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71669928
2024-10-15

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: the 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

Endress+Hauser
People for Process Automation

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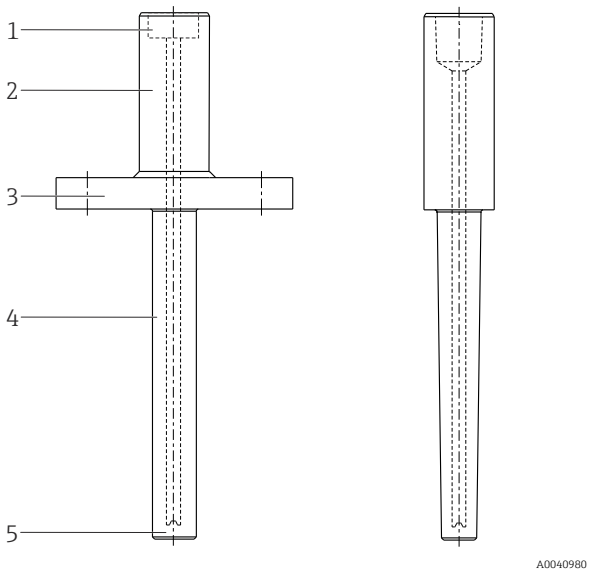
Function and system design

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: Lagging	Extension, which cannot be removed from the thermowell, allows space for installation, especially if a flange is used, and can protect the terminal head and electronics module from the heat in the process.
	3: Process connection	Connection piece on process side. Can be any type of thread, flange, weld in or socket weld and must be dimensioned to withstand the process pressure, temperature and media.
	4: Thermowell	The part of the thermowell that is inserted into the process. Available in a variety of diameters and materials to meet a wide range of applications. The material and strength selected must be such that it can withstand the static and dynamic load caused by the process conditions and is resistant to chemicals, mechanical shock and vibrations.
	5: Thermowell tip	Various tips are available. For thermowells used in pipes with a small diameter, a reduced or tapered thermowell tip can 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

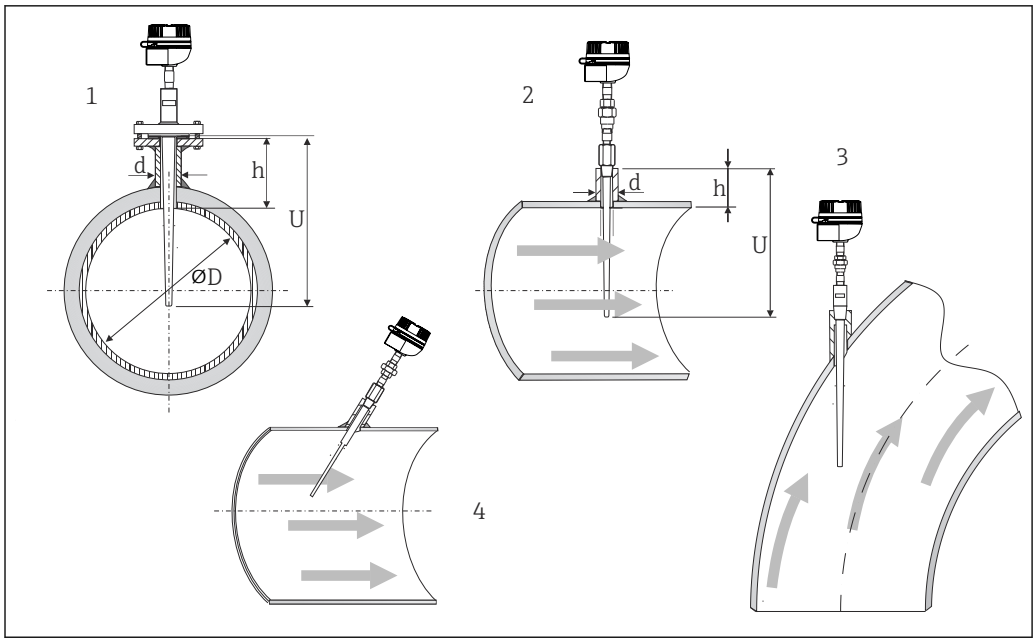
The thermowell can be installed in pipes, tanks or vessels.

Orientation

No restrictions. However, self-draining in the process should be guaranteed 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. Although the installation position may vary according to requirements, the measuring element must be completely exposed to the medium and must not be shielded by the nozzle. In pipes with a small diameter, a pipe expander can be mounted around the measuring point to ensure a sufficient immersion length.



