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Technical Information
iTHERM TT151

Barstock thermowell for a wide range of heavy duty industrial applications

Application

- Protects the temperature sensor against physical and chemical stress
- Highly robust design for challenging process conditions
- Pressure range up to 500 bar (7 252 psi)
- For use in pipes, vessels or tanks
- Easier maintenance and recalibration of the measuring point (sensor can be replaced without interrupting the process)

Your benefits

- TT151 is an industry standard thermowell manufactured from round barstock
- Extension, immersion length and total length can be chosen according to process requirements
- Wide range of dimensions, materials and process connections available

Endress+Hauser
People for Process Automation

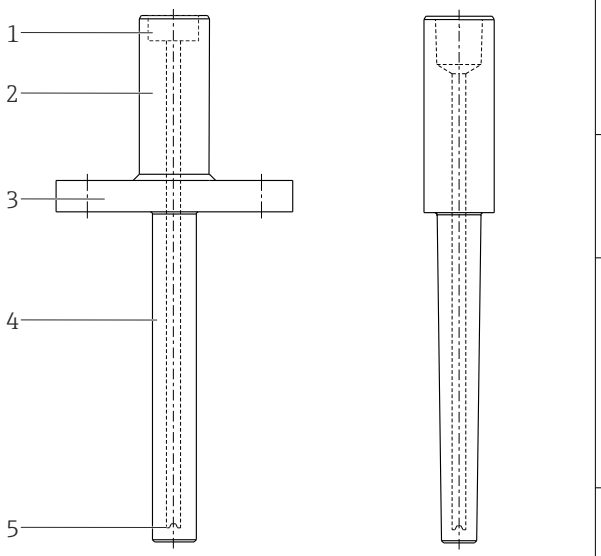
Table of contents

Function and system design

Equipment architecture

The thermowell design is based on DIN 43772 or ASME B40.9 and additionally it is available as a universal version that can be configured flexibly. The thermowell guarantees a good resistance to typical industrial processes. It comprises a full material bar stock with a root diameter from 9 to 50 mm. The tip can be straight, tapered or stepped. The thermowell can be fitted to a pipe or vessel in the system using a selection of commonly used flanged process connection, thread or weld-in versions.

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 thermowells can be installed in pipelines, tanks or vessels.

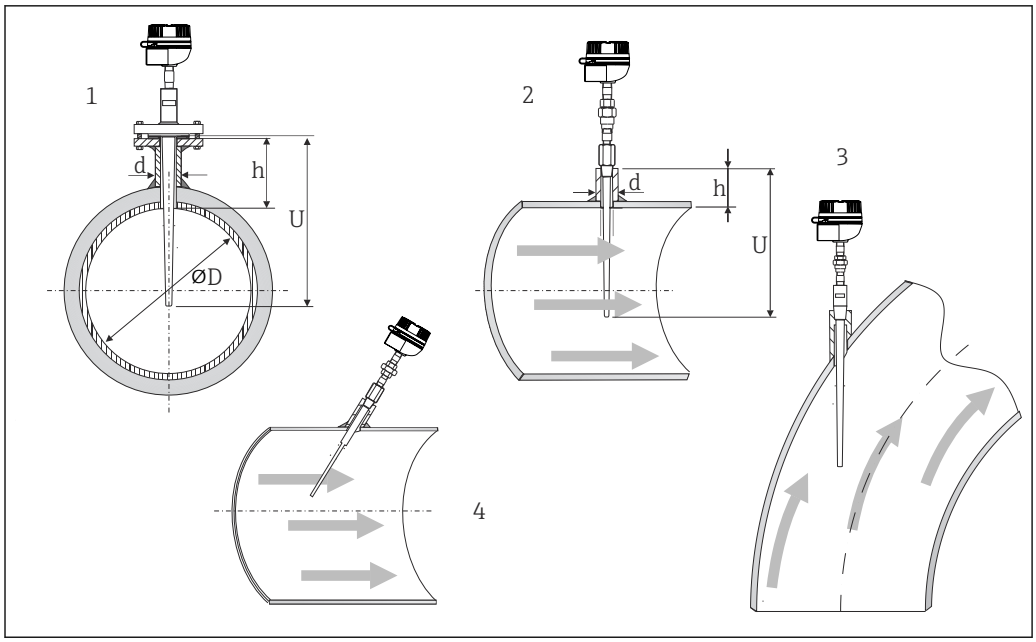
Orientation

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 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.

Installation possibilities: pipes, tanks or other plant components



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 installation.

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. → 22

It is possible to verify the mechanical loading capacity as a function of the installation and process conditions using the online TW Sizing Module for thermowells included in the Endress +Hauser Applicator software. See 'Accessories' section. → 33

Permitted flow velocity depending on the immersion length and process medium

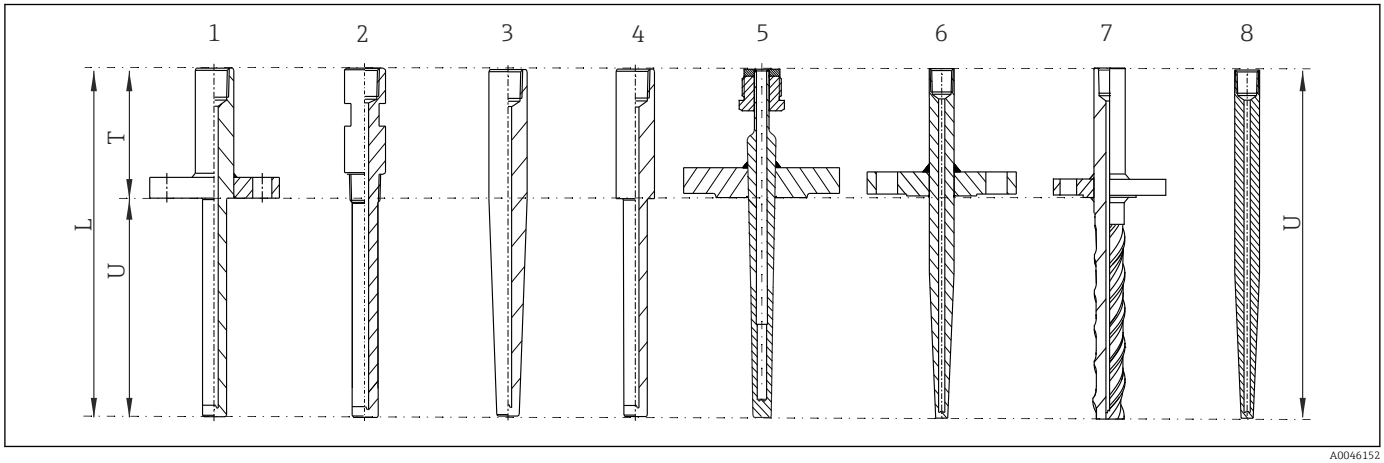
The maximum flow velocity tolerated by the thermowell diminishes with increasing thermowell immersion length exposed to the stream of the fluid. In addition, it depends on the shape and size of

the thermowell, the process connection, the medium type, process temperature and process pressure.

Process connection	Standard	Max. process pressure
Weld in version / socket weld	-	≤ 500 bar (7 252 psi)
Flange	EN1092-1 or ISO 7005-1	Depending on the flange pressure rating PNxx: 20, 40, 50 or 100 bar at 20 °C (68 °F)
	ASME B16.5	Depending on the flange pressure rating 150, 300, 600, 900/1500 or 2500 psi at 20 °C (68 °F)
	JIS B 2220	Depending on the flange pressure rating 10K
Thread	ISO 965-1 / ASME B1.13M ISO 228-1 ANSI B1.20.1 DIN EN 10226-1 / JIS B 0203	400 bar (5 802 psi) at +400 °C (+752 °F)

Mechanical construction

Design, dimensions



2 *Typical ASME, UNIVERSAL, NAMUR, DIN design, iTHERM TwistWell and references*

1 *Flanged, references acc. to ASME/Universal*
2 *With thread, references acc. to ASME/Universal*
3 *For weld-in, references acc. to ASME/Universal*
4 *Socket weld, references acc. to ASME/Universal*
5 *Flanged, references acc. to NAMUR*
6 *Flanged, references acc. to DIN*
7 *Flanged, references acc. to iTHERM TwistWell*
8 *For weld-in, references acc. to DIN*

All dimensions in mm (in). The design of the thermometer depends on the thermowell version:

Thermowells based on ASME:
- ANSI flanges
- NPT threads
- Socket weld and weld-in

Thermowells based on DIN:
- EN flanges
- M or G threads
- Socket weld and weld-in

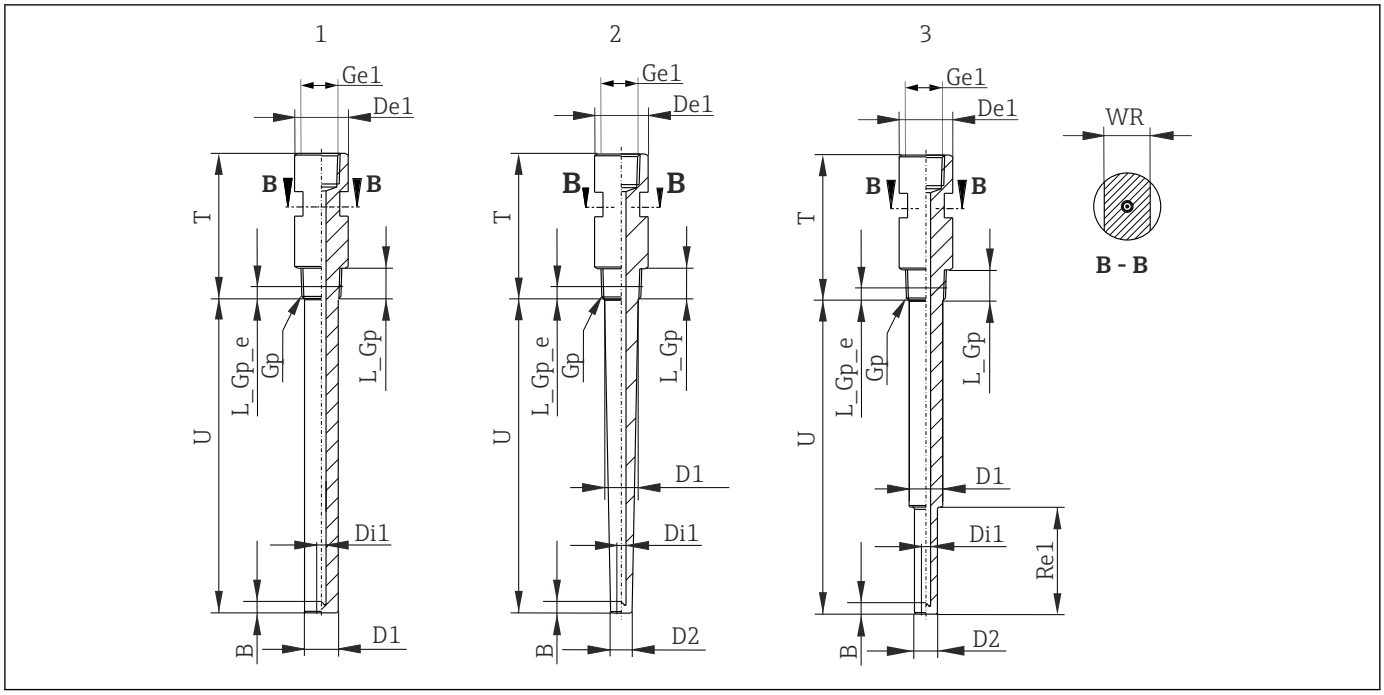
Universal:
- ANSI, EN, ISO or HG/T flange
- M, G, R or NPT threads
- Socket weld and weld-in

