and NUN)	1.4404	21.34 x 2.77	0.84 x 0.11 SCH 40

Table 2-26: Screw-in temperature assembly without thermowell

Process connection	Materials	Ø of thermowell	
		[mm]	["]
Thread G1/2, G3/4	1.4571 / AISI 316 Ti, 1.4404 / AISI 316 L	9, 10, 11, 12, 6, 17, 22	0.35, 0.39, 0.43, 0.47, 0.63, 0.67, 0.87
Thread 1/2 NPT, 3/4 NPT			

Table 2-27: Screw-in temperature assembly with thermowell

Process connection	Materials	Ø of thermowell	
		[mm]	["]
DN25 / PN40	1.4571 / AISI 316 Ti, 1.4404 / AISI 316 L	9, 10, 11, 12, 19, 22, 23, 25	0.35, 0.39, 0.43, 0.47, 0.75, 0.87, 0.98
DN50 / PN40			
1" / 150 lb, 300 lb, 600 lb			
1½" / 150 lb, 300 lb, 600 lb			
2" / 150 lb, 300 lb, 600 lb			

Table 2-28: Flanged temperature assembly

The manufacturer offers the flanged temperature assembly with process connections according to DIN EN 1092-1 or ASME/ANSI 16.5. For DIN flanges the raised face complies with Form B1 and with ASME flanges, type "RF" or type "RTJ".

Ø at the weld-in point		Materials	Ø of thermowell	
[mm]	["]		[mm]	["]
24 h7	0.94	1.4571 / AISI 316 Ti, 1.4404 / AISI 316 L, 1.7335 / AISI F12, 1.0460 / C 22.8	24 h7	0.94
26.7	1.05	1.4571 / AISI 316 Ti, 1.4404 / AISI 316 L	19	0.75
33.4	1.31	1.4571 / AISI 316 Ti, 1.4404 / AISI 316 L	23, 25	0.91, 0.98

Table 2-29: Weld temperature assembly

2.5 Measuring range and permitted load

To prevent fatal injuries or damage, never operate the temperature assembly outside of its permissible mechanical, thermal or chemical limits. For further information refer to the rest of this section and the "Technical data" section.

The information in this subsection is informative only and does not reflect the vibration load caused by flow-induced eddy shedding and the resulting vibration. If necessary, prior to purchasing and installing an industrial temperature assembly OPTITEMP TRA/TCA Plus, have a specific strength calculation performed (e. g. as per DITTRICH or MURDOCK, ASME PTC 19.3TW-2016).
For further information contact the manufacturer.

To prevent destruction or damage, only operate a temperature assembly without a thermowell in the range of 0.8...1.2 bara / 11.6...17.4 psia.

The manufacturer can provide an optional strength calculation for a fee.

Temperatures that can be measured with an industrial temperature assembly depend largely on the load of the temperature assembly. Load limits are defined through a variety of factors (see the subsection "Load limits" in the "Installation" section). For this reason, the manufacturer cannot make any universally valid statements about the measuring range and permissible load.

The thermowell operating limits specified below refer to a flow of air of 40 m/s or 131.2 ft/s or a flow of water or vapour of 5 m/s or 16.4 ft/s.

2.5.1 Operating limits for multipart, welded thermowells

TRA/TCA-TS32, -TF33 and -TS35 with Ø 12 x 2.5 mm / 0.47 x 0.10"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti	82	3.2	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		382	15.0	14.1 / 17.9	204 / 259	33.7 / 100	488 / 1450
Flanges ASME 1", 1½", 2" 150 lb		110	4.3	19.0 / 6.5	276 / 94	19.0 / 6.5	276 / 94
		410	16.1	12.3 / 15.6	179 / 94	3.4 / 6.5	49 / 94
Flanges ASME 1", 1½", 2" 300 lb		110	4.3	49.6 / 29.4	719 / 426	49.6 / 29.4	719 / 426
		410	16.1	12.3 / 15.6	179 / 226	3.4 / 29.4	49 / 426
Flanges ASME 1", 1½", 2" 600 lb		110	4.3	99.3 / 58.9	1440 / 854	99.3 / 58.9	1440 / 854
		410	16.1	12.3 / 15.6	179 / 226	3.4 / 58.9	49 / 854
Flanges DN25, DN50 PN40		160	6.3	40.0 / 31.2	580 / 452	40.0 / 31.2	580 / 452

2.5.2 Operating limits for one-piece, straight bar stock thermowells

TRA/TCA-TS36 and -TS37 with Ø 17 x 5 mm / 0.67 x 0.2"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti, 1.4404 / 316 L	82	3.2	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		382	15.0	31.1 / 39.5	451 / 572	100 / 100	1450 / 1450

TRA/TCA-TS52 with Ø 16 x 4.75 mm / 0.63 x 0.19"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti, 1.4404 / 316 L	100	3.9	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		300	11.8	44.8 / 56.7	649 / 822	100 / 100	1450 / 1450

TRA/TCA-TF55 with Ø 19 x 6.25 mm / 0.75 x 0.25"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Flanges ASME 1", 1½", 2" 150 lb	1.4404 / 316 L	100	3.9	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
		300	11.8	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
Flanges ASME 1", 1½", 2" 300 lb		100	3.9	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
		300	11.8	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
Flanges ASME 1", 1½", 2" 600 lb		100	3.9	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
		300	11.8	62.0 / 48.6	899 / 705	82.7 / 48.6	1199 / 705
Flanges DN25, DN50 PN40		100	3.9	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 352
		300	11.8	40.0 / 25.7	580 / 580	40.0 / 25.7	580 / 373

2.5.3 Operating limits for one-piece, conical bar stock thermowells

TRA/TCA-TS53 with Ø 16 to 13 mm / 0.63 to 0.51"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti, 1.4404 / 316 L	100	3.9	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		300	11.8	50.0 / 62.8	725 / 910	100 / 100	1450 / 1450

TRA/TCA-TS53 with Ø 22 to 16 mm / 0.87 to 0.63"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti, 1.4404 / 316 L	100	3.9	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		300	11.8	100 / 100	1450 / 1450	100 / 100	1450 / 1450

TRA/TCA-TF56 with Ø 22 to 16 mm / 0.87 to 0.63"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Flanges ASME 1", 1½", 2" 150 lb	1.4404 / 316 L	100	3.9	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
		300	11.8	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
Flanges ASME 1", 1½", 2" 300 lb		100	3.9	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
		300	11.8	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
Flanges ASME 1", 1½", 2" 600 lb		100	3.9	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
		300	11.8	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
Flanges DN25, DN50 PN40		100	3.9	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373
		300	11.8	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373

TRA/TCA-TF56 with Ø 25 to 19 mm / 0.98 to 0.75"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Flanges ASME 1", 1½", 2" 150 lb	1.4404 / 316 L	100	3.9	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
		300	11.8	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
Flanges ASME 1", 1½", 2" 300 lb		100	3.9	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
		300	11.8	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
Flanges ASME 1", 1½", 2" 600 lb		100	3.9	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
		300	11.8	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
Flanges DN25, DN50 PN40		100	3.9	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373
		300	11.8	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373

2.5.4 Operating limits for one-piece, reduced bar stock thermowells

TRA/TCA-TS54 with Ø 16 to 13 mm / 0.63 to 0.51"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti, 1.4404 / 316 L	100	3.9	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		300	11.8	47.0 / 59.0	681 / 855	100 / 100	1450 / 1450

TRA/TCA-TS54 with Ø 22 to 13 mm / 0.87 to 0.51"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Thread G½", G¾", ½" NPT, ¾" NPT	1.4571 / 316 Ti, 1.4404 / 316 L	100	3.9	100 / 100	1450 / 1450	100 / 100	1450 / 1450
		300	11.8	97.0 / 100	1406 / 1450	100 / 100	1450 / 1450

TRA/TCA-TF57 with Ø 12 to 9 mm / 0.47 to 0.35"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Flanges ASME 1", 1½", 2" 150 lb	1.4404 / 316 L	100	3.9	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
		300	11.8	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
Flanges ASME 1", 1½", 2" 300 lb		100	3.9	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
		300	11.8	25.8 / 24.3	374 / 352	41.4 / 24.3	600 / 352
Flanges ASME 1", 1½", 2" 600 lb		100	3.9	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
		300	11.8	25.8 / 32.7	374 / 474	82.7 / 48.6	1199 / 705
Flanges DN25, DN50 PN40		100	3.9	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373
		300	11.8	25.8 / 25.7	374 / 373	40.0 / 25.7	580 / 373

