

# Technical Information

## Industrial thermowell

### TT511

For Oil & Gas applications



Vanstone type, design with collar flange

#### Application

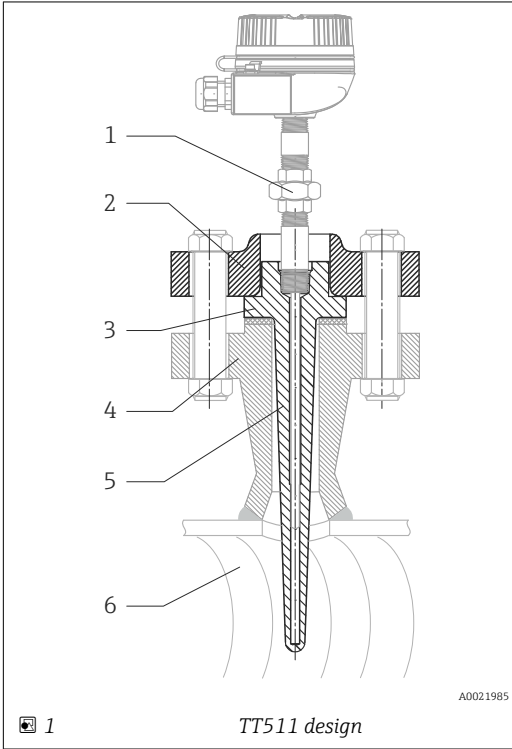
The thermowell will be used in applications with high process requirements. The predominant industries are Oil & Gas and Petrochemical. The process connection flange is not welded on the thermowell stem but designed as collar flange. This special Vanstone thermowell design enables a wide variety of applications and is suitable for resistance and thermocouple thermometers.

#### Your benefits

- Solid thermowell, made of drilled barstock material.
- Fulfillment of various, industry specific requirements with a standard product. Flexible selection of immersion length and thermowell geometry according to the process specifications.
- In accordance with Shell specification: S.38.113 rev.D and S.38.114 rev.D
- Exact thermowell stress calculation ensuring safe plant operation.
- Vanstone design with outstanding cost effectiveness:
  - Reuse of the flange if the thermowell has to be replaced.
  - Use of a standard lap joint flange according to ANSI/ASME B16.5 and EN 1092-1.
  - Flexible selection of the flange material, independent from process conditions and thermowell as it is not in contact with the process medium and it is not welded on.
  - Reduced spare parts and storing concept: one flange can be used for a variety of thermowells.

# Function and system design

## Device architecture



The TT511 Vanstone thermowell is designed as a special thermowell for thermometer installation (1). The thermowell shaft (5) and the flange (2) as the process connection are not interconnected. For installation in the process (6), the collar (3) of the thermowell is fitted between two flanges. The flange (2) on the thermowell side is a slip-on flange that is fitted onto the thermowell (2) and is bolted to the connection nozzle (4) on the process side. Many different flange versions are available to secure the unit to the permanently installed nozzle flange (4) on the process side. The thermowell is machined from solid bar stock.

1  
2  
3  
4  
5  
6

TT511 design

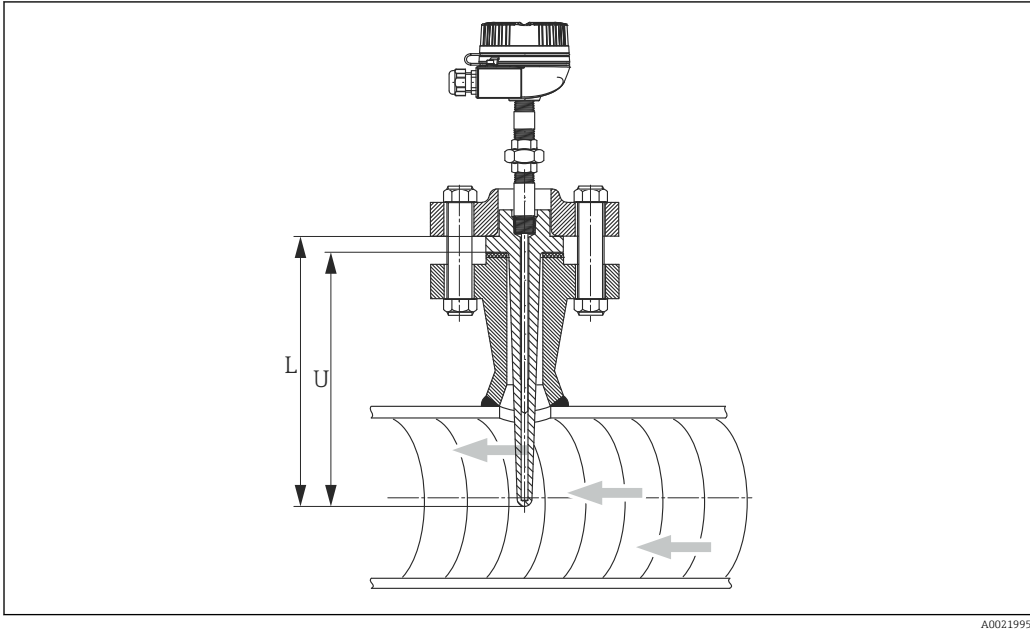
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# Installation

