Data sheet DS/TSW400–EN Rev. A

# TSW400 series Thermowells

## Safe, tough and reliable thermowells for the Oil & Gas industry

## Measurement made easy

### Engineered to international standards
— ISO19001:2000

### Manufactured with full material control
— 3.1 certification
— Traceability to producing mill
— X-Ray PMI available

### Documented to Oil & Gas industry standards
— Documents compiled on electronic media
— Material certification
— Welding certification

### Applications
— Oil & Gas downstream
— Oil & Gas upstream
— Arduous applications requiring high specification

Power and productivity
for a better world™

# TSW400 series
# Thermowells

## Available designs

The following designs are available from ABB's standard range of thermowells. However, many organizations have their own standard designs and these can be accommodated by selecting 'other design' and providing a drawing for quotation.

### Flanged

Flanged thermowells are available in three manufacturing options:

**Welded with a fillet and groove weld**

— fillet and groove welding is perfectly adequate in most circumstances; the weld is designed to be stronger than the required duty pressure.

**Welded with a full penetration weld**

— full penetration welding provides a stronger weld joint and is specified when absolute assurance of pipe-work integrity is required.

**Manufactured from a single piece, shaped forging**

— fully forged thermowells are manufactured from a shaped forging formed to closely resemble the final shape of the finished thermowell. This ensures correct granular alignment of all the thermowell components – absolutely vital in ensuring resistance to corrosion cracking.

### Weld-in and threaded

Manufactured from a single piece of high quality material, there is no welding in any of ABB's weld-in or threaded designs.

### Profiles

Three basic profiles are available:

**Straight**

— the stem diameter is consistent from the root to the tip

**Tapered**

— the profile tapers from the root to the tip

**Stepped**

— the lower portion of the thermowell steps to a smaller diameter.

A version of the stepped profile is available in the DIN designs where the step is a taper towards the tip. See the illustrations on pages 4 to 25 for details.

### Velocity collars

There are times when thermowell design fails to satisfy ASME PTC19.3 2010 TW criteria. Under these circumstances, it is advisable to shorten the thermowell and change the diameters of the stem root and tip. ABB engineers are available to advise on this. Where the thermowell would become too short, a velocity collar can be used.

**Caution.** A velocity collar relies on an interference fit between the thermowell collar and the mounting branch. The interference fit is the responsibility of the installation team and. although ABB can advise on the procedure, ABB cannot be held responsible for incorrect fitting of velocity collars.

## Dimensions

The key dimensions of a thermowell are related to the stem. The dimensions of the flange or screw thread are given by international standards.

**Immersion length (U)**
— the length of the thermowell from the underside of the flange to the tip. This is the unsupported length of the thermowell and, in the case of a threaded thermowell, is measured from the start of the screw thread. In the case of a threaded, tapered thermowell, it is normally measured 10 mm (4 in.) in from the start of the thread and for a threaded, parallel thermowell it is measured from the back of the thread.

**External length (T)**
— the additional length of the thermowell. U + T gives the total length of the thermowell.

**Tip diameter (P1)**
— the diameter of the stem at the tip (the part of the thermowell furthest from the process connection).

**Stem diameter (P2)**
— the diameter of the stem on the process side of the connection (also referred to as the stem root).

**Instrument connection diameter (P3)**
— the diameter of the stem where it connects to the instrument.

**Internal bore**
— the diameter of the hole in the stem.

**Step position**
— the distance from the tip to the beginning of the step. A stepped thermowell is a straight thermowell with a step down to a smaller diameter near the tip. A number of the DIN designs taper from the stepped position to the tip diameter.

**Velocity collar position**
— the position from the tip to the underside of the velocity collar.

**Velocity collar diameter**
— the diameter of the velocity collar (specified to the nearest millimeter).

**Tip thickness**
— the standard tip thickness is 6 mm.

**Note.** If a different tip thickness is required, *it must be specified when ordering*. Failure to specify will result in the order being completed with the standard 6 mm tip thickness.

**Stem-to-flange radius**
— the standard stem-to-flange radius is 3 mm.

**Note.** If a different stem-to-flange radius is required, *it must be specified when ordering*. Failure to specify will result in the order being completed with the standard 3 mm stem-to-flange radius.

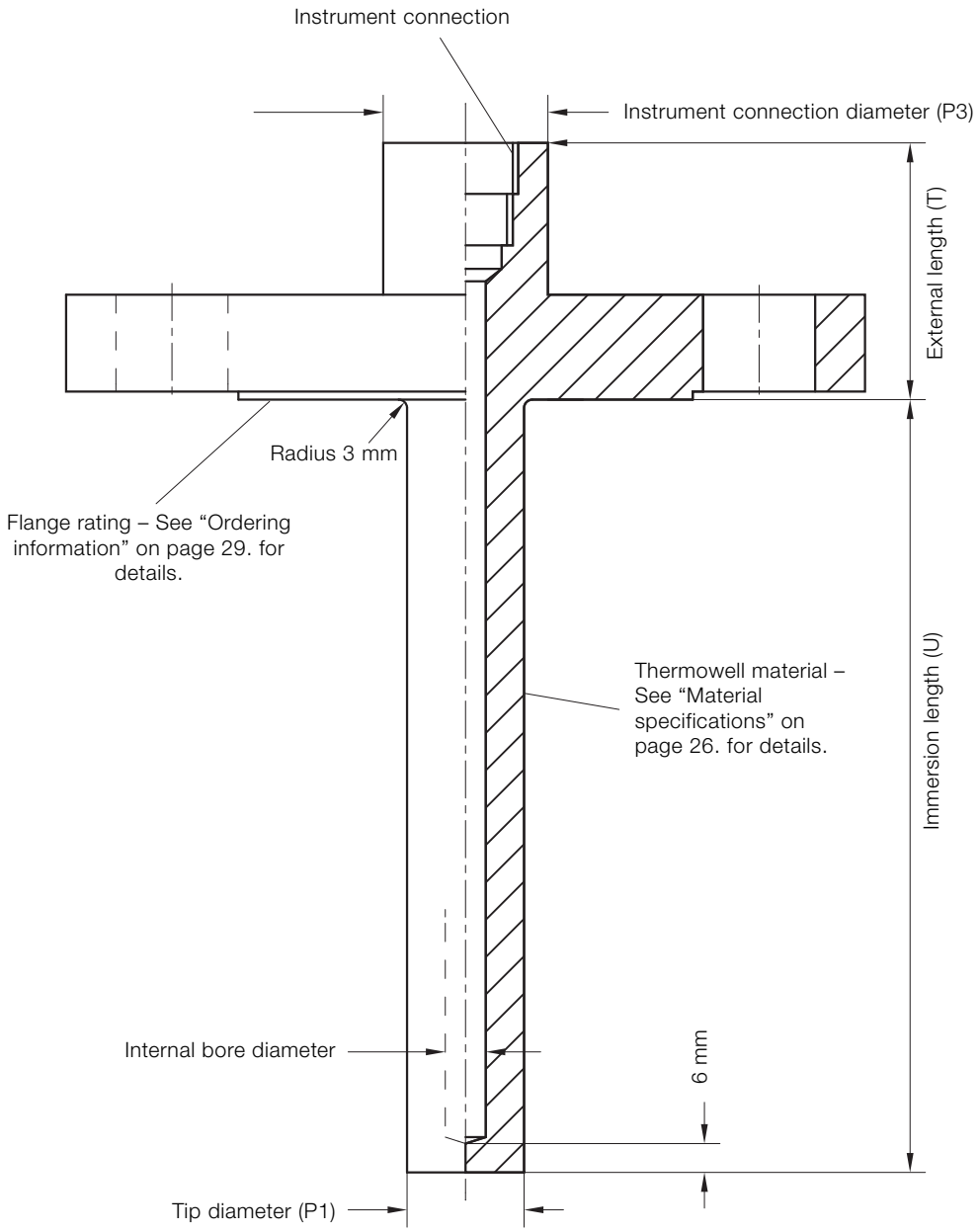
The thermowell style illustrations on pages 4 to 25 each give the dimension of the solid portion of the thermowell from the end of the bore to the end of the tip.

# TSW400 series
# Thermowells

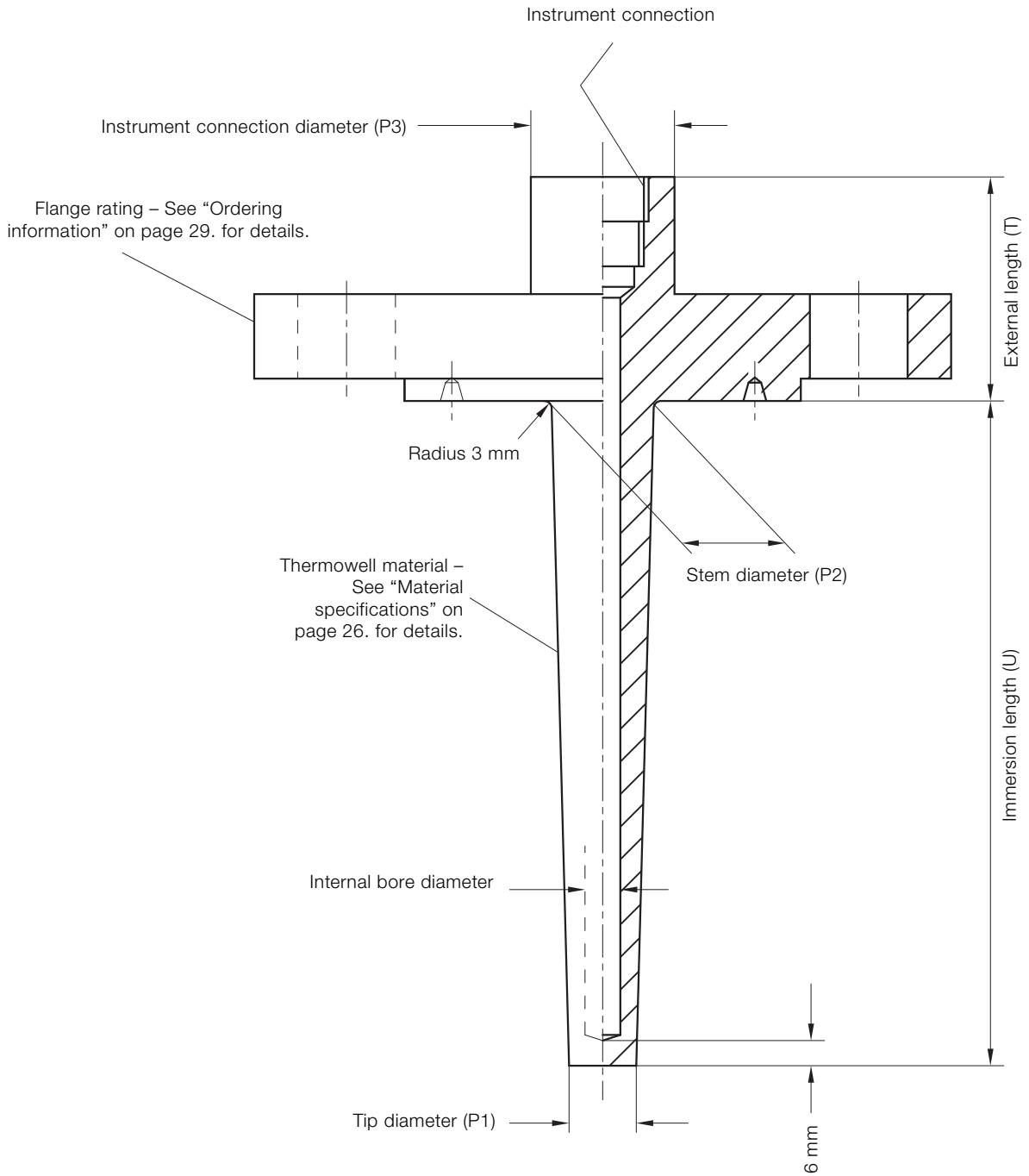
## Thermowell styles

Pages 4 to 25 show the style of thermowell available and is the first consideration when selecting a thermowell.