TRA/TCA-TF57 with Ø 19 to 13 mm / 0.75 to 0.51"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Flanges ASME 1", 1½", 2" 150 lb	1.4404 / 316 L	100	3.9	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
		300	11.8	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
Flanges ASME 1", 1½", 2" 300 lb		100	3.9	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
		300	11.8	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
Flanges ASME 1", 1½", 2" 600 lb		100	3.9	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
		300	11.8	70.0 / 48.6	1015 / 705	82.7 / 48.6	1199 / 705
Flanges DN25, DN50 PN40		100	3.9	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373
		300	11.8	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373

TRA/TCA-TF57 with Ø 23 to 13 mm / 0.91 to 0.51"

Process connection	Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
		[mm]	["]	[bar]	[psi]	[bar]	[psi]
Flanges ASME 1", 1½", 2" 150 lb	1.4404 / 316 L	100	3.9	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
		300	11.8	15.9 / 6.5	231 / 94	15.9 / 6.5	231 / 94
Flanges ASME 1", 1½", 2" 300 lb		100	3.9	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
		300	11.8	41.4 / 24.3	600 / 352	41.4 / 24.3	600 / 352
Flanges ASME 1", 1½", 2" 600 lb		100	3.9	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
		300	11.8	82.7 / 48.6	1199 / 705	82.7 / 48.6	1199 / 705
Flanges DN25, DN50 PN40		100	3.9	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373
		300	11.8	40.0 / 25.7	580 / 373	40.0 / 25.7	580 / 373

2.5.5 Operating limits for conical weld-in bar stock thermowells

TRA/TCA-T30 with Ø 24 h7 to 12.5 mm / 0.95 to 0.49"

Ø at the process connection		Material	Insertion length / cone length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
[mm]	["]		[mm]	["]	[bar]	[psi]	[bar]	[psi]
24 h7	0.95	1.4571 / 316 Ti	200 / 65	7.9 / 2.6	245 / 195	3553 / 2828	343 / 195	4974 / 2828
			260 / 125	10.2 / 4.9	158 / 187	2291 / 2712	343 / 195	4974 / 2828
		1.4404 / 316 L	200 / 65	7.9 / 2.6	245 / 195	3553 / 2828	343 / 195	4974 / 2828
			260 / 125	10.2 / 4.9	158 / 187	2291 / 2712	343 / 195	4974 / 2828
		1.7335 / AISI F12	200 / 65	7.9 / 2.6	332 / 343	4815 / 4974	442 / 343	6410 / 4974
			260 / 125	10.2 / 4.9	207 / 338	3002 / 4902	443 / 343	6410 / 4974

TRA/TCA-TW59 with various diameters

Ø at the process connection		Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
[mm]	["]		[mm]	["]	[bar]	[psi]	[bar]	[psi]
26.7 19 to 16	1.05 0.75 to 0.63	1.4404 / 316 L	100	3.9	371 / 230	5380 / 3335	414 / 235	6004 / 3408
			300	11.8	69.0 / 86.0	1000 / 1247	400 / 235	5801 / 3408
33.4 25 to 19	1.31 0.98 to 0.75		100	3.9	423 / 249	6135 / 3611	439 / 250	6367 / 3625
			300	11.8	125 / 152	1812 / 2204	438 / 250	6352 / 3625

2.5.6 Operating limits for straight, bar stock weld-in thermowells

TRA/TCA-TW58 with various diameters

Ø at the process connection		Material	Insertion length		p_{max} at +20°C / +400°C or +68°F / +752°F, air		p_{max} at +20°C / +400°C or +68°F / +752°F, water / vapour	
[mm]	["]		[mm]	["]	[bar]	[psi]	[bar]	[psi]
26.7 19	1.05 0.75	1.4404 / 316 L	100	3.9	364 / 228	5279 / 3306	436 / 249	6323 / 3611
			300	11.8	62.0 / 79.0	899 / 1145	401 / 244	5816 / 3538
33.4 23	1.31 0.91		100	3.9	402 / 244	5830 / 3538	456 / 260	6613 / 3770
			300	11.8	91.0 / 113	1319 / 1638	434 / 257	6294 / 3727

2.6 Permissible temperatures

2.6.1 Connection head

Temperature transmitter	Connection head		Temperature range	Maximum temperature limiting component
	Material	Display		
without	Metal	no	-40...+100°C / -40...+212°F	Gasket of connection head cover and cable gland
without	Plastic	no	-40...+80°C / -40...+176°F	Connection head material
with	Metal	no	-40...+85°C / -40...+185°F	Temperature transmitter
with	Plastic	no	-40...+80°C / -40...+176°F	Connection head material
with	Metal	yes	-40...+70°C / -40...+158°F	Display

Table 2-30: Connection head

For potentially explosive atmospheres, please check appropriate supplementary instructions for max temperature and available connection heads.

2.6.2 Unloaded thermowell and immersion tubes

The temperatures specified in the following tables are valid only for thermowells and immersion tubes that do not project into flowing media or media under pressure. The maximum permissible temperature is reduced under load.

If you are unsure whether the device can withstand the loads of the process when using an insertion-type temperature assembly, have a separate strength calculation done (e.g. per DITTRICH or MURDOCK, ASME PTC 19.3TW- 2016)! For further information contact the manufacturer.

The manufacturer can provide an optional strength calculation for a fee.

Type of thermowell	Material	Permissible temperature range
-T30	1.4571 / AISI 316 Ti	-200...+600°C / -328...+1112°F
	1.4404 / AISI 316 L	-200...+600°C / -328...+1112°F
	1.7335 / AISI F12	-200...+550°C / -328...+1022°F
	1.0460 / C22.8	-200...+550°C / -328...+1022°F
All others	1.4571 / AISI 316 Ti	-200...+600°C / -328...+1112°F
	1.4404 / AISI 316 L	-200...+600°C / -328...+1112°F

Table 2-31: Thermowells

Type of sensor	Cable jacket material	Permissible temperature range
Pt100 RTD	1.4404 / AISI 316 L	-200...+600°C / -328...+1112°F
Thermocouple	Inconel® 600	-40...+1100°C / -40...+1832°F

Table 2-32: Sheaths of measuring inserts made of mineral insulated cable

2.7 Sensor response times

Sensor response times are generally indicated as "50% time" (t_{05}) and "90% time" (t_{09}). "50% time" refers to the time needed for a temperature assembly signal to achieve 50% of its end value in the face of erratic temperature changes (this applies analogously to "90% time").

You can find more information about response times in VDI 3522.

Ø of thermowell		Pt100 RTD		Thermocouple	
[mm]	["]	t_{05} [s]	t_{09} [s]	t_{05} [s]	t_{09} [s]
9	0.35	17	52	14	42
11	0.43	21	58	17	46
12	0.47	22	66	18	54
Water flows against the temperature assembly at 0.4 m/s or 1.31 ft/s					

Table 2-33: Temperature assembly with welded, straight thermowell

Sensor	Water with 0.4 m/s or 1.31 ft/s		Air with 1 m/s or 3.28 ft/s	
	t_{05} [s]	t_{09} [s]	t_{05} [s]	t_{09} [s]
Pt100 RTD	3.5	8	24	54
Thermocouple	2.5	7	21	50

Table 2-34: Temperature assembly without thermowell (TRA/TCA-S34 and -S50 with Ø 6 mm / 0.24")

3.1 Intended use

Do not install or operate the industrial temperature assembly for advanced requirements in potentially explosive atmospheres, without ordered them with relevant certificates. The relevant Ex handbook contains more detailed information.

Responsibility for the use of the measurement devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The temperature assembly OPTITEMP TRA/TCA Plus is used to measure the temperature of gases, liquids, vapour and solids in industrial applications. The devices are particularly suited to the measurement of

- liquids with low viscosity,
- water and chemicals with low corrosiveness,
- saturated steam and superheated steam.

