

Technical Information

iTHERM ModuLine TT152

Barstock thermowell

Imperial thermowell for a wide range of demanding industrial applications



Application

- Protects the thermometer against mechanical and chemical stress
- Robust design suitable for demanding process conditions
- Pressure range: up to 500 bar (7 252 psi)
- For use in pipes, vessels or tanks

Your benefits

- Easy maintenance and recalibration of the thermometer: sensor can be replaced without interrupting the process
- iTHERM TwistWell with helical design: reduces vortex-induced vibrations in high flow rate applications
- Customizable shaft, immersion, and overall length to meet specific process requirements
- Wide range of dimensions, materials and process connections available
- International certification: e.g. for pressure applications

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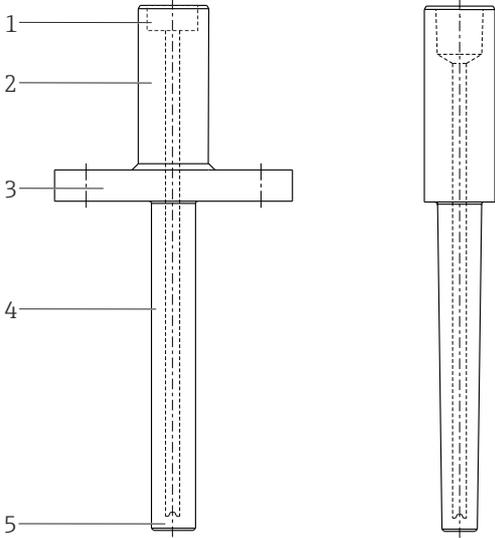
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Function and system design

Equipment architecture

The thermowell's flexibly configurable design is based on the ASME B40.9 standard, ensuring good resistance to typical industrial processes. Constructed from barstock, the thermowell features a root diameter ranging from 5/8" to 1½". The tip can be straight, tapered or stepped. The thermowell can be attached to a pipe or vessel within the system, with various commonly used process connections available for this purpose: flanged, threaded, or weld-in options.

Modular design

Design		Options
	1: Thermometer connection	Female thread
	2: Thermowell lagging	An extension that cannot be separated from the thermowell. This extension provides additional installation length, particularly when a flange is used. It can also protect the terminal head and electronics module from the heat in the process.
	3: Process connection	Connection piece on process side. This can be any type of thread, flange, weld-in connection, or socket weld. The process connection must be designed to withstand the process pressure, temperature and media.
	4: Thermowell	The part of the thermowell that is immersed in the process medium. Available in a variety of diameters and materials to cover a wide range of applications. The selected material and strength must be able to withstand the static and dynamic load caused by the process conditions. They must also be resistant to chemicals, mechanical shock and vibrations.
	5: Thermowell tip	Different tip shapes are available. For thermowells used in pipes with a small diameter, a reduced or tapered thermowell tip may be selected to reduce the flow resistance. Reduced tips also mean a faster response time, while a specially designed tip ensures the fastest response.

Installation

Mounting location

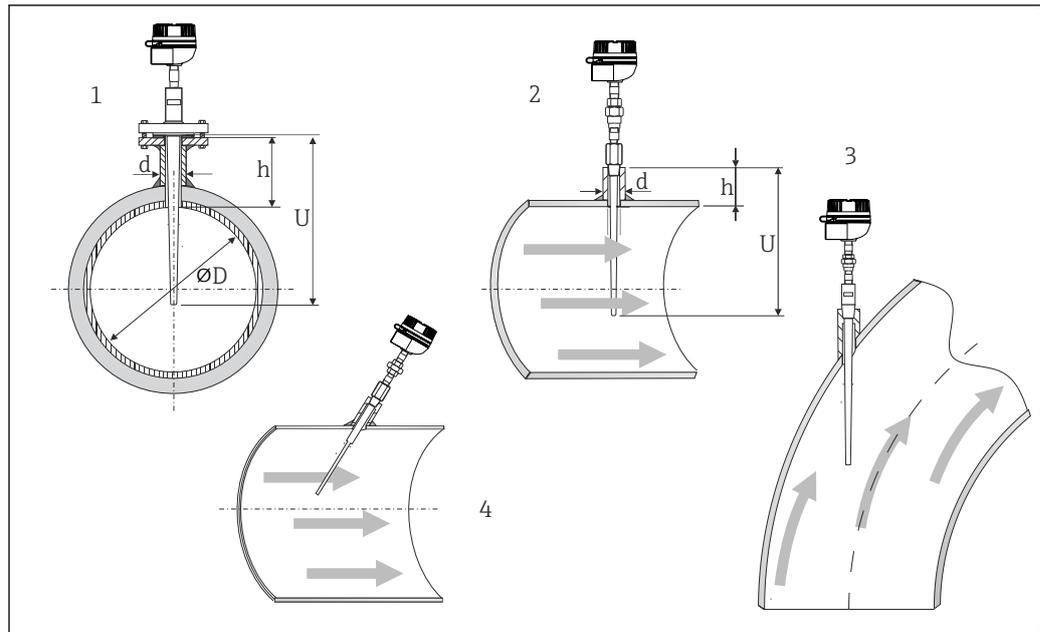
The thermowell can be installed in pipes, tanks or vessels.

Orientation

No restrictions. Self-draining in the process must be ensured, depending on the application.

Installation instructions

The immersion length of the thermometer can influence the measurement accuracy. If the immersion length is too short, this can lead to measurement errors caused by heat conduction through the process connection. If installing in a pipe, the immersion length should ideally correspond to half of the pipe diameter. The installation position may vary according to requirements; however, in all cases the measuring element must be completely exposed to the medium and not shielded by the socket. In pipes with a small diameter, a pipe expander can be mounted around the measuring point to ensure a sufficient immersion length.



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1 Installation examples

1 - 2 In pipelines with a small cross-section, the sensor tip must be positioned so that it reaches or passes beyond the axis of the pipeline (=L).

3 - 4 Angled installation.

i In pipelines with small nominal diameters, the thermometer tip must be positioned so that it extends far enough into the process and reaches or passes beyond the axis of the pipeline. Alternatively, the thermometer can be installed at an angle (4). The immersion length or installation depth must be determined taking into account all parameters of the thermometer and the medium to be measured, such as flow velocity or process pressure.

To achieve the best possible installation, the following rule should be observed: $h \sim d$; $U > D/2 + h$.

The use of iTHERM QuickSens inserts is recommended for immersion lengths $U < 70 \text{ mm (27.6 in)}$.

i The counterpieces for the process connections and the seals or sealing rings are not supplied with the thermometer.

Process

Process temperature range Depends on the type of thermowell and material used, maximum -200 to $+1100 \text{ °C (-328 to } +2012 \text{ °F)}$.

Process pressure range The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the "Process connection" section.

i It is possible to check the mechanical loading capacity as a function of the installation and process conditions online using the Sizing Thermowell calculation tool in the Endress+Hauser 'Applicator' software. See "Accessories" section.

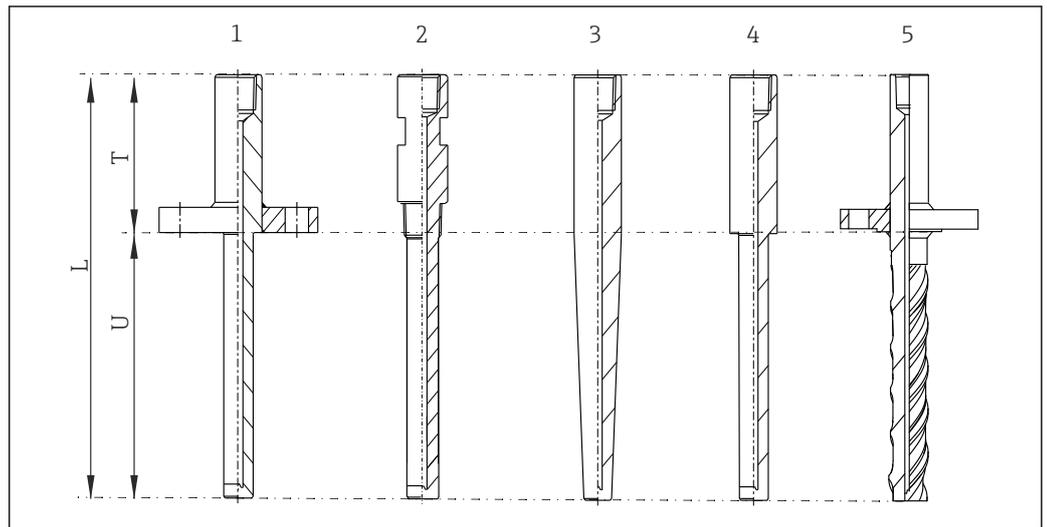
Permitted flow velocity depending on the immersion length and process medium

The maximum flow velocity tolerated by the thermowell diminishes with increasing thermowell immersion length exposed to the stream of the fluid. It depends on the shape and size of the thermowell, the process connection, the medium type, process temperature and process pressure.