1 *Installation examples*

1 - 2 In pipes with a small cross-section, the sensor tip should reach or extend slightly past the center axis of the pipe (=L).
3 - 4 Slanted orientation.

In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to project well into the process so that it extends past the pipe axis. Another possibility is to install the thermometer at an angle (4). When determining the immersion length or installation depth, all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. flow velocity, pressure).

For the best installation, apply the following rule: h ~ d; U > D/2 +h.

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

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 +1 100 °C (−328 to +2 012 °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.

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

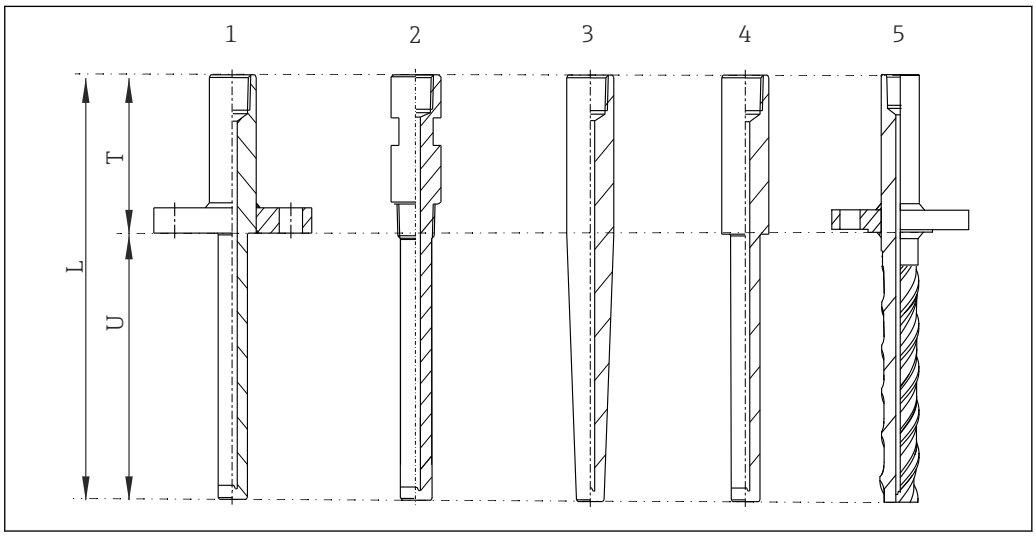
The maximum flow velocity tolerated by the thermowell diminishes with increasing thermowell immersion length exposed to the stream of the fluid. In addition, it depends on the shape and size of

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

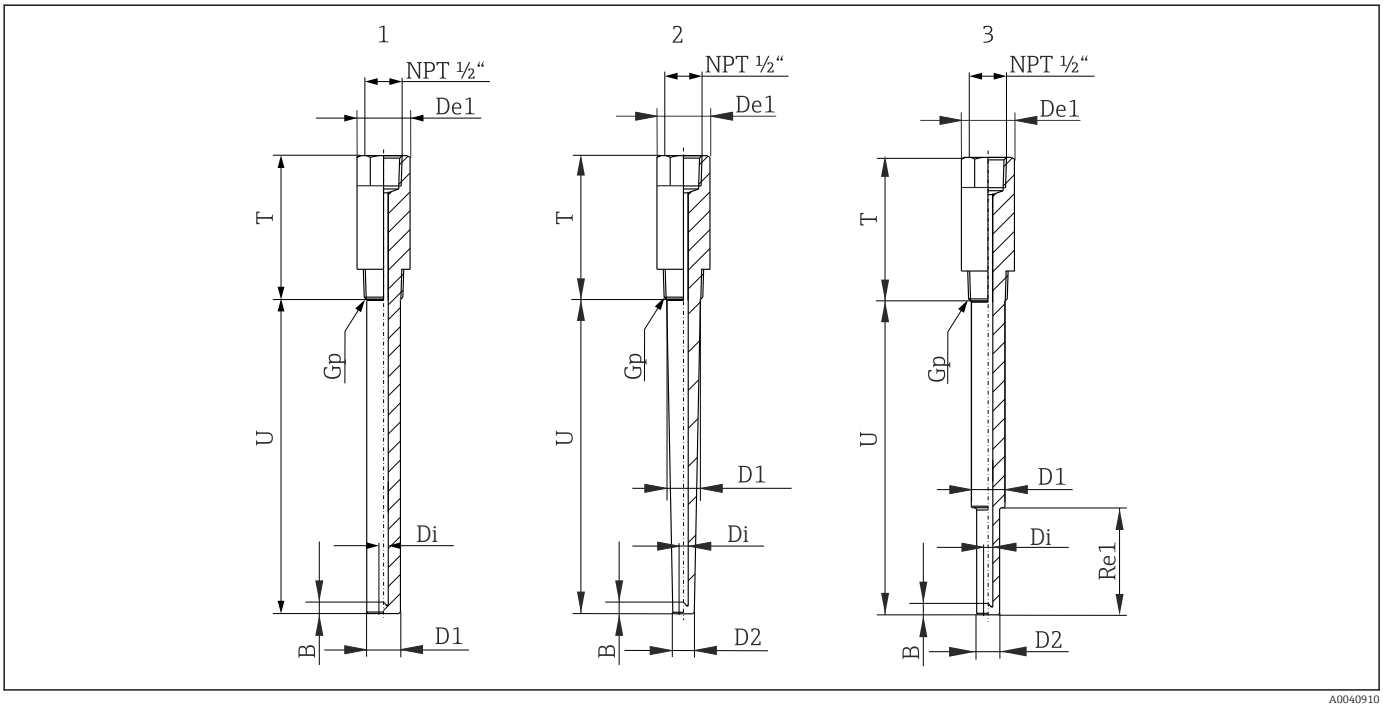
Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
L	Thermowell length (U+T)
Gp	Process connection thread
B	Thermowell bottom thickness (default value 6.35 mm (¼ in)
T	Length of thermowell lagging