3.2 General notes on installation

For devices used in potentially explosive atmospheres, additional safety notes apply; please refer to the Ex documentation.

Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

Do a check of the packing list to make sure that you have all the elements given in the order.

Look at the device nameplate to ensure that the device is delivered according to your order.

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

3.3 Storage

Always store industrial temperature assemblies OPTITEMP TRA/TCA Plus in a dry place protected from dust.
The permissible range for storage temperatures is -40...+70°C / -40...+176°F.

3.4 Transport

Always transport industrial temperature assemblies OPTITEMP TRA/TCA Plus in their original packaging. Do not expose the devices to moisture or vibration during transport. The information that applies to storage also applies to transport.

3.5 Proper installation

Take the following points into consideration prior to installing the temperature assembly:

- *The dimensions of the thermowell (length, diameter, wall thickness, type of tip) comply with the requirements of the measuring point. The mechanical load as a result of flowing media, vibration and resonances is the focus here. In addition, incorrect dimensions can lead to measurement errors.*
- *The thermowell is sufficiently resistant to chemically aggressive media (refer to the generally accessible corrosion tables). Otherwise, corrosion may occur or the medium may penetrate into the thermowell. When in doubt, select a thermowell made from the same material as your system.*

3.5.1 Possible installations

Installations include the parameters "installation site", "installation angle" and "insertion length". Depending on the space available and the diameter of the pipe, three installations are recommended for pipes with flowing product:

- Small pipe diameter: Installation directly against the direction of flow in a bend in the pipe (①).
- Small pipe diameter: Installation diagonally against the direction of flow, if a bend in the pipe is available (②).
- Large pipe diameter: Perpendicular installation, if flow-induced periodic vortex shedding does not cause the temperature assembly to vibrate in its resonance frequency (③).

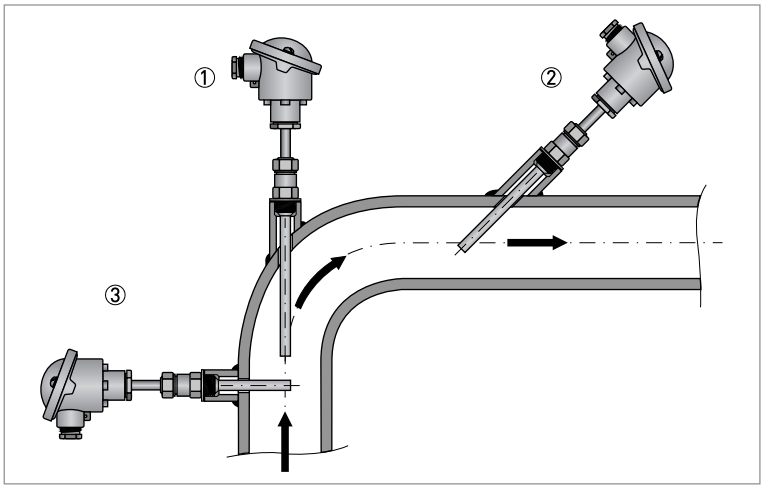


Figure 3-1: Recommended installations

Permitted insertion length of the thermowell or measuring insert

The "insertion length" of the thermowell or measuring insert refers to the distance from the seal of the process connection (for G threads), two-thirds of the thread height (for NPT threads) or the bottom of the flange (for temperature assemblies with flange) to the tip of the thermowell or sheath. This length determines how far the sensor projects into the measured medium.

To avoid measurement errors, ensure that the insertion length ("b" in the drawing below) meets the following requirements:

- Insertion length = 10...15 x thermowell diameter, but at least 100 mm / 3.94" (shorter insertion lengths are possible but they impair measuring accuracy).
- Tubes with Ø < 300 mm / 11.8": thermowell tip should project past the middle of the pipe is possible, if the flow velocity of the product allows it.

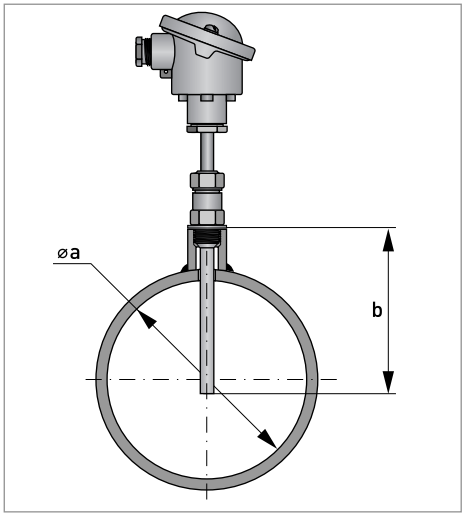


Figure 3-2: Permitted insertion length

For more information on the maximum insertion length, please refer to the subsection "Typical load types".

3.5.2 Other installation requirements

When a seal is damaged or incorrect, the medium may leak out, causing material damage or bodily harm! It is the sole responsibility of the operator to select the right seal.

- A well-insulated pipeline or tank around the measuring point reduces the heat transfer and the distorting influence of the ambient temperature.
- To avoid measurement errors caused by poor heat transfer, the measuring insert must always be in contact with the bottom of the thermowell (this is normally guaranteed by the spring-loaded version of the measuring insert).
- Choosing the right gasket for the process connection depends on the process conditions; the manufacturer can thus only give the general recommendation that the gasket must comply with the individual requirements of the measuring point (e.g. pressure, temperature, chemically aggressive media).

3.6 Load limits

The load limits of industrial temperature assemblies depend on several factors:

- Dimensions and design of the thermowell (especially the insertion length and diameter)
- Thermowell material
- Mechanical conditions the thermowell is subject to due to the measured medium (pressure, temperature, flow velocity, viscosity, density)
- Sealable pressure of the process connection
- Vibration load

The "sealable pressure" is the maximum pressure the process connection can seal against.

The sheer number of factors at play illustrates the difficulty in making universally valid statements about the load limits. The diagrams in the next subsection serve as an initial assessment.

3.6.1 Typical load types

To prevent destruction or damage, never operate the temperature assembly outside of its permissible mechanical, thermal or chemical limits. For further information refer to the rest of this section and the "Technical data" section.

The information in this subsection is informative only and does not reflect the vibration load caused by flow-induced eddy shedding and the resulting vibration. If necessary, prior to purchasing and installing an industrial temperature assembly OPTITEMP TRA/TCA Plus, have a specific strength calculation performed (e. g. as per DITTRICH or MURDOCK, ASME PTC 19.3TW-2016).
For further information contact the manufacturer.

The manufacturer can provide an optional strength calculation for a fee.

The first diagram applies to the following temperature assemblies:

- TRA/TCA-T30 (Form 4)
- Ø 24 x 8.5 mm / 0.94 x 0.33"
- Material 1.4571 / 316 Ti

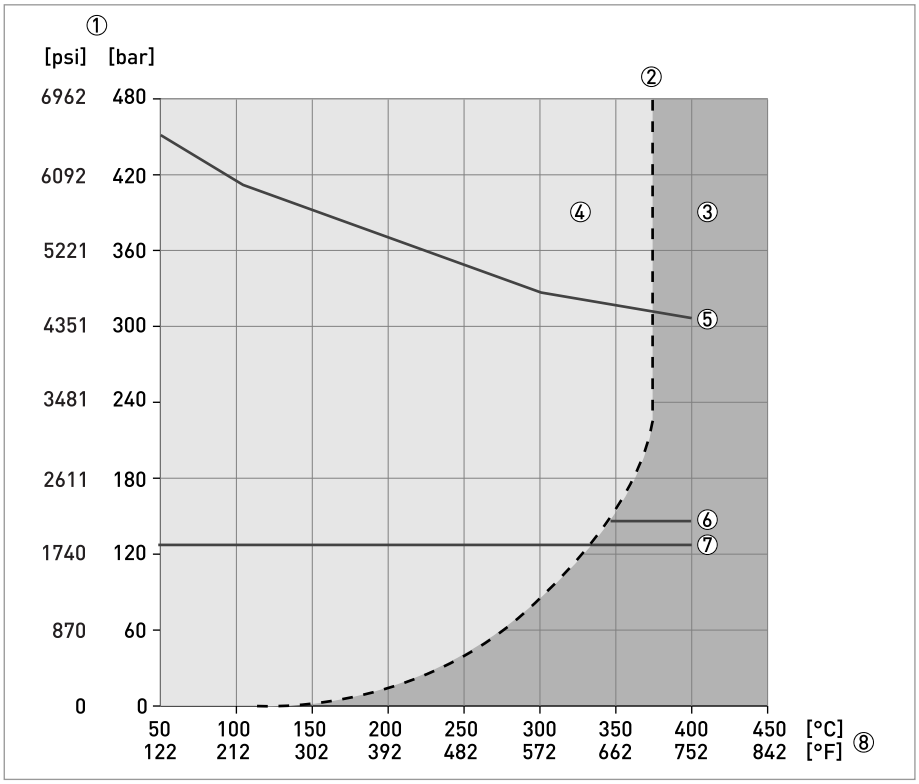


Figure 3-3: Load diagram for TRA/TCA-T30

① Pressure of the measured medium
② Steam pressure curve
③ Steam
④ Water
⑤ Insertion length 125 mm or 4.92"; water with 5 m/s or 16.4 ft/s
⑥ Insertion length 125 mm or 4.92"; steam with 60 m/s or 196.9 ft/s
⑦ Insertion length 125 mm or 4.92"; air with 60 m/s or 196.9 ft/s
⑧ Temperature of the measured medium

The second diagram applies to the following temperature assemblies:

- TRA/TCA-TS36 (Form 6 and 7)
- Ø 17 x 5 mm / 0.67 x 0.20"
- Material 1.4571 / 316 Ti

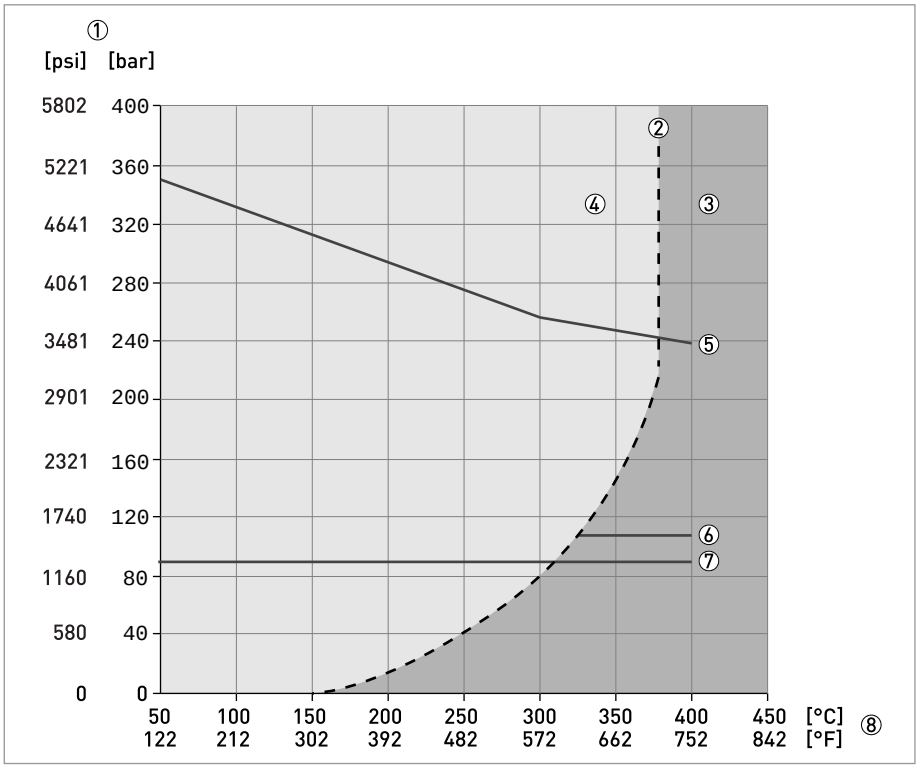


Figure 3-4: Load diagram for TRA/TCA-TS36

① Pressure of the measured medium
② Steam pressure curve
③ Steam
④ Water
⑤ Insertion length 230 mm or 9.06"; water with 3 m/s or 9.8 ft/s
⑥ Insertion length 230 mm or 9.06"; steam with 40 m/s or 131.2 ft/s
⑦ Insertion length 230 mm or 9.06"; air with 40 m/s or 131.2 ft/s
⑧ Temperature of the measured medium

3.6.2 Vibration load

Permanently operating the thermowell in its natural resonance can quickly damage or destroy the temperature assembly! So, prior to installation, ensure that this does not happen and select a thermowell with a different length, a different diameter or another material if necessary.

All temperature assemblies that feature a thermowell and extension tube and are attached to the process connection have two components that can vibrate: the thermowell and the connection head with the extension tube. That is why the terms "thermowell resonance" and "head resonance" are commonly heard.

A thermowell surrounded by the measured medium is a body behind which vortices periodically are released ("Kármán vortex street"). If the frequency of the vortex detachment is equal to the resonance frequency of the thermowell, it starts to vibrate. If this happens for a short period of time, such as when starting up the system and the frequency of the vortex detachment passes through the resonance range of the thermowell, there is generally no damage is caused. The opposite is true, however, if the vibrations remain permanently in the resonance range.

3.6.3 Temperature load

The temperature of the measured medium and the thermal dissipation via thermowell and extension tube also cause the connection head to heat up. After some time, the interior of the connection head and any existing head-mounted transmitter heat up to the temperature of the housing.
This occurs in temperature assemblies with and without extension tubes. An extension tube, however, causes thermal decoupling and can prevent the connection head or temperature transmitter from overheating at high process temperatures.

When the temperature is too high, the connection head and the components found in it (e. g. temperature transmitter or display) can be damaged or destroyed! It is your responsibility as the operator to ensure that the connection head does not get too hot. If this does happen, select another installation site or lengthen the extension tube or, with insertion-type temperature assemblies, increase the distance between the connection head and the process connection.

Sometimes even an extension tube cannot prevent the maximum permissible temperature in the connection head from being exceeded! It does cause extensive thermal decoupling of the connection head but you still have to always take into consideration the installation situation as well as the ambient and process temperatures!

The following diagram will aid in the selection of the right extension tube length and shows how the process temperature and the extension tube length impact the temperature of the connection head:

The diagram only shows the amount by which the temperature of the connection head increases. To determine the actual temperature of the connection head you must add the ambient temperature to it in a second step!

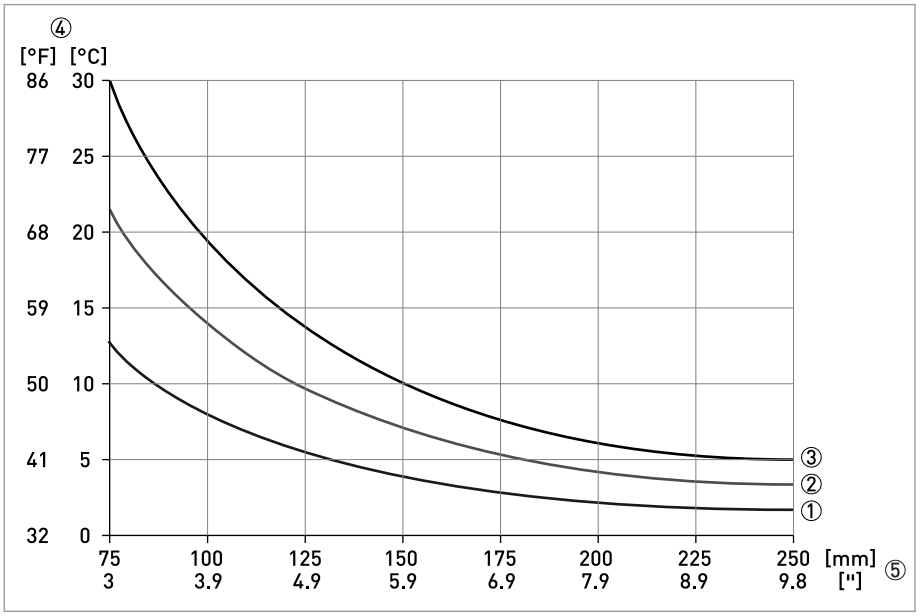


Figure 3-5: Heating of the connection head

① Process temperature +220°C / +428°F
② Process temperature +400°C / +752°F
③ Process temperature +570°C / +1058°F
④ Temperature of the connection head
⑤ Extension tube length

For more information regarding the maximum allowable temperatures, please refer to the "Technical data" section.