### Flanged, straight, forged – E1

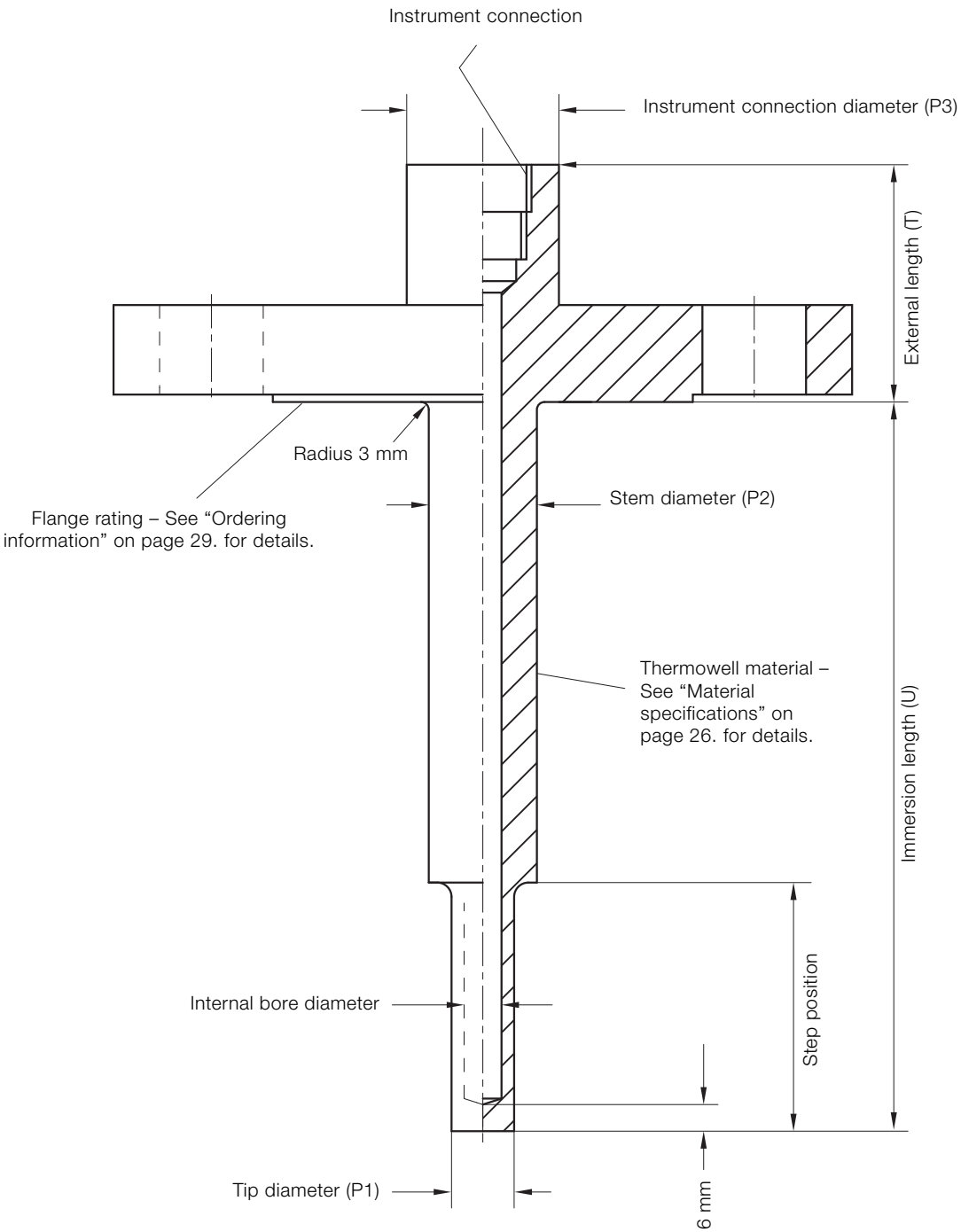


## Flanged, tapered, forged – E2

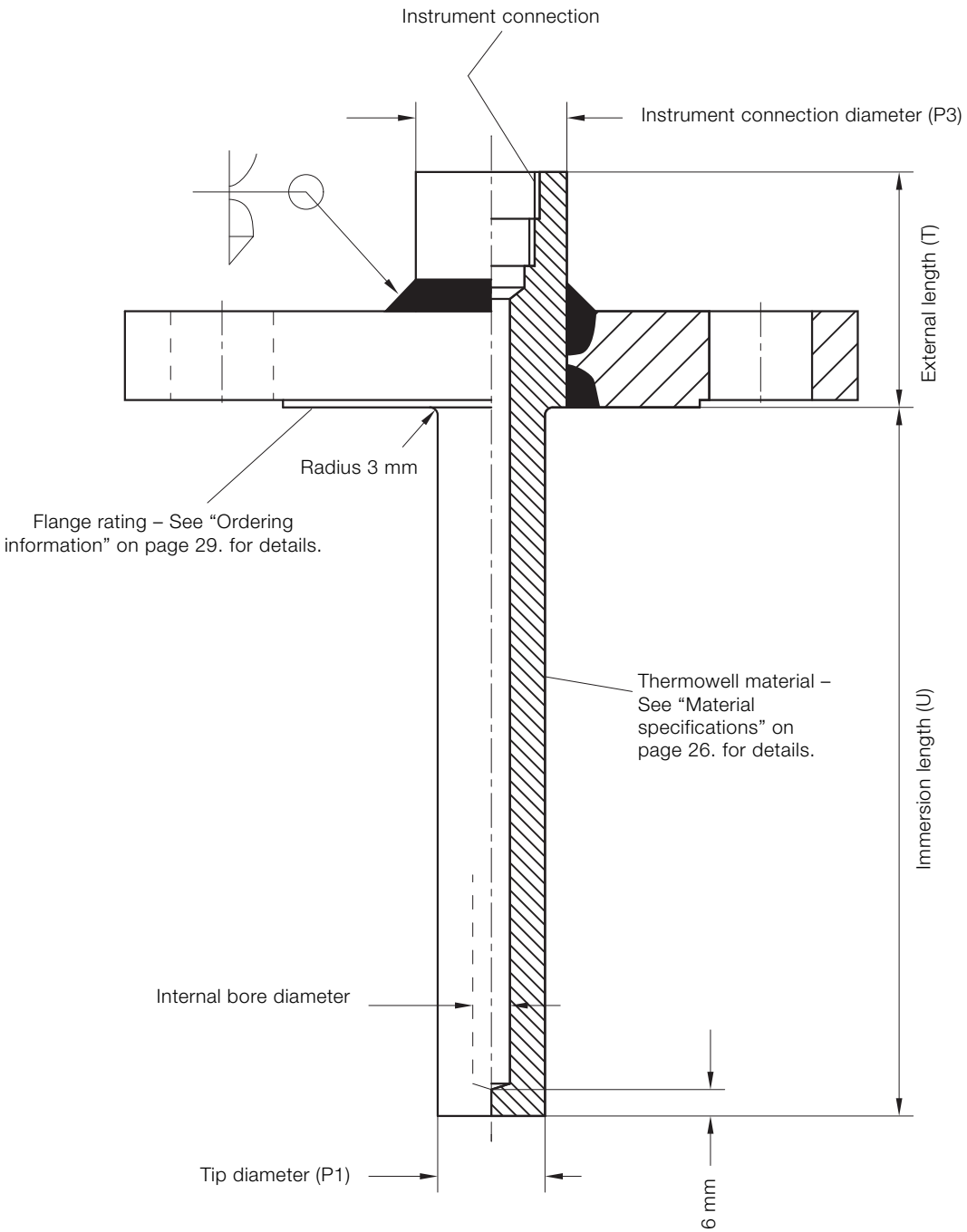


# TSW400 series
# Thermowells

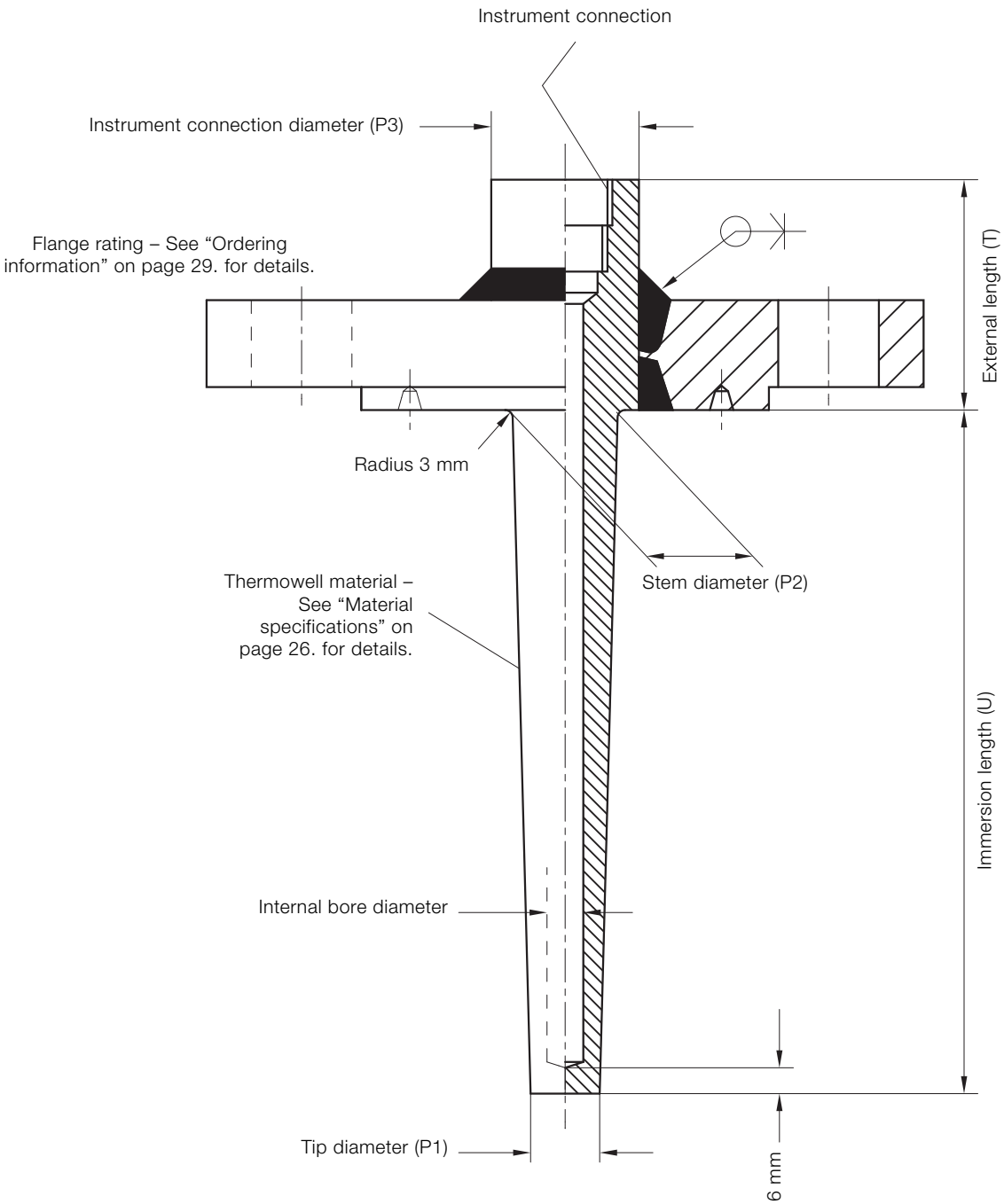
### Flanged, stepped, forged – E3



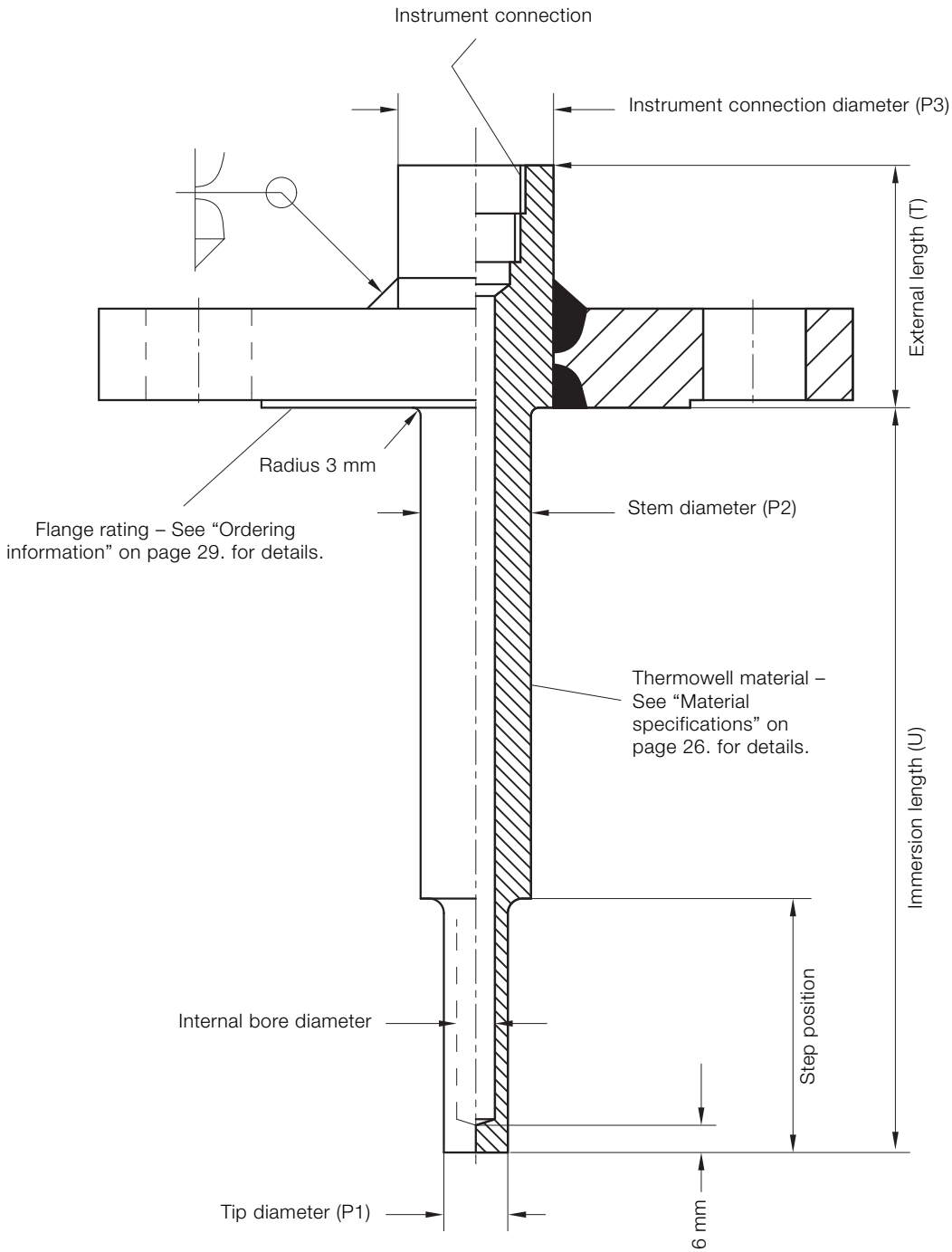