Process connection	Standard	Max. process pressure
Weld-in version/socket weld	NPS	≤ 500 bar (7 252 psi)
Flange	ASME B16.5	Depending on the flange pressure rating 150, 300, 600, 900/1500 or 2500 psi at 20 °C (68 °F)
Thread	ISO 965-1 / ASME B1.13M ISO 228-1 ANSI B1.20.1 DIN EN 10226-1 /	400 bar (5 802 psi) at +400 °C (+752 °F)

Mechanical construction

Design, dimensions



2 Typical ASME design, iTHERM TwistWell and references

- 1 Flanged, references according to ASME
- 2 Threaded, references according to ASME
- 3 Weld-in option, references according to ASME
- 4 Socket weld, references according to ASME
- 5 Flanged, references according to iTHERM TwistWell

The design of the thermometer depends on the thermowell version based on ASME:

- ANSI flanges
- NPT thread
- Socket weld and weld-in

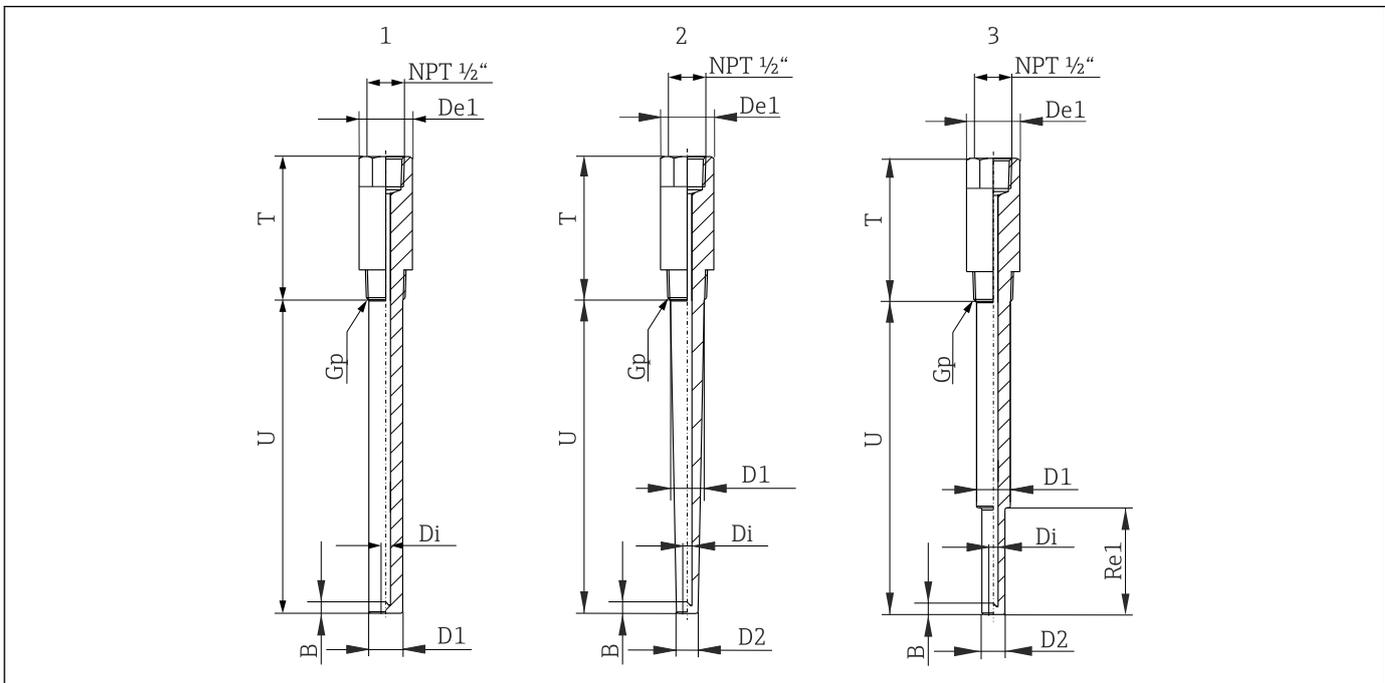
i Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Pos.	Description
L	Thermowell length (U+T)
Gp	Process connection thread

Pos.	Description
B	Thermowell bottom thickness (default value 6.35 mm (1/4 in))
T	Length of thermowell lagging
U	Immersion length
D1	Root diameter
D2	Tip diameter
C1	Length of the tapered part
Re1	Reduced tip length
Di	Bore diameter
De1	Lagging diameter
SL	Length of the coil

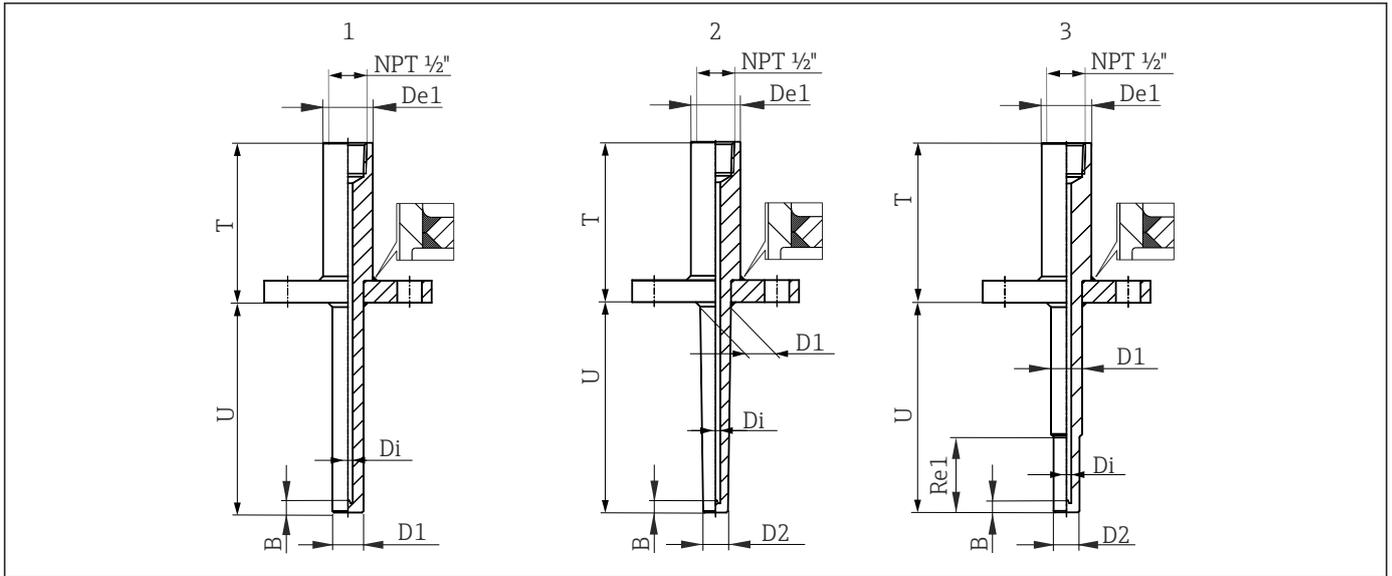
Thermowells based on ASME B40.9



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3 Thermowells based on ASME B40.9

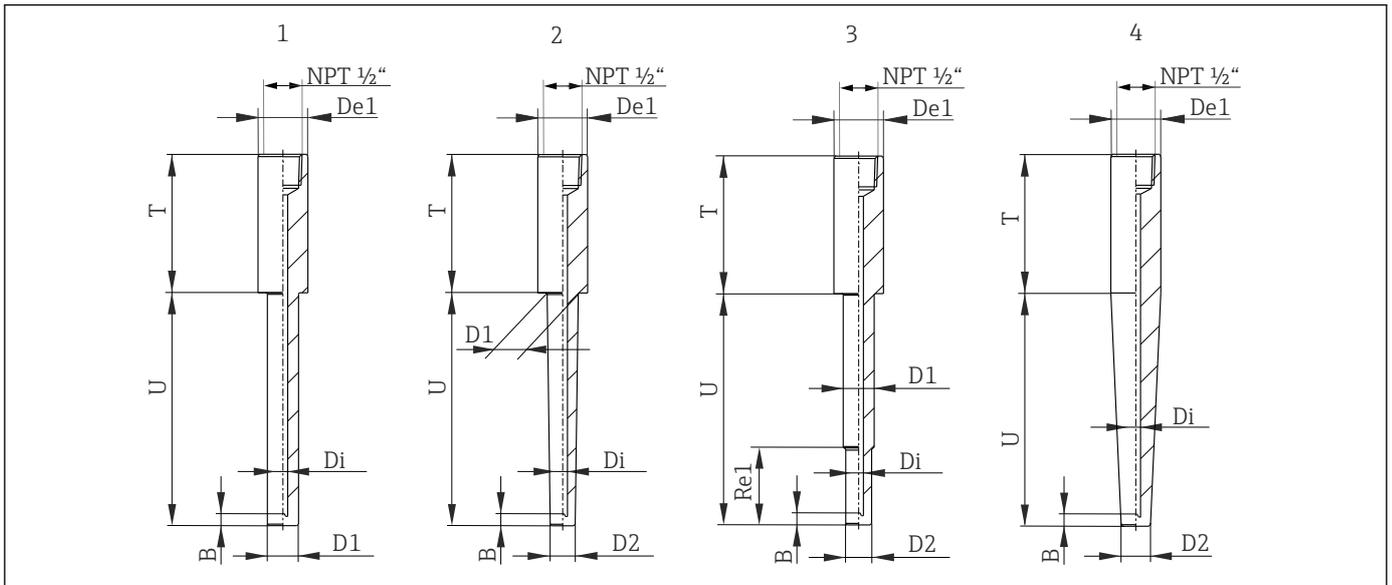
- 1 Straight-shank threaded thermowell, with hexagonal lagging (optional shaft with spanner flats)
- 2 Tapered-shank threaded thermowell, with hexagonal lagging (optional shaft with spanner flats)
- 3 Step-shank threaded thermowell, with hexagonal lagging (optional shaft with spanner flats)