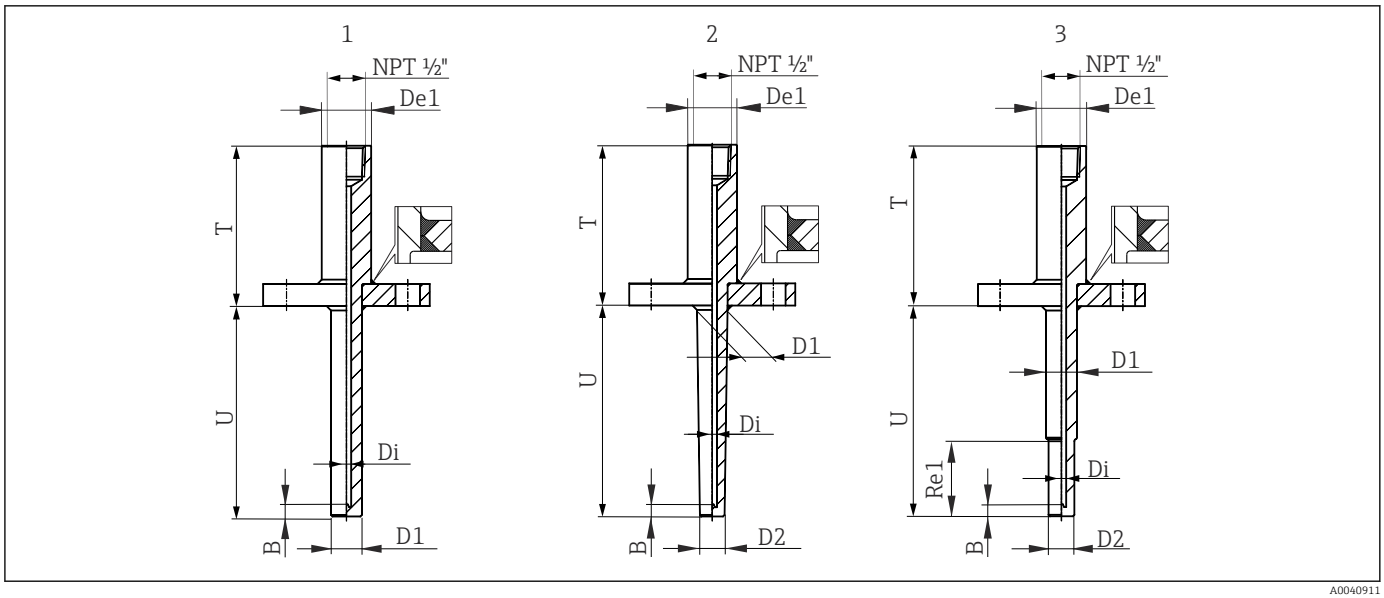
Item	Description
U	Immersion length
D1	Root diameter
D2	Tip diameter
C1	Length of the tapered part
Re1	Reduced tip length
Di	Bore diameter
De1	Lagging diameter
SL	Length of the coil