## Orientation

No restrictions.

## Installation instructions



L  
U

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2 Mounting the TT511

The immersion length U of the thermowell can influence the accuracy. If the immersion length is too small, heat conduction via the process connection and the container wall can cause measurement errors in the installed thermometer. Therefore, if installing into a pipe the immersion length should

ideally be half of the pipe diameter. When determining the immersion length or installation depth, all parameters of the thermowell and the process to be measured must be taken into account (e.g. flow velocity, process pressure). The counterpieces for the process connections and the seals or sealing rings are not included in the scope of supply for the thermowell.

Installation possibilities: pipes, tanks or other plant components

## Process

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**Process temperature range** For the maximum operating temperatures, see the 'Material' section. (→  7)

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Process pressure (static)	Process connection	Standard	Max. process pressure
	Flange	EN1092-1	Depending on the flange pressure rating PN: 40 bar, 63 bar, 100 bar or 160 bar.
		ASME B16.5	Depending on the flange pressure rating: 150 psi, 300 psi, 400 psi, 600 psi, 900 psi, 1500 psi, 2500 psi

### Permitted flow velocity depending on the immersion length

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 medium type, process temperature and process pressure.



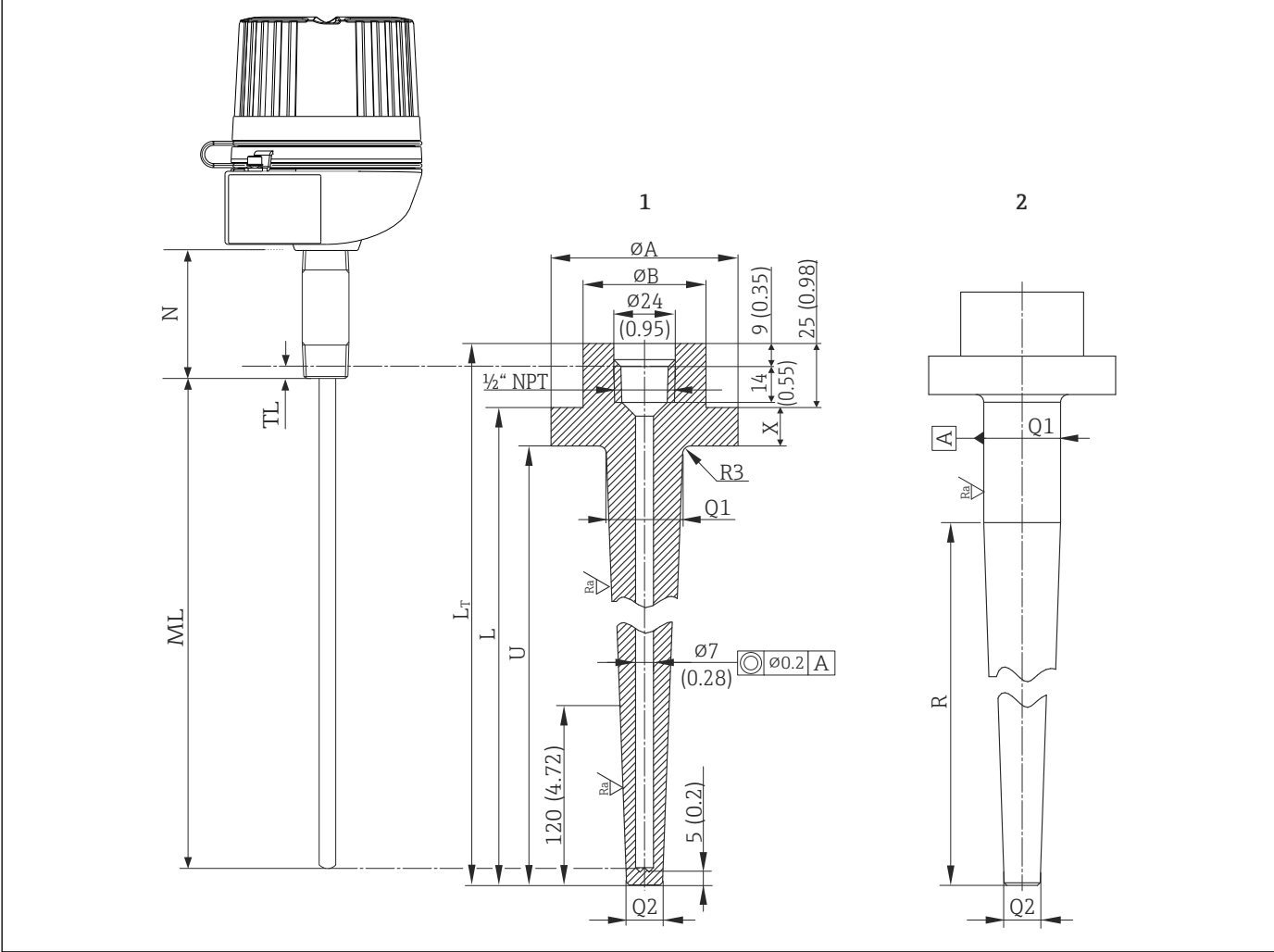
#### Thermowell sizing tool

It is possible to check the mechanical loading capacity as a function of the installation and process conditions online in the TW Sizing Module for thermowells in the Endress+Hauser Applicator software. See <https://wapps.endress.com/applicator>

# Mechanical construction

Design, dimensions

Vanstone thermowell, type 1



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3 All dimensions in mm (in)