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4 Thermowells based on ASME B40.9

- 1 Straight-shank flanged thermowell (optional full penetration welding available)
- 2 Tapered-shank flanged thermowell (optional full penetration welding available)
- 3 Step-shank flanged thermowell (optional full penetration welding available)



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5 Thermowells based on ASME B40.9

- 1 Straight-shank thermowell for socket weld
- 2 Tapered-shank thermowell for socket weld
- 3 Step-shank thermowell for socket weld
- 4 Tapered-shank weld-in thermowell

	Threaded	Flanged	For socket weld/tapered-shank weld-in
Process connection size	<ul style="list-style-type: none"> ▪ NPT 1/2" ▪ NPT 3/4" ▪ NPT 1" ▪ NPT 1 1/4" ▪ NPT 1 1/2" ▪ G 1/2" ▪ G 3/4" 	<ul style="list-style-type: none"> ▪ ANSI 1" from Cl. 150 to Cl. 600 ▪ ANSI 1 - 1/2" from Cl. 150 to Cl. 900/1500 ▪ ANSI 2" from Cl. 150 to Cl. 900/1500 ▪ ANSI 3" from Cl. 150 to Cl. 600 	<ul style="list-style-type: none"> ▪ (NPS 3/4"), Ø26.7 mm ▪ (NPS 1"), Ø33.4 mm ▪ (NPS 1 1/4"), Ø42.2 mm ▪ (NPS 1 1/2"), Ø48.3 mm ▪ (1 3/8", hygienic), Ø34.93 mm
Process connection material	<ul style="list-style-type: none"> ▪ 316/316L ▪ 304/304L ▪ Alloy 600 ▪ Alloy C276 ▪ AISI A182 F11 ▪ AISI A182 F22 ▪ AISI A182 F91 ▪ A105 ▪ Duplex S32205 	<ul style="list-style-type: none"> ▪ 316/316L ▪ 304/304L ▪ Alloy C276 ▪ Alloy 600 ▪ 316/316L + PTFE (Teflon), coated ▪ 316/316L + tantalum sleeve ▪ A105 	<ul style="list-style-type: none"> ▪ 316/316L ▪ 304/304L ▪ Alloy 600 ▪ Alloy C276 ▪ AISI A182 F11 ▪ AISI A182 F22 ▪ AISI A182 F91 ▪ A105 ▪ Duplex S32205

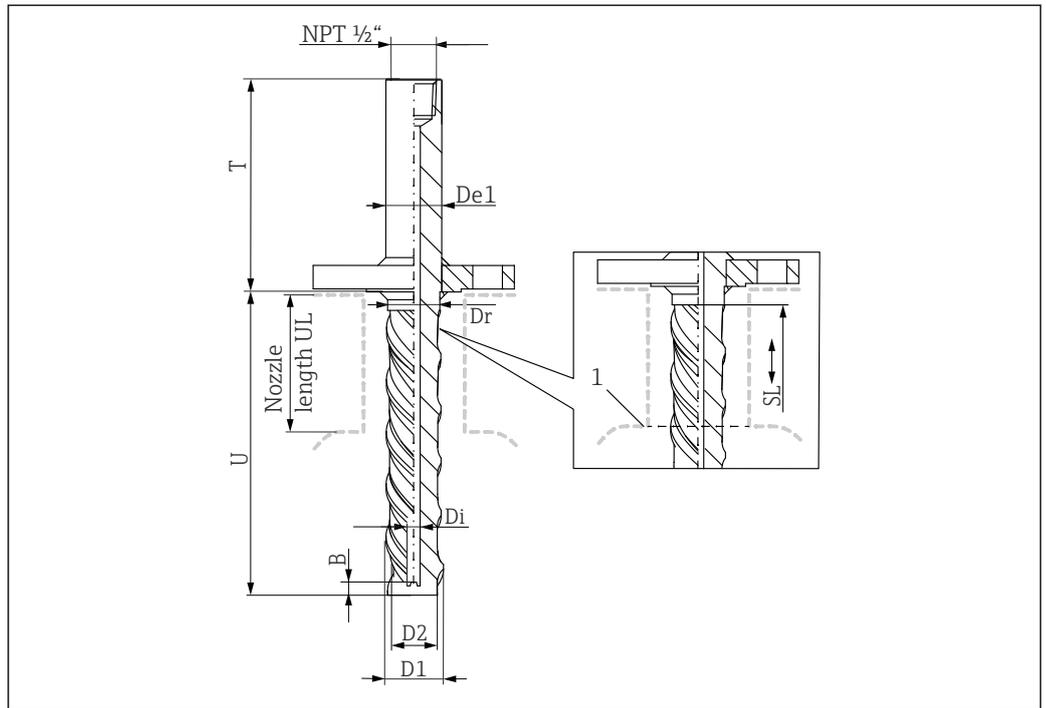
Dimensions		
	Straight-shank & tapered thermowells	Step-shank thermowells
Immersion length U	25.4 to 2 133.6 mm (1 to 84 in)	76.2 to 304.8 mm (3 to 12 in)
Lagging length T	44.5 to 209.6 mm (1.75 to 8.25 in)	
Root diameter D1	15.88 to 38.1 mm (5/8 to 1 1/2 in)	19.05 to 34.93 mm (3/4 to 1 3/8 in)
Tip diameter D2	12.7 to 38.1 mm (1/2 to 1 1/2 in) or identical to the root diameter	12.7 to 38.1 mm (1/2 to 1 1/2 in)
Bore diameter Di	<ul style="list-style-type: none"> ▪ 6.6 mm (0.26 in) (Standard) ▪ 9.78 mm (0.385 in) 	
Roughness	Default value 1.6 µm (63 µin); optional 0.76 µm (30 µin)	
Stepped length Re1	-	6.35 to 406.4 mm (0.25 to 16 in)
Bottom thickness B	Default value 6.35 mm (0.25 in)	

The thermowell is based on the ASME B40.9 standard but provides greater flexibility than outlined in ASME B40.9. In the following table are the main deviations listed.

Dimensions	All dimensions according to the imperial system
Tolerances	According to ISO 2768-mK, unless a metric or comparable system specification is given.
Terminology and definitions	According to the manufacturer's standards
Standard dimensions	The thermowell provides a wider range of dimensions than outlined in the ASME B40.9 standard.
ASME PTC-19.3	The design fulfills the limitations of ASME PTC-19.3.
Thread	The thermowell provides a wider range of threads than outlined in the ASME B40.9 standard.
Flange	The thermowell provides a wider range of flanges than outlined in the ASME B40.9 standard.
Thermowell construction	Based on ASME B40.9
Materials	The thermowell provides a wider range of materials than outlined in the ASME B40.9 standard.
ASME B40.9 Non-Mandatory Appendix for Naval Shipboard Application	The thermowell does not take the appendix into account.

Thermowell iTHERM TwistWell

Barstock thermowell with a shaft in patented helix design. This design reduces vortex-induced vibrations in process applications with high flow rates.

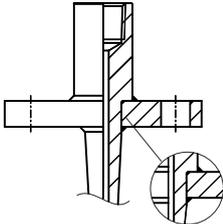
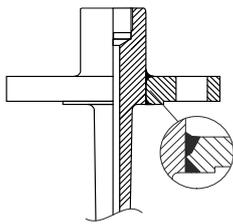


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i To ensure the stability of the thermowell, the coils must be positioned within the flow area. The length of the coil (SL) is factory-set to extend from at least the tip to the start of the nozzle (1).

Process connection size	<ul style="list-style-type: none"> ■ ANSI 1" from 150 lb/sq inch to 900/1500 lb/sq inch ■ ANSI 1 1/2" from 150 lb/sq inch to 900/1500 lb/sq inch ■ ANSI 2" from 150 lb/sq inch to 900/1500 lb/sq inch 		
Process connection material	316/316L		
Bar material	316/316L		
Immersion length U	25.4 to 609.6 mm (1 to 24 in)		
Unstreamed length UL	63.5 to 749.3 mm (2.5 to 29.5 in)		
Lagging length T	82.55 to 209.55 mm (3.25 to 8.25 in)		
Lagging diameter De1	30 mm (1.18 in)	25 mm (0.98 in)	25 mm (0.98 in)
Coil diameter (root and tip) D1	30 mm (1.18 in)	25 mm (0.98 in)	22 mm (0.87 in)
Root diameter base body Dr	28 mm (1.10 in)	22 mm (0.87 in)	20 mm (0.79 in)
Tip diameter base body D2	22 mm (0.87 in)	17 mm (0.67 in)	15 mm (0.59 in)
Bore diameter Di	6.6 mm (0.26 in) (Standard)		
Bottom thickness B	6.35 mm (0.25 in)		
Roughness	0.76 µm (30 µin)		
Number of coils	3		

Versions of flanged thermowells

Welded on both sides	With full penetration welding
 <p style="text-align: right; font-size: small;">A0052792</p>	 <p style="text-align: right; font-size: small;">A0052794</p>
<ul style="list-style-type: none"> ■ Suitable for most applications ■ Meets requirements with an optional cost-benefit ratio 	<ul style="list-style-type: none"> ■ Suitable for harsh application environments ■ Stronger welded connection

Weight 0.5 to 37 kg (1 to 82 lbs) for standard options.

