

Technical Information

iTHERM TT151

Bar stock 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

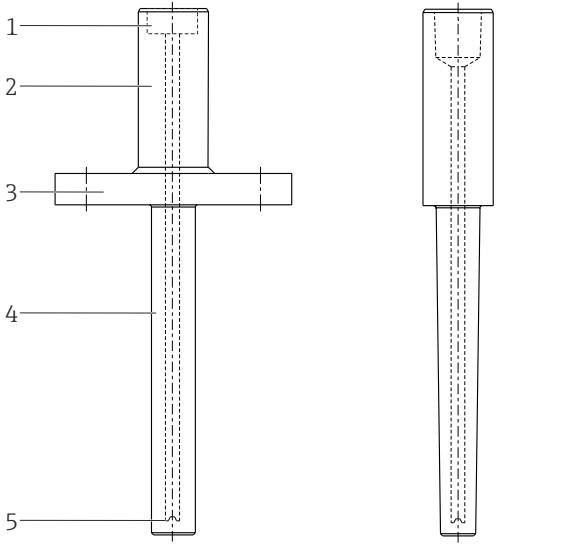
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Function and system design

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. |

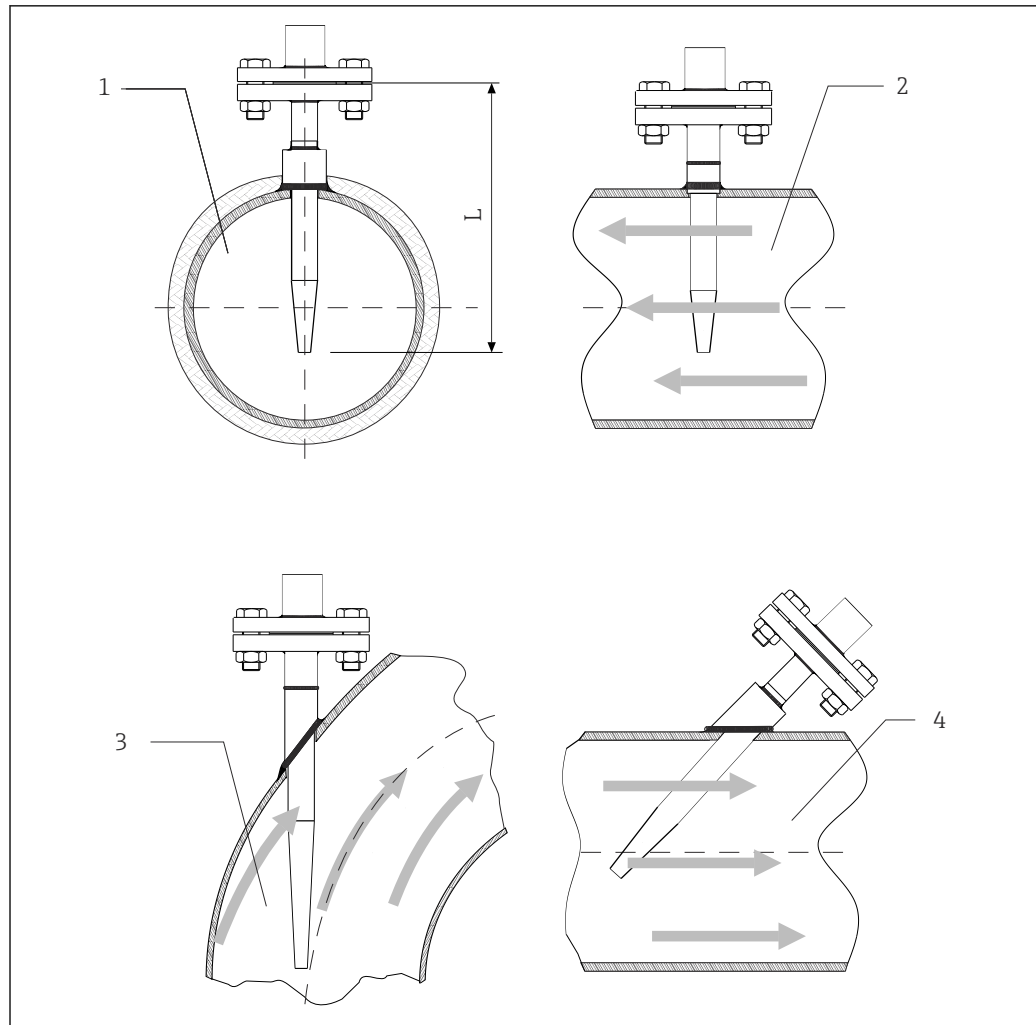
Installation

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



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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.

i 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, process pressure).

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

i The counterpieces for the process connections and the seals or sealing rings are not included in the scope of supply for 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. → 20

i 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. → 31

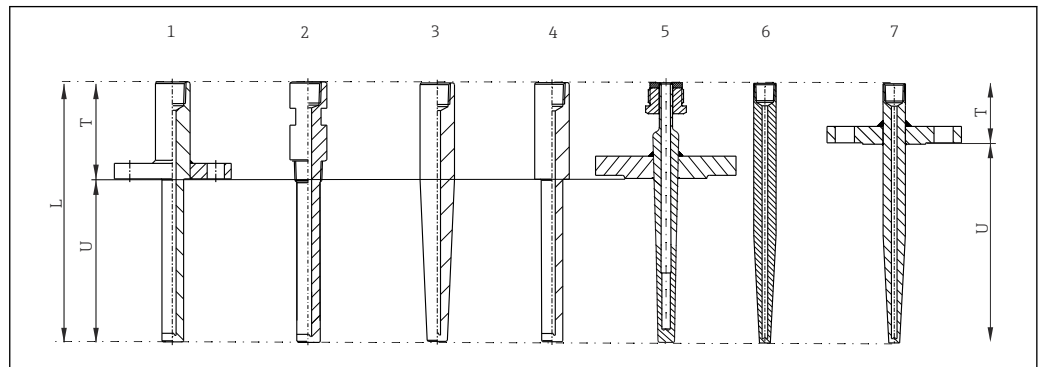
Permitted flow velocity depending on the immersion length and process medium

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 (7252 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 | 140 bar (2031 psi) at +40 °C (+140 °F) 85 bar (1233 psi) at +400 °C (+752 °F) |

Mechanical construction

Design, dimensions



2 Typical ASME, UNIVERSAL, NAMUR and DIN design and references

- 1 Flanged, references acc. ASME/universal
- 2 Threaded, referendes acc. ASME/universal
- 3 Weld in, references acc. ASME/universal
- 4 Socket Weld, references acc. ASME/universal
- 5 Flanged, references acc. NAMUR
- 6 Weld in, references acc. DIN
- 7 Flanged, references acc. DIN

All dimensions are 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:

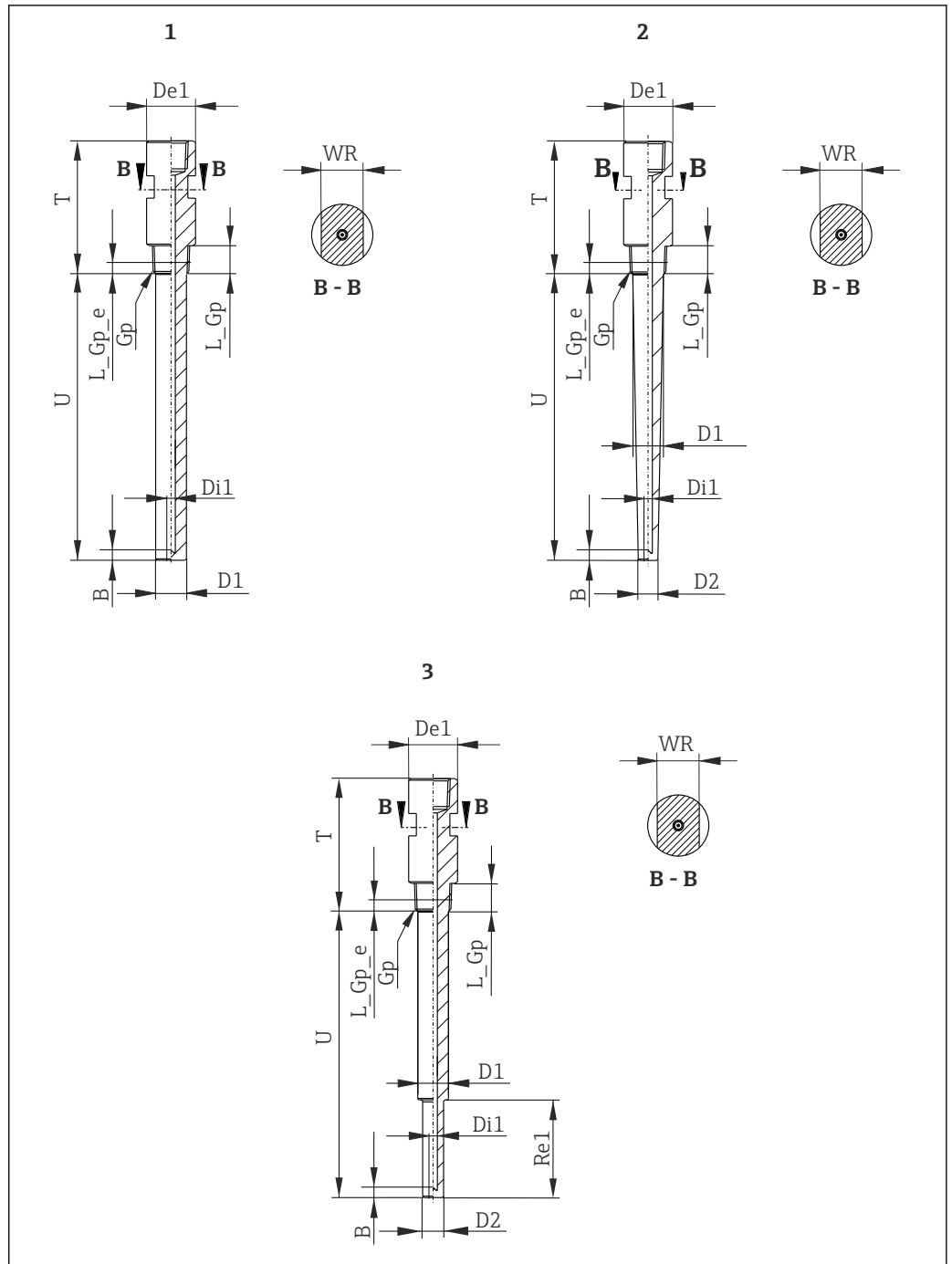
- ANSI, EN or ISO Flanges
- M, G, R or NPT Threads
- Socket weld and weld in