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:

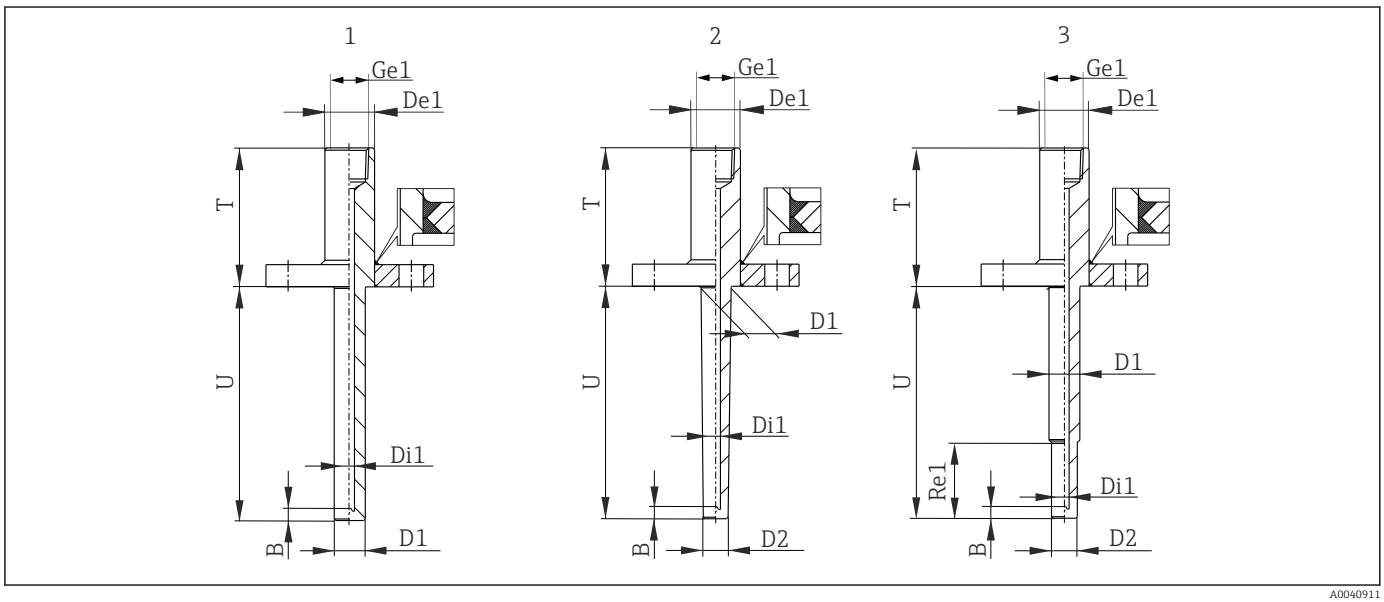
Item	Description
L	Thermowell length (U+T)
L_Gp	Thread length (complete thread length)
L_Gp_e	Thread engagement length
Gp	Process connection thread
B	Thermowell tip thickness (default value 6mm - optional other thickness available)
T	Length of thermowell lagging
U	Immersion length
D1	Root diameter
D2	Tip diameter
C1	Length of the tapered part
Re1	Reduced tip length
Di1	Bore diameter
Di2	Bore diameter tip
De1	Lagging diameter
Ge1	Thermometer connection thread
SL	Strake length

Thermowells based on ASME B40.9



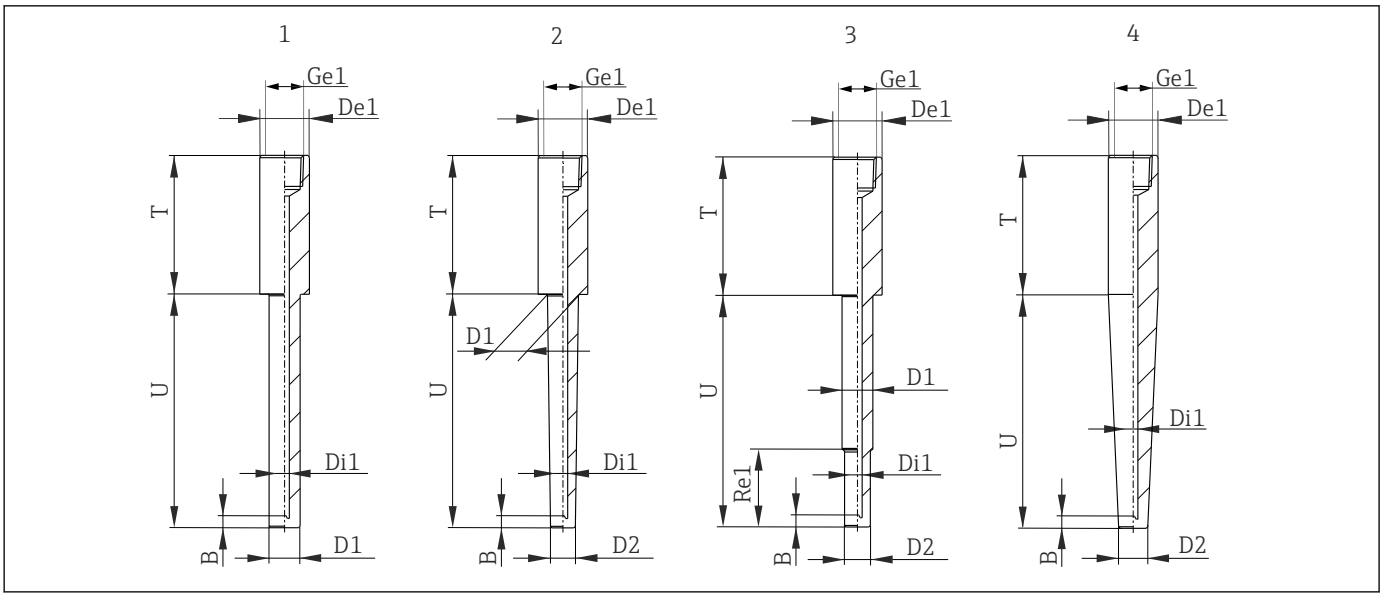
3 Thermowells based on ASME B40.9

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



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

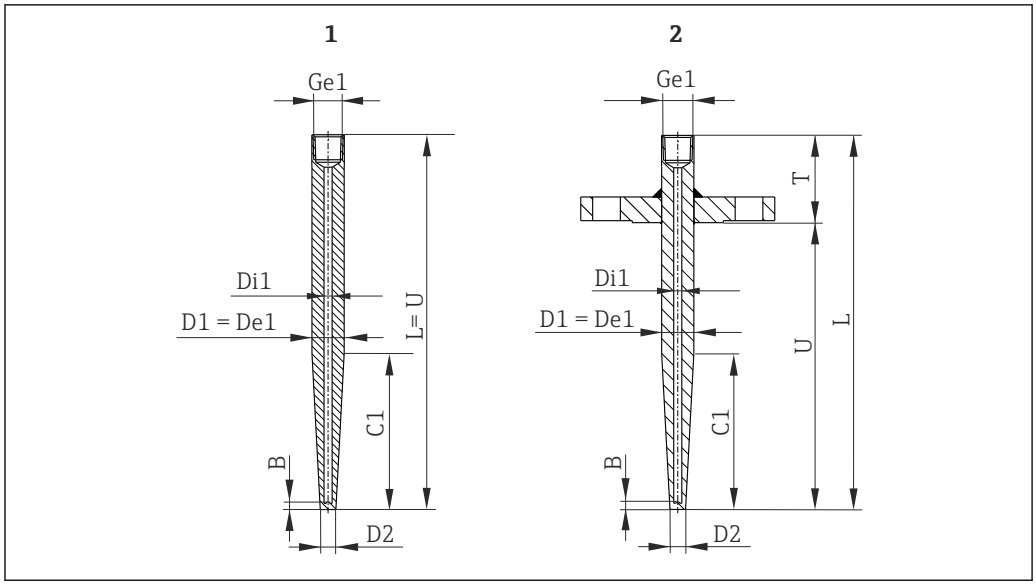
	Threaded	Flanged	Socket weld/Tapered-shank weld-in
Thermometer connection Ge1	▪ ½" NPT ▪ ½" NPSC ▪ ½" NPSM		
Process connection size	▪ ½" NPT ▪ ¾" NPT ▪ 1" NPT	▪ ANSI 1" from Cl. 150 to Cl. 600 ▪ ANSI 1 - ½" from Cl. 150 to Cl. 2500 ▪ ANSI 2" from Cl. 150 to Cl. 2500	▪ Ø18 mm (0.71 in) ▪ Ø24 mm (0.94 in) ▪ Ø26 mm (1.02 in) ▪ Ø27 mm (1.06 in) ▪ Ø28 mm (1.1 in) ▪ Ø30 mm (1.18 in) ▪ Ø32 mm (1.26 in) ▪ Ø35 mm (1.38 in) ▪ Ø40 mm (1.57 in) ▪ Ø45 mm (1.77 in) ▪ Ø50 mm (1.97 in) ▪ Ø26.7 mm (NPS ¾") ▪ Ø33.4 mm (NPS 1") ▪ Ø42.2 mm (NPS 1¼") ▪ Ø48.3 mm (NPS 1½")
Process connection material	▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 ▪ A105 ▪ C22.8	▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ Alloy C276 ▪ Alloy C276>316L ▪ Alloy 600>316L ▪ A105	▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 ▪ A105 ▪ C22.8
Bar material		▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ 347 ▪ Alloy 600 ▪ Alloy C276 ▪ A105 ▪ C22.8	

Dimensions		
	Straight-shank & tapered thermowells	**Step-shank thermowells**
Immersion length U	64 to 609 mm (2.52 to 24 in)	127 to 609 mm (5 to 24 in)
Lagging length T	70 to 300 mm (2.76 to 11.81 in)	75 to 300 mm (2.95 to 11.81 in)
Lagging diameter De1	18 to 50 mm (0.71 to 1.97 in)	18 to 50 mm (0.71 to 1.97 in)
Root diameter D1	16 to 46.5 mm (0.63 to 1.83 in)	▪ for tip diameter 12.7 mm (0.5 in): 16 to 25.4 mm (0.63 to 1 in) ▪ for tip diameter 22.2 mm (0.87 in): 25.4 to 38 mm (1 to 1.5 in)
Tip diameter D2	9.2 to 46.5 mm (0.36 to 1.83 in) or identical to root diameter	12.7 mm (0.5 in) or 22.2 mm (0.87 in)
Bore diameter Di	▪ 3.5 mm (0.14 in) ▪ 6.5 mm (0.26 in) ▪ 7 mm (0.28 in) ▪ 8 mm (0.31 in) ▪ 9.5 mm (0.37 in) ▪ 10 mm (0.39 in)	6.5 mm (0.26 in)
Roughness	Default value 1.6 µm (63 µin); optional 0.76 µm (30 µin)	Default value 1.6 µm (63 µin); optional 0.76 µm (30 µin)
Stepped length Re1	-	76 to 365 mm (2.99 to 14.4 in)
Tip thickness B	Default value 6 mm (0..24 in); optional 5 to 12 mm (0.2 to 0.47 in)	

TT151 is based on ASME B40.9 but allows higher flexibility as in ASME B40.9 specified. In the following table are the main deviations listed.