Materials Thermowell and process connections.

 Note: The maximum temperature depends on the temperature sensor used.

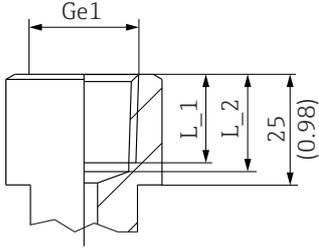
The temperatures for continuous operation specified in the following table are intended as reference values for use of the various materials in air and without any significant mechanical load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L	X5CrNiMo 17-12-2	650 °C (1 202 °F) ¹⁾	<ul style="list-style-type: none"> ■ Austenitic stainless steel ■ High corrosion resistance in general ■ Particularly high corrosion resistance in chlorinated and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)
Alloy 600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	<ul style="list-style-type: none"> ■ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ■ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ■ Corrosion from ultrapure water ■ Not to be used in sulfur-containing atmospheres
AlloyC276/2.4819	NiMo16Cr15W	1 100 °C (2 012 °F)	<ul style="list-style-type: none"> ■ A nickel-based alloy with good resistance to oxidizing and reducing atmospheres, even at high temperatures ■ Particularly resistant to chlorine gas and chloride as well as to many oxidizing mineral and organic acids
AISI 304/1.4301 AISI 304L/1.4307	X5CrNi18-10 X2CrNi18-9	550 °C (1 022 °F)	<ul style="list-style-type: none"> ■ Austenitic stainless steel ■ Suitable for use in water and slightly contaminated wastewater. ■ Only resistant to organic acids, salt solutions, sulfates, alkaline solutions, etc., at relatively low temperatures.

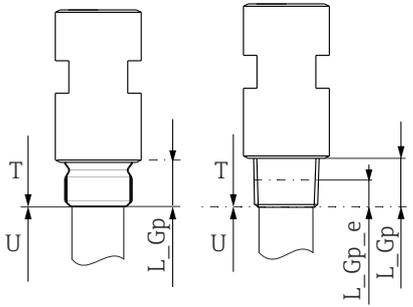
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI A105/ 1.0460	C22.8	450 °C (842 °F)	<ul style="list-style-type: none"> ■ Heat-resistant steel ■ Resistant in nitrogen-containing atmospheres and atmospheres that are low in oxygen; not suitable for acids or other aggressive media ■ Often used in steam generators, water and steam pipes, pressured vessels
AISI A182 F11/1.7335	13CrMo4-5	550 °C (1 022 °F)	<ul style="list-style-type: none"> ■ Low alloy, heat-resistant steel with chromium and molybdenum additions ■ Better corrosion resistance compared to non-alloy steels, not suitable for acids and other aggressive media ■ Often used in steam generators, water and steam pipes, pressured vessels
AISI A182 F22/1.7380	10CrMo9-10	580 °C (1 076 °F)	<ul style="list-style-type: none"> ■ Alloyed, heat-resistant steel ■ Particularly suitable for steam boilers, boiler parts, boiler drums, pressure vessels for apparatus constructions and similar purposes
AISI A182 F91/1.4903	X10CrMoVNb9-1	650 °C (1 202 °F)	<ul style="list-style-type: none"> ■ High-temperature resistant martensitic steel ■ Good mechanical properties at elevated temperatures ■ Frequently used in power engineering applications, such as turbine construction
Duplex S32205	X2CrNi-MoN22-5-3	300 °C (572 °F)	<ul style="list-style-type: none"> ■ Austenitic ferritic steel with good mechanical properties ■ High resistance to general corrosion, pitting, chlorine-induced or transgranular stress corrosion ■ Comparatively good resistance to hydrogen-induced stress corrosion
Jacket			
PTFE (Teflon)	Polytetrafluorethylene	200 °C (392 °F)	<ul style="list-style-type: none"> ■ Resistant to almost all chemicals ■ High temperature stability
Tantalum	-	250 °C (482 °F)	<ul style="list-style-type: none"> ■ With the exception of hydrofluoric acid, fluorine and fluorides, tantalum exhibits excellent resistance to most mineral acids and saline solutions ■ Prone to oxidation and embrittlement at higher temperatures in air

- 1) Can be used to a limited extent up to 800 °C (1472 °F) for low mechanical loads and in non-corrosive media. For further information, please contact the manufacturer's sales department.

Thermometer connection

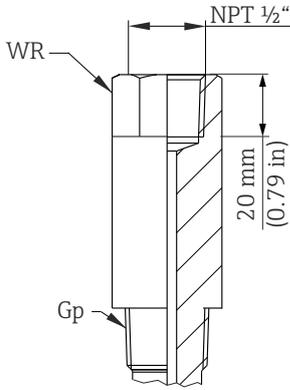
Thermometer connection	Ge1	L_1	L_2	Standard/Class
 <p>6 Female thread</p>	NPT 1/2"	17 mm (0.67 in)	20 mm (0.79 in)	ANSI B1.20.1

Process connections Thread

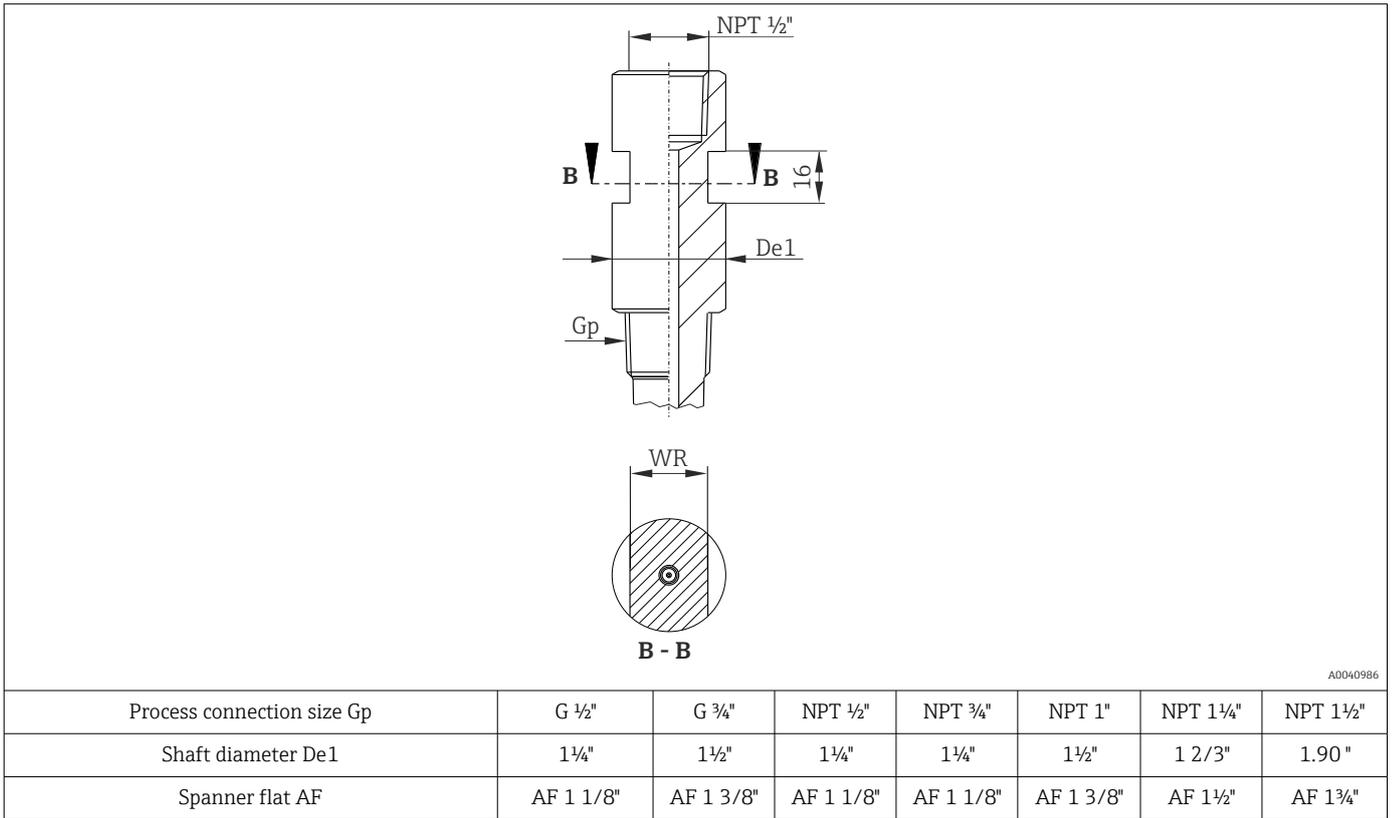
Threaded process connection	Type of fitting	Thread length L_Gp	Standard	Max. process pressure	
 <p>7 Cylindrical (left side) and conical (right side) version</p>	G	G 1/2"	ISO 228-1 A	Maximum static process pressure for threaded process connection: ¹⁾ 400 bar (5 802 psi) at +400 °C (+752 °F)	
		G 3/4"			16 mm (0.63 in)
	NPT	NPT 1/2"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)		ANSI B1.20.1
		NPT 3/4"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)		
		NPT 1"	25 mm (0.98 in) L_Gp_e: 10 mm (0.39 in)		
		NPT 1 1/4"	25.6 mm (1.01 in) L_Gp_e: 10 mm (0.39 in)		
	NPT 1 1/2"	26 mm (1.025 in) L_Gp_e: 10 mm (0.39 in)			

1) Maximum pressure specifications only apply for the thread. The failure of the thread is calculated, taking the static pressure into consideration. The calculation is based on a fully tightened thread.