 Some 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 base 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 |

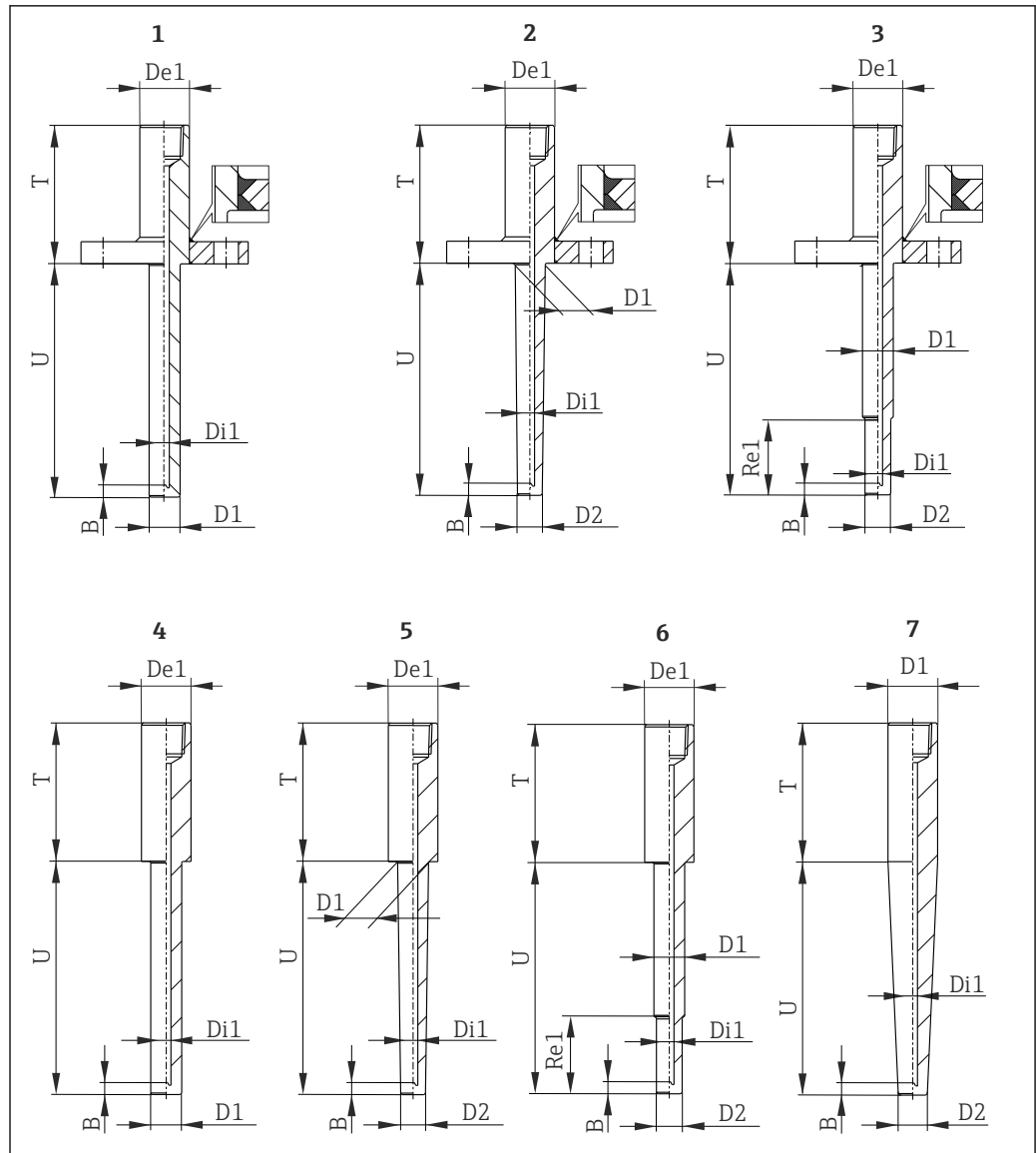
Thermowells based on ASME B40.9



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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)



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4 Thermowells based on ASME B40.9

- 1 Straight-Shank Flanged Thermowell (optional full penetration welding available)
- 2 Tapered-Shank Flanged Thermowell (optional full penetration welding available)
- 3 Stepped-Shank Flanged Thermowell (optional full penetration welding available)
- 4 Straight-Shank Socket Weld
- 5 Tapered-Shank Socket Weld
- 6 Step-Shank Socket Weld
- 7 Tapered-Shank Weld In Thermowell

| Thermowells based on ASME B40.9 | | | |
|---------------------------------|--|---------|------------------------------------|
| | Threaded | Flanged | Socket Weld /Tapered-Shank Weld In |
| Thermometer connection | <ul style="list-style-type: none"> ■ ½" NPT ■ ½" NPSC ■ ½" NPSM | | |

| Thermowells based on ASME B40.9 | | | |
|------------------------------------|--|--|--|
| Process connection size | <ul style="list-style-type: none"> ▪ ½" NPT ▪ ¾" NPT ▪ 1" NPT | <ul style="list-style-type: none"> ▪ 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 | <ul style="list-style-type: none"> ▪ Ø18 mm ▪ Ø24 mm ▪ Ø26 mm ▪ Ø27 mm ▪ Ø28 mm ▪ Ø30 mm ▪ Ø32 mm ▪ Ø35 mm ▪ Ø40 mm ▪ Ø45 mm ▪ Ø50 mm ▪ Ø26.7 mm (¾ in) ▪ Ø33.4 mm (1 in) ▪ Ø42.2 mm (1 ¼ in) ▪ Ø48.3 mm (1 ½ in) |
| Process connection material | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ Alloy C276 ▪ Alloy C276>316L ▪ Alloy 600>316L ▪ A105 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 ▪ 13CrMo4-5 |
| Bar material | <ul style="list-style-type: none"> ▪ A105 ▪ C22.8 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ 347 ▪ Alloy 600 ▪ Alloy C276 ▪ A105 ▪ C22.8 | <ul style="list-style-type: none"> ▪ A105 ▪ C22.8 |