Thermowells based on ASME B40.9



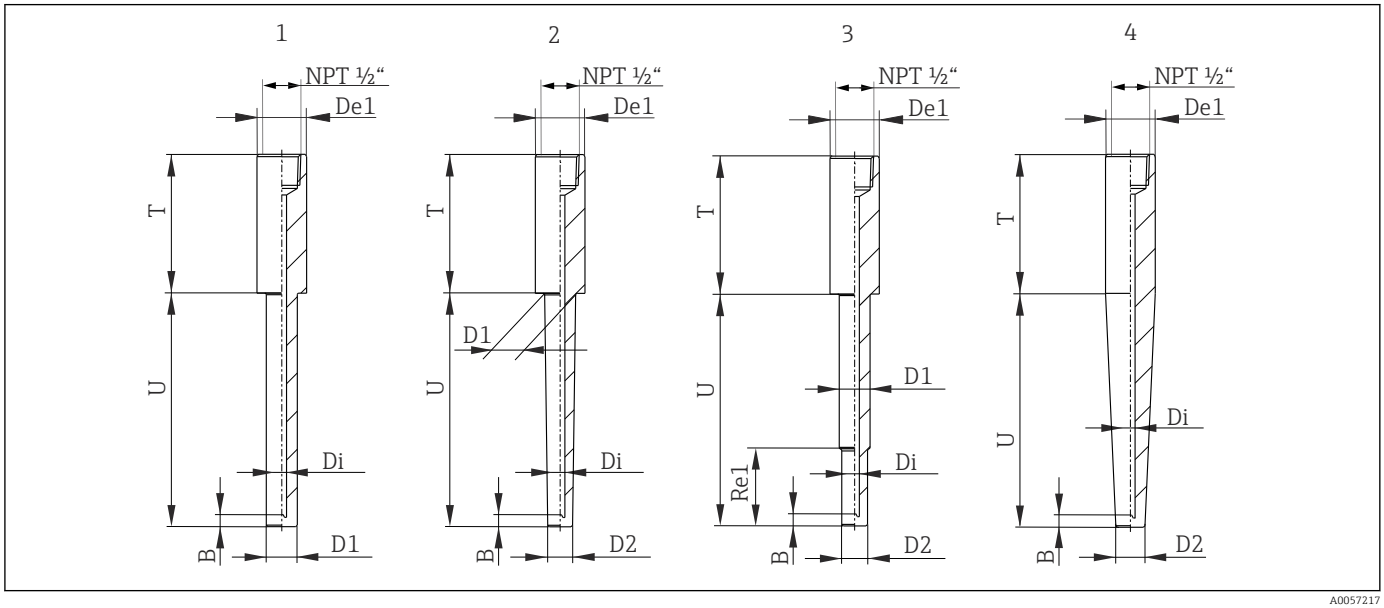
3 Thermowells based on ASME B40.9

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



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 Stepped-shank flanged thermowell (optional full penetration welding available)



5 *Thermowells based on ASME B40.9*

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

	Threaded	Flanged	Socket weld/Tapered-shank weld-in
Process connection size	▪ NPT ½" ▪ NPT ¾" ▪ NPT 1" ▪ NPT 1¼" ▪ NPT 1½" ▪ G½" ▪ G¾"	▪ ANSI 1" from Cl. 150 to Cl. 600 ▪ ANSI 1 - ½" from Cl. 150 to Cl. 900/1500 ▪ ANSI 2" from Cl. 150 to Cl. 900/1500 ▪ ANSI 3" from Cl. 150 to Cl. 600	▪ (NPS ¾"), Ø26.7 mm ▪ (NPS 1"), Ø33.4 mm ▪ (NPS 1¼"), Ø42.2 mm ▪ (NPS 1½"), Ø48.3 mm ▪ (1⅜", hygienic), ϕ34.93 mm
Process connection material	▪ 316/316L ▪ 304/304L ▪ Alloy 600 ▪ Alloy C276 ▪ AISI A182 F11 ▪ AISI A182 F22 ▪ AISI A182 F91 ▪ A105 ▪ Duplex S32205	▪ 316/316L ▪ 304/304L ▪ Alloy C276 ▪ Alloy 600 ▪ 316/316L + PTFE (Teflon), coated ▪ 316/316L + tantalum sleeve ▪ A105	▪ 316/316L ▪ 304/304L ▪ Alloy 600 ▪ Alloy C276 ▪ AISI A182 F11 ▪ AISI A182 F22 ▪ AISI A182 F91 ▪ A105 ▪ Duplex S32205