Spanner size (SW/AF - across flats) matrix for threaded thermowells (hexagonal lagging)

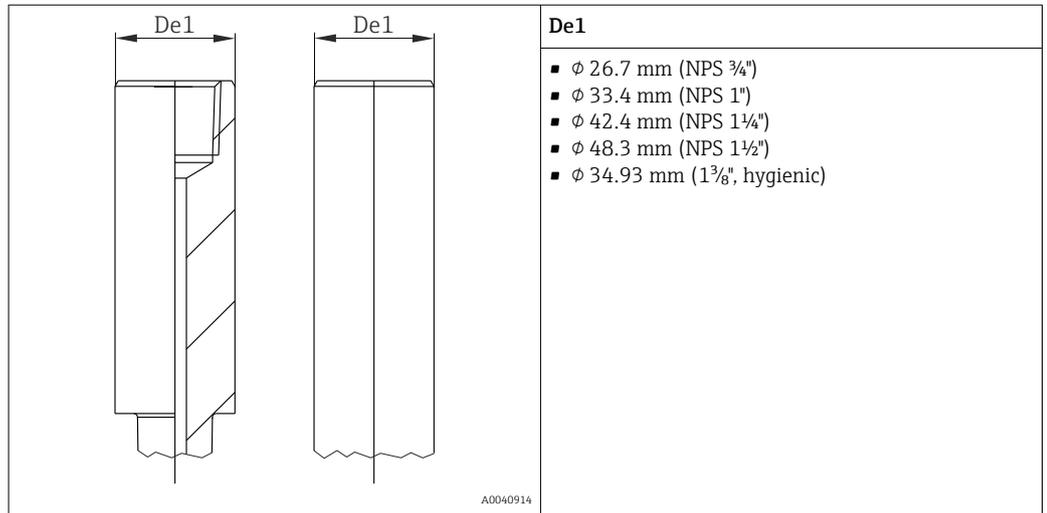
						
Process connection size Gp (male thread)						
G 1/2"	G 3/4"	NPT 1/2"	NPT 3/4"	NPT 1"	NPT 1 1/4"	NPT 1 1/2"
AF 1 1/8"	AF 1 3/8"	AF 1 1/8"	AF 1 1/8"	AF 1 3/8"	AF 1 1/2"	AF 1 3/4"

Size matrix for shaft diameters for threaded thermowells in mm(in)

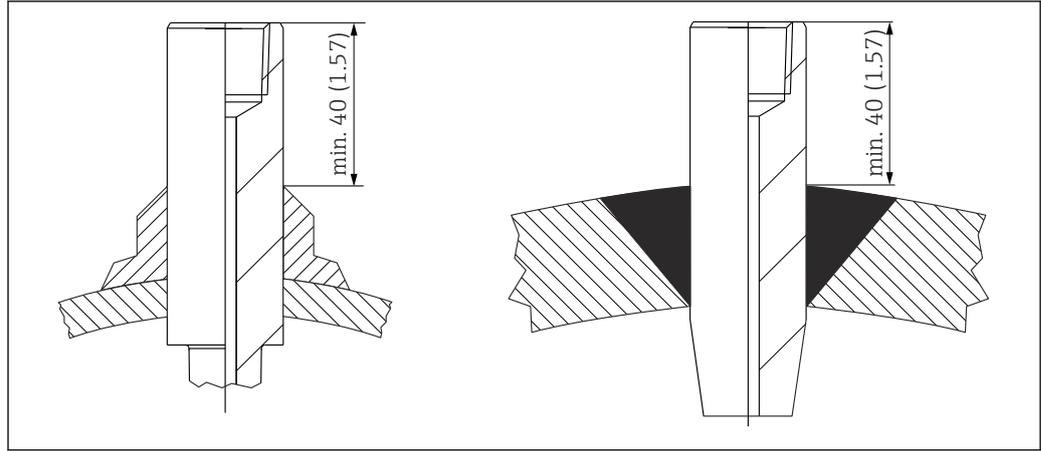


Weld-in, socket weld

Weld-in version/socket weld



-  Welding recommendation: distance between welding seam and end of thermowell must be at least 40 mm (1.57 in).
-  Use a dummy plug to prevent deformation of the thread.



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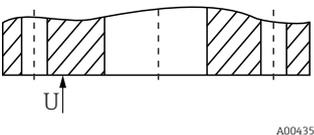
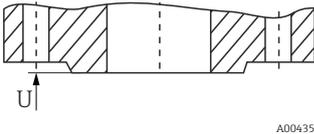
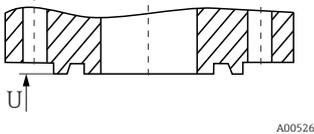
Flanges

i The different materials are classified according to their strength depending on the temperature in: DIN EN 1092-1 Tab.18 under 13E0 and in JIS B2220:2004 Tab. 5 under 023b. The ASME flanges are grouped together under Tab. 2-2.2 in ASME B16.5-2013. Inches are converted into metric units (in - mm) using the factor 25.4. In the ASME standard, the metric data is rounded to 0 or 5.

Types

ASME flanges: American Society of Mechanical Engineers ASME B16.5-2013

Geometry of sealing surfaces

Flanges	Sealing surface	DIN 2526 ¹⁾		DIN EN 1092-1			ASME B16.5	
		Form	Rz (µm)	Form	Rz (µm)	Ra (µm)	Form	Ra (µm)
without raised face		A B	- 40 to 160	A ²⁾	12.5 to 50	3.2 to 12.5	Flat face (FF)	3.2 to 6.3 (AARH 125 to 250 µin)
with raised face		C D E	40 to 160 40 16	B1 ³⁾ B2	12.5 to 50 3.2 to 12.5	3.2 to 12.5 0.8 to 3.2	Raised face (RF)	
With ring groove		-	-	-	-	-	Ring-type joint (RTJ)	1.6

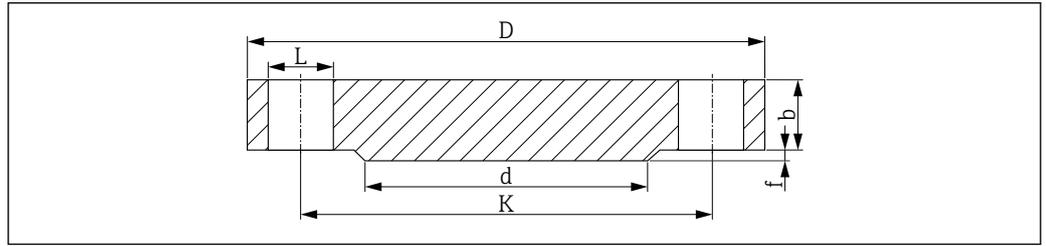
- 1) Contained in DIN 2527
- 2) Typically PN2.5 to PN40
- 3) Typically from PN63

Height of raised face¹⁾

Standard	Flanges	Height of raised face f	Tolerance
ASME B16.5 - 2013	≤ Class 300	1.6 (0.06)	±0.75 (±0.03)
	≥ Class 600	6.4 (0.25)	0.5 (0.02)

1) Dimensions in mm (in)

ASME flanges (ASME B16.5-2013)



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8 Raised face RF

L Bore diameter

d Diameter of raised face

K Diameter of pitch circle

D Flange diameter

b Total flange thickness

f Height of raised face, Class 150/300: 1.6 mm (0.06 in) or from Class 600: 6.4 mm (0.25 in)

Surface quality of sealing surface $R_a \leq 3.2$ to $6.3 \mu\text{m}$ (126 to 248 μin).