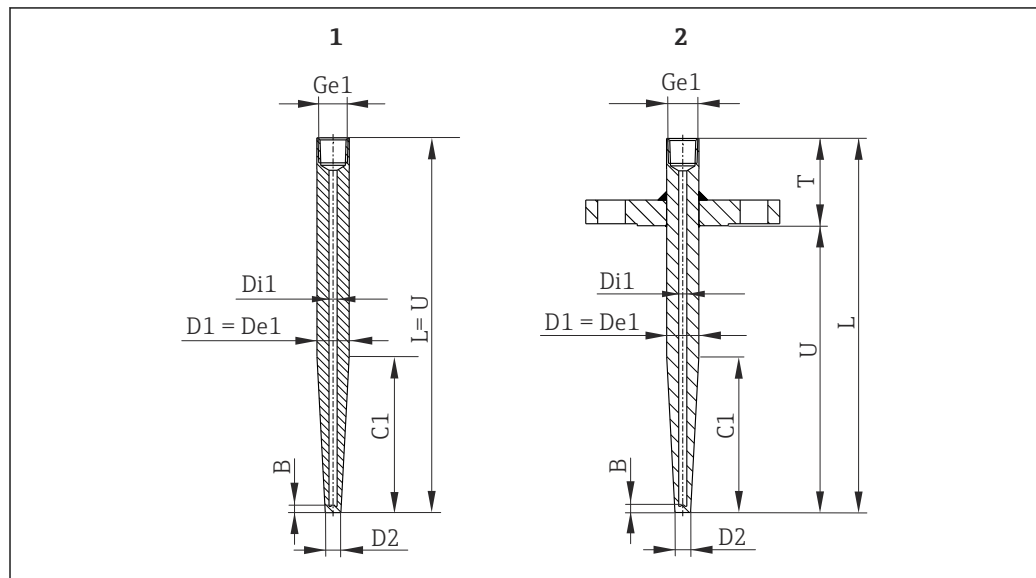
| Dimensions | | |
|-------------------------|---|--|
| | Straight-Shank & Tapered Thermowells | Step-Shank Thermowells |
| Immersion length | 64 to 609 mm | 127 to 609 mm |
| Lagging length | 75 to 300 mm | 75 to 300 mm |
| Lagging diameter | 18 to 50 mm | 18 to 50 mm |
| Root diameter | 16 to 46.5 mm | <ul style="list-style-type: none"> ▪ for tip diameter 12.7 mm: 16 to 25.4 mm ▪ for tip diameter 22.2 mm: 25.4 to 38 mm |
| Tip diameter | 9.2 to 46.5 mm or identical to root diameter | 12.7 mm or 22.2 mm |
| Bore diameter | <ul style="list-style-type: none"> ▪ 3.5 mm ▪ 6.5 mm ▪ 7 mm ▪ 8 mm ▪ 9.5 mm ▪ 10 mm | 6.5 mm |
| Roughness | 0.8 µm | 0.8 µm |
| Stepped length | - | 76 to 365 mm |
| Tip thickness | Default value 6 mm; optional 5 to 12 mm | |

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 other 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 fulfils the limitations of ASME PTC-19.3 |
| Threads: | 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 as mentioned in standard ASME B40.9 |
| Stem finish (for thermowell section in contact with medium): | $Ra \leq 0.76 \mu\text{m}$ (30 μin) |
| ASME B40.9 Nonmandatory Appendix for naval shipboard application: | TT151 doesn't consider the appendix |

Thermowells based on DIN 43772 form 4 and 4F



5 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

| Thermowells based on DIN 43772 | | |
|--------------------------------|--|--|
| | Form 4 (Weld In) | Form 4F (Flanged) |
| Thermometer connection | <ul style="list-style-type: none"> ▪ M14x1.5 ▪ M18x1.5 ▪ M20x1.5 ▪ M27x2 ▪ G 1/2" ▪ G 3/4" | |
| Process connection size | <ul style="list-style-type: none"> ▪ $\varnothing 18$ mm ▪ $\varnothing 24$ mm ▪ $\varnothing 26$ mm ▪ $\varnothing 32$ mm | <ul style="list-style-type: none"> ▪ 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 |

| Thermowells based on DIN 43772 | | |
|------------------------------------|---|---|
| Process connection material | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ Alloy C276>316L ▪ Alloy 600>316L ▪ A105 |
| Bar material | <ul style="list-style-type: none"> ▪ 10CrMo9-10 ▪ 13CrMo4-5 ▪ 16Mo3 ▪ A105 ▪ C22.8 ▪ Duplex S32205 ▪ Titan Gr2 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ 347 ▪ Alloy 600 ▪ Alloy C276 ▪ A105 ▪ C22.8 ▪ Duplex S32205 |
| Tip thickness | Default value 6 mm; optional 4 to 12 mm | |
| Roughness | Default value 1.6 µm; optional 0.76 µm | |
| Tolerances wetted part | <ul style="list-style-type: none"> ▪ +0/-0.15 for L≤410 ▪ +0/-0.2 for L>410 ▪ on demand tolerance according DIN43772 can be ordered | |

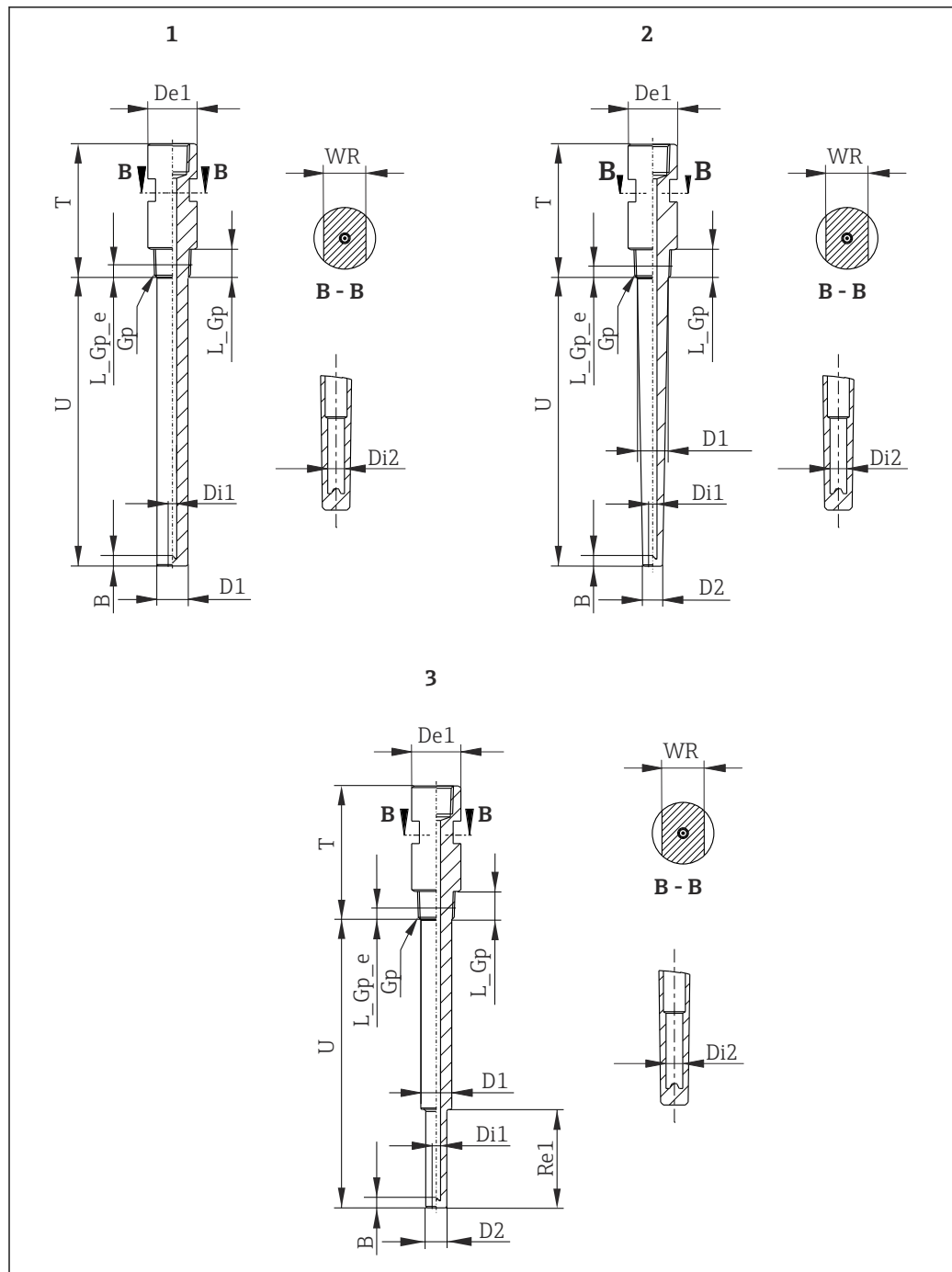
| Thermowell dimensions based on DIN 43772 Form 4/4F | | | | | |
|--|-------|---------|----------------------|---|--|
| Thermometer connection | D1 | D2 | Di1 | Length combinations | |
| | | | | Form 4 | Form 4F |
| M14x1.5 | 18 mm | 9 mm | 3.5 mm ¹⁾ | <ul style="list-style-type: none"> ▪ L = 110 mm, C 1 = 65 mm ▪ L = 110 mm, C 1 = 73 mm ▪ L = 140 mm, C 1 = 65 mm ▪ L = 170 mm, C 1 = 133 mm ▪ L = 200 mm, C 1 = 125 mm | <ul style="list-style-type: none"> ▪ L = 200 mm, U = 130 mm, C1 = 65 mm ▪ L = 260 mm, U = 190 mm, C1 = 125 mm ▪ L = 410 mm, U = 340 mm, C1 = 275 mm |
| M18x1.5 | 24 mm | 12.5 mm | 7 mm | | |
| M20x1.5 or G ½" | 26 mm | 12.5 mm | 7 mm | | |
| | | 15 mm | 9 mm | | |
| M27 x 2 or G ¾" | 32 mm | 17 mm | 11 mm | | |
| | | 19 mm | 13 mm | | |
| | | 20 mm | 14 mm | | |