## Flanged, straight, full penetration weld – E4



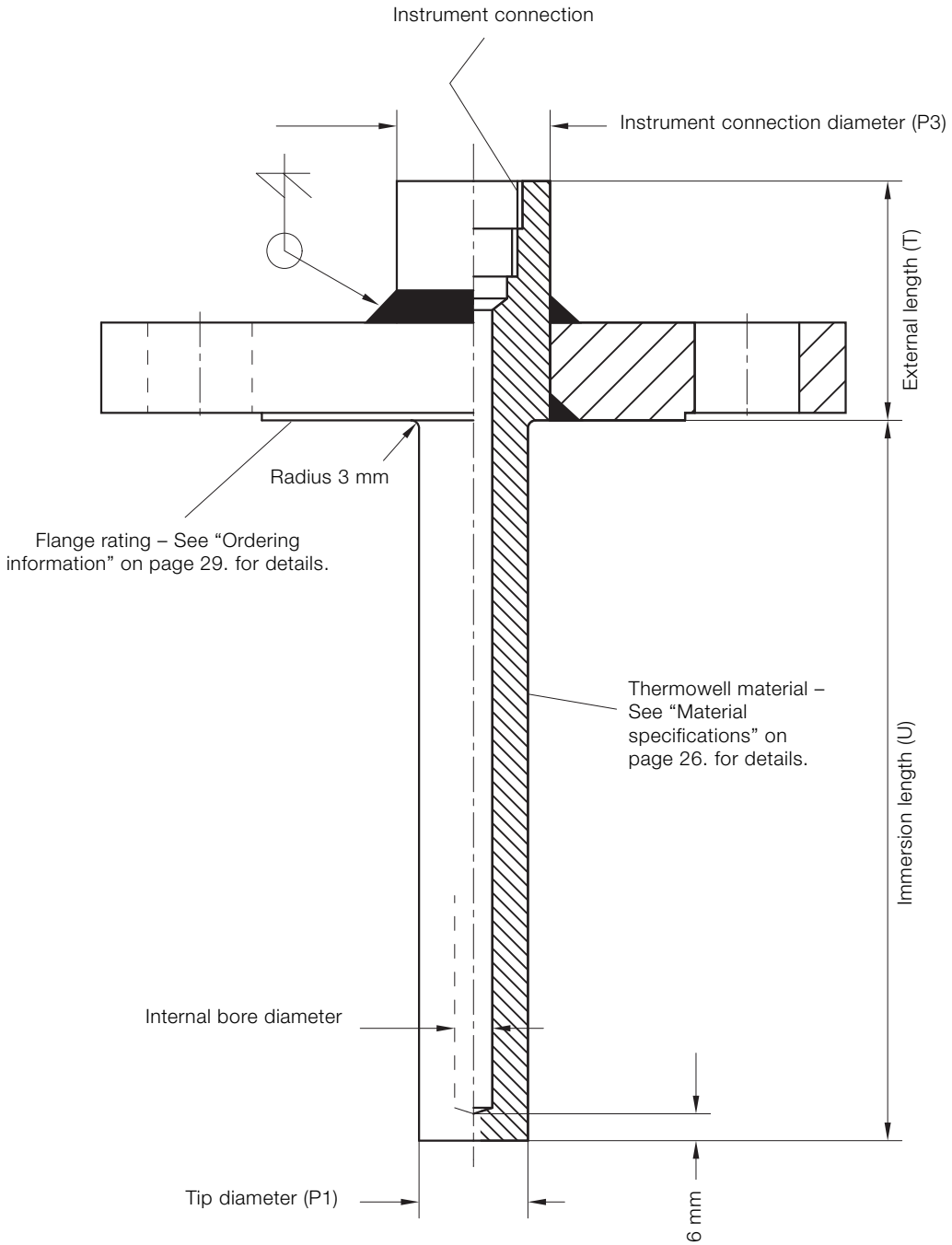
### Flanged, tapered, full penetration weld – E5



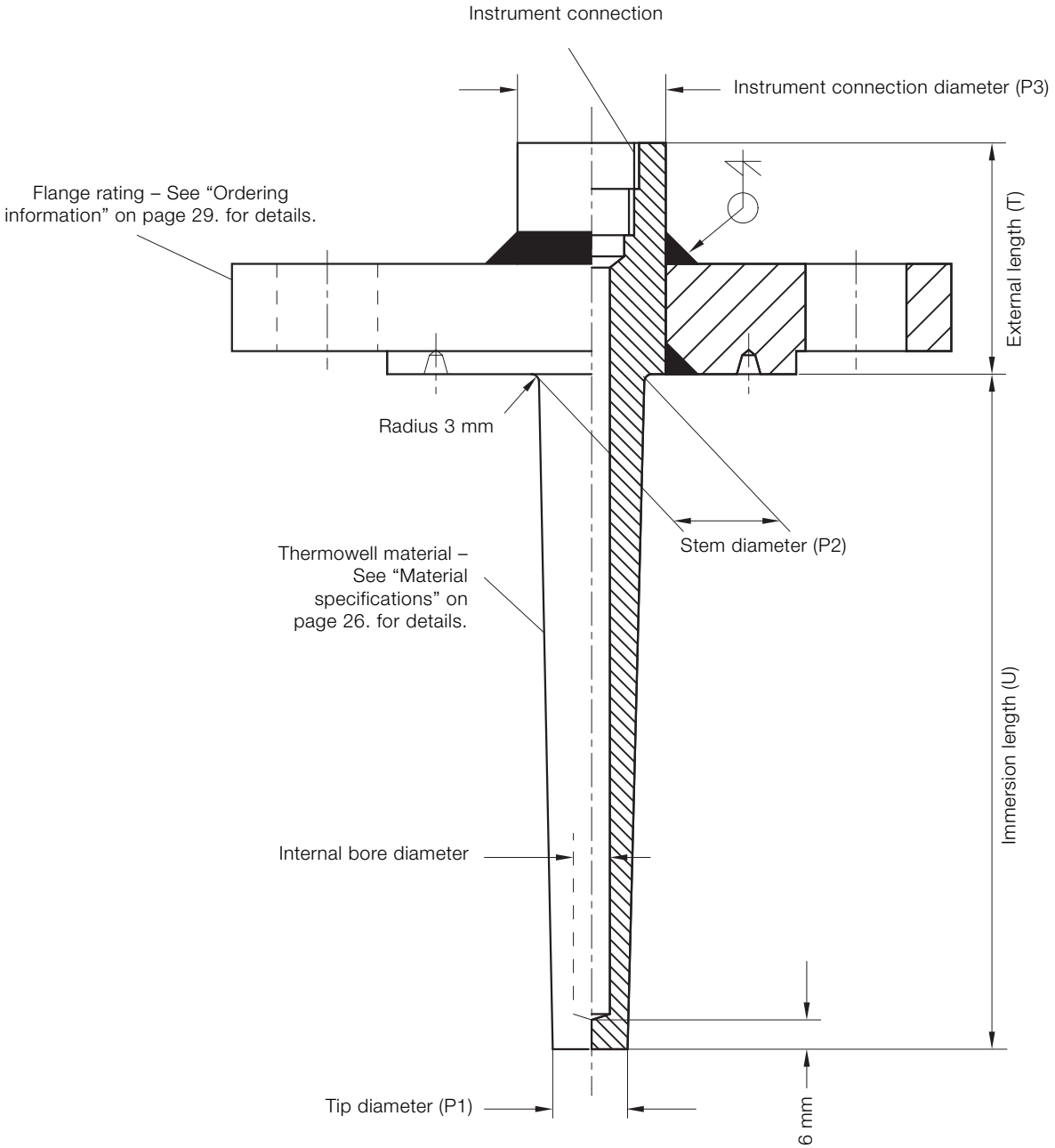
## Flanged, full penetration weld – E6



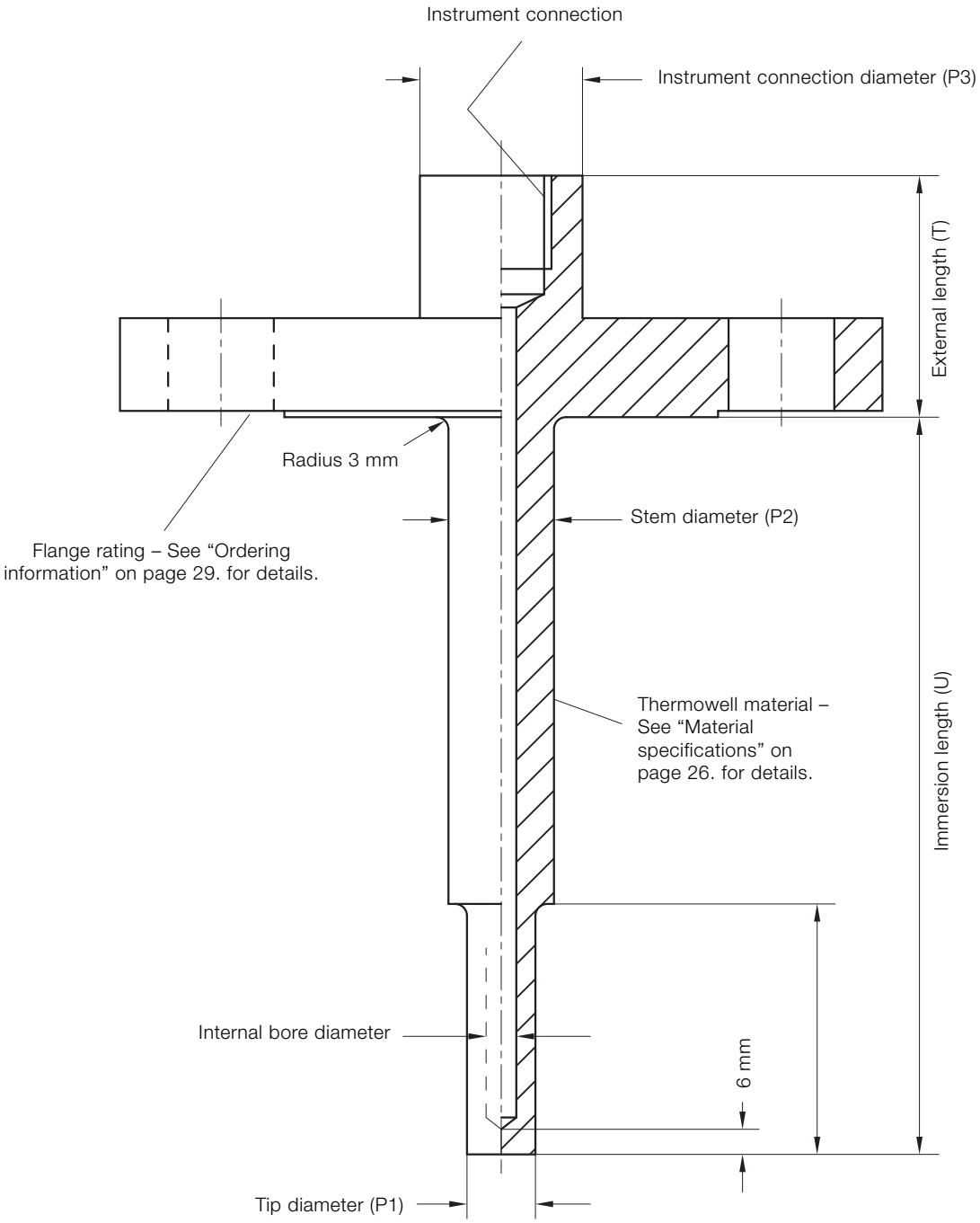
### Flanged, straight, fillet and groove weld – E7