- 1 Version DN40 (NPS 1-1/2") or DN50 (NPS 2"), tapered
- 2 Version DN40 (NPS 1-1/2") for L > 300 mm (11.81 in): straight with tapered tip
- U Immersion length
- R Length of tapered tip
- L Standard length
- LT Complete thermowell length
- ML Insertion length
- TL Thread length
- N Extension neck length



The insertion length ML is calculated as follows:

$$ML = L_T - 9 \text{ mm (0.35 in)} - 8 \text{ mm (0.31 in)}^1 - 5 \text{ mm (0.197 in)}^2 + 3 \text{ mm (0.12 in)}^3$$

Short form:  $ML = L_T - 19 \text{ mm (0.75 in)}$

Version	L	L <sub>T</sub>	U	R	Extension X	∅A	∅B	∅Q1	∅Q2
DN40 (NPS 1½")	230 mm (9.1 in)	255 mm (10.04 in)	215 mm (8.46 in)	R = U	15 mm (0.6 in)	73 mm (2.87 in)	48 mm (1.89 in)	30 mm (1.18 in)	19 mm (¾ in)
	255 mm (10.04 in)	280 mm (11.02 in)	240 mm (9.45 in)						
	305 mm (12 in)	330 mm (13 in)	290 mm (11.42 in)	240 mm (9.45 in)					
	355 mm (13.98 in)	380 mm (15 in)	340 mm (13.39 in)						
	405 mm (15.95 in)	430 mm (16.93 in)	390 mm (15.35 in)						
	455 mm (17.91 in)	480 mm (19 in)	440 mm (17.32 in)						
DN50 (NPS 2")	230 mm (9.1 in)	255 mm (10.04 in)	210 mm (8.27 in)	R = U	20 mm (0.79 in)	92 mm (3.62 in)	60 mm (2.36 in)	30 mm (1.18 in)	19 mm (¾ in)
	255 mm (10.04 in)	280 mm (11.02 in)	235 mm (9.25 in)						



Laser treated specification marking on the lateral surface, e. g. DN50 (nominal diameter), PN160 (pressure rating), L300 (standard length)-7 (bore diameter), 1.4571 (material), S/N (serial number), Heat (heat number), TAG

**Examples of product configuration**

Type 1: DN40 (NPS 1-½")

TT511-	A	11	B	12	A	13	B	14	
	A	Nominal diameter, material: DN40 (NPS 1-½"); 316							
	11	Extension: 15 mm (5/8 in) + 25 mm (1 in) DN40 (NPS 1-½")							
	B	Thermometer connection: thread NPT ½"							
	12	Thermowell geometry: Q1 = 30 mm (19/16 in), Q2 = 19 mm (¾ in), R = 240 mm (9.45 in)							
	A	Bore diameter: 7 mm (¼ in)							
	13	Bottom thickness; bore shape; tip: D = 5 mm (1/8 in); standard; flat chamfered							
	B	Surface: Ra ≤ 0.8							
	14	Standard length: 355 mm (14 in) → selectable according to requirements							