1) For L>110mm a stepped bore is used (6.5>3.5mm)

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 E+H Standard |
| Materials: | TT151 offers a wider range of materials as mentioned in DIN 43772 |
| Tolerances wetted part Form 4: | <ul style="list-style-type: none"> ▪ +0/-0.15 for L≤410 ▪ +0/-0.2 for L>410 ▪ on demand tolerance according DIN43772 can be ordered |
| Tolerances wetted part Form 4F: | <ul style="list-style-type: none"> ▪ +0/-0.15 for L≤410 ▪ +0/-0.2 for L>410 |
| Immersion length: | TT151 offers a wider range of lengths as mentioned in DIN 43772 |

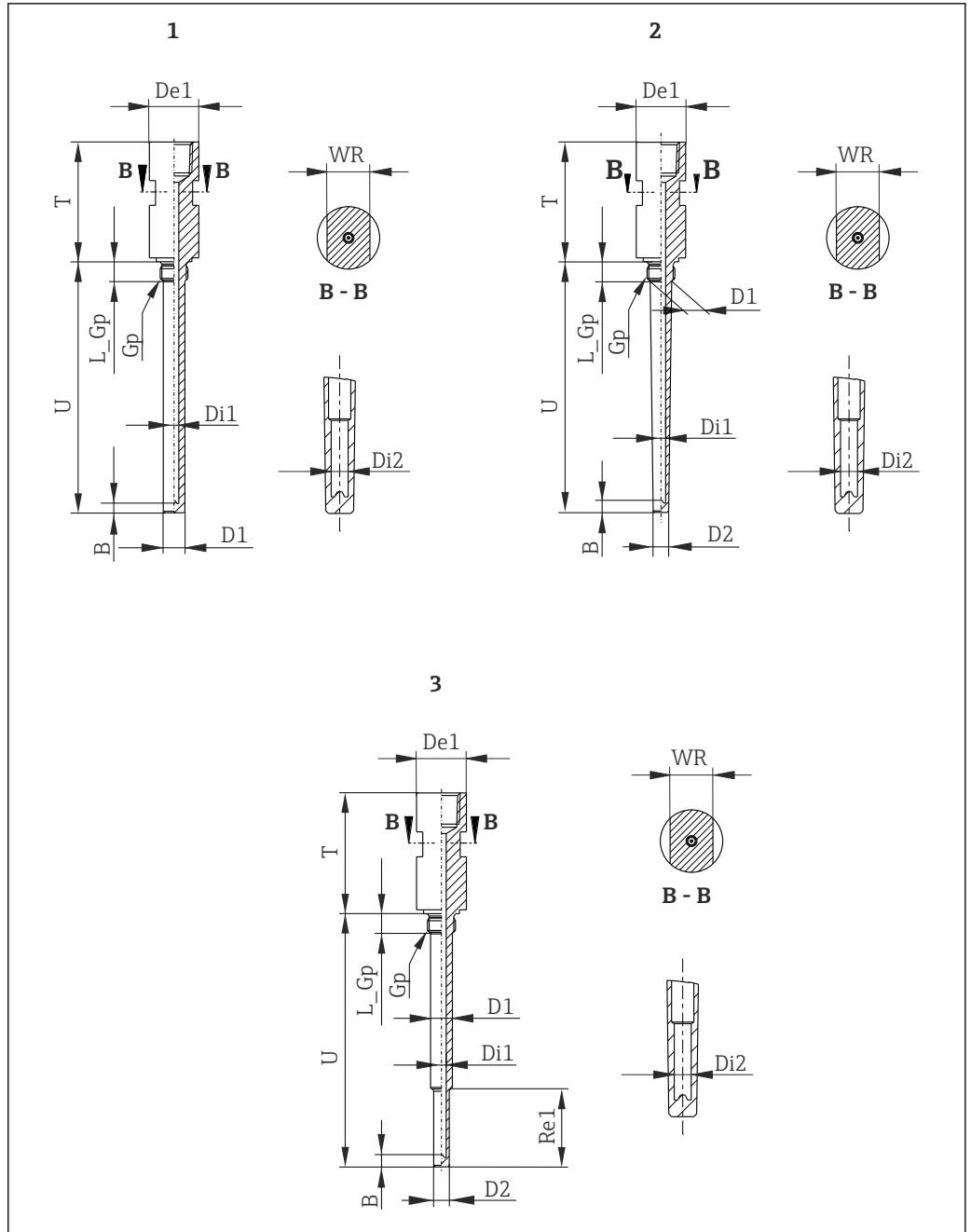
Universal Thermowells



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6 Universal Thermowells with NPT or R threads

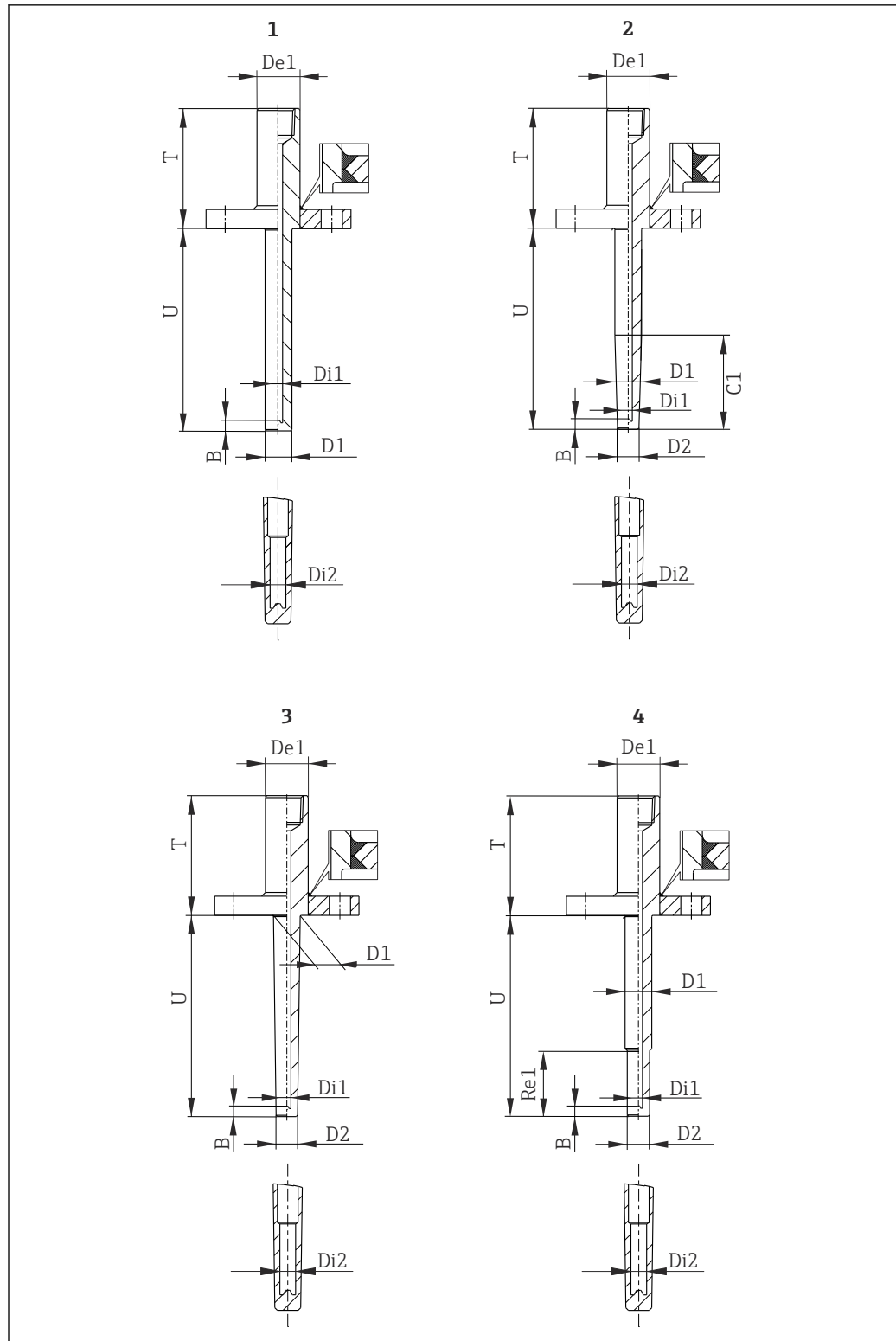
- 1 Threaded process connection and wetted part straight; lagging with spanner flats (optional hexagonal lagging available)
- 2 Threaded process connection and wetted part complete tapered; lagging with spanner flats (optional hexagonal lagging available)
- 3 Threaded process connection and wetted part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



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7 Universal Thermowells with M or G threads