Class 150¹⁾

DN	D	b	K	d	L	approx. kg (lbs)
1"	108.0 (4.25)	14.2 (0.56)	79.2 (3.12)	50.8 (2.00)	4xØ15.7 (0.62)	0.86 (1.9)
1¼"	117.3 (4.62)	15.7 (0.62)	88.9 (3.50)	63.5 (2.50)	4xØ15.7 (0.62)	1.17 (2.58)
1½"	127.0 (5.00)	17.5 (0.69)	98.6 (3.88)	73.2 (2.88)	4xØ15.7 (0.62)	1.53 (3.37)
2"	152.4 (6.00)	19.1 (0.75)	120.7 (4.75)	91.9 (3.62)	4xØ19.1 (0.75)	2.42 (5.34)
2½"	177.8 (7.00)	22.4 (0.88)	139.7 (5.50)	104.6 (4.12)	4xØ19.1 (0.75)	3.94 (8.69)
3"	190.5 (7.50)	23.9 (0.94)	152.4 (6.00)	127.0 (5.00)	4xØ19.1 (0.75)	4.93 (10.87)
3½"	215.9 (8.50)	23.9 (0.94)	177.8 (7.00)	139.7 (5.50)	8xØ19.1 (0.75)	6.17 (13.60)
4"	228.6 (9.00)	23.9 (0.94)	190.5 (7.50)	157.2 (6.19)	8xØ19.1 (0.75)	7.00 (15.44)
5"	254.0 (10.0)	23.9 (0.94)	215.9 (8.50)	185.7 (7.31)	8xØ22.4 (0.88)	8.63 (19.03)
6"	279.4 (11.0)	25.4 (1.00)	241.3 (9.50)	215.9 (8.50)	8xØ22.4 (0.88)	11.3 (24.92)
8"	342.9 (13.5)	28.4 (1.12)	298.5 (11.8)	269.7 (10.6)	8xØ22.4 (0.88)	19.6 (43.22)
10"	406.4 (16.0)	30.2 (1.19)	362.0 (14.3)	323.8 (12.7)	12xØ25.4 (1.00)	28.8 (63.50)

1) The dimensions in the following tables are in mm (in), unless otherwise specified

Class 300

DN	D	b	K	d	L	approx. kg (lbs)
1"	124.0 (4.88)	17.5 (0.69)	88.9 (3.50)	50.8 (2.00)	4xØ19.1 (0.75)	1.39 (3.06)
1¼"	133.4 (5.25)	19.1 (0.75)	98.6 (3.88)	63.5 (2.50)	4xØ19.1 (0.75)	1.79 (3.95)
1½"	155.4 (6.12)	20.6 (0.81)	114.3 (4.50)	73.2 (2.88)	4xØ22.4 (0.88)	2.66 (5.87)
2"	165.1 (6.50)	22.4 (0.88)	127.0 (5.00)	91.9 (3.62)	8xØ19.1 (0.75)	3.18 (7.01)
2½"	190.5 (7.50)	25.4 (1.00)	149.4 (5.88)	104.6 (4.12)	8xØ22.4 (0.88)	4.85 (10.69)
3"	209.5 (8.25)	28.4 (1.12)	168.1 (6.62)	127.0 (5.00)	8xØ22.4 (0.88)	6.81 (15.02)
3½"	228.6 (9.00)	30.2 (1.19)	184.2 (7.25)	139.7 (5.50)	8xØ22.4 (0.88)	8.71 (19.21)
4"	254.0 (10.0)	31.8 (1.25)	200.2 (7.88)	157.2 (6.19)	8xØ22.4 (0.88)	11.5 (25.36)
5"	279.4 (11.0)	35.1 (1.38)	235.0 (9.25)	185.7 (7.31)	8xØ22.4 (0.88)	15.6 (34.4)
6"	317.5 (12.5)	36.6 (1.44)	269.7 (10.6)	215.9 (8.50)	12xØ22.4 (0.88)	20.9 (46.08)

DN	D	b	K	d	L	approx. kg (lbs)
8"	381.0 (15.0)	41.1 (1.62)	330.2 (13.0)	269.7 (10.6)	12xØ25.4 (1.00)	34.3 (75.63)
10"	444.5 (17.5)	47.8 (1.88)	387.4 (15.3)	323.8 (12.7)	16xØ28.4 (1.12)	53.3 (117.5)

Class 600

DN	D	b	K	d	L	approx. kg (lbs)
1"	124.0 (4.88)	17.5 (0.69)	88.9 (3.50)	50.8 (2.00)	4xØ19.1 (0.75)	1.60 (3.53)
1¼"	133.4 (5.25)	20.6 (0.81)	98.6 (3.88)	63.5 (2.50)	4xØ19.1 (0.75)	2.23 (4.92)
1½"	155.4 (6.12)	22.4 (0.88)	114.3 (4.50)	73.2 (2.88)	4xØ22.4 (0.88)	3.25 (7.17)
2"	165.1 (6.50)	25.4 (1.00)	127.0 (5.00)	91.9 (3.62)	8xØ19.1 (0.75)	4.15 (9.15)
2½"	190.5 (7.50)	28.4 (1.12)	149.4 (5.88)	104.6 (4.12)	8xØ22.4 (0.88)	6.13 (13.52)
3"	209.5 (8.25)	31.8 (1.25)	168.1 (6.62)	127.0 (5.00)	8xØ22.4 (0.88)	8.44 (18.61)
3½"	228.6 (9.00)	35.1 (1.38)	184.2 (7.25)	139.7 (5.50)	8xØ25.4 (1.00)	11.0 (24.26)
4"	273.1 (10.8)	38.1 (1.50)	215.9 (8.50)	157.2 (6.19)	8xØ25.4 (1.00)	17.3 (38.15)
5"	330.2 (13.0)	44.5 (1.75)	266.7 (10.5)	185.7 (7.31)	8xØ28.4 (1.12)	29.4 (64.83)
6"	355.6 (14.0)	47.8 (1.88)	292.1 (11.5)	215.9 (8.50)	12xØ28.4 (1.12)	36.1 (79.6)
8"	419.1 (16.5)	55.6 (2.19)	349.3 (13.8)	269.7 (10.6)	12xØ31.8 (1.25)	58.9 (129.9)
10"	508.0 (20.0)	63.5 (2.50)	431.8 (17.0)	323.8 (12.7)	16xØ35.1 (1.38)	97.5 (214.9)

Class 900

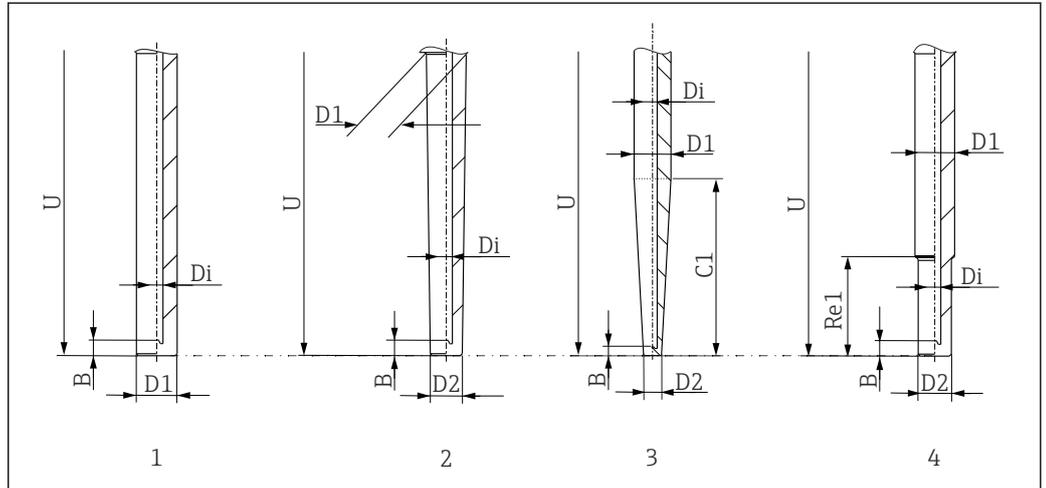
DN	D	b	K	d	L	approx. kg (lbs)
1"	149.4 (5.88)	28.4 (1.12)	101.6 (4.0)	50.8 (2.00)	4xØ25.4 (1.00)	3.57 (7.87)
1¼"	158.8 (6.25)	28.4 (1.12)	111.3 (4.38)	63.5 (2.50)	4xØ25.4 (1.00)	4.14 (9.13)
1½"	177.8 (7.0)	31.8 (1.25)	124.0 (4.88)	73.2 (2.88)	4xØ28.4 (1.12)	5.75 (12.68)
2"	215.9 (8.50)	38.1 (1.50)	165.1 (6.50)	91.9 (3.62)	8xØ25.4 (1.00)	10.1 (22.27)
2½"	244.4 (9.62)	41.1 (1.62)	190.5 (7.50)	104.6 (4.12)	8xØ28.4 (1.12)	14.0 (30.87)
3"	241.3 (9.50)	38.1 (1.50)	190.5 (7.50)	127.0 (5.00)	8xØ25.4 (1.00)	13.1 (28.89)
4"	292.1 (11.50)	44.5 (1.75)	235.0 (9.25)	157.2 (6.19)	8xØ31.8 (1.25)	26.9 (59.31)
5"	349.3 (13.8)	50.8 (2.0)	279.4 (11.0)	185.7 (7.31)	8xØ35.1 (1.38)	36.5 (80.48)
6"	381.0 (15.0)	55.6 (2.19)	317.5 (12.5)	215.9 (8.50)	12xØ31.8 (1.25)	47.4 (104.5)
8"	469.9 (18.5)	63.5 (2.50)	393.7 (15.5)	269.7 (10.6)	12xØ38.1 (1.50)	82.5 (181.9)
10"	546.1 (21.50)	69.9 (2.75)	469.0 (18.5)	323.8 (12.7)	16xØ38.1 (1.50)	122 (269.0)