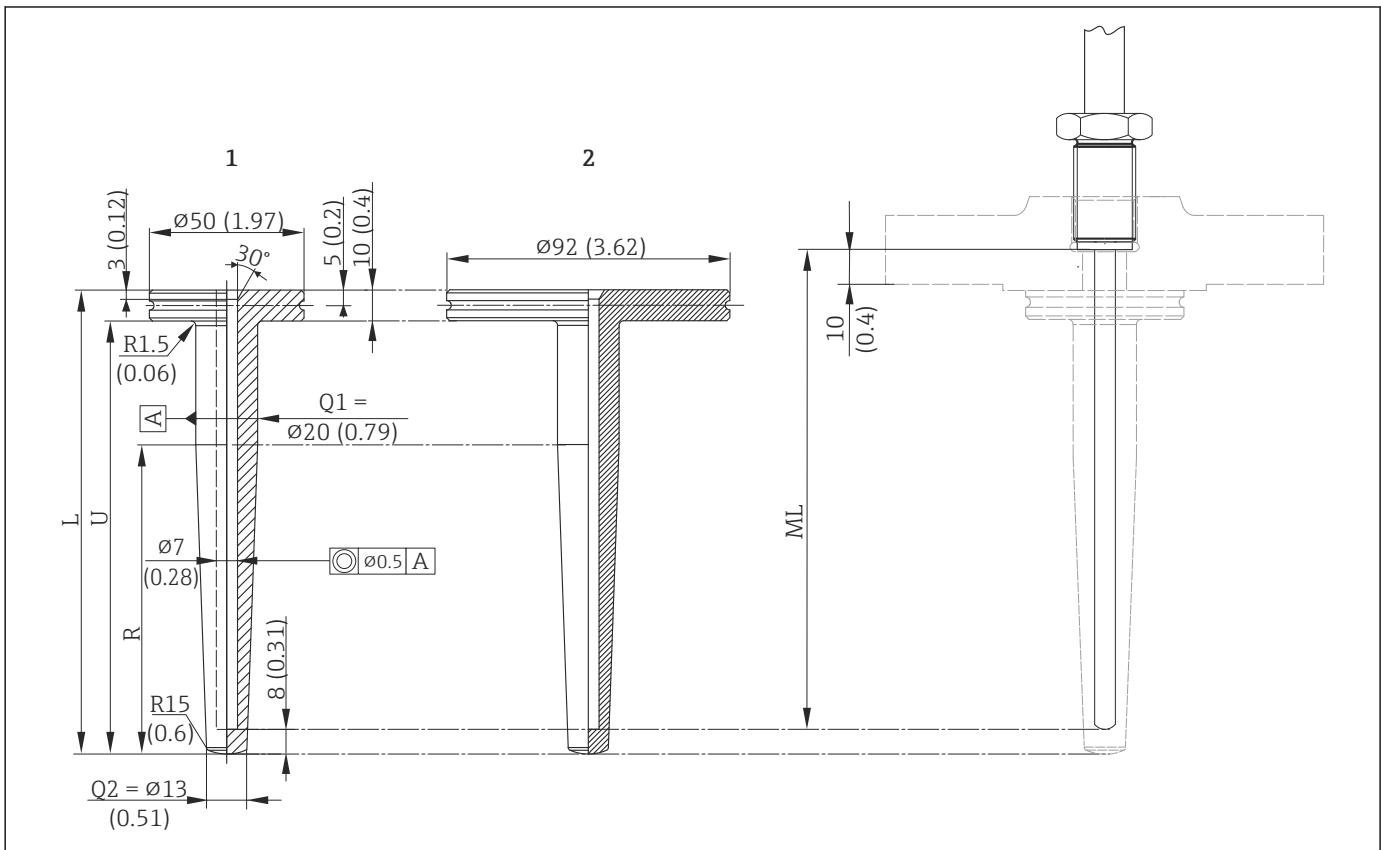
Type 1: DN50 (NPS 2")

TT511-	B	12	B	11	A	13	A	11	
	B	Nominal diameter, material: DN50 (NPS 2"); 316							
	12	Extension: 20 mm (¾ in) + 25 mm (1 in) DN50 (NPS 2")							
	B	Thermometer connection: thread NPT ½"							
	11	Thermowell geometry: Q1 = 30 mm (19/16 in), Q2 = 19 mm (¾ in), tapered							