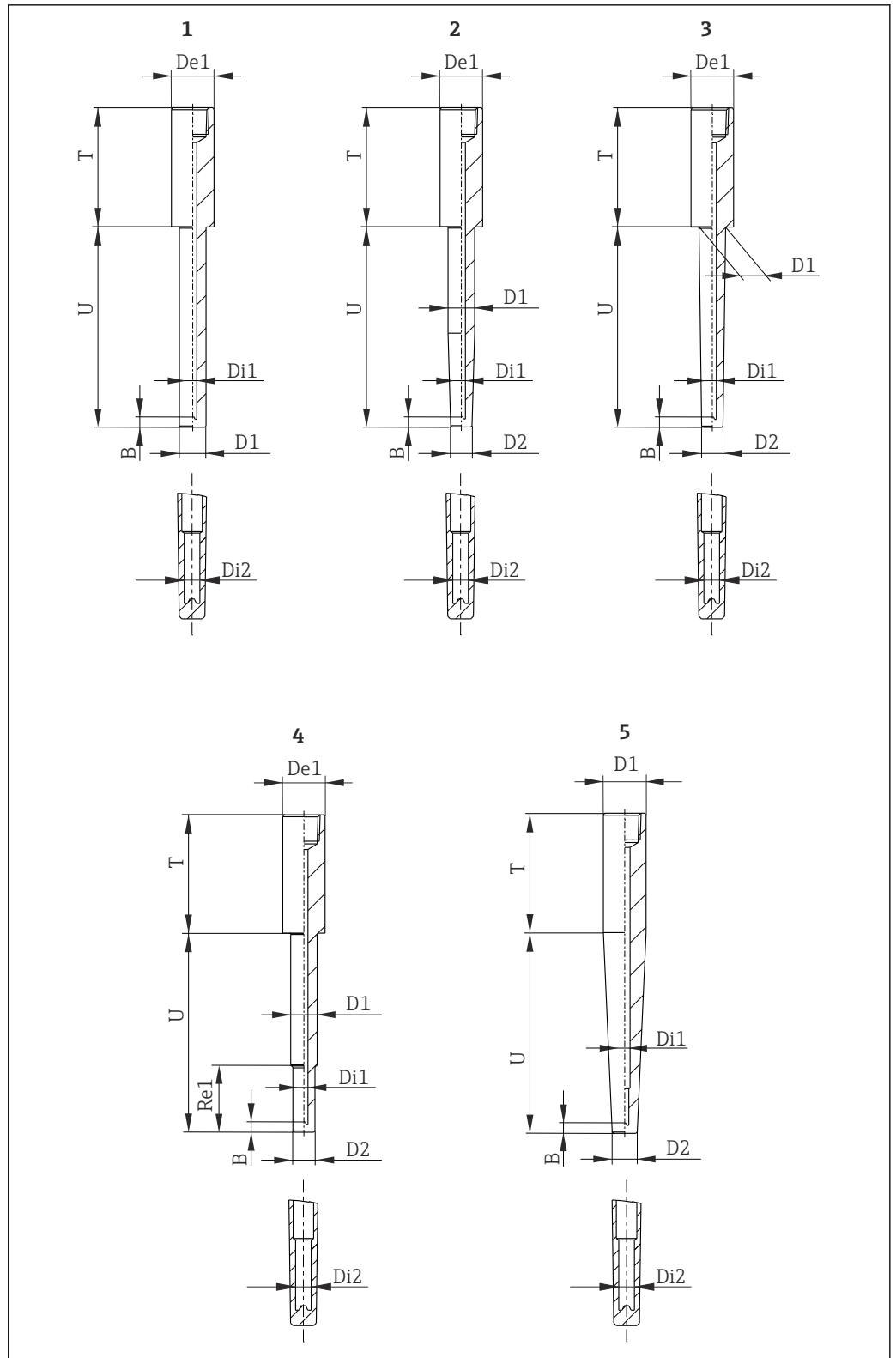
- 1 Threaded process connection and wetted part straight; lagging with spanner flats (optional hexagonal lagging available)
- 2 Threaded process connection and wetted part complete tapered; lagging with spanner flats (optional hexagonal lagging available)
- 3 Threaded process connection and wetted part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



A0040983

8 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)



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9 Universal Thermowells

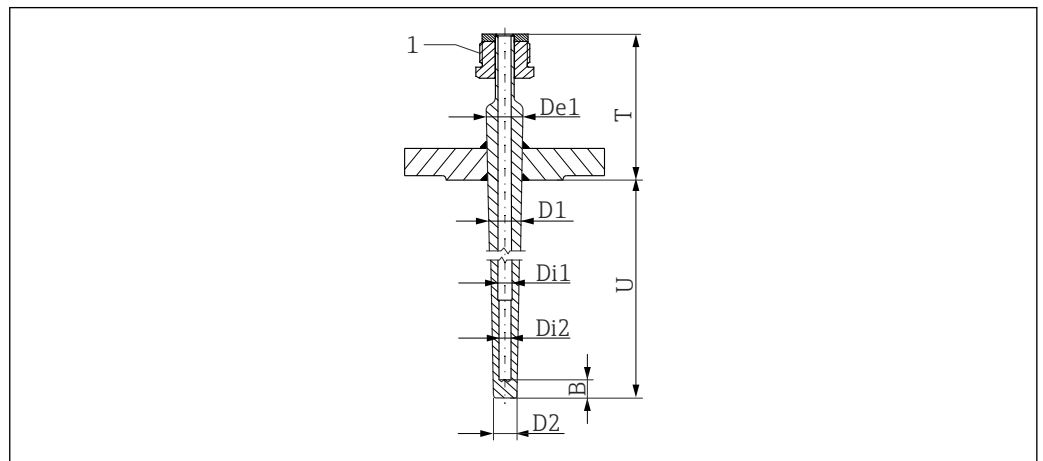
- 1 Socket weld process connection and wetted part straight
- 2 Socket weld process connection and wetted part partial tapered
- 3 Socket weld process connection and wetted part tapered
- 4 Socket weld process connection and wetted part stepped
- 5 Weld In process connection and wetted part tapered

| Universal Thermowells | | | |
|------------------------------------|--|---|--|
| | Threaded | Flanged | Socket Weld /Weld in |
| Thermometer connections | <ul style="list-style-type: none"> ▪ M14x1.5 ▪ M18x1.5 ▪ M20x1.5 ▪ M27x1.5 ▪ G ½" ▪ G ¾" ▪ ½" NPT ▪ ½" NPSC ▪ ½" NPSM | | |
| Process connection size | <ul style="list-style-type: none"> ▪ 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" | <ul style="list-style-type: none"> ▪ 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 ▪ 10K JIS 50A | <ul style="list-style-type: none"> ▪ Ø18 mm ▪ Ø24 mm ▪ Ø26 mm ▪ Ø27 mm ▪ Ø28 mm ▪ Ø30 mm ▪ Ø32 mm ▪ Ø35 mm ▪ Ø40 mm ▪ Ø45 mm ▪ Ø50 mm ▪ Ø26.7 mm (¾ in) ▪ Ø33.4 mm (1 in) ▪ Ø42.2 mm (1 ¼ in) ▪ Ø48.3 mm (1 ½ in) |
| Process connection material | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ Alloy C276 ▪ Alloy C276 > 316L ▪ Alloy 600 > 316L ▪ A105 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 347 ▪ 310 ▪ Alloy 600 ▪ Alloy C276 ▪ 10CrMo9-10 |
| Bar material | <ul style="list-style-type: none"> ▪ 13CrMo4-5 ▪ 16Mo3 ▪ A105 ▪ C22.8 ▪ Titan Gr2 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ 310 ▪ 347 ▪ Alloy 600 ▪ Alloy C276 ▪ A105 ▪ C22.8 | <ul style="list-style-type: none"> ▪ 13CrMo4-5 ▪ 16Mo3 ▪ A105 ▪ C22.8 ▪ Titan Gr2 |
| Immersion length | 30 to 1500 mm ¹⁾ | | |
| Lagging length | 75 to 300 mm | | |
| Lagging diameter | Please see table → 21 | 9 to 50 mm | Equal to "process connection size" |
| Root diameter | 9 to 30 mm ²⁾ | 9 to 50 mm | 9 to 50 mm |
| Tip diameter | 9 to 50 mm ³⁾ | | |
| Bore diameter | <ul style="list-style-type: none"> ▪ 3.5 mm ⁴⁾ ▪ 6.5 mm ▪ 7 mm ▪ 8 mm ▪ 9 mm ▪ 9.5 mm ▪ 10 mm ▪ stepped 6.5 > 3.5 mm (length 35 mm) ▪ stepped 10 > 6.5 mm (length 35 mm) ⁵⁾ | | |
| Tip thickness | <ul style="list-style-type: none"> ▪ Default value 6 mm ▪ Optional 4 to 12 mm | | |

| Universal Thermowells | |
|-----------------------|----------------------------|
| Roughness | 0.76 µm or 1.6 µm |
| Stepped length | 50 to 350 mm ⁶⁾ |