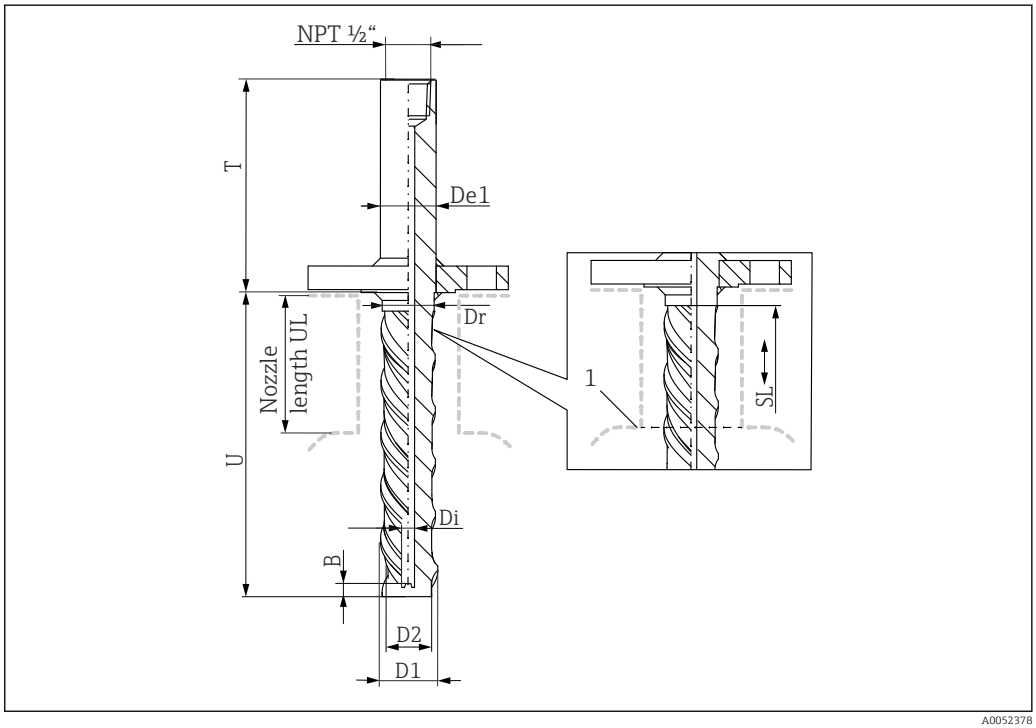
Dimensions		
	Straight-shank & tapered thermowells	**Step-shank thermowells**
Immersion length U	25.4 to 2 133.6 mm (1 to 84 in)	76.2 to 304.8 mm (3 to 12 in)
Lagging length T	44.5 to 209.6 mm (1.75 to 8.25 in)	
Root diameter D1	15.88 to 38.1 mm (5/8 to 1½ in)	19.05 to 34.93 mm (¾ to 1 3/8 in)
Tip diameter D2	12.7 to 38.1 mm(½ to 1½ in) or identical to the root diameter	12.7 to 38.1 mm (½ to 1½ in)
Bore diameter Di	▪ 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)
Tip 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 are based on the imperial system
Tolerances	According to ISO 2768-mK, unless a metric or comparable system is specified.
Terminology and definitions	According to Endress+Hauser norms
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
Flanges	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

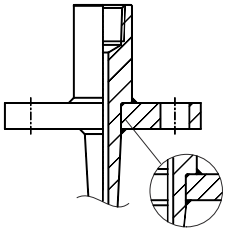
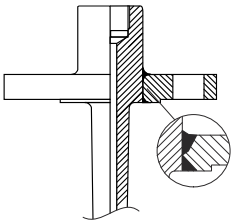
Helical design. This design reduces vortex-induced vibrations in process applications with high flow rates.