Dimensions	All dimensions are based on metric
Tolerances	According to ISO 2768-mK, if not otherwise specified
Terminology and definitions	According to E+H Standard
Standard dimensions	TT151 offers a wider range of dimensions as mentioned in standard ASME B40.9
ASME PTC-19.3	TT151 design fulfills the limitations of ASME PTC-19.3
Thread	TT151 offers a wider range of threads as mentioned in standard ASME B40.9
Flanges	TT151 offers a wider range of flanges as mentioned in standard ASME B40.9
Thermowell construction	Based on ASME B40.9
Materials	TT151 offers a wider range of materials than mentioned in standard ASME B40.9
ASME B40.9 Non-Mandatory Appendix for Naval Shipboard Application	TT151 does not consider the appendix

Thermowells based on DIN 43772 form 4 and 4F



6 Thermowells based on DIN 43772 form 4 and 4F

1 Weld-in thermowell based on DIN 43772 form 4
2 Weld-in thermowell based on DIN 43772 form 4F

	Form 4 (weld-in)	Form 4F (flanged)
Thermometer connection Ge1	▪ M14x1.5 ▪ M18x1.5 ▪ M20x1.5 ▪ M27x2 ▪ G ½" ▪ G ¾"	
Process connection size	▪ Ø18 mm (0.71 in) ▪ Ø24 mm (0.95 in) ▪ Ø26 mm (1.02 in) ▪ Ø32 mm (1.26 in)	▪ EN or ISO flanges DN25 from PN16 to PN100 ▪ EN or ISO flanges DN40 PN40 ▪ EN or ISO flanges DN50 from PN40 to PN63 ▪ EN or ISO flanges DN80 PN6
Process connection material	▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 ▪ 16Mo3 ▪ A105 ▪ C22.8 ▪ Duplex S32205 ▪ Titan Gr2	▪ 316 ▪ 316L ▪ 316Ti ▪ Alloy C276>316L ▪ Alloy 600>316L ▪ A105
Bar material		▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ 347 ▪ Alloy 600 ▪ Alloy C276 ▪ A105 ▪ C22.8 ▪ Duplex S32205
Tip thickness B	Default value 6 mm (0.24 in); optional 4 to 12 mm (0.16 to 0.47 in)	
Roughness	Default value 1.6 µm (63 µin); optional 0.76 µm (30 µin)	
Tolerances wetted part	▪ +0/-0.15 mm (0.006 in) for L ≤ 410 mm (16.14 in) ▪ +0/-0.2 mm (0.008 in) for L > 410 mm (16.14 in) ▪ on demand tolerance according DIN43772 can be ordered	

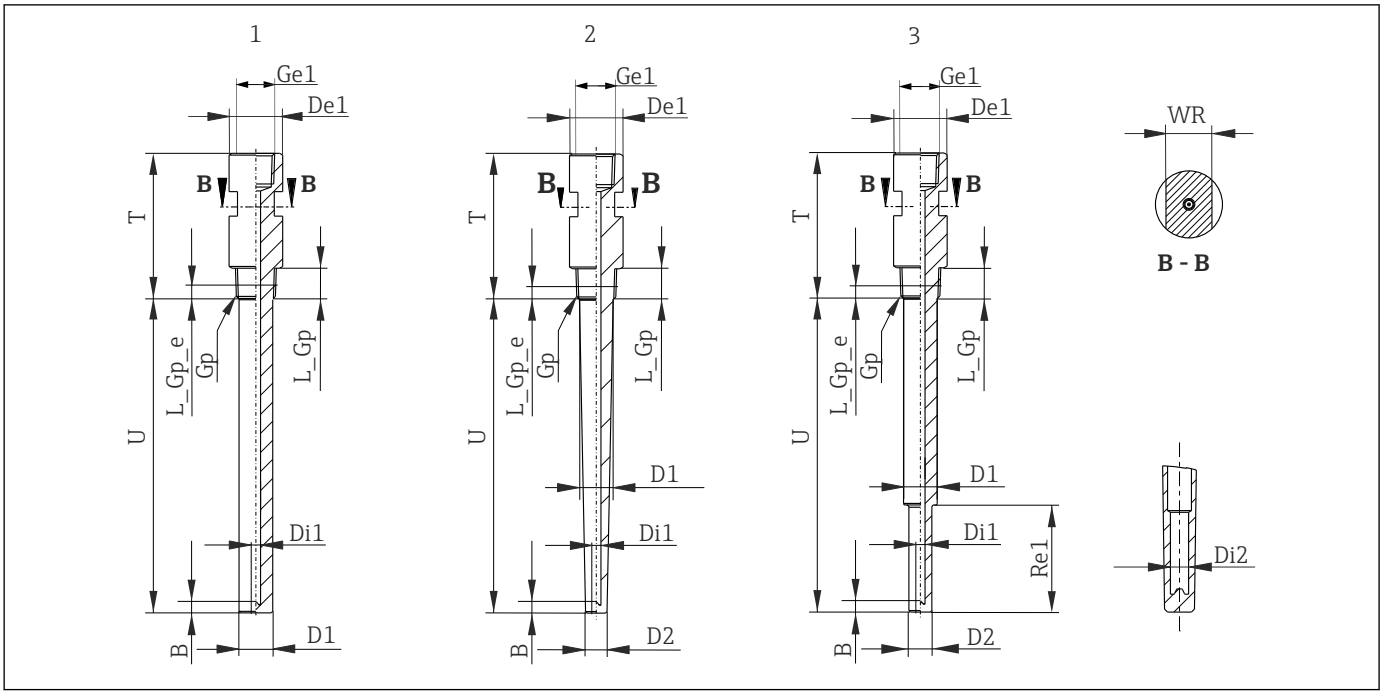
Thermometer connection Ge1	D1	D2	Di1	Length combinations	
				Form 4	Form 4F
M14x1.5	18 mm (0.71 in)	9 mm (0.35 in)	3.5 mm (0.14 in) [1]	▪ L = 110 mm (4.3 in), C1 = 65 mm (2.56 in) ▪ L = 110 mm (4.3 in), C1 = 73 mm (2.87 in) ▪ L = 140 mm (5.51 in), C1 = 65 mm (2.56 in) ▪ L = 170 mm (6.7 in), C1 = 133 mm (5.24 in) ▪ L = 200 mm (7.87 in), C1 = 125 mm (4.92 in)	▪ L = 200 mm (7.87 in), U = 130 mm (5.12 in), C1 = 65 mm (2.56 in) ▪ L = 260 mm (10.24 in), U = 190 mm (7.5 in), C1 = 125 mm (4.92 in) ▪ L = 410 mm (16.14 in), U = 340 mm (13.39 in), C1 = 275 mm (10.83 in)
M18x1.5	24 mm (0.95 in)	12.5 mm (0.49 in)	7 mm (0.28 in)		
M20x1.5 or G ½"	26 mm (1.02 in)	12.5 mm (0.49 in)	7 mm (0.28 in)		
		15 mm (0.6 in)	9 mm (0.35 in)		
M27x2 or G ¾"	32 mm (1.26 in)	17 mm (0.67 in)	11 mm (0.43 in)		
		19 mm (0.75 in)	13 mm (0.51 in)		
		20 mm (0.79 in)	14 mm (0.55 in)		

1) For L > 110 mm (4.3 in), a stepped bore is used (6.5 mm (0.26 in) > 3.5 mm (0.14 in)

TT151 is based on DIN 43772 form 4/4F but allows higher flexibility as in DIN 43772 specified. In the following table are the main deviations listed.

Terminology and definitions	According to Endress+Hauser norms
Materials	TT151 offers a wider range of materials as mentioned in DIN 43772
Tolerances wetted part Form 4	▪ +0/-0.15 mm (0.006 in) for L ≤ 410 mm (16.14 in) ▪ +0/-0.2 mm (0.008 in) for L > 410 mm (16.14 in) ▪ on demand tolerance according DIN43772 can be ordered
Tolerances wetted part Form 4F	▪ +0/-0.15 mm (0.006 in) for L ≤ 410 mm (16.14 in) ▪ +0/-0.2 mm (0.008 in) for L > 410 mm (16.14 in)
Immersion length U	TT151 offers a wider range of lengths than those mentioned in DIN 43772

Universal thermowells



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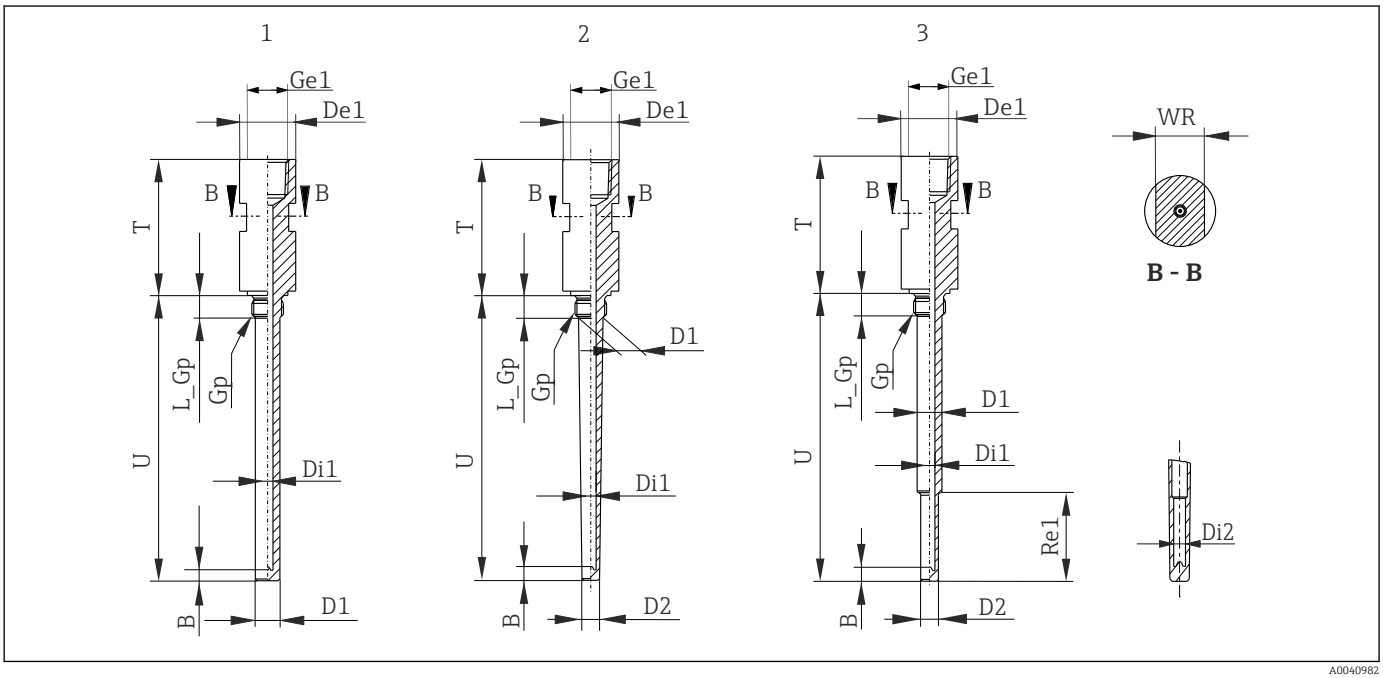
7 Universal thermowells with NPT or R threads

1 *Threaded process connection and wetted part straight; lagging with spanner flats (optional hexagonal lagging available)*
2 *Threaded process connection and wetted part complete tapered; lagging with spanner flats (optional hexagonal lagging available)*
3 *Threaded process connection and wetted part partial tapered; lagging with spanner flats (optional hexagonal lagging available)*