- 1) Maximum immersion length depends on the lagging length
- 2) Maximum root diameter depends on the process connection size
- 3) Tip diameter $D2 \leq$ Root diameter $D1$
- 4) For $L > 110$ mm a stepped bore is used ($6.5 > 3.5$ mm)
- 5) Max. bore diameter depends on the tip diameter
- 6) Stepped length $Re1 \ll$ Immersion length U

Thermowell based on NAMUR NE170



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10 Thermowell based on NAMUR NE170

1 Sliding female nut

| Thermowell based on NAMUR NE170 | |
|---------------------------------|---|
| Thermometer connection | M24x1.5 sliding male thread |
| Process connection size | <ul style="list-style-type: none"> ▪ 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 | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ Alloy C276 |
| Bar material | <ul style="list-style-type: none"> ▪ 316 ▪ 316L ▪ 316Ti ▪ Alloy C276 |
| Immersion length | 30 to 610 mm |
| Lagging length | 30 to 300 mm |
| Lagging diameter | 20 mm, reduced to 12 mm |
| Root diameter | 20 mm |
| Tip diameter | 13 mm |
| Bore diameter | Stepped $7 > 6.1$ mm (length 50 mm) |

| Thermowell based on NAMUR NE170 | |
|---------------------------------|--|
| Tip thickness | 7 mm |
| Roughness | Default value 1.6 µm; optional 0.76 µm |

| Compatibility of DIN-inserts with thermowells | | | | |
|---|---------------------------|------------------|-----------------------------|------------------|
| Insert length | Thermowell acc. DIN 43772 | | Thermowell acc. NAMUR NE170 | |
| | Form | Immersion length | Form | Immersion length |
| 315 mm | 3F1 | 225 mm | NF1 | 165 mm |
| 375 mm | 3F2 | 285 mm | NF2 | 225 mm |
| 435 mm | 3F3 | 345 mm | NF3 | 285 mm |


| Maximum flow velocity of process media | | | | | |
|--|------|------------------|--------------------|----------|----------|
| Calculation standard | Form | Immersion length | Max. flow velocity | | |
| | | | Water | CO2 | Air |
| ASME PTC 19.3 | NF1 | 165 mm | 12.5 m/s | 13.1 m/s | 14.0 m/s |
| ASME PTC 19.3 | NF2 | 225 mm | 6.9 m/s | 7.7 m/s | 8.1 m/s |
| ASME PTC 19.3 | NF3 | 285 mm | 4.6 m/s | 5.0 m/s | 5.2 m/s |
| Reference value | | | | | |
| DIN 43772 | 3F1 | 4.2 mm | 4.2 m/s | 4.2 m/s | 4.2 m/s |

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.

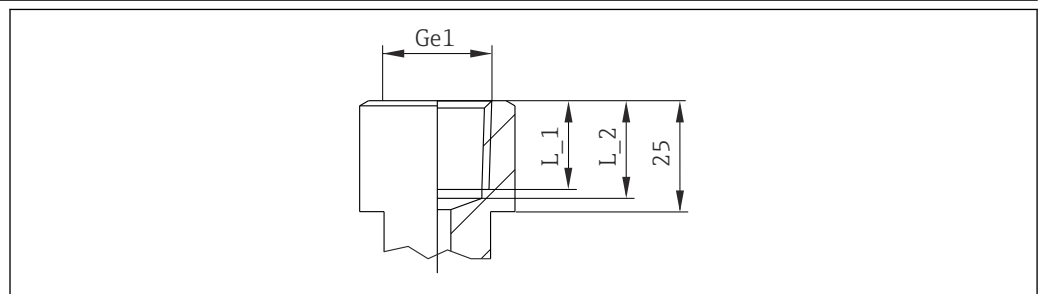
 Please be aware, the maximum temperature is always also depending on the used temperature sensor!

| Material name | Short form | Recommended max. temperature for continuous use in air | Properties |
|--------------------------------|------------------------------------|--|--|
| AISI 316L/ 1.4404 1.4435 | X2CrNiMo17-12-2 X2CrNiMo18-14-3 | 650 °C (1202 °F) ¹⁾ | <ul style="list-style-type: none"> ▪ 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 |
| AISI 316Ti/ 1.4571 | X6CrNiMoTi17-12-2 | 700 °C (1292 °F) ¹⁾ | <ul style="list-style-type: none"> ▪ Properties comparable to 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 |
| AISI A105/ 1.0460 | C22.8 | 450 °C (842 °F) | <ul style="list-style-type: none"> ▪ Heat-resistant steel ▪ Resistant in nitrogen-containing atmospheres and atmospheres that are low in oxygen; not suitable for acids or other aggressive media ▪ Often used in steam generators, water and steam pipes, pressure vessels |
| Inconel600/ 2.4816 | NiCr15Fe | 1 100 °C (2012 °F) | <ul style="list-style-type: none"> ▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistant to corrosion caused by chlorine gas and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in a sulfur-containing atmosphere |
| Hastelloy C276/ 2.4819 | NiMo16Cr15W | 1 100 °C (2012 °F) | <ul style="list-style-type: none"> ▪ A nickel-based alloy with good resistance to oxidizing and reducing atmospheres, even at high temperatures ▪ Particularly resistant to chlorine gas and chloride as well as to many oxidizing mineral and organic acids |
| AISI A182 F11/ 1.7335 | 13CrMo4-5 | 550 °C (1022 °F) | <ul style="list-style-type: none"> ▪ Low alloy, heat-resistant steel with chromium and molybdenum additions ▪ Better corrosion resistance compared to nonalloy steels, not suitable for acids and other aggressive media ▪ Often used in steam generators, water and steam pipes, pressure vessels |
| Titanium / 3.7035 | - | 600 °C (1 112 °F) | <ul style="list-style-type: none"> ▪ 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 (O₂, N₂, Cl₂, H₂) at higher temperatures and/or increased pressure ▪ Can only be used in chlorine gas and chlorinated media at comparatively low temperatures (<400 °C) |

| Material name | Short form | Recommended max. temperature for continuous use in air | Properties |
|---------------|------------------|--|---|
| 1.5415 | 16Mo3 | 530 °C (986 °F) | <ul style="list-style-type: none"> 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) | <ul style="list-style-type: none"> Austenitic ferritic steel with good mechanical properties High resistance to general corrosion, pitting, chlorine-induced or transgranular stress corrosion Comparatively good resistance to hydrogeninduced stress corrosion |

- 1) 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.

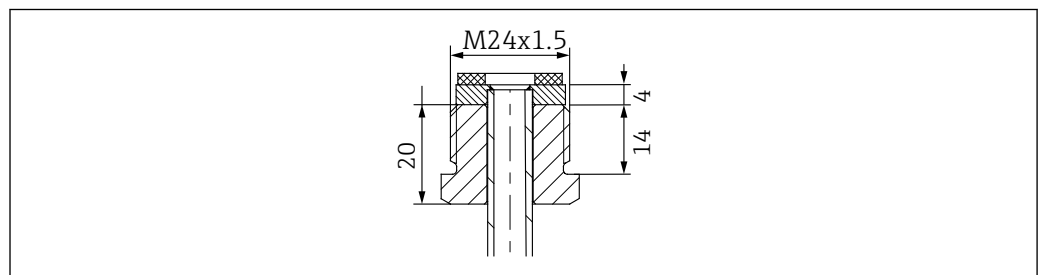
Thermometer connection



A0040912

11 Thermometer connection

| Ge1 | L_1 | L_2 | Standard/Class |
|------------------|-------|-------|--------------------------|
| M14x1.5 | 13 mm | 16 mm | ASME B1.13M/ISO 965-1 H6 |
| M18x1.5 | 13 mm | 16 mm | ASME B1.13M/ISO 965-1 H6 |
| M20x1.5 | 15 mm | 18 mm | ASME B1.13M/ISO 965-1 H6 |
| M27x2 | 17 mm | 20 mm | ASME B1.13M/ISO 965-1 H6 |
| G½" | 16 mm | 19 mm | ISO 228-1 A |
| G¾" | 17 mm | 20 mm | ISO 228-1 A |
| ½" NPT/NPSC/NPSM | 17 mm | 20 mm | ANSI B1.20.1 |



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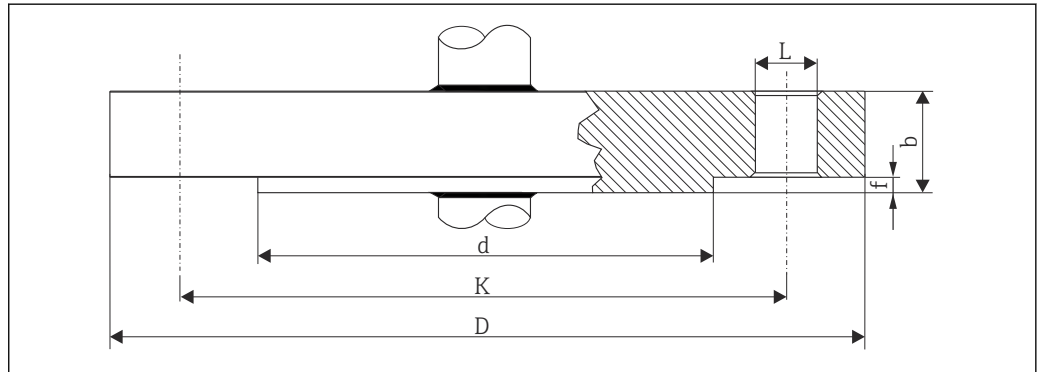
12 Sliding female thread

Process connections

Standard connections are available as weld in, socket weld, threaded connection or with flange.