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	▪ ANSI 1" from 150 lb/sq inch to 900/1500 lb/sq inch ▪ ANSI 1 ½" 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)		
Tip 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
 A0052792	 A0052794
▪ Suitable for most applications ▪ Meets requirements with an optional cost-benefit ratio	▪ Suitable for harsh application environments ▪ Stronger welded connection ▪ Higher costs

Weight

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

Materials

Thermowell and process connections.

Please note that the maximum temperature also always depends on the temperature sensor used!

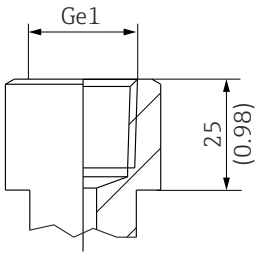
The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant mechanical load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such 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]	▪ 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)
Alloy600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	▪ 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)	▪ 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)	▪ Austenitic, stainless steel ▪ Suitable for use in water and slightly contaminated wastewater. ▪ Only resistant to organic acids, salt solutions, sulfates, basic solutions, etc., at relatively low temperatures.

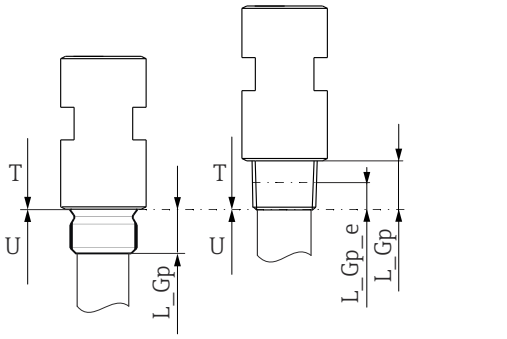
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI A105/ 1.0460	C22.8	450 °C (842 °F)	▪ Heat-resistant steel ▪ Resistant in nitrogen-containing atmospheres and atmospheres that are low in oxygen; not suitable for acids or other aggressive media ▪ Often used in steam generators, water and steam piping, pressured vessels
AISI A182 F11/1.7335	13CrMo4-5	550 °C (1022 °F)	▪ 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 piping, pressured vessels
AISI A182 F22/1.7380	10CrMo9-10	580 °C (1076 °F)	▪ 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 (1202 °F)	▪ 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)	▪ 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)	▪ Resistant to almost all chemicals ▪ High temperature stability
Tantalum	-	250 °C (482 °F)	▪ 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

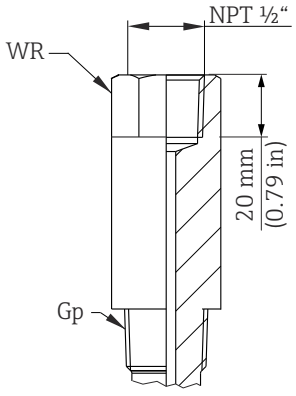
Thermometer connection	Ge1	L_1	L_2	Standard/Class
 6 *Internal thread*	NPT ½"	17 mm (0.67 in)	20 mm (0.79 in)	ANSI B1.20.1

Process connections Thread

Threaded process connection	Version		Thread length L_Gp	Standard	Max. process pressure
 7 *Cylindrical (left side) and conical (right side) version*	G	G ½"	15 mm (0.6 in)	ISO 228-1 A	Maximum static process pressure for threaded process connection: [1] 400 bar (5 802 psi) at +400 °C (+752 °F)
		G ¾"	16 mm (0.63 in)		
	NPT	NPT ½"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)	ANSI B1.20.1	
		NPT ¾"	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 1¼"	25.6 mm (1.01 in) L_Gp_e: 10 mm (0.39 in)		
		NPT 1½"	26 mm (1.025 in) L_Gp_e: 10 mm (0.39 in)		

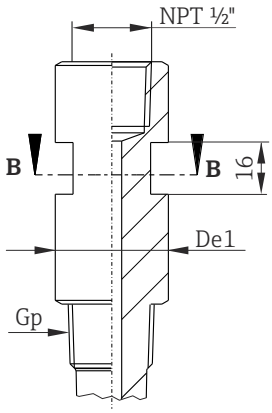
1) Maximum pressure specifications only for the thread. The failure of the thread is calculated, taking the static pressure into consideration. The calculation is based on a fully tightened thread

WR size matrix for threaded thermowells (hexagonal lagging)



Process connection size Gp (male thread)						
G ½"	G ¾"	NPT ½"	NPT ¾"	NPT 1"	NPT 1¼"	NPT 1½"
WR 1 1/8"	WR 1 3/8"	WR 1 1/8"	WR 1 1/8"	WR 1 3/8"	WR 1½"	WR 1¾"