1) TL = Thread length  
 2) Bottom thickness  
 3) Distance spring load

TT511-	B	12	B	11	A	13	A	11
	A	Bore diameter: 7 mm (1/4 in)						
	13	Bottom thickness; bore shape; tip: D = 5 mm (1/5 in); standard; flat chamfered						
	A	Surface: roughened Ra = 6						
	11	Standard length: 230 mm (9.055 in) → selectable according to requirements						

**Vanstone thermowell, type 2**



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4 All dimensions in mm (in)

1 Version DN25, round tip, surface roughness  $Ra \leq 1.6$

2 Version DN50, round tip, surface roughness  $Ra \leq 1.6$ , full penetration welded collar

U Immersion length

L Standard length in a range from 150 mm (5.9 in) to 500 mm (19.7 in) in 50 mm (1.97 in) increments

R Tapered length 150 mm (5.9 in) or 175 mm (6.9 in), dependent on standard length L

ML Insertion length

**i** The insertion length ML is calculated as follows:

$$ML = L - 8 \text{ mm (0.31 in)}^4 + 10 \text{ mm (0.4 in)} + 3 \text{ mm (0.12 in)}^5$$

$$\text{Short form: } ML = L + 5 \text{ mm (0.197 in)}$$

4) Bottom thickness  
5) Distance spring load

**Examples of product configuration**

*Type 2: DN25*

TT511- C 31 A 31 A 31 C 22	
C	Nominal diameter, material: DN25; 1.4571
31	Extension: 10 mm (0.4 in)
A	Thermometer connection: without
31	Thermowell geometry: Q1 = 20 mm (¾ in), Q2 = 13 mm (0.51 in), R = 100 mm (3.94 in)
A	Bore diameter: 7 mm (¼ in)
31	Bottom thickness; bore shape; tip: D = 8 mm (0.32 in); flat; round R15
C	Surface: Ra ≤ 1.6
22	Standard length: 200 mm (7.87 in) → selectable according to requirements

*Type 2: DN50*

TT511- D 32 A 32 A 31 C 26	
D	Nominal diameter, material: DN50; 1.4571
32	Extension: 10 mm (0.4 in), welded version
A	Thermometer connection: without
32	Thermowell geometry: Q1 = 20 mm (¾ in), Q2 = 13 mm (0.51 in), R = 175 mm (6.9 in)
A	Bore diameter: 7 mm (¼ in)
31	Bottom thickness; bore shape; tip: D = 8 mm (0.32 in); flat; round R15
C	Surface: Ra ≤ 1.6
26	Standard length: 400 mm (15.75 in) → selectable according to requirements

 Laser treated specification marking on the lateral surface, e. g. DN50 (nominal diameter), PN160 (pressure rating), B300 (standard length)-7 (bore diameter), 1.4571 (material), S/N (serial number), Heat (heat number), TAG

**Weight**

Variable, according to version and standard length. Some examples:

<b>Version DN40 (NPS 1½")</b>	1.9 kg (4.2 lb) with L = 305 mm (12 in)
<b>Version DN40 (NPS 2")</b>	2.3 kg (5 lb) with L = 230 mm (9.05 in)
<b>Version DN25, round tip</b>	0.6 kg (1.32 lb) with L = 300 mm (11.81 in)
<b>Version DN50, round tip, full penetration welded collar</b>	1.1 kg (2.43 lb) with L = 300 mm (11.81 in)

**Material**

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 compressive load.

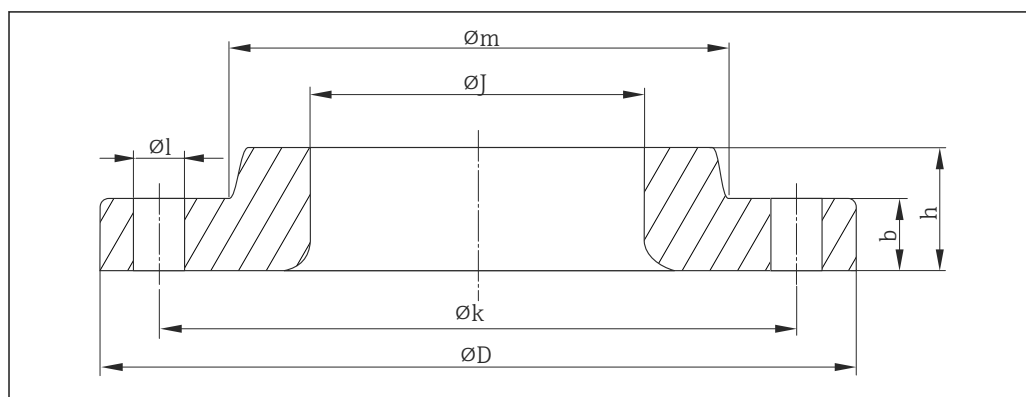
The maximum operation temperatures are reduced considerably in some cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1202 °F)	<ul style="list-style-type: none"> <li>▪ Austenitic, stainless steel</li> <li>▪ High corrosion resistance in general</li> <li>▪ 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)</li> </ul>
AISI A105/1.0460	C22.8	450 °C (842 °F)	<ul style="list-style-type: none"> <li>▪ Heat-resistant steel</li> <li>▪ Resistant to atmospheres which contain nitrogen and are low in oxygen; not suitable for acids or other aggressive media</li> <li>▪ Often used for boilers, water and steam pipes, pressure vessels</li> </ul>
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1292 °F)	<ul style="list-style-type: none"> <li>▪ Addition of titanium means increased resistance to intergranular corrosion even after welding</li> <li>▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry</li> <li>▪ Can only be polished to a limited extent, titanium streaks can form</li> </ul>