Flange connection

The process connection is flanged with a double sided standard weld or a full penetration weld. The following figure shows the basic dimensions of the available flanges.



13 Flange connection

For detailed information on the flange dimensions refer to the following flange standards:

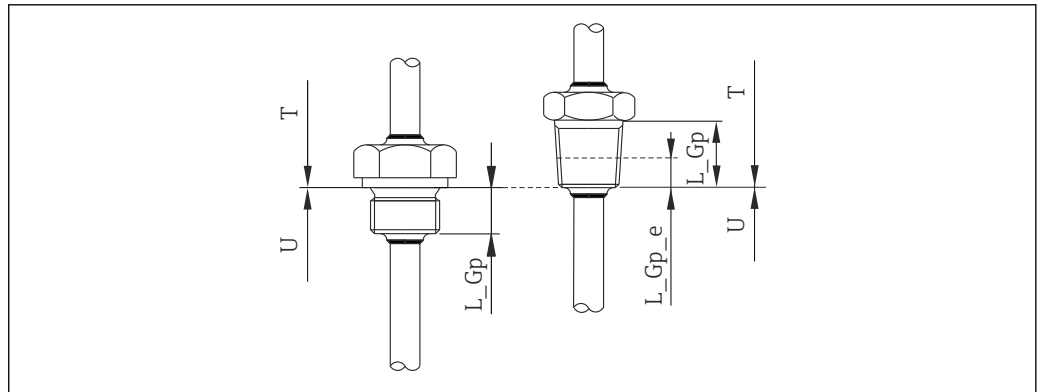
- ANSI/ASME B16.5
- ISO 7005-1
- EN 1092-1
- JIS B 2220 : 2004

The flange material should be the same as of the stem of the thermowell. Models in Alloy C276 are available as full alloy flanges or flanges in basic material SS 316L and a disc in Alloy C276 on the surface in contact with the process media.

Models in Alloy 600 are available in basic material SS 316L and a disc in Alloy 600 on the surface in contact with the process media.

Full penetration welding only in combination with lagging diameter \varnothing 27 mm or \varnothing 32 mm possible.

Thread connections



14 Threaded process connection

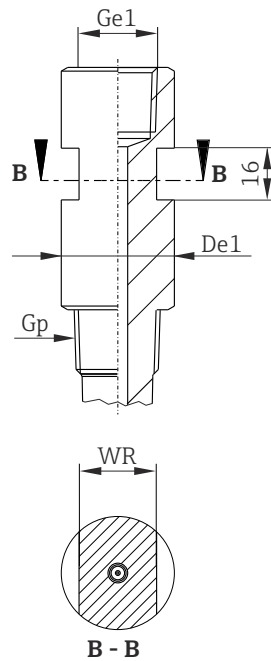
| Version | Thread length L_Gp | Standard | Max. process pressure |
|---------|-----------------------|-----------------------------|--|
| M | M20x1.5 | ASME B1.13M ISO 965-1 g6 | Maximum static process pressure for threaded process connection: <ul style="list-style-type: none"> ■ 140 bar (2 031 psi) at +40 °C (+140 °F) ■ 85 bar (1 233 psi) at +400 °C (+752 °F) |
| | M18x1.5 | | |
| | M27x2 | | |
| | M33x2 | | |

| Version | | Thread length L_Gp | Standard | Max. process pressure |
|---------|-------|-------------------------|------------------------------|--|
| G | G½" | 15 mm (0.6 in) | ISO 228-1 A | Maximum static process pressure for threaded process connection: <ul style="list-style-type: none"> ■ 140 bar (2 031 psi) at +40 °C (+140 °F) ■ 85 bar (1 233 psi) at +400 °C (+752 °F) |
| | G1" | 18 mm (0.71 in) | | |
| | G¾" | 16 mm (0.6 in) | | |
| | G3/8" | 12 mm (0.47 in) | | |
| NPT | NPT½" | 20 mm (L_Gp_e 8 mm) | ANSI B1.20.1 | Maximum static process pressure for threaded process connection: <ul style="list-style-type: none"> ■ 140 bar (2 031 psi) at +40 °C (+140 °F) ■ 85 bar (1 233 psi) at +400 °C (+752 °F) |
| | NPT¾" | 20 mm (L_Gp_e 8 mm) | | |
| | NPT1" | 25 mm (L_Gp_e 10 mm) | | |
| R | R½" | 20 mm (L_Gp_e 8 mm) | DIN EN 10226-1 JIS B 0203 | Maximum static process pressure for threaded process connection: <ul style="list-style-type: none"> ■ 140 bar (2 031 psi) at +40 °C (+140 °F) ■ 85 bar (1 233 psi) at +400 °C (+752 °F) |
| | R¾" | 20 mm (L_Gp_e 8 mm) | | |

WR size matrix for threaded thermowells (hexagonal lagging)

| | | 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 | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | M18x1.5 | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | M20x1.5 | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | NPT½" | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | G½" | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | NPSC1/2 | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | NPSM1/2 | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 36 | 36 | 36 | 41 | 41 |
| | M27x2 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 41 | 41 |
| | G¾" | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 41 | 41 |

De1 size matrix for threaded thermowells (spanner flat)

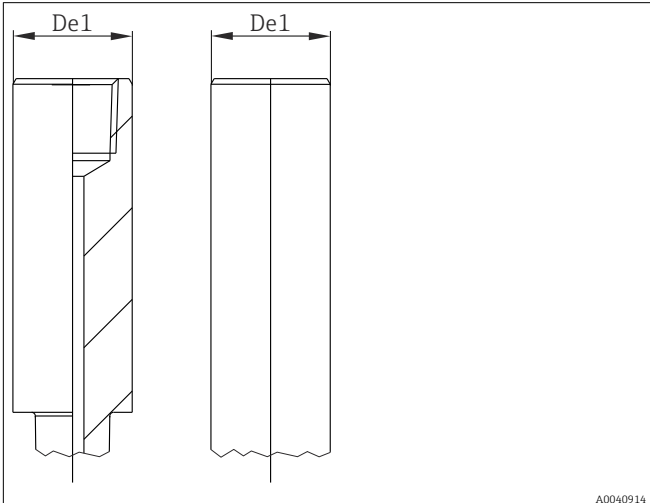


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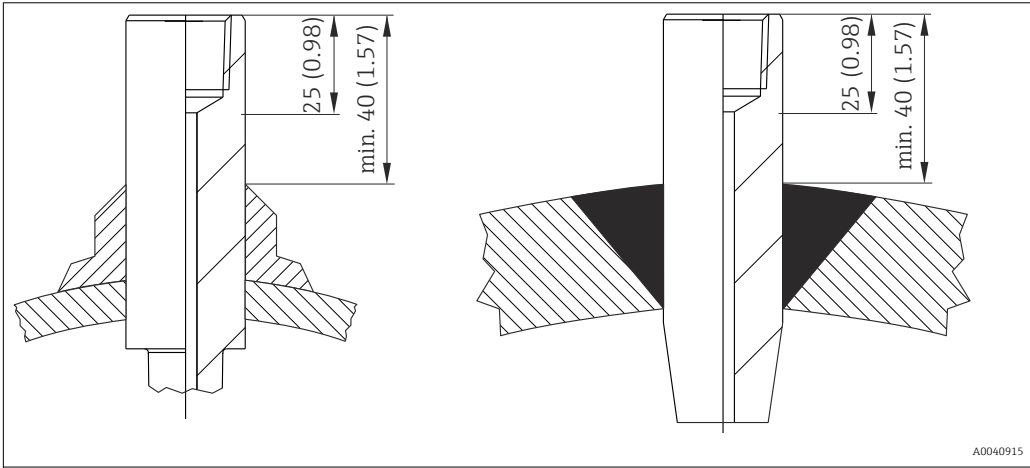
| | | Process connection size Gp (male thread) | | | | | | | | | | | | |
|---|---------|--|-------|-------|------|---------|------|------|-------|-------|------|-------|-------|-----|
| | | M18x1.5 | G3/8" | NPT½" | R ½" | M20x1.5 | G½" | R¾" | NPT¾" | M27x2 | G¾" | NPT1" | M33x2 | G1" |
| Thermometer connection size Ge1 (female thread) | M14x1.5 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 33.4 | 33.4 | 33.4 | 40 | 40 |
| | M18x1.5 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 33.4 | 33.4 | 33.4 | 40 | 40 |
| | M20x1.5 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 33.4 | 33.4 | 33.4 | 40 | 40 |
| | NPT½" | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 33.4 | 33.4 | 33.4 | 40 | 40 |
| | G½" | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 26.7 | 33.4 | 33.4 | 33.4 | 40 | 40 |
| | M27x2 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 33.4 | 33.4 | 33.4 | 40 | 40 |
| | G¾" | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 33.4 | 33.4 | 33.4 | 40 | 40 |

| ø De1 | WR |
|------------|----|
| 26.7/27/28 | 22 |
| 30 | 24 |
| 32/33.4/35 | 27 |
| 40/42.2/45 | 36 |
| 48.3/50 | 41 |