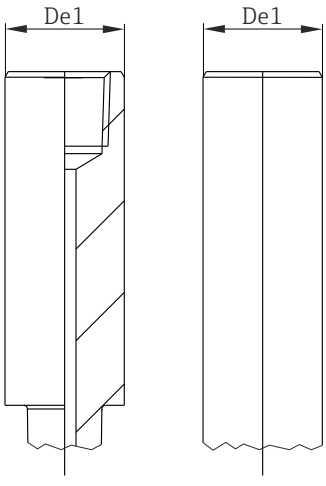
De1 size matrix for screw-in thermowells in mm (in)



Process connection size Gp (male thread)						
G ½"	G ¾"	NPT ½"	NPT ¾"	NPT 1"	NPT 1¼"	NPT 1½"
1¼"	1½"	1¼"	1¼"	1½"	1 2/3"	1.90 "
Spanner flats						
WR 1 1/8"	WR 1 3/8"	WR 1 1/8"	WR 1 1/8"	WR 1 3/8"	WR 1½"	WR 1¾"

Weld-in, socket weld

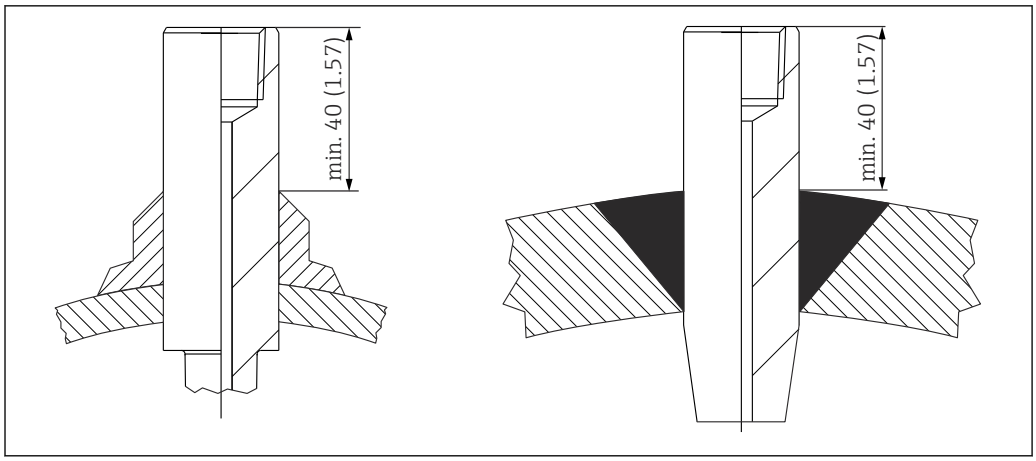
Weld-in version/socket weld



De1

- Φ 26.7 mm (NPS ¾")
- Φ 33.4 mm (NPS 1")
- Φ 42.4 mm (NPS 1¼")
- Φ 48.3 mm (NPS 1½")
- Φ 34.93 mm (1⅜", hygienic)

Welding recommendation: distance between welding seam and end of thermowell should be at least 40 mm (1.57 in). To avoid thread deformations a dummy plug is recommended.

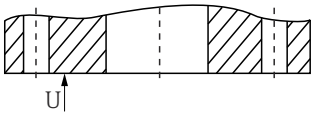
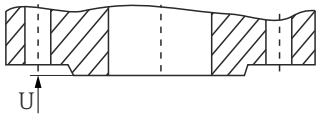
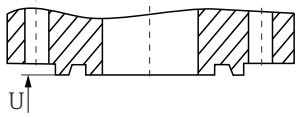


Flanges

The different materials are categorized according to their strength-temperature properties 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.

Versions
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

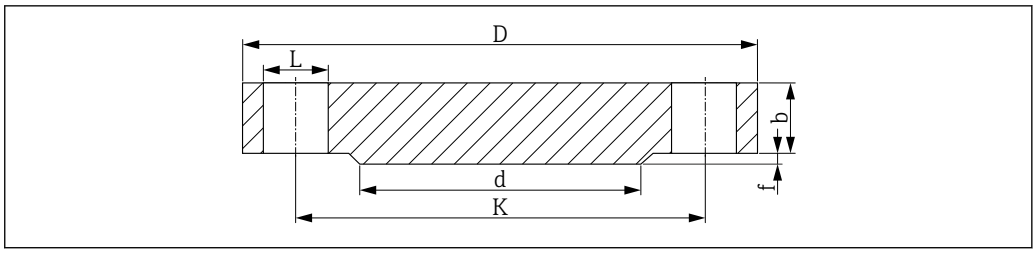
1) Contained in DIN 2527
2) Typically PN2.5 to PN40
3) Typically from PN63

Height of raised face [1]

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)



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 Ra ≤ 3.2 to 6.3 µm (126 to 248 µin).