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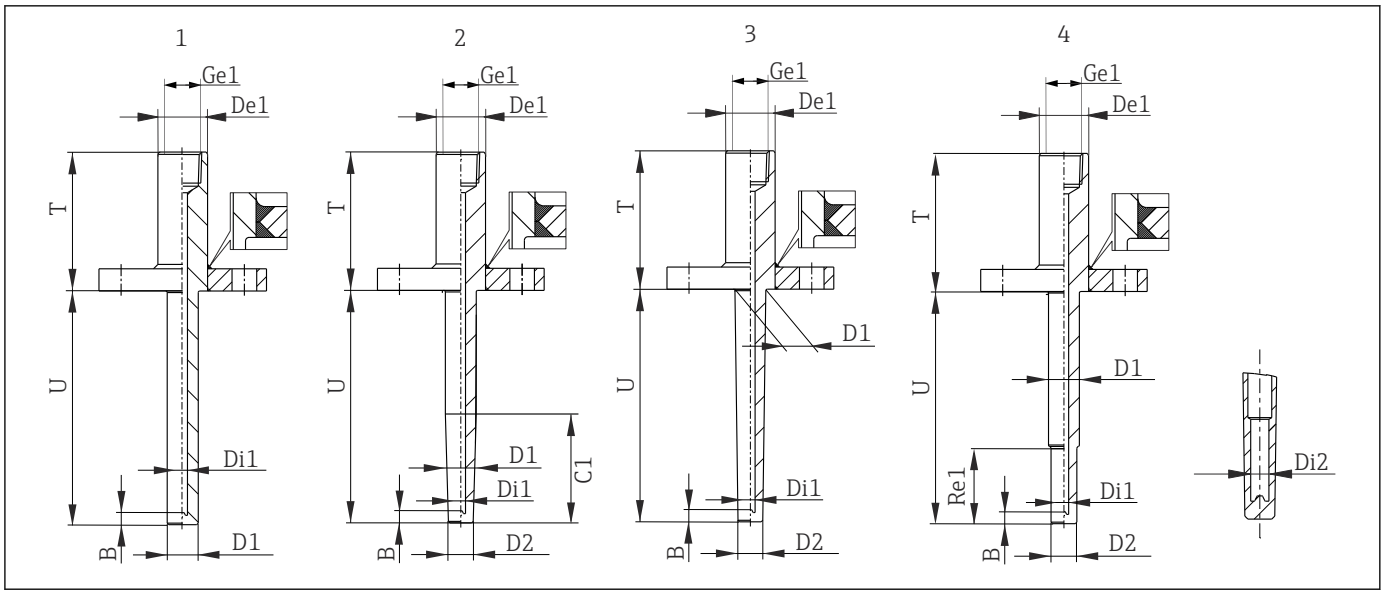
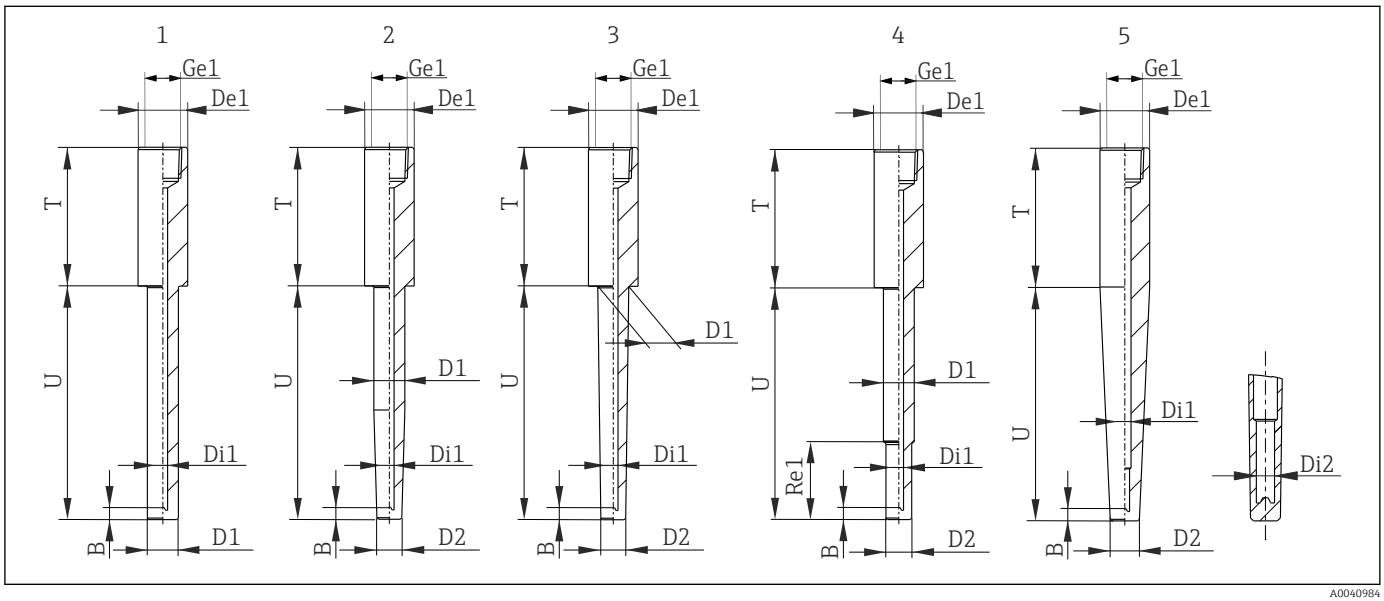
8 Universal thermowells with M or G threads

1 *Threaded process connection and wetted part straight; lagging with spanner flats (optional hexagonal lagging available)*
2 *Threaded process connection and wetted part complete tapered; lagging with spanner flats (optional hexagonal lagging available)*
3 *Threaded process connection and wetted part partial tapered; lagging with spanner flats (optional hexagonal lagging available)*



9 *Universal thermowells*

1 *Flanged process connection and wetted part straight (optional full penetration welding available)*
2 *Flanged process connection and wetted part partial tapered (optional full penetration welding available)*
3 *Flanged process connection and wetted part tapered (optional full penetration welding available)*
4 *Flanged process connection and wetted part stepped (optional full penetration welding available)*



10 *Universal thermowells*

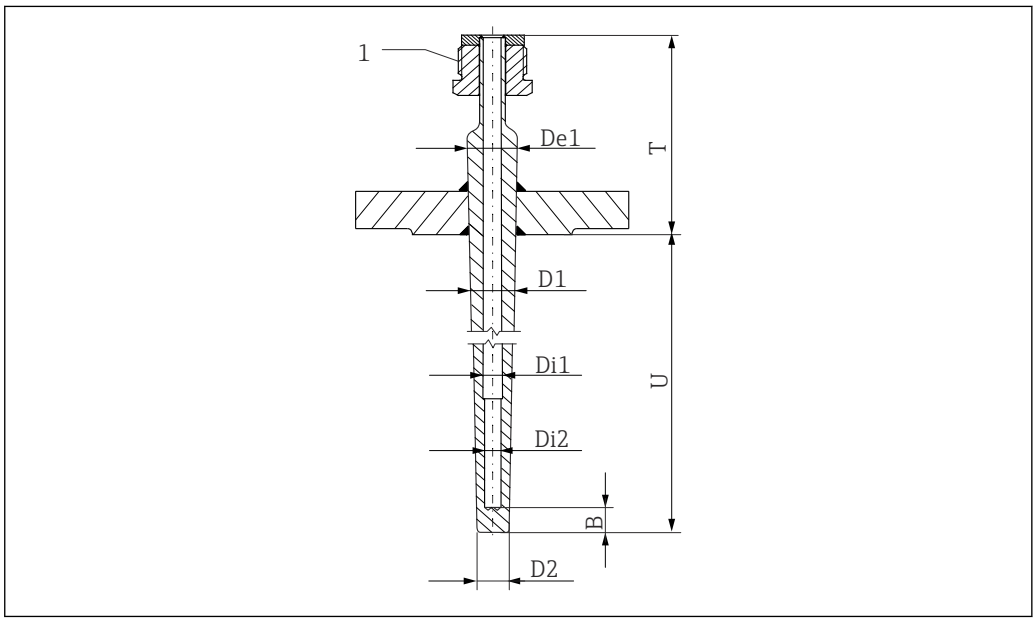
1 *Socket weld process connection and wetted part straight*
2 *Socket weld process connection and wetted part partial tapered*
3 *Socket weld process connection and wetted part tapered*
4 *Socket weld process connection and wetted part stepped*
5 *Weld-in process connection and wetted part tapered*

	Threaded	Flanged	Socket weld/Weld-in
Thermometer connections Ge1	▪ M14x1.5 ▪ M18x1.5 ▪ M20x1.5 ▪ M27x1.5 ▪ G ½" ▪ G ¾" ▪ ½" NPT ▪ ½" NPSC ▪ ½" NPSM		
Process connection size	▪ M18x1.5 ▪ M20x1.5 ▪ M27x2 ▪ M33x2 ▪ G ½" ▪ G ¾" ▪ G 3/8" ▪ G 1" ▪ ½" NPT ▪ ¾" NPT ▪ 1" NPT ▪ R ½" ▪ R ¾"	▪ ANSI 1" from Cl. 150 to Cl. 600 ▪ ANSI 1 ½" from Cl. 150 to Cl. 2500 ▪ ANSI 2" from Cl. 150 to Cl. 2500 ▪ ANSI 3" from Cl. 150 ▪ ANSI 4" from Cl. 300 ▪ PN16 DN25 ▪ PN6 DN80 ▪ PN20 DN25 ▪ PN40 DN25 ▪ PN50 DN25 ▪ PN63 DN50 ▪ PN100 DN25	▪ Ø18 mm (0.71 in) ▪ Ø24 mm (0.94 in) ▪ Ø26 mm (1.02 in) ▪ Ø27 mm (1.06 in) ▪ Ø28 mm (1.1 in) ▪ Ø30 mm (1.18 in) ▪ Ø32 mm (1.26 in) ▪ Ø35 mm (1.38 in) ▪ Ø40 mm (1.57 in) ▪ Ø45 mm (1.77 in) ▪ Ø50 mm (1.97 in) ▪ Ø26.7 mm (NPS ¾") ▪ Ø33.4 mm (NPS 1") ▪ Ø42.2 mm (NPS 1¼") ▪ Ø48.3 mm (NPS 1½")
Process connection material	▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 ▪ 16Mo3 ▪ A105 ▪ C22.8 ▪ Titan Gr2	▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ Alloy C276 ▪ Alloy C276 > 316L ▪ Alloy 600 > 316L ▪ A105	▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 ▪ 16Mo3 ▪ A105 ▪ C22.8 ▪ Titan Gr2
Bar material		▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ 347 ▪ Alloy 600 ▪ Alloy C276 ▪ A105 ▪ C22.8	
Immersion length U	30 to 1 500 mm (1.18 to 59.1 in) [1]		
Lagging length L	70 to 300 mm (2.76 to 11.81 in)		
Lagging diameter De1	See table → 🖹 22	18 to 50 mm (0.71 to 1.97 in)	Equal to "process connection size"
Root diameter D1	9 to 30 mm (0.35 to 1.18 in) [2]	9 to 50 mm (0.35 to 1.97 in)	9 to 50 mm (0.35 to 1.97 in)
Tip diameter D2	9 to 50 mm (0.35 to 1.97 in) [3]		
Bore diameter Di	▪ 3.5 mm (0.14 in) [4] ▪ 6.5 mm (0.26 in) ▪ 7 mm (0.28 in) ▪ 8 mm (0.31 in) ▪ 9 mm (0.35 in) ▪ 9.5 mm (0.37 in) ▪ 10 mm (0.39 in) ▪ Stepped: Di1 = 6.5 mm (0.26 in) > Di2 = 3.5 mm (0.14 in), length: 35 mm (1.38 in) ▪ Stepped: Di1 = 10 mm (0.39 in) > Di2 = 6.5 mm (0.26 in), length: 35 mm (1.38 in) [5]		
Tip thickness B	Default value 6 mm (0.24 in); optional 4 to 12 mm (0.16 to 0.47 in)		