3.7 Installation notes on the individual device classes

3.7.1 Weld temperature assembly

Compared to other types of fastening, weld temperature assembly allows for higher process pressures and flow velocities. Weld temperature assemblies can be installed in two different ways:

- Welded in directly: possible in pipes and tanks with a wall thickness ≥ 20 mm / 0.79"
- Welded in using a welded sleeve: pipes and tanks with a wall thickness < 20 mm / 0.79" require welding of a sleeve, into which the thermowell is then welded.

The following drawing shows a weld-in sleeve suitable for the TRA/TCA-T30 version:

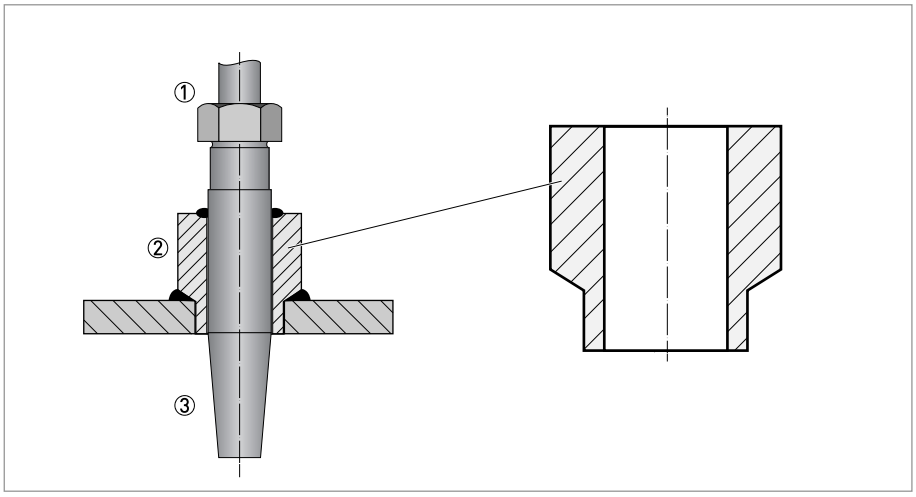


Figure 3-6: Welded sleeve for thermowells according to DIN 43772, Form 4

① Extension tube
② Welded sleeve
③ Thermowell

When installing welded sleeves, always make sure that the transition point between the conical and straight part of the thermowell is flush with the inner wall of the pipe or tank. You, the user, are responsible for proper welding, not the manufacturer!

Sometimes even an extension tube cannot prevent the maximum permissible temperature in the connection head from being exceeded! It does cause extensive thermal decoupling of the connection head but you still have to always take into consideration the installation situation as well as the ambient and process temperatures!

For more information on the dimensions of the welded sleeve, please see the subsection "Dimensions" in the section "Technical data". Note that the welded sleeve is not included in the scope of standard delivery but is an optional accessory.

3.7.2 Screw-in temperature assembly

A screw-in temperature assembly can be installed two different ways:

- Screwed in directly: Pipes with a wall thickness ≥ 20 mm / 0.8" make it possible to drill a hole and cut a thread.
- Screw into threaded sleeves: Pipes with a wall thickness ≥ 20 mm / 0.8" require a sleeve to be welded in; these are not included in delivery but make up part of the accessories range.

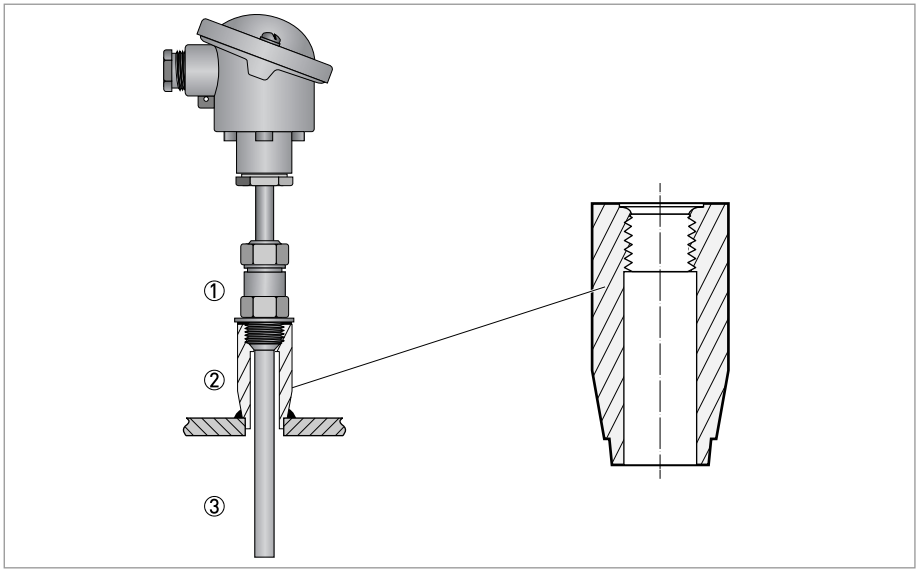


Figure 3-7: Welded sleeve for Screw-in temperature assembly

① Extension tube with connection head
② Permanently welded on threaded sleeve
③ Thermowell

You, the user, are responsible for selecting a suitable sealing material for the process connection, not the manufacturer! When installing the seals to the process connection, always ensure a good fit!

Sometimes even an extension tube cannot prevent the maximum permissible temperature in the connection head from being exceeded! It does cause extensive thermal decoupling of the connection head but you still have to always take into consideration the installation situation as well as the ambient and process temperatures!

For more information on the dimensions of the threaded sleeve please see the subsection "Dimensions" in the section "Technical data". Note that the threaded sleeve is not included in the scope of standard delivery but is an optional accessory.

3.7.3 Flanged temperature assembly

The flanged temperature assembly can be installed using a Welded-on flange (Nozzle), for example, as shown in the following drawing:

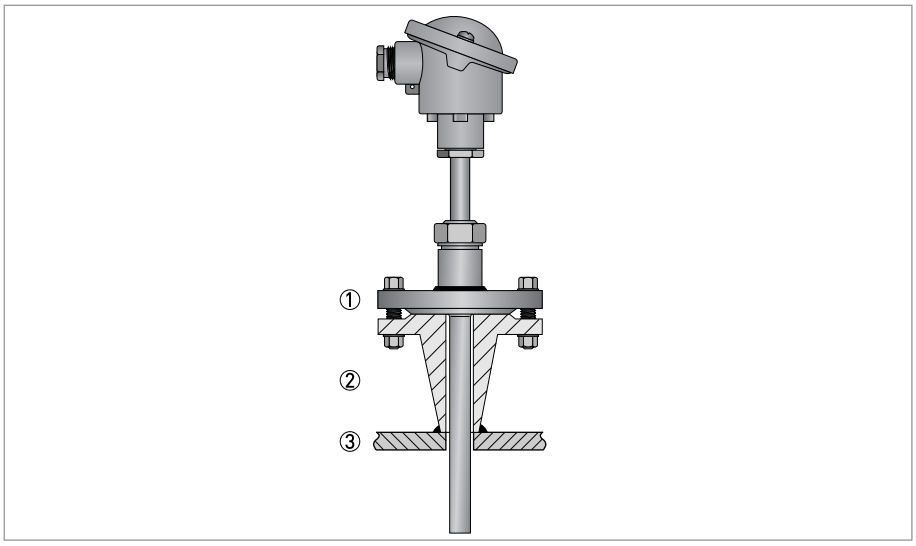


Figure 3-8: Installing a temperature assembly with a welded-on flange (Nozzle)

① Thermowell with flange as process connection
② Welded-on flange (Nozzle)
③ Pipeline or container wall

When attaching the flange, tighten the screws evenly and crosswise to avoid leaks at the process connection.

You, the user, are responsible for selecting a suitable sealing material for the process connection, not the manufacturer! When installing the seals to the process connection, always ensure a good fit!

4.1 Safety instructions

All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

Observe the national regulations for electrical installations!

For devices used in potentially explosive atmospheres, additional safety notes apply; please refer to the Ex documentation.