### Process connection

The process connection is provided via the following specified flange connections. The figures shown below feature the relevant dimensions.

- Standard lap joint flange according to ASME B16.5 for thermowell types DN40 (NPS 1-½") and DN50 (NPS 2").
- Special design flange (lap joint flange) similar to DIN EN 1092-1, including safety plug with chain, length = 150 mm (5.9 in).



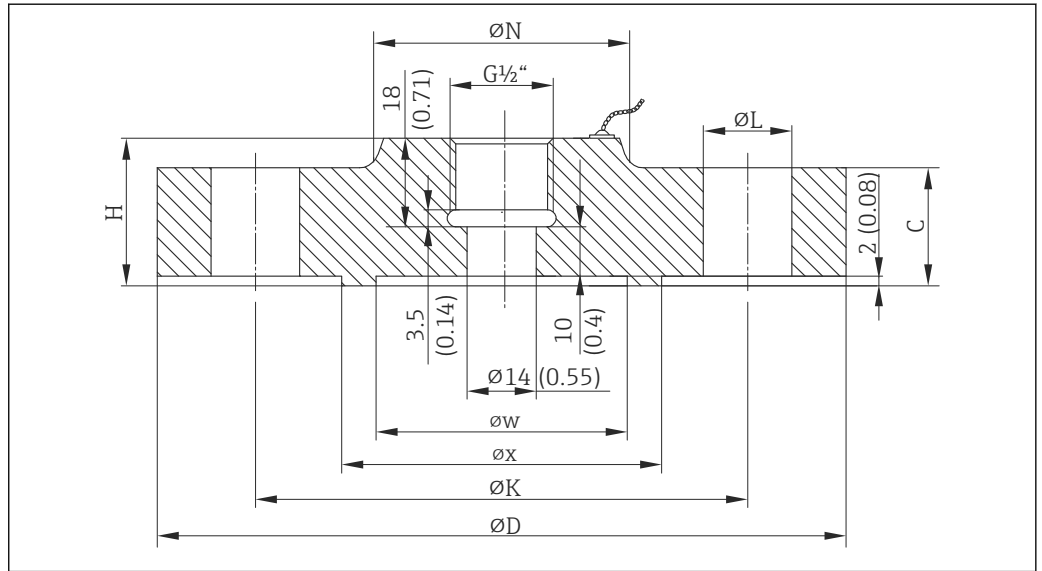
5 Dimensions of process connection flange DN40 (NPS 1-½") and DN50 (NPS 2") according to ASME B16.5

Dimensions of process connection flange according to ASME B16.5 in mm (in)

Version	Nominal pressure steps in lb/in <sup>2</sup>	ØD	b	h	Øk	Øl	ØJ	Øm
DN40 (1½")	150	127 (5)	17.5 (0.69)	22.4 (0.88)	98.6 (3.88)	15,7 (0,62) x4	50 (1,97)	65 (2,56)
	300	155.4 (6.12)	20.6 (0.81)	30.2 (1.19)	114.3 (4.5)	22.4 (0.88) x4		69.9 (2.75)
	400/600		22.4 (0.88)	31.8 (1.25)				
	900/1500	177.8 (7)	31.8 (1.25)	44.5 (1.75)	124 (4.88)	28.4 (1.12) x4		