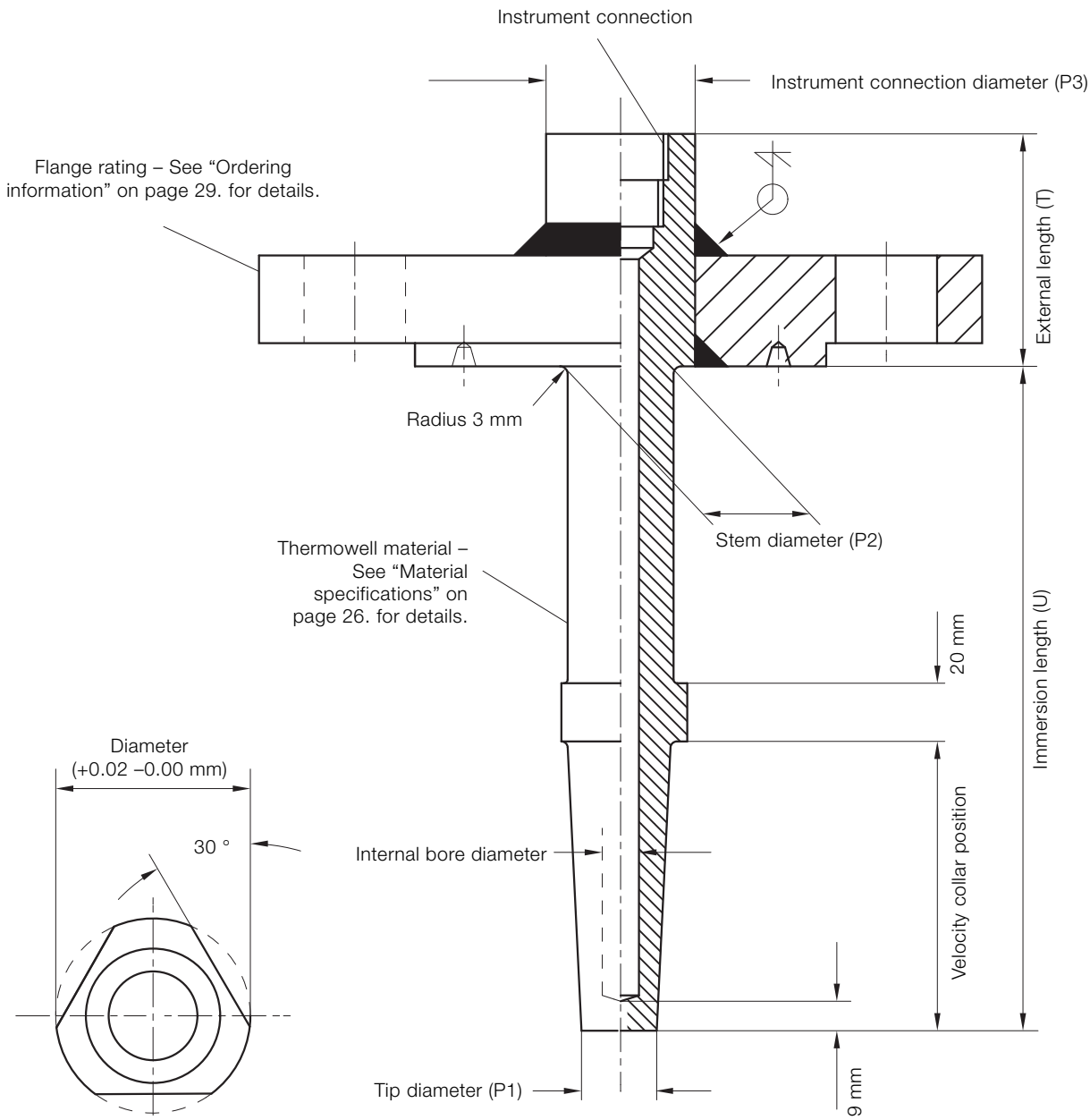
## Flanged, tapered, fillet and groove weld – E8



### Flanged, stepped, fillet and groove weld – G1



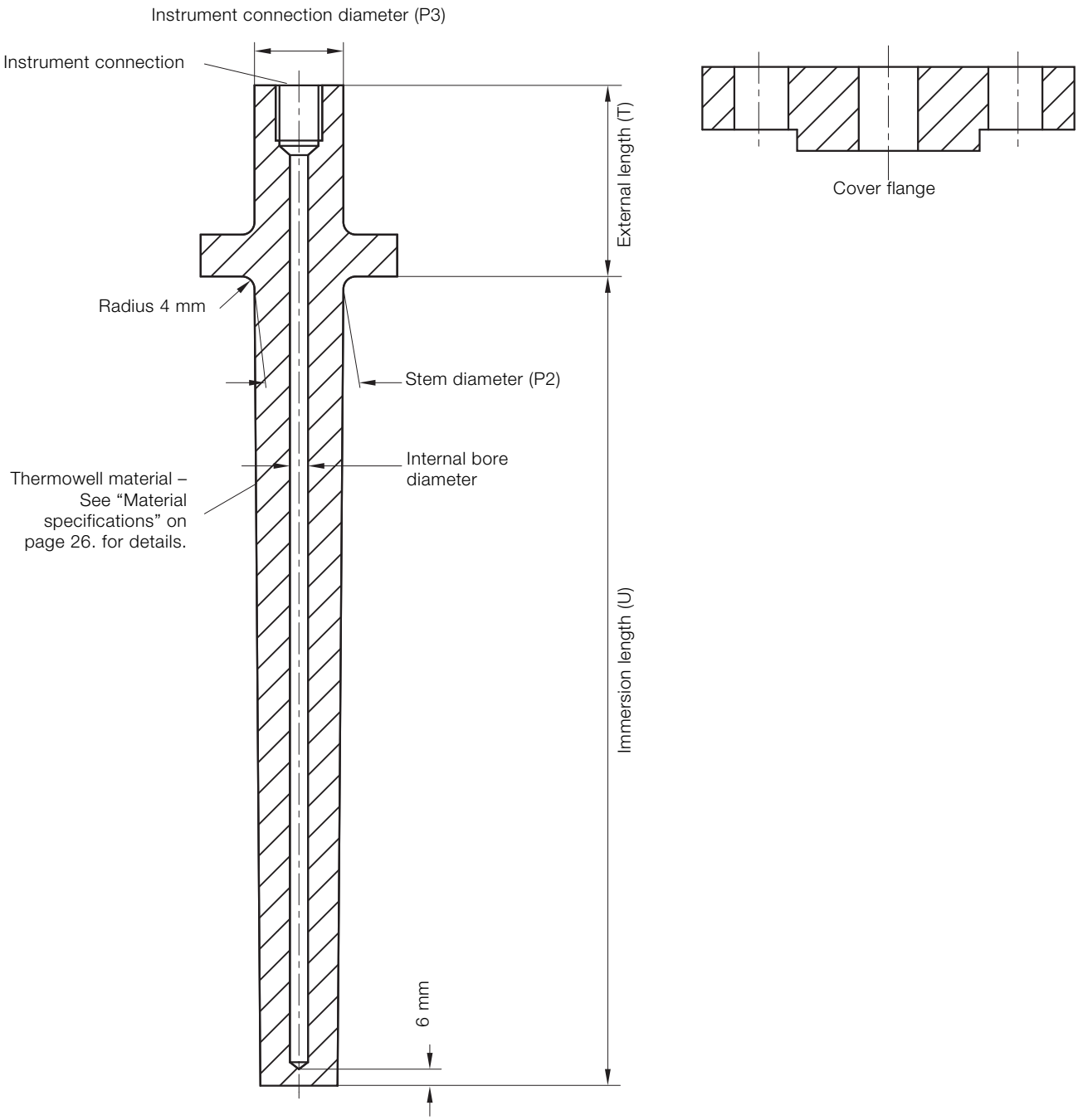
## Flanged, tapered, fillet and groove weld with velocity collar – H1