Roughness	Default value 1.6 µm (63 µin); optional 0.76 µm (30 µin)
Stepped length Re1	50 to 350 mm (1.97 to 13.78 in) [6]

1) Maximum immersion length depends on the lagging length
2) Maximum root diameter depends on the process connection size
3) Tip diameter D2 ≤ Root diameter D1
4) For L > 110 mm (4.3 in), a stepped bore is used (6.5 mm (0.26 in) > 3.5 mm (0.14 in)
5) The max. bore diameter depends on the tip diameter
6) Stepped length Re1 << Immersion length U

Thermowell based on NAMUR NE 170



11 Thermowell based on NAMUR NE 170

1 Rotatable male thread

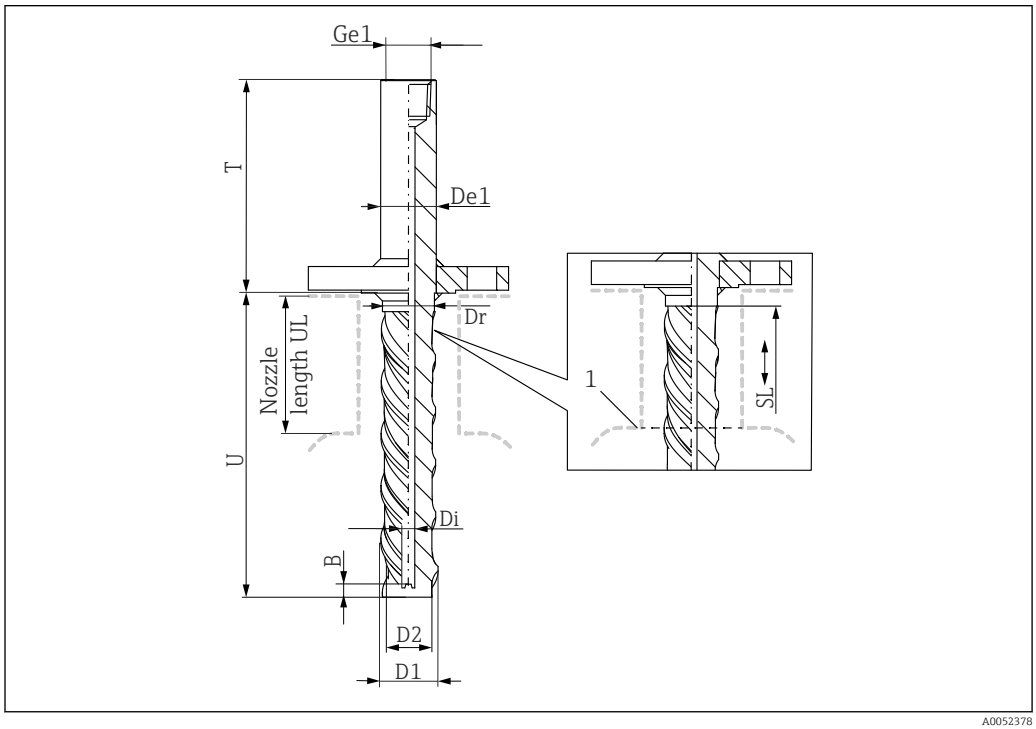
Thermometer connection	Rotatable male thread M24x1.5
Process connection size	▪ ANSI 1" from 150 lb/sq inch to 600 lb/sq inch ▪ ANSI 1 ½" from 150 lb/sq inch to 600 lb/sq inch ▪ ANSI 2" from 150 lb/sq inch to 600 lb/sq inch ▪ EN PN16 DN25 ▪ EN PN40 DN25 ▪ EN PN40 DN40 ▪ EN PN40 DN50
Process connection material	▪ 316 ▪ 316L ▪ 316Ti ▪ Alloy C276
Bar material	▪ 316 ▪ 316L ▪ 316Ti ▪ Alloy C276
Immersion length U	30 to 610 mm (1.18 to 24.02 in)
Lagging length L	142 mm (5.6 in)
Lagging diameter De1	20 mm (0.79 in), reduced to 12 mm (0.47 in)
Root diameter D1	20 mm (0.79 in)
Tip diameter D2	13 mm (0.51 in)

Bore diameter Di	Stepped: Di1 = 7 mm (0.27 in) > Di2 = 6.1 mm (0.24 in), length: 50 mm (1.97 in)
Tip thickness B	7 mm (0.27 in)
Roughness	Default value 0.76 µm (30 µin)

Compatibility of DIN-inserts with thermowells					
Inserts IL	**Thermowell acc. to DIN 43772**		**Thermowell acc. to NAMUR NE 170**		**ModuLine TM151 (without thermowell, without neck pipe)**
	Form	**Immersion length U**	**Form**	**Immersion length U**	**Immersion length U**
315 mm (12.4 in)	3F1	225 mm (8.9 in)	NF1	165 mm (6.5 in)	304 mm (12 in)
375 mm (14.8 in)	3F2	285 mm (11.2 in)	NF2	225 mm (8.9)	364 mm (14.3 in)
435 mm (17.1 in)	3F3	345 mm (13.6 in)	NF3	285 mm (11.82 in)	424 mm (16.7 in)

Maximum flow velocity of process media					
Calculation standard	**Form**	**Immersion length U**	**Max. flow velocity**		
			Water	**CO2**	**Air**
ASME PTC 19.3	NF1	165 mm (6.5 in)	12.5 m/s (39.4 ft/s)	13.1 m/s (43 ft/s)	14.0 m/s (45.9 ft/s)
ASME PTC 19.3	NF2	225 mm (8.86 in)	6.9 m/s (22.6 ft/s)	7.7 m/s (25.3 ft/s)	8.1 m/s (26.6 ft/s)
ASME PTC 19.3	NF3	285 mm (11.2 in)	4.6 m/s (15.1 ft/s)	5.0 m/s (16.4 ft/s)	5.2 m/s (17.1 ft/s)
Reference value					
DIN 43772	3F1	225 mm (8.86 in)	4.2 m/s (13.8 ft/s)	4.2 m/s (13.8 ft/s)	4.2 m/s (13.8 ft/s)

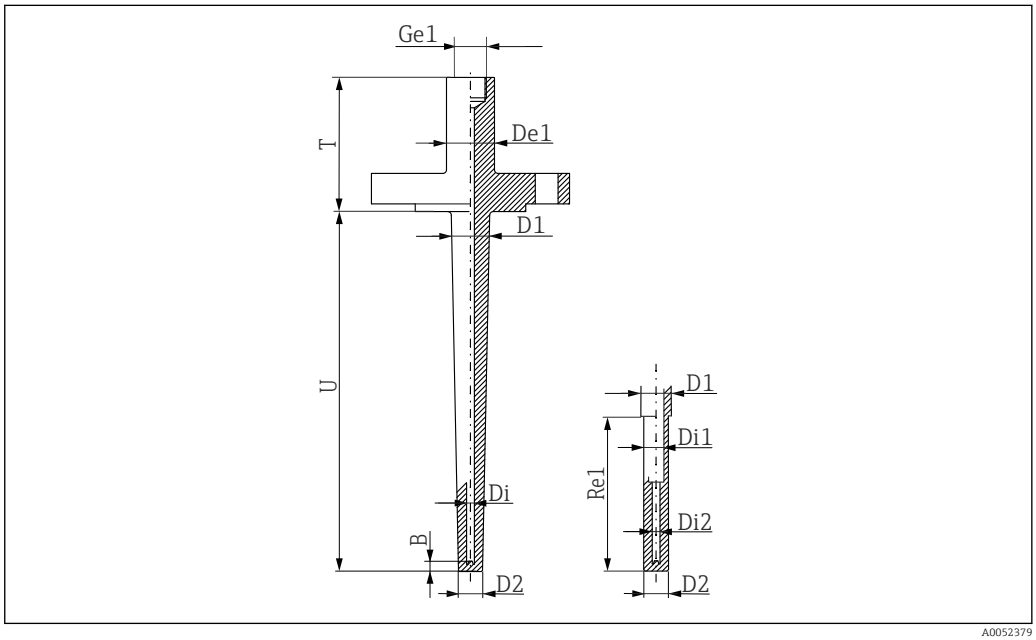
Thermowell iTHERM TwistWell



The strakes must be in the flow area to ensure the stability of the thermowell. The length of the strakes (SL) is set at the factory so that it extends at least from the tip to the start of the nozzle (1).

Thermometer connection Ge1	▪ M18x1.5 ▪ G ½" ▪ NPT ½"		
Process connection size	▪ ANSI 1" from 150 lb/sq inch to 600 lb/sq inch ▪ ANSI 1 ½" from 150 lb/sq inch to 600 lb/sq inch ▪ ANSI 2" from 150 lb/sq inch to 600 lb/sq inch ▪ EN PN16 DN25 ▪ EN PN40 DN25 ▪ EN PN50 DN25 ▪ EN PN40 DN40 ▪ EN PN40 DN50 ▪ EN PN63 DN50		
Process connection material	▪ 316 ▪ 316L ▪ 316Ti		
Bar material	▪ 316 ▪ 316L ▪ 316Ti		
Immersion length U	60 to 800 mm (2.36 to 31.5 in)		
Unstreamed length UL	60 to 790 mm (2.36 to 31.1 in)		
Lagging length T	70 to 300 mm (2.76 to 11.81 in)		
Lagging diameter De1	30 mm (1.18 in)	25 mm (0.98 in)	25 mm (0.98 in)
Strake diameter (root and tip) D1	30 mm (1.18 in)	25 mm (0.98 in)	22 mm (0.87 in)
Root diameter meter body Dr	28 mm (1.10 in)	22 mm (0.87 in)	20 mm (0.79 in)
Tip diameter meter body D2	22 mm (0.87 in)	17 mm (0.67 in)	15 mm (0.59 in)
Bore diameter Di	▪ 6.5 mm (0.26 in) ▪ 7 mm (0.28 in) ▪ Stepped: Di1 = 7 mm (0.28 in) > Di2 = 6.1 mm (0.24 in), length: 50 mm (1.97 in)		
Tip thickness B	6 mm (0.24 in)		
Roughness	0.76 µm (30 µin)		
Number of strakes	3		

Forged thermowell



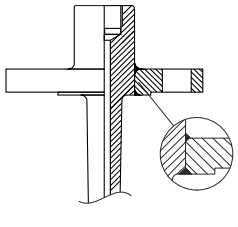
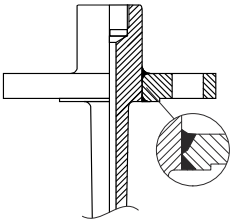
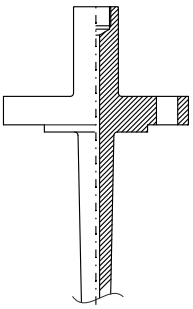
A0052379

To avoid having to use welded flanged process connections, you can opt for a forged thermowell. This offers the highest level of fatigue resistance in accordance with ASME PTC 19.3 TW. Opting for a forged thermowell means that welding seam checks and faults can be excluded. It can be used in extreme process environments.