Observe without fail the local occupational health and safety regulations.
Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

Look at the device nameplate to ensure that the device is delivered according to your order.

4.2 Grounding

The thermowells on the industrial temperature assembly for advanced requirements are grounded via the process connection. No additional grounding is required. One exception is the coated flange thermowells, which must be grounded separately.

4.3 Ingress protection

The ingress protection (IP) of an industrial temperature assembly depends on the type of connection and the cable gland used. Connection heads with 1/2-14 NPT threads are supplied without cable glands.For more information, refer to chapter "Types of connection heads" in handbood of OPTITEMP TRA/TCA Plus

4.4 Power supply

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

The only components of an industrial temperature assembly OPTITEMP TRA/TCA Plus that require a power supply are the measuring insert and any temperature transmitter used. For more detailed information on supplying these components with power, consult the product-specific manuals.

5.1 Type code VTS2

- The following type code is valid for TRA- and TCA- S34, T30, T32/36, TF31, TF33, TS35/37
- The characters of the type code highlighted in light grey describe the standard.
- "Ex" indicates that the version in question is available in both the non-Ex and Ex version.

VTS2	4	1. Type	
		1	TRA-T30: weld temperature assembly
		2	TRA-TF31: flanged temperature assembly
		3	TRA-TS32: screw-in temperature assembly
		4	TRA-TF33: flanged temperature assembly
		5	TRA-S34: screw-in temperature assembly, without thermowell
		6	TRA-TS35: screw-in temperature assembly
		7	TRA-TS36: screw-in temperature assembly
		8	TRA-TS37: screw-in temperature assembly
		A	TCA-T30: weld temperature assembly
		B	TCA-TF31: flanged temperature assembly
		C	TCA-TS32: screw-in temperature assembly
		D	TCA-TF33: flanged temperature assembly
		E	TCA-S34: screw-in temperature assembly, without thermowell
		F	TCA-TS35: screw-in temperature assembly
		G	TCA-TS36: screw-in temperature assembly
		H	TCA-TS37: screw-in temperature assembly
			2. Certificate
			0 Without
			1 ATEX II 1G Ex ia IIC T6 Ga, ATEX II 1/2 G Ex ia IIC T6 Ga/Gb, ATEX II 1 D Ex ia IIIC T...°C Da IP65
			4 IECEx Ex ia IIC Ga/Gb, IECEx Ex ia IIIC T...°C Da IP65
VTS2	4		Continued on next page

						3. Connection head		**Cable gland thread**
						1	BA: screw top, aluminium	M20 x 1.5 mm / IP65
						2	BUZ-S: hinged cover, aluminium	M20 x 1.5 mm / IP65
						3	BUZ-T: hinged cover, aluminium, Ex	M20 x 1.5 mm / IP65
						4	BGK: screw cover, aluminium	M20 x 1.5 mm / IP65
						5	BUZ-H: hinged cover, aluminium, Ex	M20 x 1.5 mm / IP65
						6	BUZ-HW: hinged cover with display, aluminium	M20 x 1.5 mm / IP65
						7	BBK: screw cover, polyamide	M20 x 1.5 mm / IP54
						8	BVA: screw cover, stainless steel	M20 x 1.5 mm / IP65
						A	AXD: screw cover, aluminium, Ex	M20 x 1.5 mm / IP68
						B	BUZ-HK: hinged cover, polyamide, Ex	M20 x 1.5 mm / IP54
						C	SXD: screw cover, stainless steel, Ex	M20 x 1.5 mm / IP68
						M	BHY: screw cover, stainless steel	M20 x 1.5 mm / IP67
						P	AXD-W: screw cover with indicator, aluminium, Ex	M20 x 1.5 mm / IP68
						R	SXD-W: screw cover with indicator, stainless steel, Ex	M20 x 1.5 mm / IP68
							4. Measuring insert (sensor / wiring)	
							2	1 x Pt100, 3-wire connection, Ex
							3	1 x Pt100, 4-wire connection, Ex
							4	2 x Pt100, 3-wire connection, tolerance class A, wire-wound (WW), Ex
							5	2 x Pt100, 4-wire connection, tolerance class A, wire-wound (WW), Ex
							8	1 x Pt100, 3-wire connection + Smart Sense
							A	1 x thermocouple type J (Fe-CuNi), Ex
							B	1 x thermocouple type K (NiCr-Ni), Ex
							D	2 x thermocouple type J (Fe-CuNi), Ex
							E	2 x thermocouple type K (NiCr-Ni), Ex
								5. Measuring insert / tolerance class
								0 Without
								1 Tolerance class B, mineral insulated (Mi), thin film (TF), Ex -50...+500°C / -58...+932°F
								2 Tolerance class A, mineral insulated (Mi), thin film (TF), Ex -30...+300°C / -22...+572°F
								3 Tolerance class A, mineral insulated (Mi), thin film (TF), vibration-proof, Ex -20...+200°C / -4...+392°F
								4 Tolerance class A, mineral insulated (Mi), wire-wound (WW), Ex -100... +450°C / -148...+842°F, Ex
								5 Tolerance class AA, mineral insulated (Mi), wire-wound (WW), Ex -50...+250°C / -58...+482°F
								6 Tolerance class B, mineral insulated (Mi), wire-wound (WW), Ex -196...+600°C / -320,8°F...+1112°F
								7 Tolerance class 1/10 DIN B at 0°C / +32°F, mineral insulated (Mi), wire-wound (WW), Ex
								A Tolerance class 1, mineral insulated (Mi), thermocouple, Ex
VTS2	4							Continued on next page

											6. Thermowell material	
										0	Without	
										1	1.4571 / 316 Ti: Ø 9/10/11/12/17/24 mm or Ø 0.35/0.39/0.43/0.47/0.66/0.94", up to +600°C / +1112°F	
										3	1.4404 / 316 L: Ø 9/10/11/12/17/24 mm or Ø 0.35/0.39/0.43/0.47/0.66/0.94", up to +600°C / +1112°F	
										H	2.4602 / Hastelloy C22: Only for Ø 12 mm / Ø 0.47" and G1/2 process connection	
											7. Thermowell diameter	
											0	Without
											1	9 mm / 0.35"
											2	10 mm / 0.39"
											3	11 mm / 0.43"
											4	12 mm / 0.47"
											7	17 mm / 0.66", form 7 and 9
											A	24mm, form 4, c = 140 mm / d = 65 mm
											B	24mm, form 4, c = 200 mm / d = 25 mm
											C	24mm, form 4, c = 200 mm / d = 65 mm
											D	24mm, form 4, c = 260 mm / d = 125 mm
												8. Process connection
												0 Without / thread
												1 G 1/2" A
												2 G 3/4" A
												3 G 1" A
												5 1/2" NPT
												6 3/4" NPT
												B Flange DN25 according to EN 1092-1
												C Flange DN40 according to EN 1092-1
												D Flange DN50 according to EN 1092-1
												H 1" flange acc. to ASME B16.5
												L 1 1/2" flange acc. to ASME B16.5
												X Weld-in fitting Ø 48 mm x 50 mm
												9. Pressure rating
												0 Without / Thread
												1 PN40, raised face: Form B1 acc. to EN 1092-1
												A 150 lb, raised face: RF acc. to ASME B16.5
												B 300 lb, raised face: RF acc. to ASME B16.5
VTS2	4											Continued on next page

	10. Insertion length	
	0	Without
	1	80 mm / 3.1" or 82mm / 3.2" (TRA/TCA-32 and 36)
	2	100 mm / 3.9"
	3	110 mm / 4.3"
	4	140 mm / 5.5" or 142 mm / 5.6" (TRA/TCA-32 and 36)
	5	170 mm / 6.6"
	6	200 mm / 7.8"
	7	230 mm / 9.0" or 232 mm / 9.1" (TRA/TCA-32 and 36)
	8	260 mm / 10.2"
	A	300 mm / 11.8"
	B	350 mm / 13.7"
	C	380 mm / 15.0" or 382 mm / 15.0" (TRA/TCA-32 and 36)
	D	400 mm / 15.7"
	E	410 mm / 16.1"
	H	450 mm / 17.7"
	K	500 mm / 19.7"
	P	Form 4, D1...5
	Z	Customised length
	11. Extension tube length	
	1	80 mm / 3.1"
	2	90 mm / 3.5"
	4	110 mm / 4.3"
	5	145 mm / 5.7"
	6	165 mm / 6.4"
	A	70 mm / 2.75"
	B	100 mm / 3.9"
	C	120 mm / 4.7"
	D	140 mm / 5.5"
	E	150 mm / 5.9"
	F	160 mm / 6.2"
	G	170 mm / 6.6"
	H	180 mm / 7"
	K	190 mm / 7.4"
	L	200 mm / 7.8"
	Z	Customised length
VTS2 4		Continued on next page