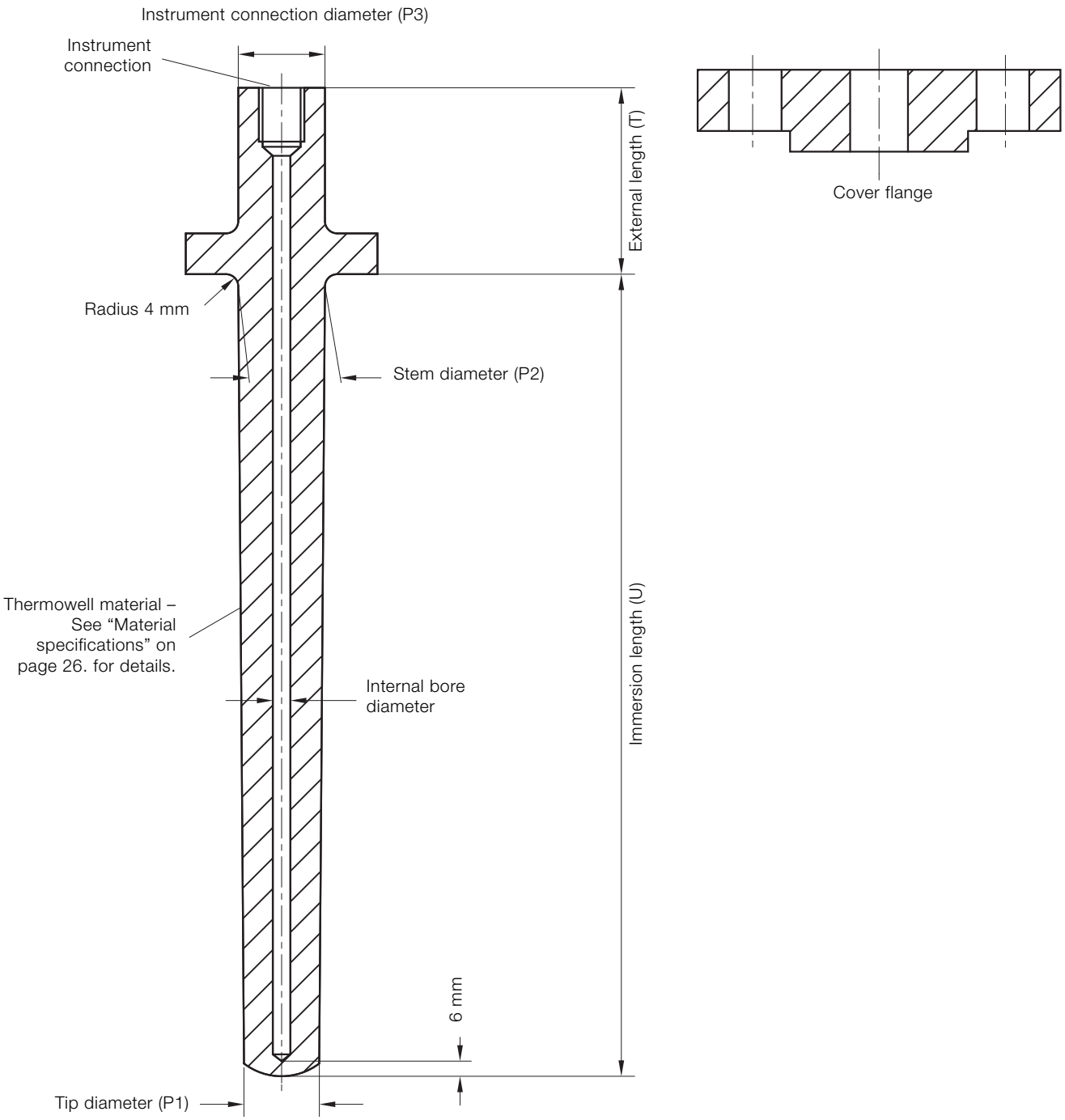

**Velocity collar detail showing chamfers**. Applies also to G2, G3, G4, G5, G6, G7, G8, H1 and H2

# TSW400 series
# Thermowells

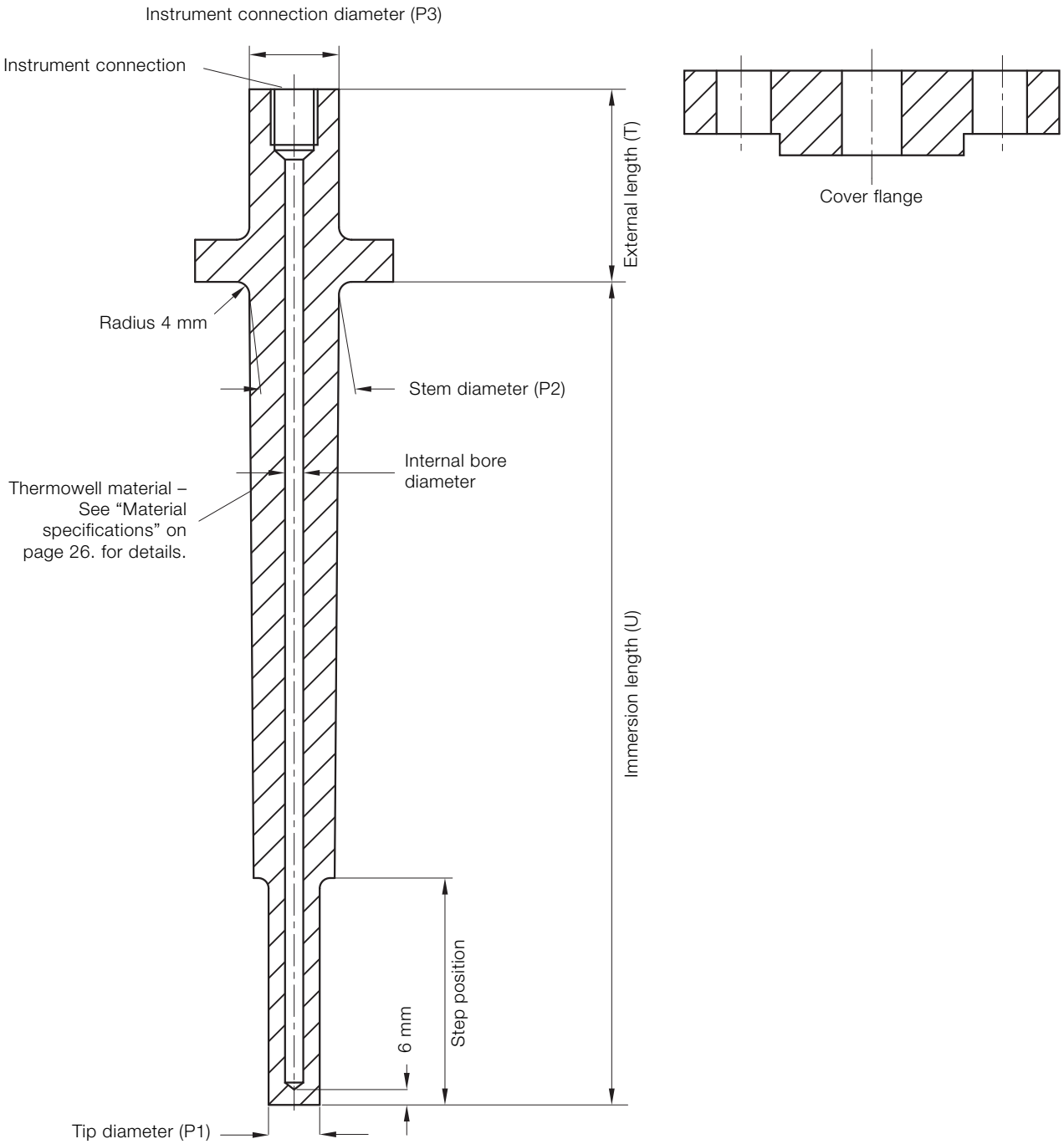
### Van Stone, straight with cover flange – H3



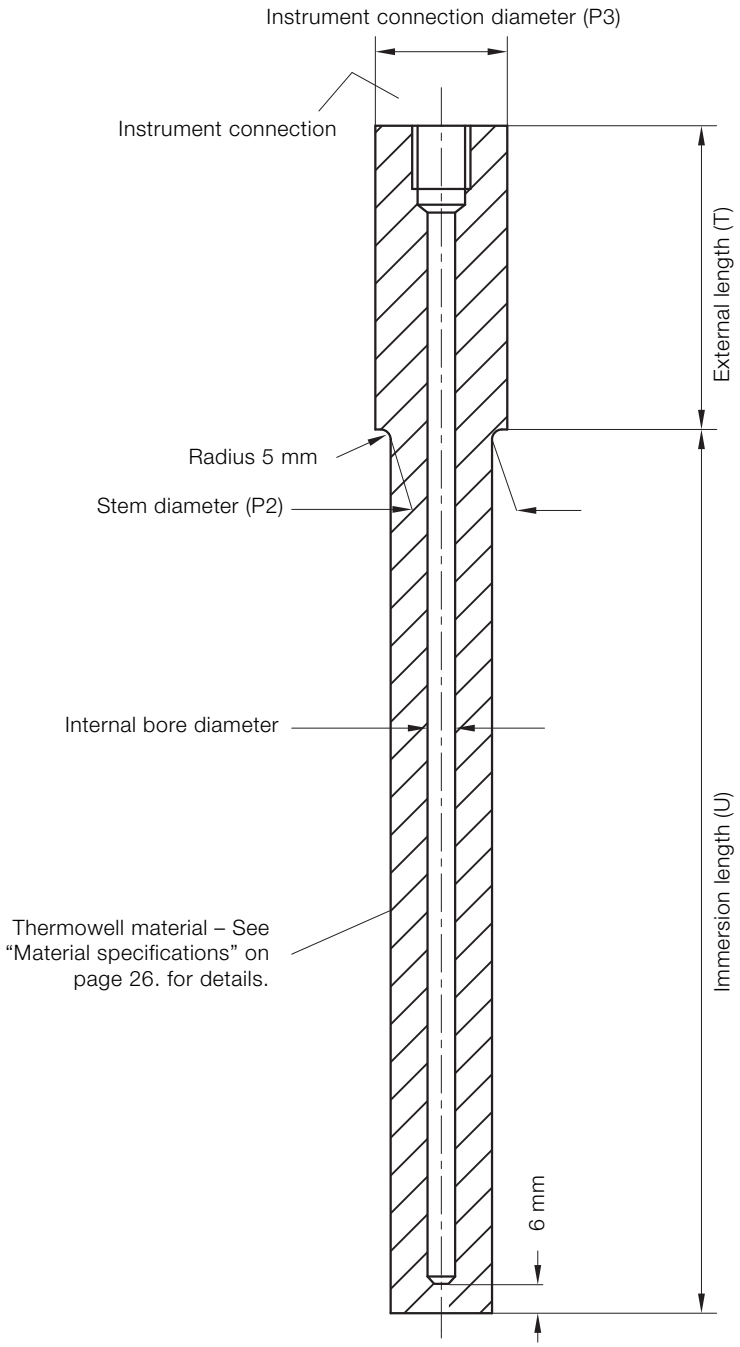
## Van Stone, tapered with cover flange – H4