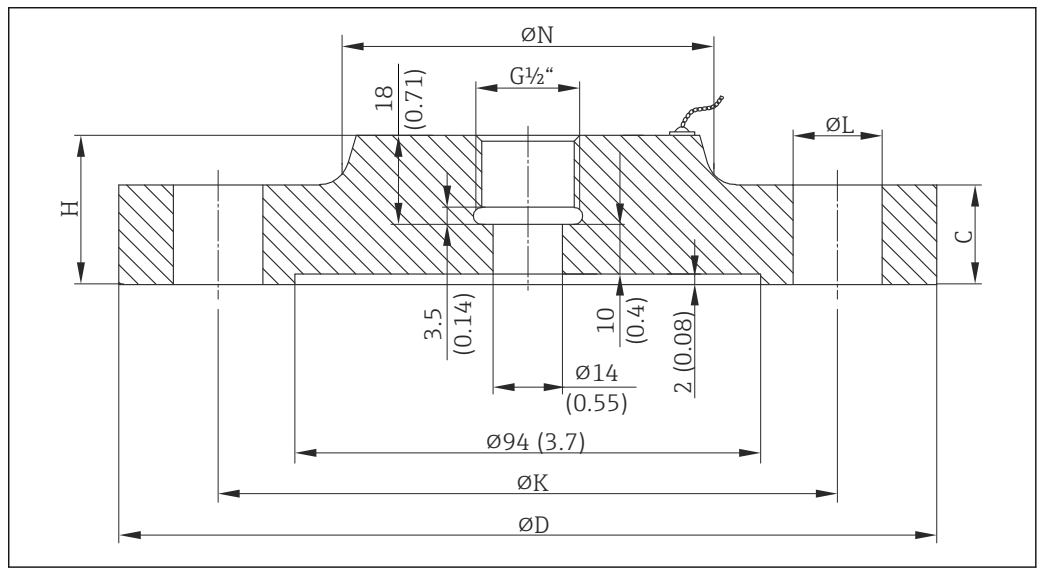
Version	Nominal pressure steps in lb/in <sup>2</sup>	∅D	b	h	∅k	∅l	∅J	∅m
DN50 (2")	150	152.4 (6)	19.1 (0.75)	25.4 (1)	120.7 (4.75)	19.1 (0.75) x4	62.5 (2.46)	77.7 (3.06)
	300	165.1 (6.5)	22.4 (0.88)	33.3 (1.31)	127 (5)	19.1 (0.75) x8		84.1 (3.31)
	400/600		25.4 (1)	36.6 (1.44)				104.6 (4.12)
	900/1500	215.9 (8.5)	38.1 (1.5)	57.2 (2.25)	165.1 (6.5)	25.4 (1) x8		104.6 (4.12)
	2500	235 (9.25)	50.8 (2)	69.9 (2.75)	171.5 (6.75)	28.4 (1.12) x8		95.3 (3.75)



6 Dimensions of process connection flange similar to DIN EN 1092-1, version DN25, PN40 - PN160

Dimensions of process connection flange according to DIN EN 1092-1 in mm (in)

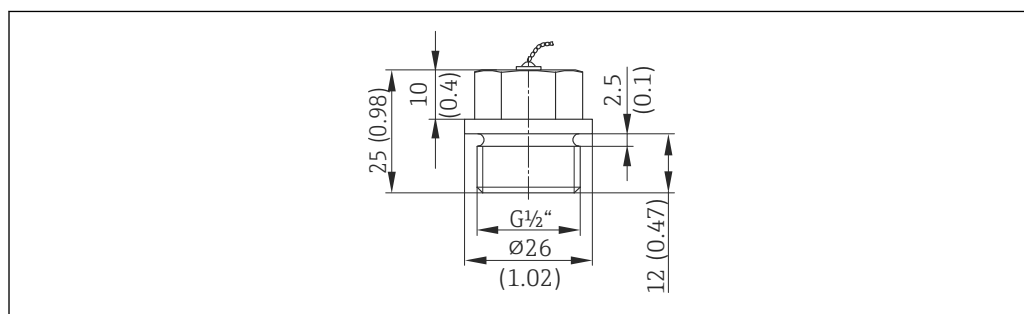
Version	∅D	C	H	∅K	∅L	∅N	∅w	∅x
DN25/PN40	115 (4.53)	18 (0.71)	30 (1.18)	85 (3.35)	14 (0.55), x4	46 (1.81)	51 (2)	68 (2.7)
DN25/PN100, PN160	140 (5.51)	24 (0.95)		100 (3.94)	18 (0.71), x4	52 (2.05)		65 (2.56)



7 Dimensions of process connection flange similar to DIN EN 1092-1, version DN50, PN40, PN63, PN100 - PN160 and DN80, PN40

Dimensions of process connection flange according to DIN EN 1092-1 in mm (in)

Version	ØD	C	H	ØK	ØL	ØN
DN50/PN40	165 (6.5)	20 (0.79)	30 (1.18)	125 (4.9)	18 (0.71), x4	75 (2.95)
DN50, PN63	235 (9.25)	25 (0.98)		180 (7.1)	23 (0.91), x4	90 (3.54)
DN50/PN100, PN160	195 (7.7)	-		145 (5.71)	27 (1.06), x4	-
DN80, PN40	200 (7.9)	24 (0.94)		160 (6.3)	18 (0.71), x4	105 (4.13)



8 Safety plug with chain

## Certificates and approvals

### PED approval

The thermowell complies with Art. 3.3 of Pressure Equipment Directive 97/23/EC and is not labeled separately.