This applies to the following thermowell versions: flanged, references acc. to ASME/Universal/DIN

Thermometer connection Ge1	▪ M14x1.5 ▪ M18x1.5 ▪ M20x1.5 ▪ M27x2 ▪ G ½" ▪ G ¾" ▪ ½" NPT ▪ ½" NPSC ▪ ½" NPSM
Process connection size	▪ ANSI 1" from 150 lb/sq inch to 600 lb/sq inch ▪ ANSI 1 ½" from 150 lb/sq inch to 600 lb/sq inch ▪ ANSI 2" from 150 lb/sq inch to 600 lb/sq inch ▪ EN PN16 DN25 ▪ EN PN40 DN25 ▪ EN PN50 DN25 ▪ EN PN100 DN25 ▪ EN PN40 DN40 ▪ EN PN40 DN50 ▪ 10K JIS 50A
Process connection material **Bar material**	▪ 316 ▪ 316L
Immersion length U	30 to 580 mm (1.18 to 22.8 in)
Lagging length T	70 to 100 mm (2.76 to 3.93 in)
Lagging diameter De1	18 to 45 mm (0.71 to 1.77 in)
Root diameter D1 **Tip diameter D2**	9 to 45 mm (0.35 to 1.77 in)
Bore diameter Di	▪ 6.5 mm (0.26 in) ▪ 7 mm (0.28 in) ▪ 8 mm (0.32 in) ▪ 9 mm (0.35 in) ▪ 9.5 mm (0.37 in) ▪ 10 mm (0.39 in) ▪ 11 mm (0.43 in) ▪ 13 mm (0.51 in) ▪ 14 mm (0.55 in) ▪ Stepped: Di1 = 6.5 mm (0.26 in) > Di2 = 3.5 mm (0.14 in), length: 35 mm (1.38 in) ▪ Stepped: Di1 = 10 mm (0.39 in) > Di2 = 6.5 mm (0.26 in), length: 35 mm (1.38 in)
Tip thickness B	Default value 6 mm (0.24 in); optional 4 to 12 mm (0.16 to 0.47 in)
Roughness	Default value 1.6 µm (63 µin); optional 0.76 µm (30 µin)
Stepped length Re1	50 to 350 mm (1.97 to 13.8 in)

Versions of flanged thermowells

Welded on both sides	Full penetration weld	Forged - not welded
 A0052792	 A0052794	 A0052702
▪ Suitable for majority of applications ▪ Meets the requirements for a reasonable cost-benefit ratio	▪ Suitable for harsh application conditions ▪ Stronger welds ▪ Higher costs	▪ Suitable for harsh application conditions ▪ No welding ▪ More cost-effective alternative to a full penetration welded flange

Weight

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

Materials

Thermowell and process connections.

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.

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

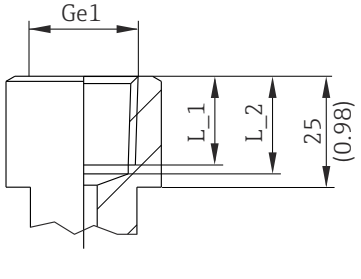
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorinated and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)
AISI 316L/1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1202 °F) [2]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316Ti/1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F) [2)]	▪ Properties comparable with AISI316L ▪ Addition of titanium means increased resistance to intergranular corrosion even after welding ▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ▪ Can only be polished to a limited extent, titanium streaks can form
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 347 / 1.4550	X6CrNiNb18-10	900 °C (1 652 °F)	▪ Austenitic, stainless steel ▪ Better intercrystalline corrosion resistance in oxidizing environments ▪ Good welding properties ▪ For high-temperature applications like furnaces
AISI 310 / 1.4841	X15CrNiSi25-20	1 100 °C (2 012 °F)	▪ Austenitic, stainless steel ▪ Generally good resistance to oxidizing and reducing atmospheres ▪ Due to the higher chromium content, good resistance to oxidizing aqueous solutions and neutral salts melting at higher temperatures ▪ Only low resistance to sulfur-containing gases
AISI A105/ 1.0460	C22.8	450 °C (842 °F)	▪ Heat-resistant steel ▪ Resistant in nitrogen-containing atmospheres an 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)	▪ 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

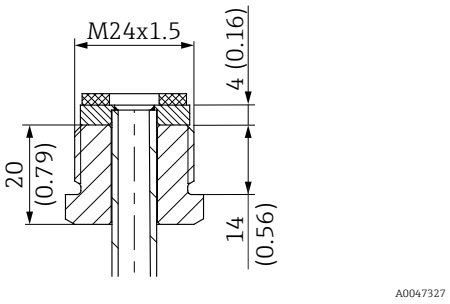
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
Titanium / 3.7035	-	600 °C (1 112 °F)	▪ A light metal with very high corrosion resistance and strength values ▪ Very good resistance to many oxidizing mineral and organic acids, saline solutions, sea water etc. ▪ Prone to fast embrittlement at high temperatures through the absorption of oxygen, nitrogen and hydrogen ▪ Compared to other metals, titanium reacts readily with many media (O_2, N_2, Cl_2, H_2) at higher temperatures and/or increased pressure ▪ Can only be used in chlorine gas and chlorinated media at comparatively low temperatures (<400 °C)
1.5415	16Mo3	530 °C (986 °F)	▪ Alloyed creep-resistant steel ▪ Particularly well suited as pipe material for boiler construction, super heater tube, superheated steam and collecting pipe, stove and line pipes, for heat exchangers and for the purposes of oil-refining industries
Duplex S32202	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
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

1) Can be used to a limited extent up to 800 °C (1472 °F) for low mechanical loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.
2) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.

Thermometer connection

Thermometer connection	Ge1	L_1	L_2	Standard/Class
 12 *Female thread*	M14x1.5	17 mm (0.67 in)	20 mm (0.79 in)	ASME B1.13M/ISO 965-1 H6
	M18x1.5			ASME B1.13M/ISO 965-1 H6
	M20x1.5			ASME B1.13M/ISO 965-1 H6
	M27x2			ASME B1.13M/ISO 965-1 H6
	G½"			ISO 228-1 A
	G¾"			ISO 228-1 A

Thermometer connection	Ge1	L_1	L_2	Standard/Class
	½" NPT/NPSC/NPSM			ANSI B1.20.1

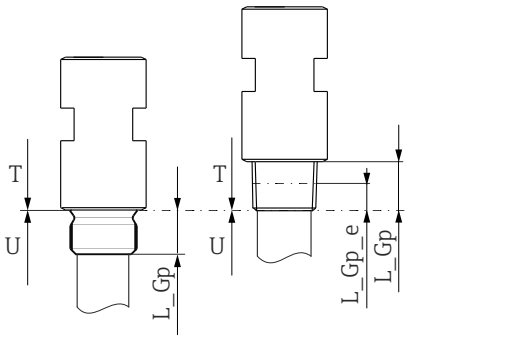


13 Adjustable male thread

Process connections

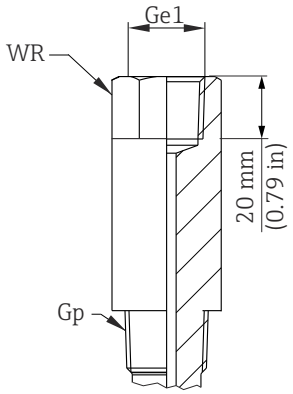
Standard connections are available as weld-in, socket weld, threaded connection or flanged versions.

Thread

Threaded process connection	Version		Thread length L_Gp	Standard	Max. process pressure
 *14 Cylindrical (left side) and conical (right side) version*	M	M20x1.5	14 mm (0.55 in)	ASME B1.13M ISO 965-1 g6	Maximum static process pressure for threaded process connection: [1] 400 bar (5 802 psi) at +400 °C (+752 °F)
		M18x1.5	12 mm (0.47 in)		
		M27x2	16 mm (0.63 in)		
		M33x2	18 mm (0.71 in)		
	G	G½"	15 mm (0.6 in)	ISO 228-1 A	
		G1"	18 mm (0.71 in)		
		G¾"	16 mm (0.6 in)		
		G3/8"	12 mm (0.47 in)		
	NPT	NPT½"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)	ANSI B1.20.1	
		NPT¾"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)		
		NPT1"	25 mm (0.98 in) L_Gp_e: 10 mm (0.39 in)		
	R	R½"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)	DIN EN 10226-1 JIS B 0203	
		R¾"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 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 (with hexagonal lagging)



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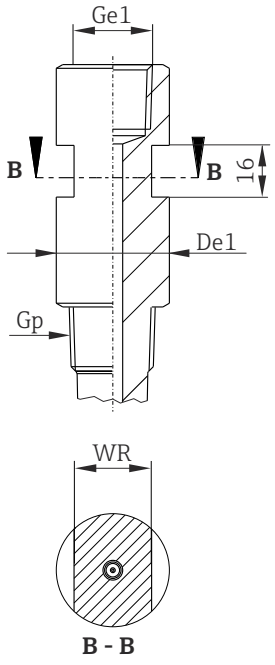
		Process connection size Gp (male thread)											
		M18x1.5	G3/8"	NPT½"	R ½"	M20x1.5	G½"	R¾"	NPT¾"	M27x2	G¾"	NPT1"	M33x2	G1"
Thermometer connection size Ge1 (female thread)	M14x1.5	WR 24	WR 24	WR 24	WR 24	WR 27	WR 27	WR 27	WR 27	WR 36	WR 36	WR 36	WR 41	WR 41
	M18x1.5													
	M20x1.5													
	NPT½"													
	G½"													
	NPSC1/2													
	NPSM1/2													
	M27x2	WR 36	WR 36	WR 36	WR 36	WR 36	WR 36	WR 36	WR 36					
	G¾"													

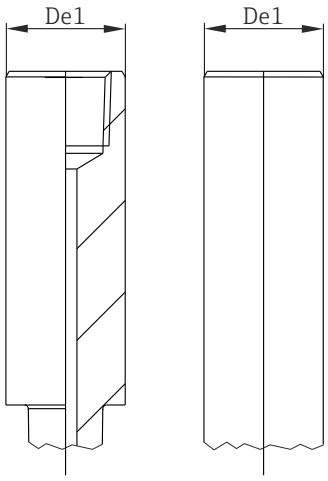
WR size matrix for threaded thermowells with spanner flats



A0040986

Lagging diameter De1 (dimensions in mm (in))	Spanner flat WR
26.7 mm (1.05 in)/27 mm (1.06 in)/28 mm (1.10 in)	22
30 mm (1.18 in)	24
32 mm (1.26 in)/33.4 mm (1.32 in)/35 mm (1.38 in)	27
40 mm (1.57 in)/42 mm (1.65 in)/45 mm (1.77 in)	36
48.3 mm (1.9 in)/50 mm (1.97 in)	41

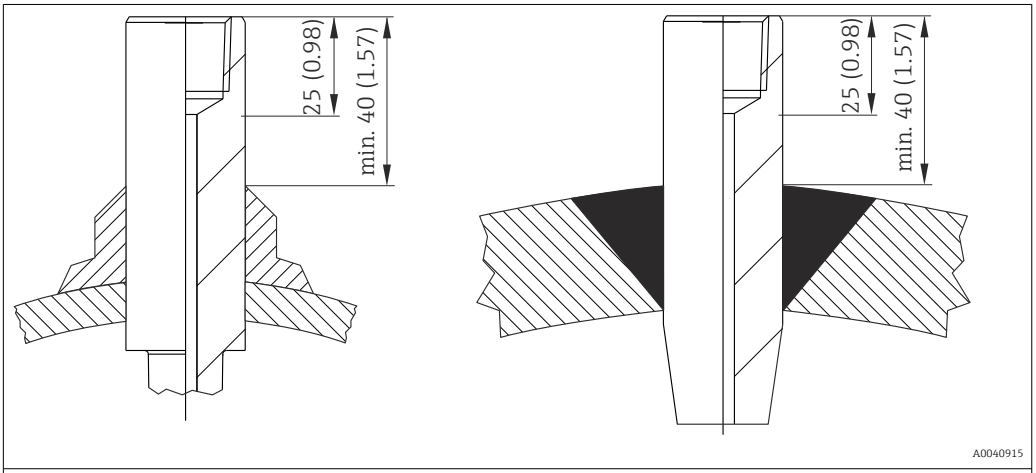
Weld-in version/socket weld



De1

- Φ 18 mm (0.71 in)
- Φ 24 mm (0.94 in)
- Φ 26 mm (1.02 in)
- Φ 27 mm (1.06 in)
- Φ 28 mm (1.10 in)
- Φ 30 mm (1.18 in)
- Φ 32 mm (1.26 in)
- Φ 35 mm (1.38 in)
- Φ 40 mm (1.57 in)
- Φ 45 mm (1.77 in)
- Φ 50 mm (1.97 in)
- Φ 26.7 mm (NPS ¾")
- Φ 33.4 mm (NPS 1")
- Φ 42.2 mm (NPS 1¼")
- Φ 48.3 mm (NPS 1½")