Weld in, socket weld

| | |
|--|--|
|  | <p>De1</p> <ul style="list-style-type: none"> ■ ϕ 18 mm ■ ϕ 24 mm ■ ϕ 26 mm ■ ϕ 27 mm ■ ϕ 28 mm ■ ϕ 30 mm ■ ϕ 32 mm ■ ϕ 35 mm ■ ϕ 40 mm ■ ϕ 45 mm ■ ϕ 50 mm ■ ϕ 26.7 mm ($\frac{3}{4}$") ■ ϕ 33.4 mm (1") ■ ϕ 42.2 mm ($1\frac{1}{4}$") ■ ϕ 48.3 mm ($1\frac{1}{2}$") |
|--|--|

Welding recommendation

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

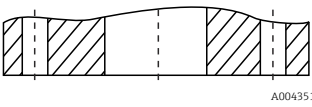
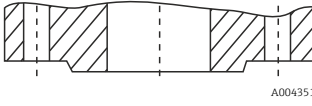
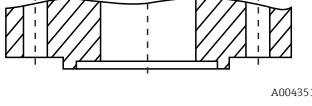
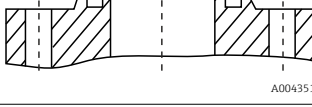
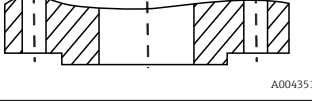
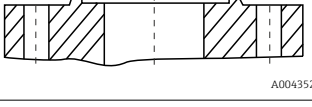

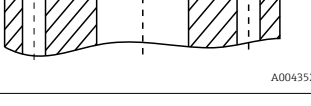
Flanges

i 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

Geometry of sealing surfaces

| Flanges | Sealing surface | DIN 2526 ¹⁾ | | DIN EN 1092-1 | | |
|---------------------|--|------------------------|-----------------------|------------------------|---------------------------|---------------------------|
| | | Shape | Rz (µm) | Shape | Rz (µm) | Ra (µm) |
| without raised face |  | A B | - 40 to 160 | A ²⁾ | 12.5 to 50 | 3.2 to 12.5 |
| 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 |
| Tongue |  | F | - | C | 3.2 to 12.5 | 0.8 to 3.2 |
| Groove |  | N | | D | | |
| Projection |  | V 13 | - | E | 12.5 to 50 | 3.2 to 12.5 |
| Recess |  | R 13 | | F | | |
| Projection |  | V 14 | for O-rings | H | 3.2 to 12.5 | 3.2 to 12.5 |
| Recess |  | R 14 | | G | | |

- 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.

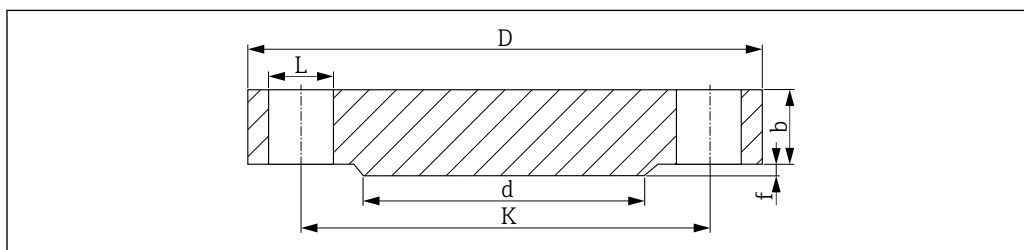
Height of raised face ¹⁾

| 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 | - |

| Standard | Flanges | Height of raised face f | Tolerance |
|----------|------------------|-------------------------|-----------|
| | > 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)



A0029176

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))

PN16¹⁾

| 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) |
| 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) |

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

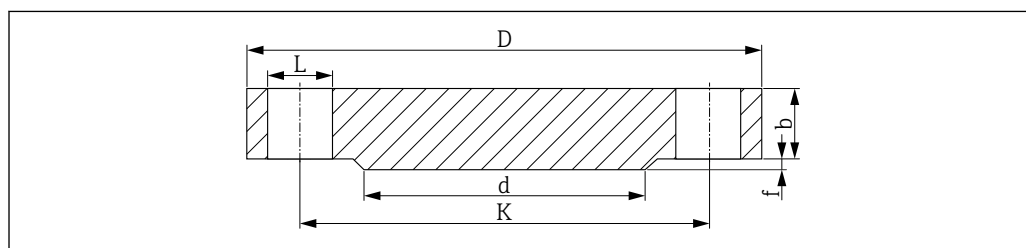
| DN | D | b | K | d | L | approx. kg (lbs) |
|-----|------------|-----------|------------|------------|---------------|------------------|
| 25 | 140 (5.51) | 24 (0.94) | 100 (3.94) | 68 (2.68) | 4xØ18 (0.71) | 2.50 (5.51) |
| 32 | 155 (6.10) | 24 (0.94) | 110 (4.33) | 78 (3.07) | 4xØ22 (0.87) | 3.50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

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



A0029175

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 raised face $R_a \leq 3.2$ to $6.3 \mu\text{m}$ (126 to $248 \mu\text{in}$).Class 150¹⁾

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

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

Class 300

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

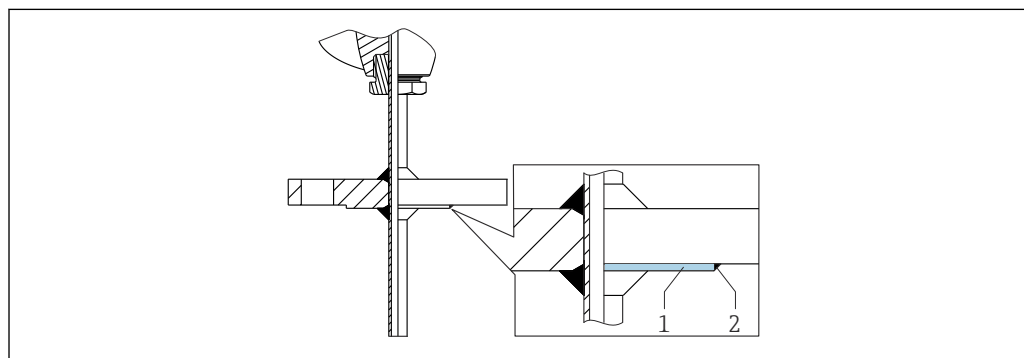
| DN | D | b | K | d | L | approx. kg (lbs) |
|-----|---------------|-------------|--------------|--------------|-----------------|------------------|
| 1" | 149.4 (5.88) | 28.4 (1.12) | 101.6 (4.0) | 50.8 (2.00) | 4xØ25.4 (1.00) | 3.57 (7.87) |
| 1¼" | 158.8 (6.25) | 28.4 (1.12) | 111.3 (4.38) | 63.5 (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) |

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.



A0043523

- 1 Raised face
2 Weld

Surface roughness*Specifications for surfaces in contact with medium*

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

Certificates and approvals

Current certificates and approvals for the product are available via the Product Configurator at www.endress.com.

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

The **Configuration** button opens the Product Configurator.

Ordering information

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

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.

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.

Service-specific accessories

| Accessories | Description |
|--------------|---|
| Applicator | <p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> ■ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ■ Graphic illustration of the calculation results <p>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.</p> <p>Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator</p> |
| Configurator | <p>Product Configurator - the tool for individual product configuration</p> <ul style="list-style-type: none"> ■ 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 <p>The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select 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.</p> |
| W@M | <p>Life cycle management for your plant</p> <p>W@M supports with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.</p> <p>The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.</p> <p>W@M is available: Via the Internet: www.endress.com/lifecyclemanagement</p> |

Documentation

Operating Instructions: Thermowells for thermometers in industrial applications (BA02041T)

Technical Information:

- Modular RTD or TC Thermometer:
 - iTHERM TM131 (TI01373T)
 - iTHERM TM121 (TI01455T)
- Insert:
iTHERM TS111 (TI01014T) and iTHERM TS211 (TI01411T)



71529200

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