Class 1500

DN	D	b	K	d	L	approx. kg (lbs)
1"	149.4 (5.88)	28.4 (1.12)	101.6 (4.0)	50.8 (2.00)	4xØ25.4 (1.00)	3.57 (7.87)
1¼"	158.8 (6.25)	28.4 (1.12)	111.3 (4.38)	63.5 (2.50)	4xØ25.4 (1.00)	4.14 (9.13)
1½"	177.8 (7.0)	31.8 (1.25)	124.0 (4.88)	73.2 (2.88)	4xØ28.4 (1.12)	5.75 (12.68)
2"	215.9 (8.50)	38.1 (1.50)	165.1 (6.50)	91.9 (3.62)	8xØ25.4 (1.00)	10.1 (22.27)
2½"	244.4 (9.62)	41.1 (1.62)	190.5 (7.50)	104.6 (4.12)	8xØ28.4 (1.12)	14.0 (30.87)
3"	266.7 (10.5)	47.8 (1.88)	203.2 (8.00)	127.0 (5.00)	8xØ31.8 (1.25)	19.1 (42.12)
4"	311.2 (12.3)	53.8 (2.12)	241.3 (9.50)	157.2 (6.19)	8xØ35.1 (1.38)	29.9 (65.93)
5"	374.7 (14.8)	73.2 (2.88)	292.1 (11.5)	185.7 (7.31)	8xØ41.1 (1.62)	58.4 (128.8)

DN	D	b	K	d	L	approx. kg (lbs)
6"	393.7 (15.50)	82.6 (3.25)	317.5 (12.5)	215.9 (8.50)	12xØ38.1 (1.50)	71.8 (158.3)
8"	482.6 (19.0)	91.9 (3.62)	393.7 (15.5)	269.7 (10.6)	12xØ44.5 (1.75)	122 (269.0)
10"	584.2 (23.0)	108.0 (4.25)	482.6 (19.0)	323.8 (12.7)	12xØ50.8 (2.00)	210 (463.0)

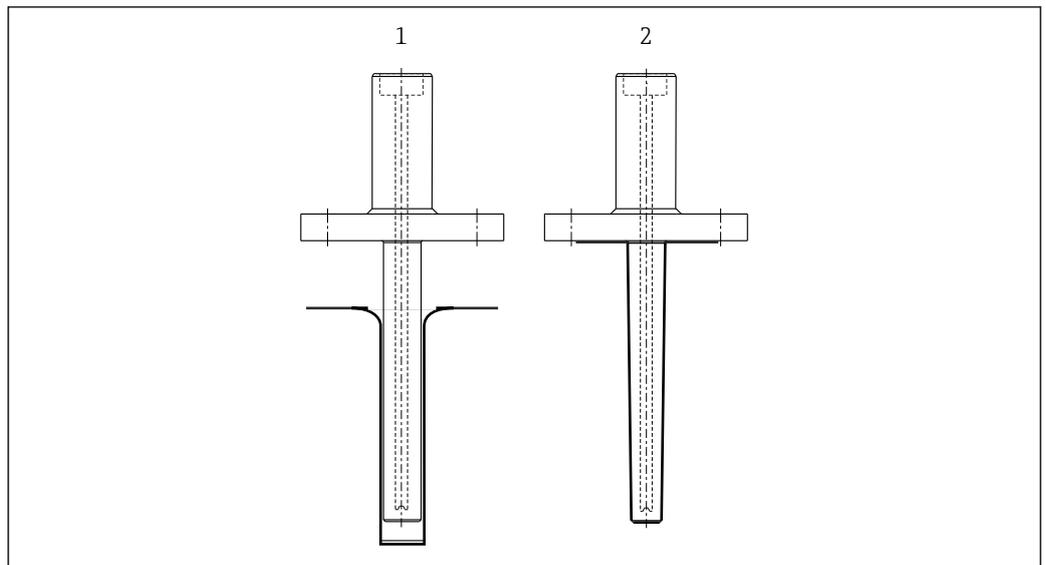
Geometry of wetted parts



A0056216

- 1 Straight (complete length U)
- 2 Tapered (complete length U)
- 3 Tapered (over length C1)
- 4 Stepped, Re1 = 63.5 mm (2.5 in)

Protective sheath made of corrosion-resistant material



A0059962

- 1 Tantalum sleeve
- 2 PTFE coating

Maximum process pressure values for the individual materials depending on the process temperature. Data in bar (PSI)

Temperature in °C (°F)	Tantalum	PTFE
-251 (-420)	-	80 (1160.3)
-200 (-328)	130 (1885.5)	69 (1000.7)
-100 (-148)	75 (1087.8)	46 (667.2)
0 (+32)	60 (870.2)	7.5 (108.8)

Temperature in °C (°F)	Tantalum	PTFE
+20 (+68)	57 (826.7)	6 (87)
+50 (+122)	55 (797.7)	3.75 (54.4)
+100 (+212)	49 (710.7)	2.5 (36.3)
+200 (+392)	40 (580.2)	1.1 (16)
+260 (+500)	37 (536.6)	0.9 (13.1)
+300 (+572)	35 (507.6)	-
+320 (+608)	34 (493.1)	-
+500 (+932)	29 (420.6)	-
+750 (+1382)	23 (333.6)	-
+1000 (+1832)	16.5 (239.3)	-

i Use within a vacuum is not recommended.

i **Response times**
Depending on the material, the protective sheath restricts heat transfer considerably and results in significantly higher response times. Response times t_{90} of several minutes can be expected.

Surface roughness

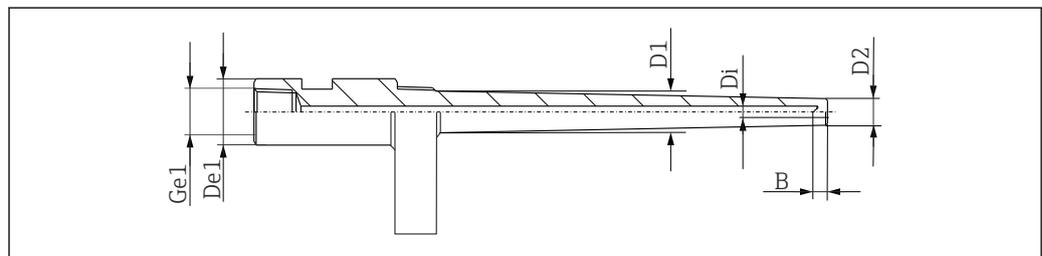
Specifications for surfaces in contact with medium

Standard surface	$R_a \leq 1.6 \mu\text{m}$ (63 μin)
Finely honed surface, buffed	$R_a \leq 0.76 \mu\text{m}$ (30 μin)

Pre-defined versions

i Pre-defined standard geometries apply if no other options for special geometries are selected in the optional configuration section.

Thermometer with thermowell according to ASME standard



A0052234

The pre-defined geometries are the result of combining the thermowell standard, the process connection and the geometry of the wetted parts.

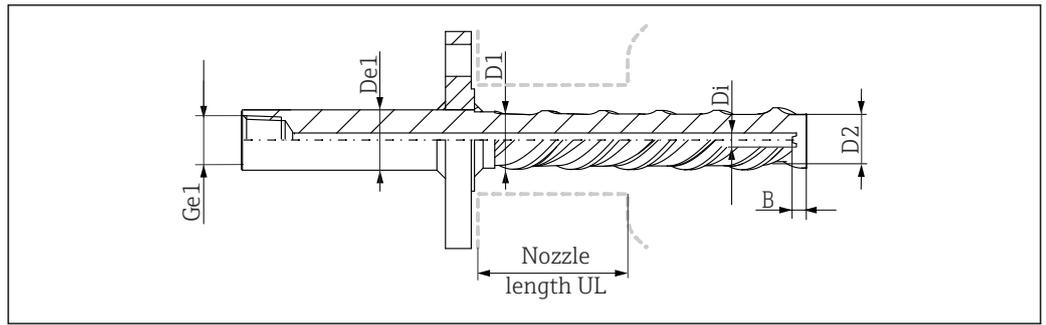
Thermowell standard	Process connection	Geometry of wetted parts	Root \varnothing D1	Tip \varnothing D2	Bore \varnothing Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging- \varnothing De1
Imperial, ASME with flange	Flange 1"	Straight	22.23 mm ($\frac{7}{8}$ in)	22.23 mm ($\frac{7}{8}$ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	RF	NPT $\frac{1}{2}$ "	31.75 mm (1 $\frac{1}{4}$ in)
		Tapered	22.23 mm ($\frac{7}{8}$ in)	15.9 mm ($\frac{5}{8}$ in)					
		Stepped	22.23 mm ($\frac{7}{8}$ in)	12.7 mm ($\frac{1}{2}$ in)					