Welding recommendation



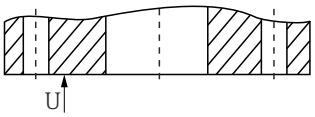
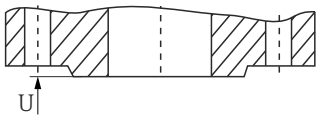
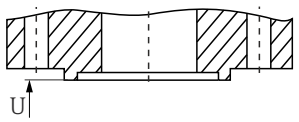
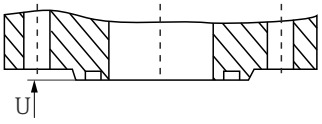
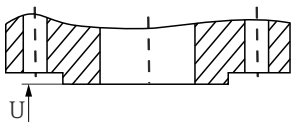
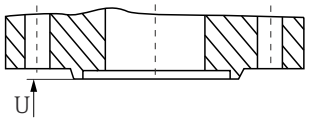
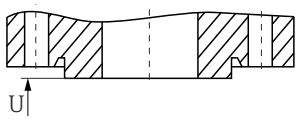
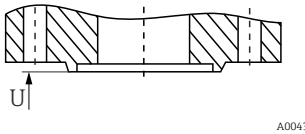
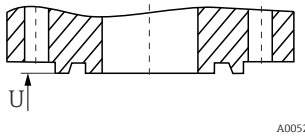
Welding recommendation: Distance between welding seam and end of thermowell should be minimum 40 mm. To avoid thread deformations a dummy plug is recommended.

Flanges

The flanges are supplied in stainless steel AISI 316L with material number 1.4404 or 1.4435. With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in DIN EN 1092-1 Tab.18 and under 023b in JIS B2220:2004 Tab. 5. 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 2.54. In the ASME standard, the metric data is rounded to 0 or 5.

Versions
- DIN flanges: German Standards Institute DIN 2527
- EN flanges: European standard DIN EN 1092-1:2002-06 and 2007
- ASME flanges: American Society of Mechanical Engineers ASME B16.5-2013
- JIS flanges: Japanese Industrial Standard B2220:2004
- HG/T flanges: Chinese Chemical Standard HG/T 20592-2009 and 20615-2009

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	 A0043514	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	 A0043516	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)	
Tongue	 A0043517	F	-	C	3.2 to 12.5	0.8 to 3.2	Tongue (T)	3.2
Groove	 A0043518	N		D			Groove (G)	
Projection	 A0043519	V 13	-	E	12.5 to 50	3.2 to 12.5	Male (M)	3.2
Recess	 A0043520	R 13		F			Female (F)	
Projection	 A0043521	V 14	for O-rings	H	3.2 to 12.5	3.2 to 12.5	-	-
Recess	 A0043522	R 14		G			-	-
With ring-type joint	 A0052680	-	-	-	-	-	Ring-type joint (RTJ)	1.6

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

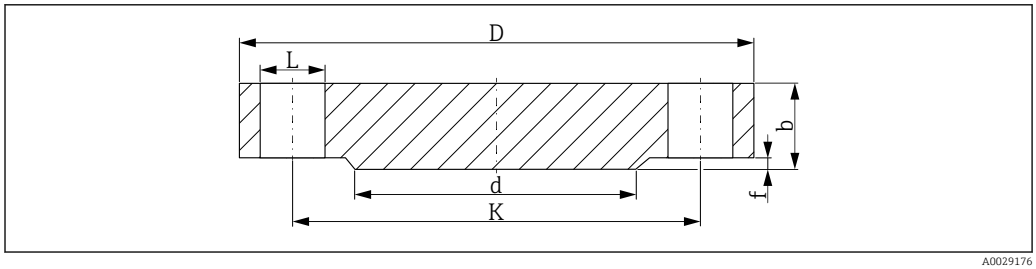
Flanges according to the old DIN standard are compatible with the new DIN EN 1092-1 standard.
Change in pressure ratings: Old DIN standards PN64 → DIN EN 1092-1 PN63.

Height of raised face [1)]

Standard	Flanges	Height of raised face f	Tolerance
DIN EN 1092-1:2002-06	all types	2 (0.08)	0 −1 (−0.04)
DIN EN 1092-1:2007	≤ DN 32		
	> DN 32 to DN 250	3 (0.12)	0 −2 (−0.08)
	> DN 250 to DN 500	4 (0.16)	0 −3 (−0.12)
	> DN 500	5 (0.19)	0 −4 (−0.16)
ASME B16.5 - 2013	≤ Class 300	1.6 (0.06)	±0.75 (±0.03)
	≥ Class 600	6.4 (0.25)	0.5 (0.02)
JIS B2220:2004	< DN 20	1.5 (0.06) 0	-
	> DN 20 to DN 50	2 (0.08) 0	
	> DN 50	3 (0.12) 0	

1) Dimensions in mm (in)

EN flanges (DIN EN 1092-1)



15 Raised face B1

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 (generally 2 mm (0.08 in)

PN16 [1)]

DN	D	b	K	d	L	approx. kg (lbs)
25	115 (4.53)	18 (0.71)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
32	140 (5.51)	18 (0.71)	100 (3.94)	78 (3.07)	4xØ18 (0.71)	2.00 (4.41)
40	150 (5.91)	18 (0.71)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	18 (0.71)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	2.90 (6.39)
65	185 (7.28)	18 (0.71)	145 (5.71)	122 (4.80)	8xØ18 (0.71)	3.50 (7.72)
80	200 (7.87)	20 (0.79)	160 (6.30)	138 (5.43)	8xØ18 (0.71)	4.50 (9.92)
100	220 (8.66)	20 (0.79)	180 (7.09)	158 (6.22)	8xØ18 (0.71)	5.50 (12.13)
125	250 (9.84)	22 (0.87)	210 (8.27)	188 (7.40)	8xØ18 (0.71)	8.00 (17.64)

DN	D	b	K	d	L	approx. kg (lbs)
150	285 (11.2)	22 (0.87)	240 (9.45)	212 (8.35)	8xØ22 (0.87)	10.5 (23.15)
200	340 (13.4)	24 (0.94)	295 (11.6)	268 (10.6)	12xØ22 (0.87)	16.5 (36.38)
250	405 (15.9)	26 (1.02)	355 (14.0)	320 (12.6)	12xØ26 (1.02)	25.0 (55.13)
300	460 (18.1)	28 (1.10)	410 (16.1)	378 (14.9)	12xØ26 (1.02)	35.0 (77.18)

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

PN25

DN	D	b	K	d	L	approx. kg (lbs)
25	115 (4.53)	18 (0.71)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
32	140 (5.51)	18 (0.71)	100 (3.94)	78 (3.07)	4xØ18 (0.71)	2.00 (4.41)
40	150 (5.91)	18 (0.71)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	20 (0.79)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	3.00 (6.62)
65	185 (7.28)	22 (0.87)	145 (5.71)	122 (4.80)	8xØ18 (0.71)	4.50 (9.92)
80	200 (7.87)	24 (0.94)	160 (6.30)	138 (5.43)	8xØ18 (0.71)	5.50 (12.13)
100	235 (9.25)	24 (0.94)	190 (7.48)	162 (6.38)	8xØ22 (0.87)	7.50 (16.54)
125	270 (10.6)	26 (1.02)	220 (8.66)	188 (7.40)	8xØ26 (1.02)	11.0 (24.26)
150	300 (11.8)	28 (1.10)	250 (9.84)	218 (8.58)	8xØ26 (1.02)	14.5 (31.97)
200	360 (14.2)	30 (1.18)	310 (12.2)	278 (10.9)	12xØ26 (1.02)	22.5 (49.61)
250	425 (16.7)	32 (1.26)	370 (14.6)	335 (13.2)	12xØ30 (1.18)	33.5 (73.9)
300	485 (19.1)	34 (1.34)	430 (16.9)	395 (15.6)	16xØ30 (1.18)	46.5 (102.5)

PN40

DN	D	b	K	d	L	approx. kg (lbs)
15	95 (3.74)	16 (0.55)	65 (2.56)	45 (1.77)	4xØ14 (0.55)	0.81 (1.8)
25	115 (4.53)	18 (0.71)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
32	140 (5.51)	18 (0.71)	100 (3.94)	78 (3.07)	4xØ18 (0.71)	2.00 (4.41)
40	150 (5.91)	18 (0.71)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	20 (0.79)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	3.00 (6.62)
65	185 (7.28)	22 (0.87)	145 (5.71)	122 (4.80)	8xØ18 (0.71)	4.50 (9.92)
80	200 (7.87)	24 (0.94)	160 (6.30)	138 (5.43)	8xØ18 (0.71)	5.50 (12.13)
100	235 (9.25)	24 (0.94)	190 (7.48)	162 (6.38)	8xØ22 (0.87)	7.50 (16.54)
125	270 (10.6)	26 (1.02)	220 (8.66)	188 (7.40)	8xØ26 (1.02)	11.0 (24.26)
150	300 (11.8)	28 (1.10)	250 (9.84)	218 (8.58)	8xØ26 (1.02)	14.5 (31.97)
200	375 (14.8)	36 (1.42)	320 (12.6)	285 (11.2)	12xØ30 (1.18)	29.0 (63.95)
250	450 (17.7)	38 (1.50)	385 (15.2)	345 (13.6)	12xØ33 (1.30)	44.5 (98.12)
300	515 (20.3)	42 (1.65)	450 (17.7)	410 (16.1)	16xØ33 (1.30)	64.0 (141.1)

PN63

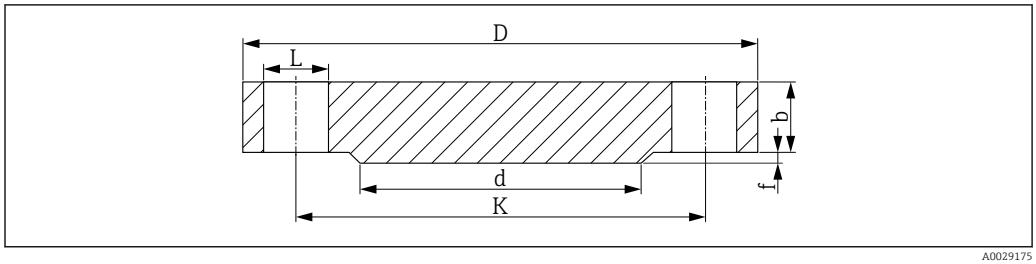
DN	D	b	K	d	L	approx. kg (lbs)
25	140 (5.51)	24 (0.94)	100 (3.94)	68 (2.68)	4xØ18 (0.71)	2.50 (5.51)
32	155 (6.10)	24 (0.94)	110 (4.33)	78 (3.07)	4xØ22 (0.87)	3.50 (7.72)
40	170 (6.69)	26 (1.02)	125 (4.92)	88 (3.46)	4xØ22 (0.87)	4.50 (9.92)