### Material certification

The material certificate 3.1 (according to standard EN 10204) can be selected directly in the order code. Other material-specific certificates can be requested separately. The "short form" certificate includes a simplified declaration and has no enclosures of documents related to the materials used, but guarantees the traceability of the materials through the identification number of the thermowell. The data related to the origin of the materials can subsequently be requested by the client if necessary.

### Canadian Registration Number (CRN)

CRN-No: OF16064.5

The CRN approval applies for the following thermowell options:

- Nominal diameter DN40 (NPS 1½") for a standard length L up to 455 mm (18 in)<sup>6)</sup>
- Nominal diameter DN50 (NPS 2") for a standard length L up to 255 mm (10 in)<sup>7)</sup>

More detailed information is available:

- In the download section of the Endress+Hauser website: [www.endress.com](http://www.endress.com) → Select country → Download → Enter product root/device → Search area: approvals & certificates → Select certificate type → Start search
- From your Endress+Hauser Sales Center: [www.endress.com/worldwide](http://www.endress.com/worldwide)

### Test on thermowell

Helium leak test as per EN 1779	Leak test for thermowells, welding seams and threaded joints. Depending on the design and size of the thermowell, it can be subjected to helium gas internally or externally. With inspection certificate
Hydrostatic pressure test	External and internal pressure test with maximum 400 bar (5 801 psi) to check the pressure resistance and leak-tightness of thermowells, without flanges. Internal pressure test only possible for thermowells with an internal thread (type 1). With inspection certificate

6) Product configuration, item 10, option A

7) Product configuration, item 10, option B

Positive material identification (PMI) test	Nondestructive material identification and testing of welded joints. Material identification check, X-ray fluorescence analysis With inspection certificate
Load capacity calculation for the thermowell	In accordance with DIN 43772 or ASME PTC19.3 with calculation certificate
Dye penetration test as per ASME V and EN571-1	Suitable for checking welding seam surfaces, e.g. detection of small cracks, etc. With inspection certificate
Bore concentricity test for thermowells	With inspection certificate
Radiographic test as per ASME V, VIII, TW welding	With inspection certificate

## Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser web site: [www.endress.com](http://www.endress.com) → Choose your country → Products → Select measuring technology, software or components → Select product (picklists: measurement method, product family etc.) → Device support (right-hand column): Configure the selected product → The Product Configurator for the selected product is opened.
- From your Endress+Hauser Sales Center: [www.addresses.endress.com](http://www.addresses.endress.com)


### 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

### Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: <ul style="list-style-type: none"> <li>▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.</li> <li>▪ Graphic illustration of the calculation results</li> </ul> Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: <ul style="list-style-type: none"> <li>▪ Via the Internet: <a href="https://wapps.endress.com/applicator">https://wapps.endress.com/applicator</a></li> <li>▪ On CD-ROM for local PC installation.</li> </ul>
Konfigurator <sup>+temperature</sup>	Software for selecting and configuring the product depending on the measuring task, supported by graphics. Includes a comprehensive knowledge database and calculation tools: <ul style="list-style-type: none"> <li>▪ For temperature competence</li> <li>▪ Quick and easy design and sizing of temperature measuring points</li> <li>▪ Ideal measuring point design and sizing to suit the processes and needs of a wide range of industries</li> </ul> The Konfigurator is available: On request from your Endress+Hauser sales office on a CD-ROM for local PC installation.

W@M	<p>Life cycle management for your plant</p> <p>W@M supports you 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:</p> <ul style="list-style-type: none"><li>▪ Via the Internet: <a href="http://www.endress.com/lifecyclemanagement">www.endress.com/lifecyclemanagement</a></li><li>▪ On CD-ROM for local PC installation.</li></ul>
FieldCare	<p>FDT-based plant asset management tool from Endress+Hauser.</p> <p>It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.</p> <p> For details, see Operating Instructions BA00027S and BA00059S</p>

[www.addresses.endress.com](http://www.addresses.endress.com)