Thermowell standard	Process connection	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging-Ø De1
	Flange 1½"	Straight	22.23 mm (7/8 in)	22.23 mm (7/8 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	RF	NPT ½"	31.75 mm (1¼ in)
		Tapered	27 mm (1 1/16 in)	15.9 mm (5/8 in)					
		Stepped	22.23 mm (7/8 in)	12.7 mm (½ in)					
	Flange 2"	Straight	22.23 mm (7/8 in)	22.23 mm (7/8 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	RF	NPT ½"	31.75 mm (1¼ in)
		Tapered	27 mm (1 1/16 in)	15.9 mm (5/8 in)					
		Stepped	22.23 mm (7/8 in)	12.7 mm (½ in)					
	Flange 3"	Straight	22.23 mm (7/8 in)	22.23 mm (7/8 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	RF	NPT ½"	31.75 mm (1¼ in)
		Tapered	27 mm (1 1/16 in)	15.9 mm (5/8 in)					
		Stepped	22.23 mm (7/8 in)	12.7 mm (½ in)					
Imperial, ASME with thread	NPT ½" male thread	Straight	15.9 mm (5/8 in)	15.9 mm (5/8 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	31.75 mm (1¼ in)
		Tapered	15.9 mm (5/8 in)	15.9 mm (5/8 in)					
		Stepped	15.9 mm (5/8 in)	12.7 mm (½ in)					
	NPT ¾" male thread	Straight	19 mm (¾ in)	19 mm (¾ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	31.75 mm (1¼ in)
		Tapered	22.23 mm (7/8 in)	15.9 mm (5/8 in)					
		Stepped	19 mm (¾ in)	12.7 mm (½ in)					
	NPT 1" male thread	Straight	22.23 mm (7/8 in)	22.23 mm (7/8 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	38.1 mm (1½ in)
		Tapered	27 mm (1 1/16 in)	15.9 mm (5/8 in)					
		Stepped	22.23 mm (7/8 in)	12.7 mm (½ in)					
	NPT 1¼" male thread	Straight	31.75 mm (1¼ in)	31.75 mm (1¼ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	42.4 mm (1 2/3 in)
		Tapered	34.9 mm (1 3/8 in)	22.23 mm (7/8 in)					
		Stepped	31.75 mm (1¼ in)	22.23 mm (7/8 in)					
	NPT 1½" male thread	Straight	38.1 mm (1½ in)	38.1 mm (1½ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	48.3 mm (1.90 in)
		Tapered	41.3 mm (1 5/8 in)	25.4 mm (1 in)					
		Stepped	38.1 mm (1½ in)	22.23 mm (7/8 in)					
G½" male thread ¹⁾	Straight	15.9 mm (5/8 in)	15.9 mm (5/8 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	31.75 mm (1¼ in)	

Thermowell standard	Process connection	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging-Ø De1
	G¾", male thread	Stepped	15.9 mm ($\frac{5}{8}$ in)	12.7 mm ($\frac{1}{2}$ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	38.1 mm (1½ in)
		Straight	19 mm (¾ in)	19 mm (¾ in)					
		Tapered	22.23 mm ($\frac{7}{8}$ in)	15.9 mm ($\frac{5}{8}$ in)					
		Stepped	19 mm (¾ in)	12.7 mm (½ in)					
Imperial, ASME for weld-in	NPS ¾", 26.7 mm	Tapered	26.7 mm (1.05 in)	15.88 mm (0.625 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	19.05 mm (¾ in)
	NPS 1", 33.4 mm		33.4 mm (1.31 in)	15.88 mm (0.625 in)					25.4 mm (1 in)
	NPS 1¼", 42.4 mm		42.2 mm (1.66 in)	25.4 mm (1 in)					31.75 (1 ¼ in)
	NPS 1½", 48.3 mm		48.3 mm (1.9 in)	28.58 mm (1 1/8 in)					38.1 mm (1½ in)
	1 3/8", hygienic		34.9 mm (1 3/8 in)	15.9 mm ($\frac{5}{8}$ in)					34.92 mm (1 3/8 in)
Imperial, ASME with socket weld	NPS ¾", 26.7 mm	Straight	19 mm (¾ in)	19 mm (¾ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	19.05 mm (¾ in)
		Tapered	22.23 mm ($\frac{7}{8}$ in)	15.9 mm ($\frac{5}{8}$ in)					
		Stepped	19 mm (¾ in)	12.7 mm (½ in)					
	NPS 1", 33.4 mm	Straight	25.4 mm (1 in)	25.4 mm (1 in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	25.4 mm (1 in)
		Tapered	25.4 mm (1 in)	15.9 mm ($\frac{5}{8}$ in)					
		Stepped	22.23 mm ($\frac{7}{8}$ in)	12.7 mm (½ in)					
	NPS 1¼", 42.4 mm	Straight	31.75 mm (1¼ in)	31.75 mm (1¼ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	31.75 (1 ¼ in)
		Tapered	31.75 mm (1¼ in)	22.23 mm ($\frac{7}{8}$ in)					
		Stepped	31.75 mm (1¼ in)	22.23 mm ($\frac{7}{8}$ in)					
	NPS 1½", 48.3 mm	Straight	38.1 mm (1½ in)	38.1 mm (1½ in)	6.6 mm (0.26 in)	6.35 mm (0.25 in)	-	NPT ½"	38.1 mm (1½ in)
		Tapered	38.1 mm (1½ in)	22.23 mm ($\frac{7}{8}$ in)					
		Stepped	38.1 mm (1½ in)	22.23 mm ($\frac{7}{8}$ in)					

1) Tapered version not available

Thermometer with iTHERM TwistWell thermowell

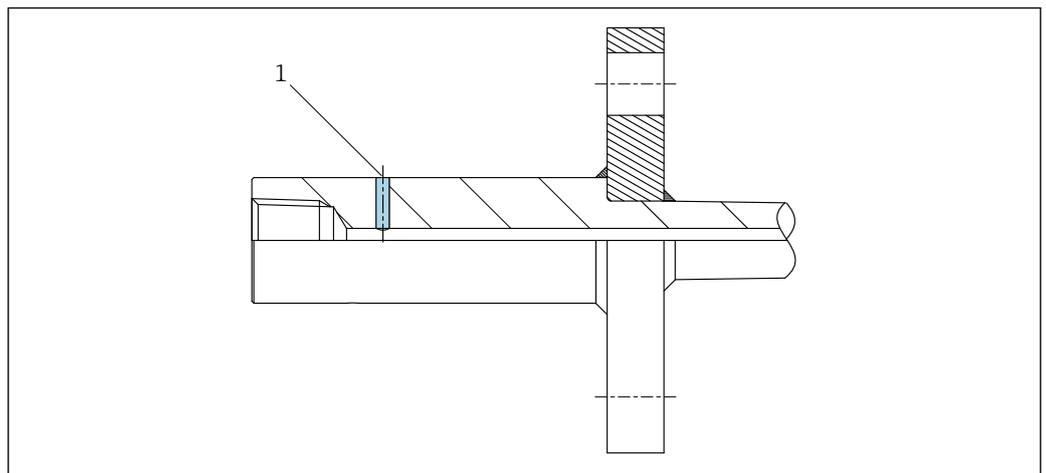


A0052240

The pre-defined geometry results from the iTHERM TwistWell (version: D1 30 mm (1.18 in))

Thermowell type	Process connection size	Geometry of wetted parts	Root \varnothing D1	Tip \varnothing D2	Bore \varnothing Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging- \varnothing De1
iTHERM TwistWell, flanged	Every selectable flange size	Unstreamed length	30 mm (1.18 in)	22 mm (0.87 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	B1/RF	NPT 1/2"	30 mm (1.18 in)

Vent hole



A0060182

1 Vent hole

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3. Select Configuration.

i Product Configurator - the tool for individual product configuration

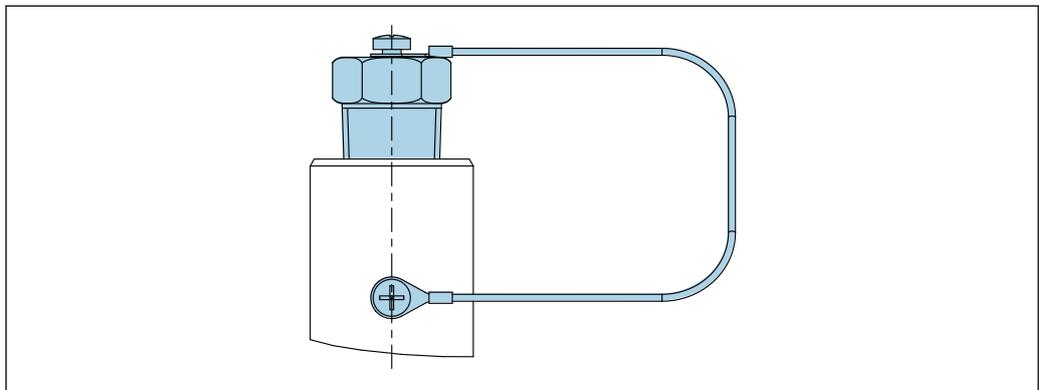
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
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3. Select **Spare parts & Accessories**.

Device-specific accessories



A0053784

 9 Safety plug for the thermowell + chain

Online tools

Product information about the entire life cycle of the device is available at: www.endress.com/onlinetools

Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid for your device The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	Guide that takes you quickly to the 1st measured value The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	Your reference document The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

Document type	Purpose and content of the document
Description of Device Parameters (GP)	<p>Reference for your parameters The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.</p>
Safety instructions (XA)	<p>Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions.</p> <p> The nameplate indicates which Safety Instructions (XA) apply to the device.</p>
Supplementary device-dependent documentation (SD/FY)	<p>Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.</p>



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