### Van Stone, stepped with cover flange – H5

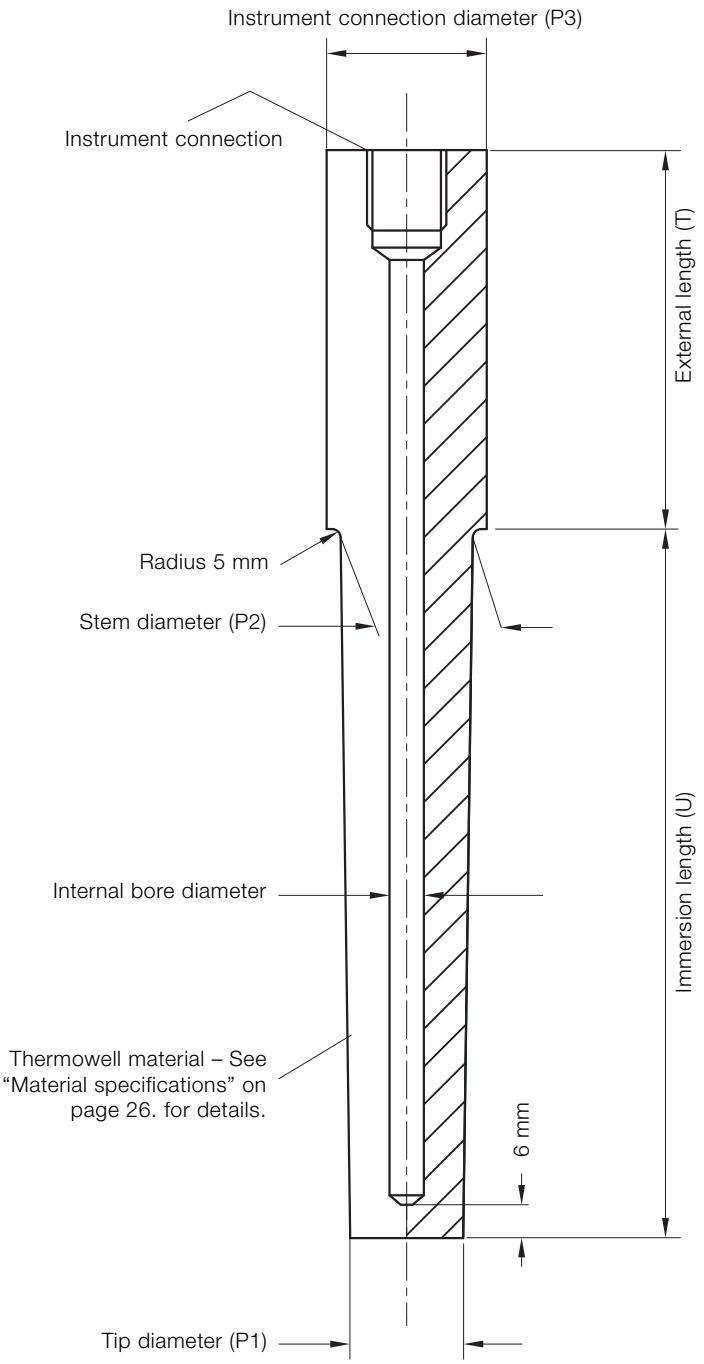


## Weld-in, straight – J1

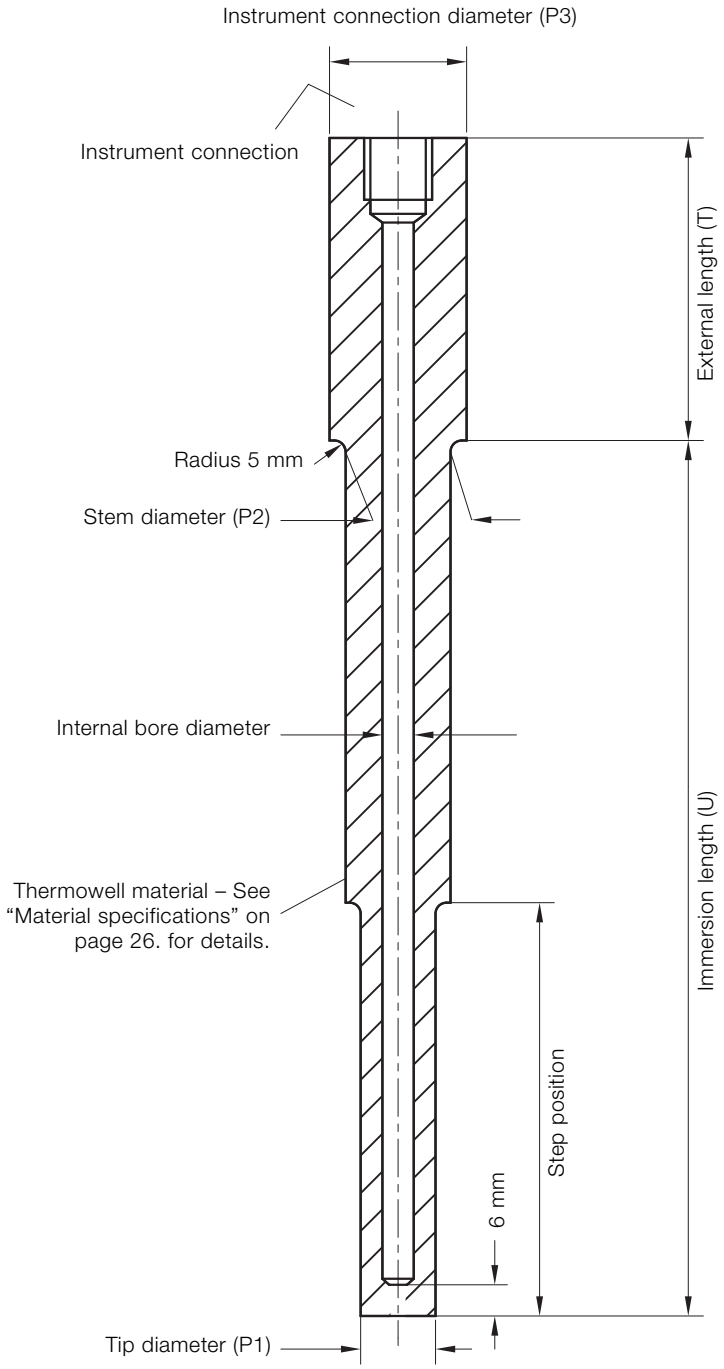


# TSW400 series
# Thermowells

### Weld-in, tapered – J2

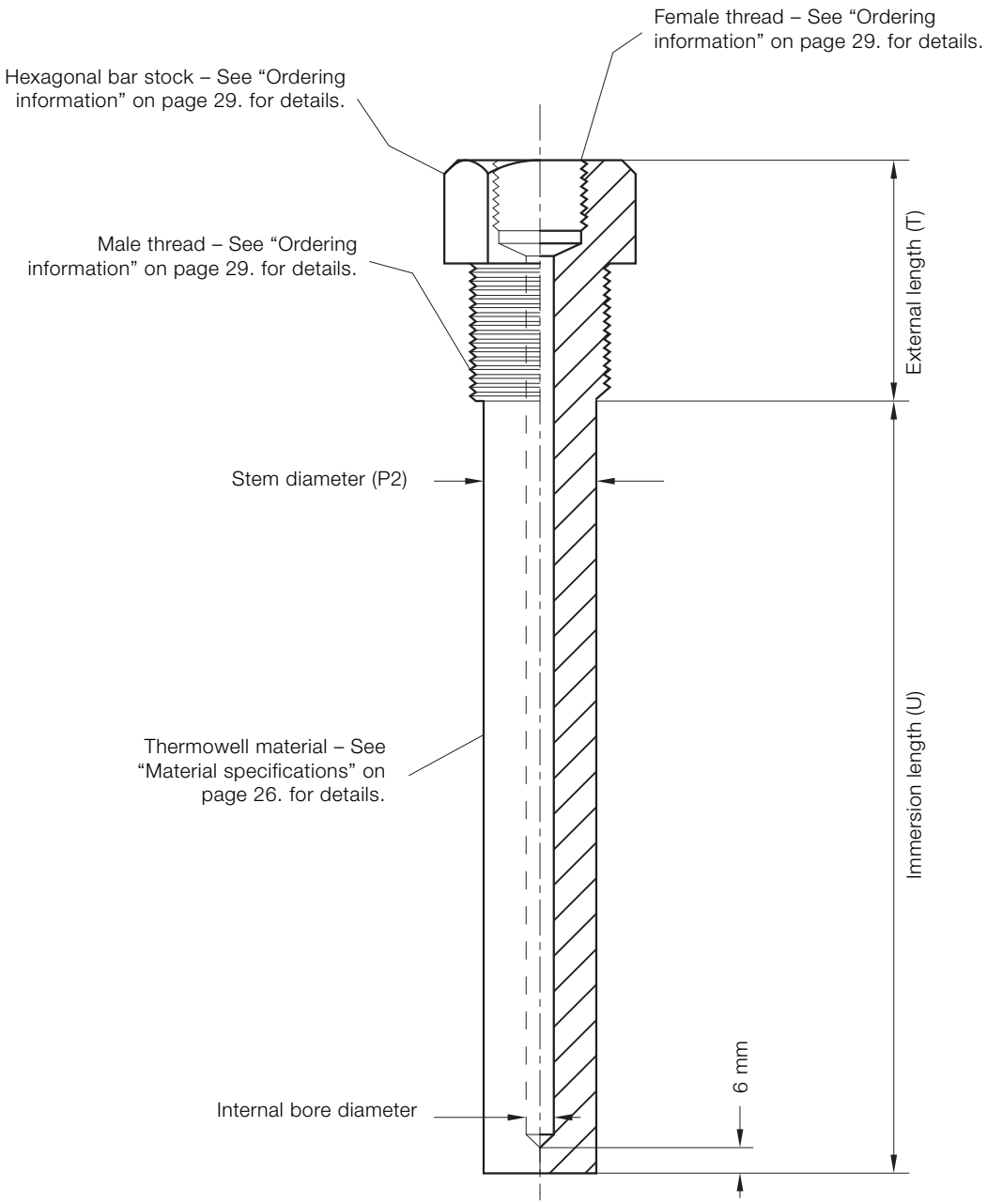


## Weld-in, stepped – J3

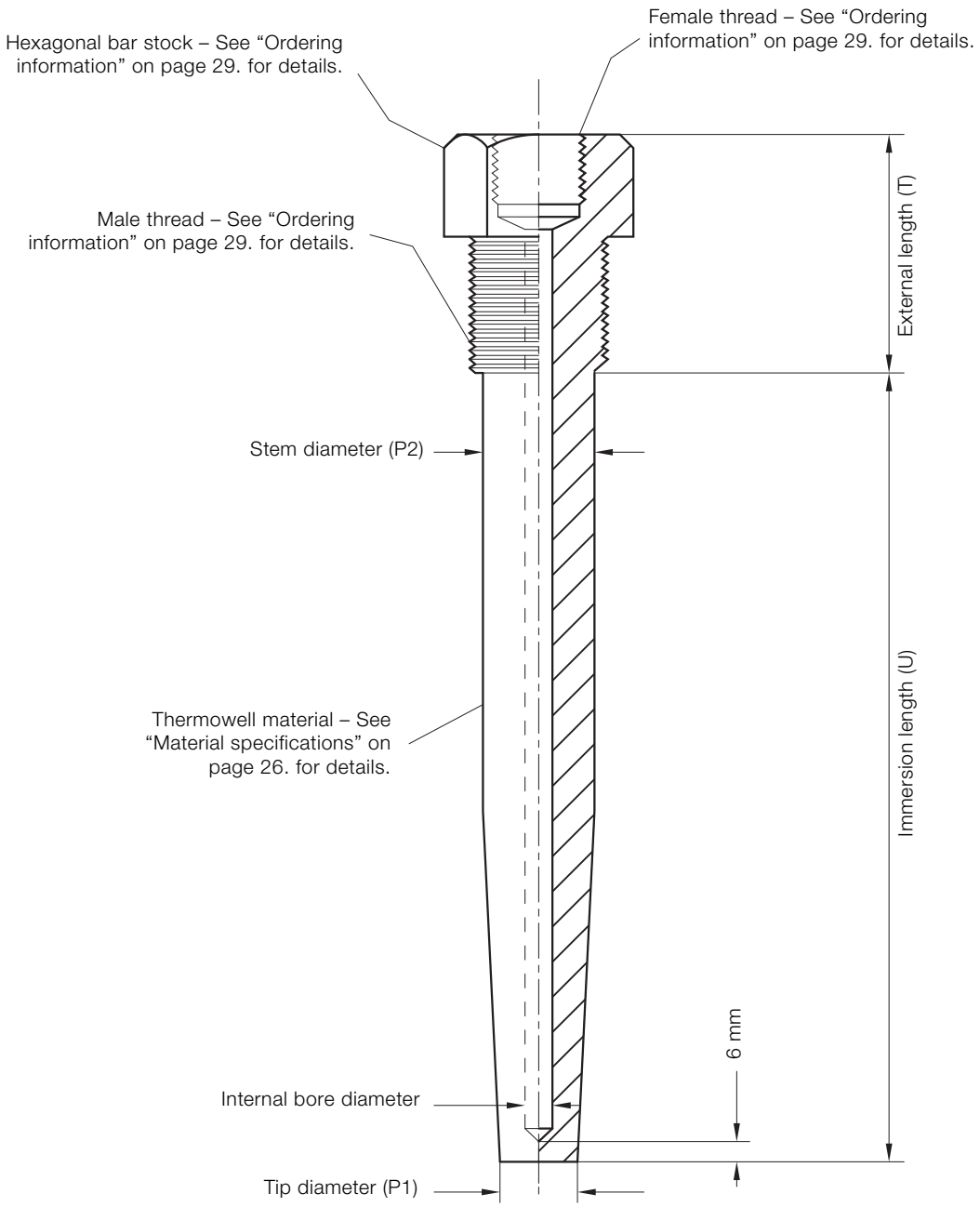


# TSW400 series
# Thermowells

### Threaded, straight – J4

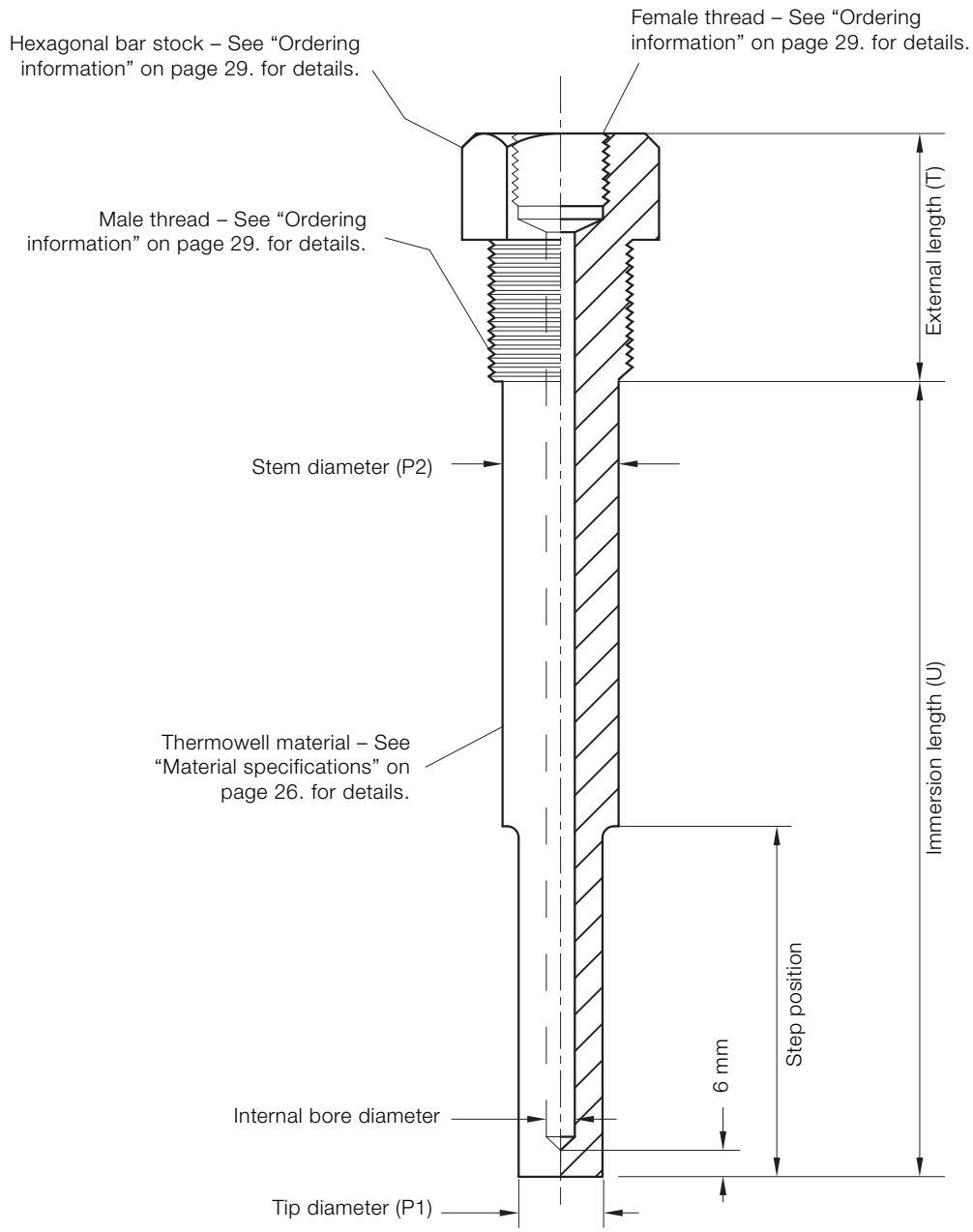


## Threaded, tapered – J5

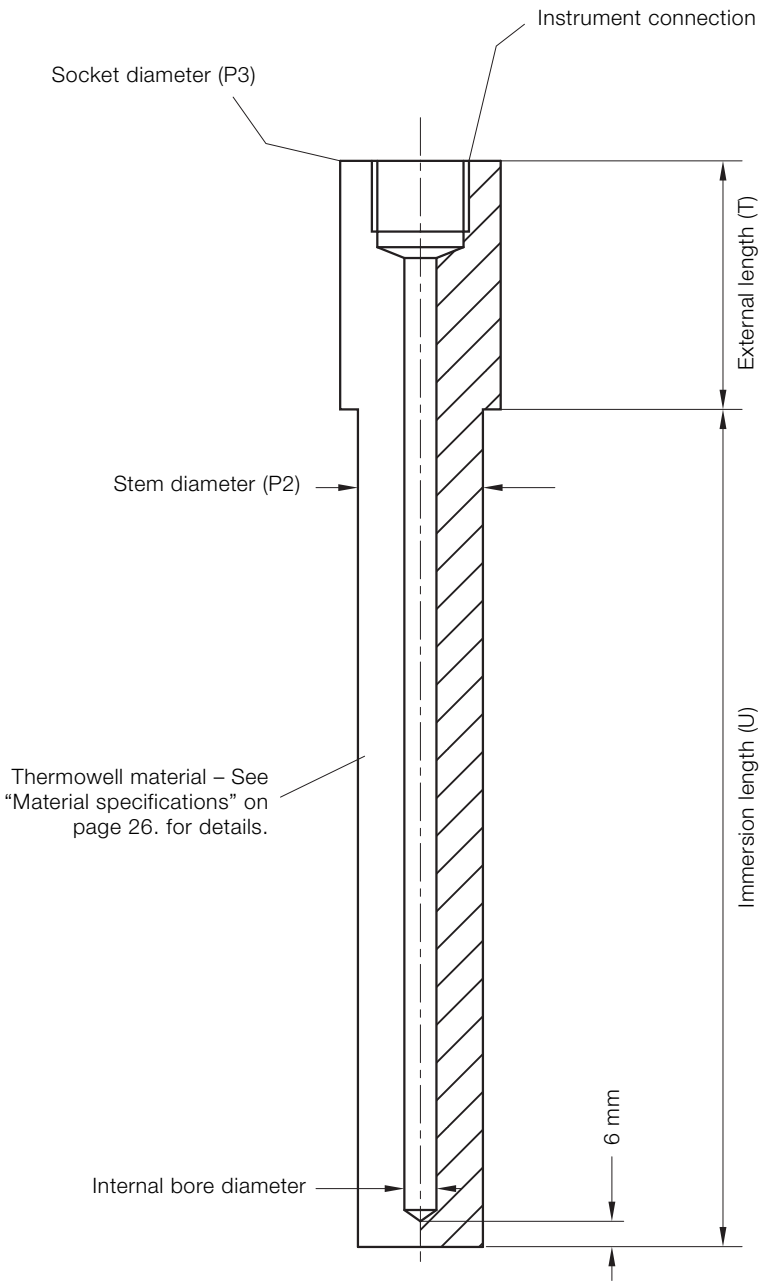


# TSW400 series
# Thermowells

### Threaded, stepped – J6

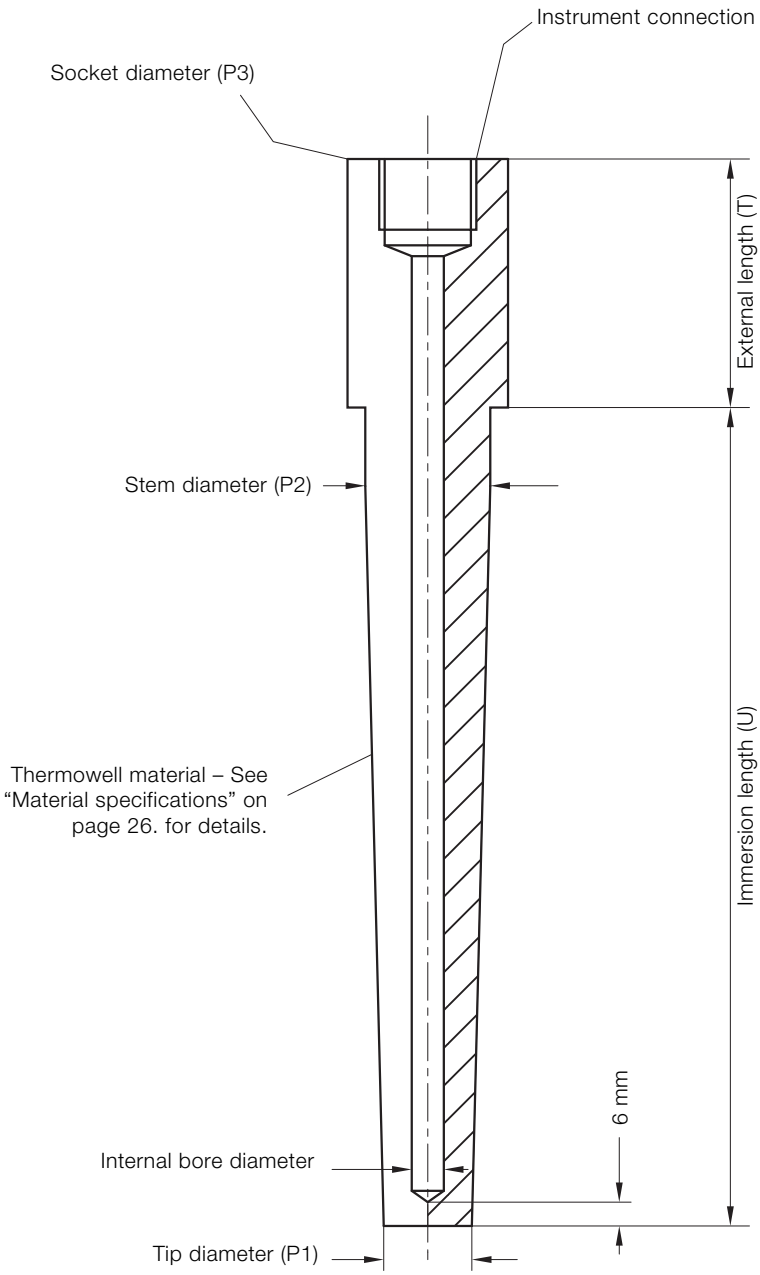


## Socket-weld, straight – J7

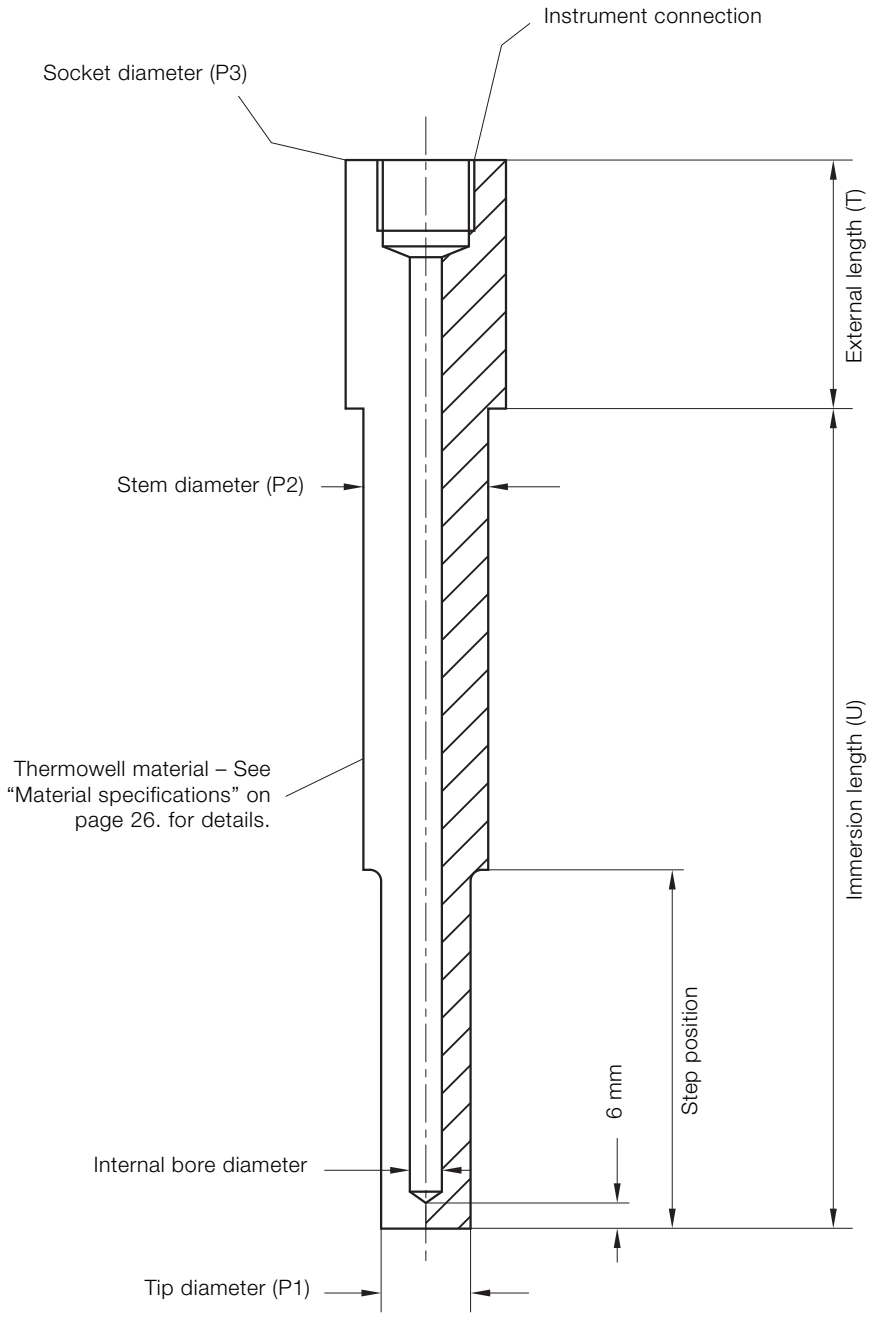


# TSW400 series
# Thermowells

### Socket-weld, tapered – J8



## Socket-weld, stepped – L1



## Material specifications

ABB can manufacture thermowells from almost any commercially available material. If the material required is not in the following list, contact ABB for advice.

— **316/ 316L stainless steel**
the most commonly used material for thermowells combining excellent corrosion resistance with good strength and availability.

— **316Ti stainless steel**
an enhanced version of 316 – a small amount of titanium is added to help stabilize the material at temperatures over 800 °C (1472 °F).

— **321 stainless steel**
offers similar properties to 316 and 316Ti but is more suitable for operation at higher temperatures.

— **Hastelloy C-276**
a material favored for chloride atmospheres and processes. 300 series stainless steels are not recommended for use in high chloride and low oxygen environments.

— **Inconel 600**
a high nickel alloy containing chromium – suitable for use at high temperatures and in both oxidizing and reducing atmospheres.

— **Monel 400**
a high nickel alloy containing copper – highly resistant to corrosion in a wide variety of environments.