12. Extension tube connection thread			
1	M18 x 1.5 mm		
3	G 1/2"		
4	G 3/4"		
D	Union nut G 1/2"		
E	Union nut G 3/4"		
	13. Type of connection / head-mounted transmitter		
	0	Measuring insert with flying wires for transmitter assembly	
	1	Standard version with terminal block	
	L	TT 12 C, digital, basic, RTD / TC	
	4	TT 22 C, digital, basic, RTD, Ex	
	C	TT 33 C, digital, universal, Ex	
	E	TT 51 C, digital, HART®, Ex, SIL2	
	M	TT 53 C, digital, HART®, Ex	
		14. Type of connection / rail-mounted transmitter	
		0	Without
		L	TT 12 R, digital, basic, RTD / TC
		C	TT 33 R, digital, universal, Ex
		H	TT 51 R, digital, HART®, Ex, SIL2
		M	TT 53 R, digital, HART®, Ex

VTS2	4														Continued on next page

	15. Measuring range		
	0	Without transmitter	
	1	Customised	
	2	-50...+50°C / -58...+122°F	
	3	-50...+100°C / -58...+212°F	
	4	-50...+150°C / -58...+302°F	
	5	0...+50°C / +32...+122°F	
	6	0...+100°C / +32...+212°F	
	7	0...+150°C / +32...+302°F	
	8	0...+200°C / +32...+392°F	
	A	0...+250°C / +32...+482°F	
	B	0...+300°C / +32...+572°F	
	C	0...+350°C / +32...+662°F	
	D	0...+400°C / +32...+752°F	
	E	0...+450°C / +32...+842°F	
	F	0...+500°C / +32...+932°F	
	G	0...+600°C / +32...+1112°F	
	H	0...+800°C / +32...+1472°F	
	K	0...+1000°C / +32...+1832°F	
		16. Calibration report	
		0	Without
		1	1 sensor, room temperature (single- or double-sensor)
		2	2 points: 0% and 100% (single-sensor)
		3	2 points: 0% and 100% (double-sensor)
		4	3 points: 0%, 50% and 100% (single-sensor)
		5	3 points: 0%, 50% and 100% (double-sensor)
		6	Customised (single-sensor)
		7	Customised (double-sensor)
VTS2 4			Continued on next page

Continued "Certificates"	
A	2 points: 0 and 100% (single sensor & transmitter)
B	3 points: 0, 50 and 100% (single sensor & transmitter)
C	5 points: 0, 25, 50, 75 and 100% (single sensor & transmitter)
E	2 points: 0 and 100% (single sensor & transmitter), including adjustment
F	3 points: 0, 50 and 100% (single sensor & transmitter), including adjustment
G	5 points: 0, 25, 50, 75 and 100% (single sensor & transmitter), including adjustment
H	Calibration according to customer specifications (single sensor & transmitter), including adjustment
P	2 points: 0°C / 32°F and 100°C / 212°F (single sensor)
R	2 points: 0°C / 32°F and 100°C / 212°F (double sensor)
S	3 points: 0°C / 32°F, 50°C / 122°F and 100°C / 212°F (single sensor)
T	3 points: 0°C / 32°F, 50°C / 122°F and 100°C / 212°F (double sensor)

17. Test certificate	
0	Without
1	Declaration of compliance with order, 2.1 acc. to EN 10204

18. Pressure test on wetted parts	
0	Without
1	Pressure test with test report 2.2 acc. to EN 10204
2	Pressure test with inspection certificate 3.1 acc. to EN 10204

19. Material certification on wetted parts	
0	Without
1	Material certificate 3.1 acc. to EN 10204
2	PMI test metallic, pressurized wetted parts, certificate 3.1 acc. to EN 10204
4	Material & PMI test certificate 3.1 acc. to EN 10204

20. Marking	
0	Without
1	Stainless steel plate, 40 x 20 mm / 1.57 x 0.79"
2	Stainless steel plate, 120 x 46 mm / 4.72 x 1.81"
6	PVF tag plate, 45 x 15 mm / 1.77 x 0.59"

VTS2	4	Continued on next page

	21.Operating instructions			
	0	Without		
	1	German		
	3	English		
	4	French		
	5	Spanish		
	G	German / English		
		22. Private Label		
		0	KROHNE	
		1	INOR	
			23. Version	
			0	Without
			1	SIL2 (TT 51)
VTS2 4				Complete type code

5.2 Type code VTS3

- The following type code is valid for TRA- and TCA- S50, TS 52/53/54, TF 55/56/57, TW 58/59
- The characters of the type code highlighted in light grey describe the standard.
- "Ex" indicates that the version in question is available in both the non-Ex and Ex version.

VTS3	4	1. Type	
		0	TRA-S50: screw-in temperature assembly, without thermowell
		2	TRA-TS52: screw-in temperature assembly, straight
		3	TRA-TS53: screw-in temperature assembly, conical
		4	TRA-TF54: screw-in temperature assembly, reduced
		5	TRA-TF55: flanged temperature assembly, straight
		6	TRA-TF56: flanged temperature assembly, conical
		7	TRA-TS57: flanged temperature assembly, reduced
		8	TRA-TW58: Weld temperature assembly, straight
		A	TRA-TW59: weld temperature assembly, conical
		E	TCA-S50: screw-in temperature assembly, without thermowell
		G	TCA-TS52: screw-in temperature assembly, straight
		H	TCA-TS53: screw-in temperature assembly, conical
		K	TCA-TS54: screw-in temperature assembly, reduced
		L	TCA-TF55: flanged temperature assembly, straight
		M	TCA-TF56: flanged temperature assembly, conical
		N	TCA-TF57: flanged temperature assembly, reduced
		P	TCA-TW58: weld temperature assembly, straight
		R	TCA-TW59: weld temperature assembly, conical
			2. Certificate
			0 Without
			1 ATEX II 1G Ex ia IIC T6 Ga, ATEX II 1/2 G Ex ia IIC T6 Ga/Gb, ATEX II 1 D Ex ia IIIC T...°C Da IP65
			4 IECEx Ex ia IIC Ga/Gb, IECEx Ex ia IIIC T...°C Da IP65
VTS3	4		Continued on next page

		3. Connection head		Cable gland thread
		1	BA: screw top, aluminium	M20 x 1.5 mm / IP65
		2	BUZ-S: snap top, hinged cover, aluminium	M20 x 1.5 mm / IP65
		3	BUZ-T: screw top, hinged cover, aluminium, Ex	M20 x 1.5 mm / IP65
		4	BGK: screw cover, aluminium	M20 x 1.5 mm / IP65
		5	BUZ-H: hinged cover, aluminium, Ex	M20 x 1.5 mm / IP65
		6	BUZ-HW: hinged cover with display, aluminium	M20 x 1.5 mm / IP65
		7	BBK: screw cover, polyamide	M20 x 1.5 mm / IP54
		8	BVA: screw cover, stainless steel	M20 x 1.5 mm / IP65
		A	AXD: screw cover, aluminium, Ex	M20 x 1.5 mm / IP68
		B	BUZ-HK: hinged cover, polyamide, Ex	M20 x 1.5 mm / IP68
		C	SXD: screw cover, stainless steel, Ex	M20 x 1.5 mm / IP68
		E	BUZ-T: screw top, hinged cover, aluminium, Ex	1/2" NPT / IP65
		F	BGK: screw cover, aluminium	1/2" NPT / IP65
		G	BUZ-H: hinged cover, aluminium, Ex	1/2" NPT / IP65
		H	BUZ-HW: hinged cover with display, aluminium	1/2" NPT / IP65
		K	AXD: screw cover, aluminium, Ex	1/2" NPT / IP68
		L	SXD: screw cover, stainless steel, Ex	1/2" NPT / IP68
		P	AXD-W: screw cover with indicator, aluminium, Ex	M20 x 1.5 mm / IP68
		R	SXD-W: screw cover with indicator, stainless steel, Ex	M20 x 1.5 mm / IP68
		S	AXD-W: screw cover with indicator, aluminium, Ex	1/2" NPT / IP68
		T	SXD-W: screw cover with indicator, stainless steel, Ex	1/2" NPT / IP68
			4. Measuring insert (sensor / wiring)	
			2	1 x Pt100, 3-wire connection, Ex
			3	1 x Pt100, 4-wire connection, Ex
			4	2 x Pt100, 3-wire connection, tolerance class A, wire-wound (WW), Ex
			5	2 x Pt100, 4-wire connection, tolerance class A, wire-wound (WW), Ex
			8	1 x Pt100, 3-wire connection + Smart Sense
			A	1 x thermocouple type J (Fe-CuNi), Ex
			B	1 x thermocouple type K (NiCr-Ni), Ex
			D	2 x thermocouple type J (Fe-CuNi), Ex
			E	2 x thermocouple type K (NiCr-Ni), Ex
VTS3	4			Continued on next page