Class 150 [1)]

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)
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)

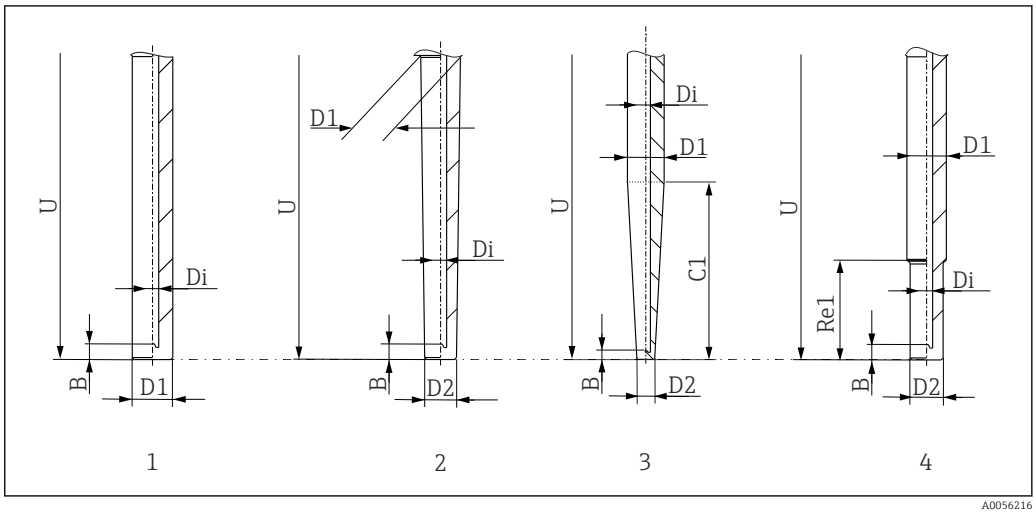
Class 900

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)
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



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

Surface roughness

Specifications for surfaces in contact with medium

Standard surface	$R_a \leq 1.6$ µm (63 µin)
Finely honed surface, buffed	$R_a \leq 0.76$ µm (30 µin)

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

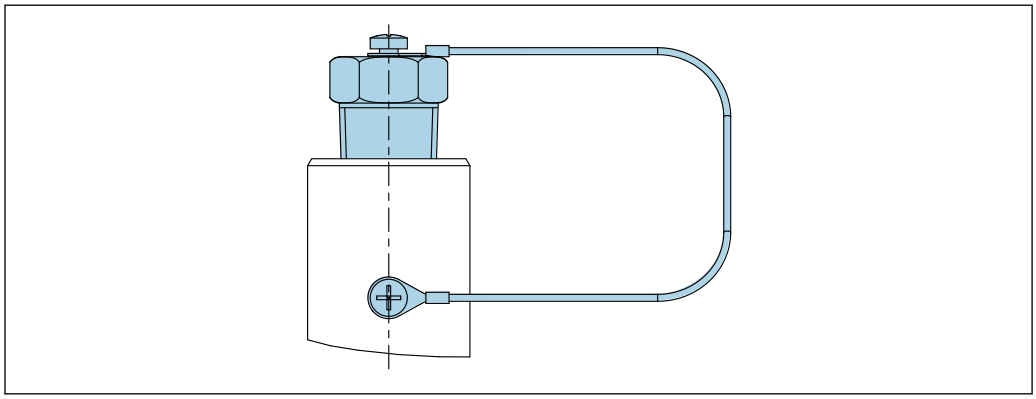
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessory

The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Device-specific accessory



9 *Dummy plug for thermowell + chain*

Online tools

Product information over the entire life cycle of the device: www.endress.com/onlinetools

Documentation

The following types of documentation are available on the product pages and in the Download Area of the Endress+Hauser website (www.endress.com/downloads) (depending on the selected device version):

Document	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.
Safety instructions (XA)	Safety Instructions (XA) are supplied with the device, depending on the approval. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.

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