DN	D	b	K	d	L	approx. kg (lbs)
50	180 (7.09)	26 (1.02)	135 (5.31)	102 (4.02)	4xØ22 (0.87)	5.00 (11.03)
65	205 (8.07)	26 (1.02)	160 (6.30)	122 (4.80)	8xØ22 (0.87)	6.00 (13.23)
80	215 (8.46)	28 (1.10)	170 (6.69)	138 (5.43)	8xØ22 (0.87)	7.50 (16.54)
100	250 (9.84)	30 (1.18)	200 (7.87)	162 (6.38)	8xØ26 (1.02)	10.5 (23.15)
125	295 (11.6)	34 (1.34)	240 (9.45)	188 (7.40)	8xØ30 (1.18)	16.5 (36.38)
150	345 (13.6)	36 (1.42)	280 (11.0)	218 (8.58)	8xØ33 (1.30)	24.5 (54.02)
200	415 (16.3)	42 (1.65)	345 (13.6)	285 (11.2)	12xØ36 (1.42)	40.5 (89.3)
250	470 (18.5)	46 (1.81)	400 (15.7)	345 (13.6)	12xØ36 (1.42)	58.0 (127.9)
300	530 (20.9)	52 (2.05)	460 (18.1)	410 (16.1)	16xØ36 (1.42)	83.5 (184.1)

PN100

DN	D	b	K	d	L	approx. kg (lbs)
25	140 (5.51)	24 (0.94)	100 (3.94)	68 (2.68)	4xØ18 (0.71)	2.50 (5.51)
32	155 (6.10)	24 (0.94)	110 (4.33)	78 (3.07)	4xØ22 (0.87)	3.50 (7.72)
40	170 (6.69)	26 (1.02)	125 (4.92)	88 (3.46)	4xØ22 (0.87)	4.50 (9.92)
50	195 (7.68)	28 (1.10)	145 (5.71)	102 (4.02)	4xØ26 (1.02)	6.00 (13.23)
65	220 (8.66)	30 (1.18)	170 (6.69)	122 (4.80)	8xØ26 (1.02)	8.00 (17.64)
80	230 (9.06)	32 (1.26)	180 (7.09)	138 (5.43)	8xØ26 (1.02)	9.50 (20.95)
100	265 (10.4)	36 (1.42)	210 (8.27)	162 (6.38)	8xØ30 (1.18)	14.0 (30.87)
125	315 (12.4)	40 (1.57)	250 (9.84)	188 (7.40)	8xØ33 (1.30)	22.5 (49.61)
150	355 (14.0)	44 (1.73)	290 (11.4)	218 (8.58)	12xØ33 (1.30)	30.5 (67.25)
200	430 (16.9)	52 (2.05)	360 (14.2)	285 (11.2)	12xØ36 (1.42)	54.5 (120.2)
250	505 (19.9)	60 (2.36)	430 (16.9)	345 (13.6)	12xØ39 (1.54)	87.5 (192.9)
300	585 (23.0)	68 (2.68)	500 (19.7)	410 (16.1)	16xØ42 (1.65)	131.5 (289.9)

ASME flanges (ASME B16.5-2013)



16 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)

DN	D	b	K	d	L	approx. kg (lbs)
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)

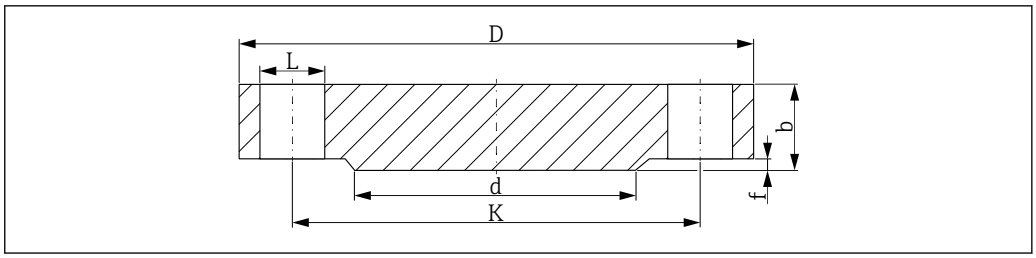
Class 900

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)

HG/T flanges (HG/T 20592-2009)



17 *Raised face*

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 (generally 2 mm (0.08 in)

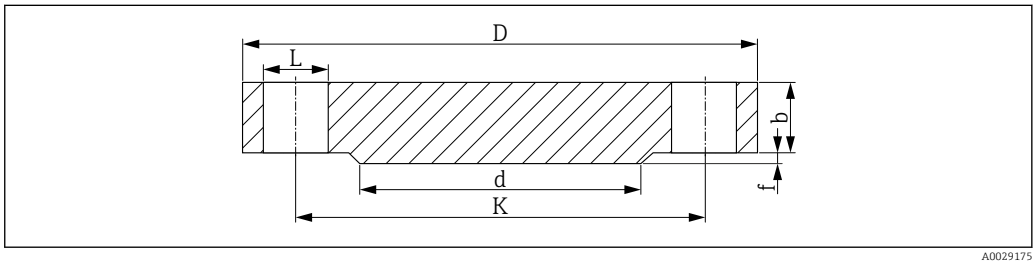
PN40

DN	D	b	K	d	L	approx. kg (lbs)
25	115 (4.53)	16 (0.63)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
40	150 (5.91)	16 (0.63)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	18 (0.71)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	3.00 (6.62)

PN63

DN	D	b	K	d	L	approx. kg (lbs)
50	180 (7.09)	24 (0.95)	135 (5.31)	102 (4.02)	4xØ22 (0.87)	5.00 (11.03)

HG/T flanges (HG/T 20615-2009)



18 *Raised face*

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: 2 mm (0.08 in) or from Class 600: 7 mm (0.28 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"	110.0 (4.33)	12.7 (0.5)	79.4 (3.13)	50.8 (2.00)	4xØ16 (0.63)	0.86 (1.9)
1½"	125.0 (4.92)	15.9 (0.63)	98.4 (3.87)	73.0 (2.87)	4xØ16 (0.63)	1.53 (3.37)
2"	150 (5.91)	17.5 (0.69)	120.7 (4.75)	92.1 (3.63)	4xØ18 (0.71)	2.42 (5.34)

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

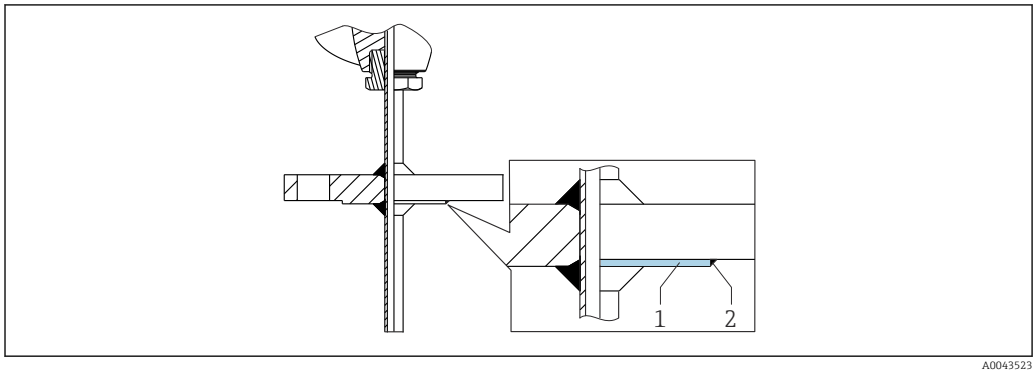
Class 300

DN	D	b	K	d	L	approx. kg (lbs)
1"	125.0 (4.92)	15.9 (0.63)	88.9 (3.50)	50.8 (2.00)	4xØ18 (0.71)	1.39 (3.06)
1½"	155 (6.10)	19.1 (0.75)	114.3 (4.50)	73 (2.87)	4xØ22 (0.87)	2.66 (5.87)
2"	165 (6.50)	20.7 (0.82)	127.0 (5.00)	92.1 (3.63)	8xØ18 (0.71)	3.18 (7.01)

Class 600

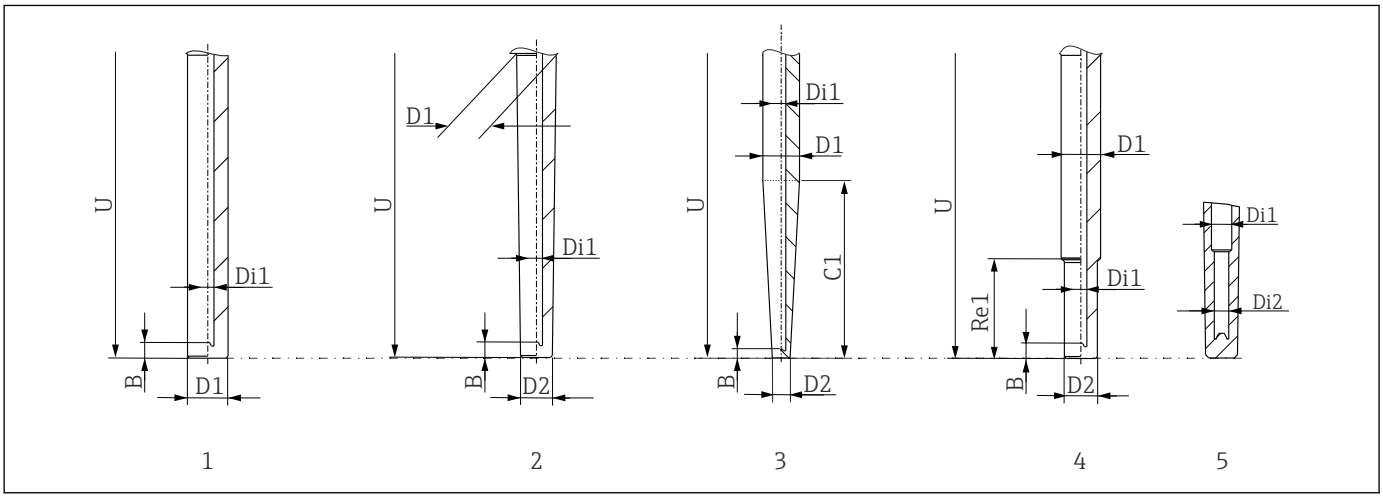
DN	D	b	K	d	L	approx. kg (lbs)
2"	165 (6.50)	25.4 (1.00)	127.0 (5.00)	92.1 (3.63)	8xØ18 (0.71)	4.15 (9.15)

Thermowell material, nickel-based, with flange
If the thermowell materials Alloy600 and Alloy C276 are combined with a flange process connection, only the raised face and not the complete flange is made of the alloy for cost reasons. This is welded onto a flange with the parent material 316L. Identified in the order code by the material designation Alloy600 > 316L or Alloy C276 > 316L.



1 Raised face
2 Weld

Geometry of parts in contact with medium



1 Straight (complete length U)
2 Tapered (complete length U)
3 Tapered (over length C1)
4 Stepped, Re1 = 63.5 mm (2.5 in)
5 Stepped bore diameter (Di1/Di2)

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:

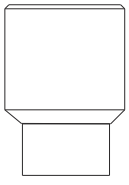
1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as 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

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories

Accessories	Description
Welding boss TA115  A0054624	Welding boss for barstock thermowell according to DIN 43772 form 4. Round barstock, diameter 50 mm, L=50 mm **Order number: TA115-**

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser devices: ▪ Calculation of all the necessary data for identifying the optimum device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator

Accessories	Description
Configurator	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 The Product Configurator is available on the Endress+Hauser website: www.endress.com-> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.

Supplementary 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.
Description of Device Parameters (GP)	**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.
Safety Instructions (XA)	Depending on the approval, Safety Instructions (XA) are supplied with the device. The Safety Instructions are an integral part of the Operating Instructions. Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.

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