									5. Measuring insert / tolerance class	
									1	Tolerance class B, mineral insulated (Mi), thin film (TF), Ex -50...+500°C / -58...+932°F
									2	Tolerance class A, mineral insulated (Mi), thin film (TF), Ex -30...+300°C / -22...+572°F
									3	Tolerance class A, mineral insulated (Mi), thin film (TF), vibration-proof, Ex -20...+200°C / -4...+392°F
									4	Tolerance class A, mineral insulated (Mi), wire-wound (WW), Ex -100... +450°C / -148...+842°F, Ex
									5	Tolerance class AA, mineral insulated (Mi), wire-wound (WW), Ex -50...+250°C / -58...+482°F
									6	Tolerance class B, mineral insulated (Mi), wire-wound (WW), Ex -196...+600°C / -320,8°F...+1112°F
									7	Tolerance class 1/10 DIN B at 0°C / +32°F, mineral insulated (Mi), wire-wound (WW), Ex
									A	Tolerance class 1, mineral insulated (Mi), thermocouple, Ex
										6. Thermowell material
									0	Without
									1	1.4571 / 316 Ti, up to +600°C / +1112°F
									3	1.4404 / 316 L, up to +600°C / +1112°F
										7. Thermowell diameter
									0	Without
									4	12 mm / 0.47"
									8	16 mm / 0.62"
									C	19 mm / 0.74"
									F	22 mm / 0.86"
									G	23 mm / 0.90"
									K	25 mm / 0.98"
										8. Process connection
									0	Without
									1	G 1/2" A
									2	G 3/4" A
									3	G 1" A
									5	1/2" NPT
									6	3/4" NPT
									7	1" NPT
									B	Flange DN25 according to EN 1092-1
									C	Flange DN40 according to EN 1092-1
									D	Flange DN50 according to EN 1092-1
									H	1" flange acc. to ASME B16.5
									K	1 1/2" flange acc. to ASME B16.5
									L	2" flange acc. to ASME B16.5
									V	Weld-in variant Ø26.7 mm
									W	Weld-in variant Ø33.4 mm
VTS3	4									Continued on next page

		9. Pressure rating
	0	Screw-in / weld-in variant
	1	PN40, raised face: Form B1 acc. to EN 1092-1
	A	150 lb, raised face: RF acc. to ASME B16.5
	B	300 lb, raised face: RF acc. to ASME B16.5
	C	600 lb, raised face: RF acc. to ASME B16.5
	F	300 lb, ring type joint: RTJ acc. to ASME B16.5
	G	600 lb, ring type joint: RTJ acc. to ASME B16.5
		10. Flange - well connection type
	0	Without
	1	Double side welded, 3 mm
	2	Double side welded, 6 mm
	4	Full penetration welding
		11. Insertion length
	2	100 mm / 3.9"
	3	150 mm / 5.9"
	4	200 mm / 7.8"
	5	250 mm / 9.8"
	6	300 mm / 11.8"
	7	350 mm / 13.7"
	8	400 mm / 15.7"
	Z	Customized length
		12. Extension tube connection, thermowell - head
	3	G 1/2" - M24 x 1.5 mm
	6	1/2" NPT - 1/2" NPT
		13. Extension tube length
	2	76 mm / 3", NN
	3	102 mm / 4", NN
	4	152 mm / 5", NUN
	7	165 mm / 6.5", DIN, Ø12 mm
	Z	Customised length
		14. SIL version
	0	Standard, no SIL
	1	SIL 2
VTS3	4	Continued on next page

Code	Description
	15. Type of connection / head-mounted transmitter
0	Measuring insert with flying wires for transmitter assembly
1	Standard version with terminal block
L	TT 12 C, digital, basic, RTD / TC
4	TT 22 C, digital, basic, RTD, Ex
C	TT 33 C, digital, universal, Ex
E	TT 51 C, digital, HART®, Ex, SIL2
M	TT 53 C, digital, HART®, Ex
	16. Type of connection / rail-mounted transmitter
0	Without
L	TT 12 R, digital, basic, RTD / TC
C	TT 33 R, digital, universal, Ex
H	TT 51 R, digital, HART®, Ex, SIL2
M	TT 53 R, digital, HART®, Ex
	17. Measuring range
0	Without transmitter
1	Customised
2	-50...+50°C / -58...+122°F
3	-50...+100°C / -58...+212°F
4	-50...+150°C / -58...+302°F
5	0...+50°C / +32...+122°F
6	0...+100°C / +32...+212°F
7	0...+150°C / +32...+302°F
8	0...+200°C / +32...+392°F
A	0...+250°C / +32...+482°F
B	0...+300°C / +32...+572°F
C	0...+350°C / +32...+662°F
D	0...+400°C / +32...+752°F
E	0...+450°C / +32...+842°F
F	0...+500°C / +32...+932°F
G	0...+600°C / +32...+1112°F
H	0...+800°C / +32...+1472°F
K	0...+1000°C / +32...+1832°F
VTS3 4	Continued on next page

	18. Calibration report
0	Without
1	1 sensor, room temperature (single- or double-sensor)
2	2 points: 0% and 100% (single-sensor)
3	2 points: 0% and 100% (double-sensor)
4	3 points: 0%, 50% and 100% (single-sensor)
5	3 points: 0%, 50% and 100% (double-sensor)
6	Customised (single-sensor)
7	Customised (double-sensor)
A	2 points: 0 and 100% (single sensor & transmitter)
B	3 points: 0, 50 and 100% (single sensor & transmitter)
C	5 points: 0, 25, 50, 75 and 100% (single sensor & transmitter)
E	2 points: 0 and 100% (single sensor & transmitter), including adjustment
F	3 points: 0, 50 and 100% (single sensor & transmitter), including adjustment
G	5 points: 0, 25, 50, 75 and 100% (single sensor & transmitter), including adjustment
H	Calibration according to customer specifications (single sensor & transmitter), including adjustment

	19. Test certificate
0	Without
1	Declaration of compliance with order, 2.1 acc. to EN 10204

	20. Pressure test on wetted parts
0	Without
1	Pressure test with test report 2.2 acc. to EN 10204
2	Pressure test with inspection certificate 3.1 acc. to EN 10204

	21. Material certification on wetted parts
0	Without
1	Material certificate 3.1 acc. to EN 10204
2	PMI test metallic, pressurized wetted parts, certificate 3.1 acc. to EN 10204
4	Material & PMI test certificate 3.1 acc. to EN 10204

VTS3	4	Continued on next page

22. Marking				
0	Without			
1	Stainless steel plate, 40 x 20 mm / 1.57 x 0.79"			
2	Stainless steel plate, 120 x 46 mm / 4.72 x 1.81"			
6	PVF tag plate, 45 x 15 mm / 1.77 x 0.59"			
	23.Operating instructions			
	0	Without		
	1	German		
	3	English		
	4	French		
	5	Spanish		
	G	German / English		
		24. Private Label		
		0	KROHNE	
		1	INOR	
VTS3 4				Complete type code

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