— **Duplex**
a stainless steel designed specifically for use in salt water environments where it offers excellent corrosion resistance.

— **Super duplex**
a variant of duplex steel that includes a small amount of copper – preferred over duplex for its enhanced high temperature properties.

**Note.** ABB are unable to specify a particular material for a process plant as this requires detailed process knowledge. However, ABB can discuss the implications of such choices on speed of delivery and cost. In addition, ABB welding engineers are available to advise on welding procedures for all materials.

## Additional material specifications

Materials for use in 'sour' environments (environments containing high concentrations of hydrogen sulphide) normally demand material that complies with the NACE standard. ABB can comply fully with all these requirements.

Certain countries require that materials conform to particular requirements (for example, the NORSOK standard for materials for use in the North Sea).

### ASME PTC 19.3 2010 TW stress calculations

The only published international code for the evaluation of the stresses placed on thermowells in service. ABB engineers can perform a calculation to the ASME code on request. Certification is supplied when requested.

### X-ray fluorescence PMI

When absolute verification of the material supplied is required, ABB can perform an in-house X-ray fluorescence examination. This technique provides a quantitative analysis of the heavy elements in the chemical makeup of the material. The result can then be compared to the certification supplied by the producing mill.

### Pressure testing

Two types of hydrostatic pressure test are offered by ABB:

— **External**
tests the thermowell with pressure applied externally to the thermowell at 1.5 times the flange rating.

— **Internal**
tests the thermowell internally for leaks.

### Weld integrity testing

Weld integrity can be determined using:

— **dye penetrant**
to detect external flaws in the weld

— **X-ray**
to look deeply into the weld to detect internal flaws.

Only X-ray testing produces a permanent record of the weld integrity test in the form of a photograph (X-ray radiograph).

### Bore concentricity

The concentricity of the thermowell bore is vitally important to the performance and safety of the thermowell. ABB uses specially designed, deep-hole drilling machines to produce an absolute confidence in bore concentricity. Additional ultrasonic testing of bore concentricity is standard practice in ABB factories. Additional verification is available in the form of two-axis radiographs that show the concentric bore.

### Stainless steel surface treatment

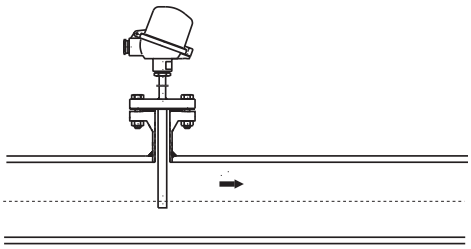
Stainless steels retain their stainless properties by virtue of a thin chromium oxide layer. This layer can be damaged by contaminants during manufacturing. The removal of these contaminants to enable the oxide layer to rebuild is vital for thermowell corrosion integrity. ABB standard practice is to thoroughly degrease each thermowell, both externally and internally, before delivery.

Upon request, ABB can also arrange for a separate 'pickling and passivation' procedure. This is done by first immersing the thermowell in a hot acid bath to remove any contaminants. The thermowell is then 'passivated' to rebuild the chromium oxide layer.

## Other considerations

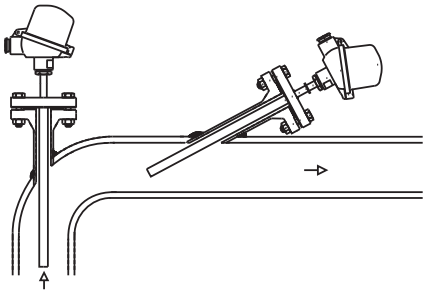
### Thermowell insertion depth

Ideally, the thermowell tip should be positioned in the center third of the pipe. In this position, the temperature measured is an accurate representation of the process temperature.



Additionally, the stem of the thermowell must be at least ten times longer than the tip diameter to minimize heat conduction errors. For example, a thermowell with a tip diameter of 16 mm (0.63 in.) must have a stem that is at least 160 mm (6.3 in.) long.

Narrow pipelines may prevent these two conditions from being met. In this case, it is acceptable to fit the thermowell into the pipe-line at angle or in a bend to accommodate the minimum recommended stem length.



However, if the pipeline is well lagged, a shorter thermowell may also provide a high degree of accuracy.

# TSW400 series
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## Speed of response

The factors that affect speed of response are many and varied.They include:

- the thermal conductivity of the medium
- the flow rate of the medium
- the thermal conductivity of the thermowell material
- the thermowell dimensions

All these factors play a part in the eventual speed of response.

In general, thermowell-mounted instruments respond to changes in temperature faster than the process itself. If an increased rate of response is required, it can be achieved only by reducing the amount of material surrounding the measuring element therefore a stepped design thermowell must be used. However, a compromise must be made between the rate of response achievable and the strength required from the thermowell design.

## Special designs

There may be occasions where a design of thermowell is required that cannot be developed from the available codes. ABB engineers can help with such a requirement. ABB has experience of delivering specialist designs within the Oil & Gas industry and can quote for such a need.

Some customers require approval before manufacture of designs; this can be achieved using ABB-engineered special designs.

Whatever the need – be it a special design or a problem with erosion or corrosion – ABB engineers can help.

# Ordering information

| TSW 400 series thermowells | TSW400 | Main code XX | XX | XX | XXX | X | XX | X | XX | XX | X | XXX | Optional code XX | XXX | XX | XX | XX | XX | XX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Thermowell design** | | | | | | | | | | | | | | | | | | | |
| Flanged, straight, forged | E1 | | | | | | | | | | | | | | | | | | |
| Flanged, tapered, forged | E2 | | | | | | | | | | | | | | | | | | |
| Flanged, stepped, forged | E3 | | | | | | | | | | | | | | | | | | |
| Flanged, straight, full penetration weld | E4 | | | | | | | | | | | | | | | | | | |
| Flanged, tapered, full penetration weld | E5 | | | | | | | | | | | | | | | | | | |
| Flanged, stepped, full penetration weld | E6 | | | | | | | | | | | | | | | | | | |
| Flanged, straight, fillet & groove | E7 | | | | | | | | | | | | | | | | | | |
| Flanged, tapered, fillet & groove | E8 | | | | | | | | | | | | | | | | | | |
| Flanged, stepped, fillet & groove | G1 | | | | | | | | | | | | | | | | | | |
| Flanged, straight, forged with velocity collar | G2 | | | | | | | | | | | | | | | | | | |
| Flanged, tapered, forged with velocity collar | G3 | | | | | | | | | | | | | | | | | | |
| Flanged, stepped, forged with velocity collar | G4 | | | | | | | | | | | | | | | | | | |
| Flanged, straight, full penetration weld with velocity collar | G5 | | | | | | | | | | | | | | | | | | |
| Flanged, tapered, full penetration weld with velocity collar | G6 | | | | | | | | | | | | | | | | | | |
| Flanged, stepped, full penetration weld with velocity collar | G7 | | | | | | | | | | | | | | | | | | |
| Flanged, straight, fillet & groove with velocity collar | G8 | | | | | | | | | | | | | | | | | | |
| Flanged, tapered, fillet & groove with velocity collar | H1 | | | | | | | | | | | | | | | | | | |
| Flanged, stepped, fillet & groove with velocity collar | H2 | | | | | | | | | | | | | | | | | | |
| Van Stone, straight | H3 | | | | | | | | | | | | | | | | | | |
| Van Stone, tapered | H4 | | | | | | | | | | | | | | | | | | |
| Van Stone, stepped | H5 | | | | | | | | | | | | | | | | | | |
| Van Stone, straight with velocity collar | H6 | | | | | | | | | | | | | | | | | | |
| Van Stone, tapered with velocity collar | H7 | | | | | | | | | | | | | | | | | | |
| Van Stone, stepped with velocity collar | H8 | | | | | | | | | | | | | | | | | | |
| Weld-in, straight | J1 | | | | | | | | | | | | | | | | | | |
| Weld-in, tapered | J2 | | | | | | | | | | | | | | | | | | |
| Weld-in, stepped | J3 | | | | | | | | | | | | | | | | | | |
| Threaded, straight | J4 | | | | | | | | | | | | | | | | | | |
| Threaded, tapered | J5 | | | | | | | | | | | | | | | | | | |
| Threaded, stepped | J6 | | | | | | | | | | | | | | | | | | |
| Socket-weld, straight | J7 | | | | | | | | | | | | | | | | | | |
| Socket-weld, tapered | J8 | | | | | | | | | | | | | | | | | | |
| Socket-weld, stepped | L1 | | | | | | | | | | | | | | | | | | |
| DIN 43772 form 4 | D1 | | | | | | | | | | | | | | | | | | |
| ABB form 4S | D2 | | | | | | | | | | | | | | | | | | |
| ABB form PW | P1 | | | | | | | | | | | | | | | | | | |
| DIN 43772 form 4F | D3 | | | | | | | | | | | | | | | | | | |
| ABB form 4FS | D4 | | | | | | | | | | | | | | | | | | |
| ABB form PF | P2 | | | | | | | | | | | | | | | | | | |
| ABB form PS | P3 | | | | | | | | | | | | | | | | | | |
| Other | Z9 | | | | | | | | | | | | | | | | | | |

Continued on next page …

See page 34

# TSW400 series
# Thermowells

| | | Main code | | | | | | | | | | Optional code | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TSW 400 series thermowells** | **TSW400** | **XX** | **XX** | **XX** | **XXX** | **X** | **XX** | **X** | **XX** | **XX** | **X** | **XXX** | **XX** | **XXX** | **XX** | **XX** | **XX** | **XX** | **XX** |
| | See page 29 | | | | | | | | | | | | See page 34 | | | | | | |
| **Immersion length (U)** | | | | | | | | | | | | | | | | | | | |
| 50 to 100 mm | | | A5 | | | | | | | | | | | | | | | | |
| 101 to 150 mm | | | B1 | | | | | | | | | | | | | | | | |
| 151 to 200 mm | | | B5 | | | | | | | | | | | | | | | | |
| 201 to 250 mm | | | C1 | | | | | | | | | | | | | | | | |
| 251 to 300 mm | | | C5 | | | | | | | | | | | | | | | | |
| 301 to 350 mm | | | D1 | | | | | | | | | | | | | | | | |
| 351 to 400 mm | | | D5 | | | | | | | | | | | | | | | | |
| 401 to 450 mm | | | E1 | | | | | | | | | | | | | | | | |
| 451 to 500 mm | | | E5 | | | | | | | | | | | | | | | | |
| 501 to 550 mm | | | F1 | | | | | | | | | | | | | | | | |
| 551 to 600 mm | | | F5 | | | | | | | | | | | | | | | | |
| 601 to 650 mm | | | G1 | | | | | | | | | | | | | | | | |
| 651 to 700 mm | | | G5 | | | | | | | | | | | | | | | | |
| 701 to 750 mm | | | H1 | | | | | | | | | | | | | | | | |
| 751 to 800 mm | | | H5 | | | | | | | | | | | | | | | | |
| 801 to 850 mm | | | J1 | | | | | | | | | | | | | | | | |
| 851 to 999 mm | | | J5 | | | | | | | | | | | | | | | | |
| **Thermowell material** | | | | | | | | | | | | | | | | | | | |
| Stainless steel 1.4404 / 316L | | | | S1 | | | | | | | | | | | | | | | |
| Stainless steel 1.4571 / 316Ti | | | | S2 | | | | | | | | | | | | | | | |
| Stainless steel 1.4541 / 321L | | | | S6 | | | | | | | | | | | | | | | |
| Hastelloy C-276 / 2.4819 | | | | N1 | | | | | | | | | | | | | | | |
| Monel 400 | | | | N4 | | | | | | | | | | | | | | | |
| Inconel 600 | | | | N5 | | | | | | | | | | | | | | | |
| Duplex | | | | D1 | | | | | | | | | | | | | | | |
| Super duplex | | | | D2 | | | | | | | | | | | | | | | |
| Others | | | | Z9 | | | | | | | | | | | | | | | |

Continued on next page …

| TSW 400 series thermowells | TSW400 | XX | XX | XX | XXX | X | XX | X | XX | XX | X | XXX | XX | XXX | XX | XX | XX | XX | XX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | See pages 29 and 30 | Main code | | | | | | | | | | | Optional code | | | | | | |
| | | | | | | | | | | | | | See page 34 | | | | | | |
| **Process connection type** | | | | | | | | | | | | | | | | | | | |
| None | | | | | Y00 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 150 RF | | | | | F07 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 300 RF | | | | | F08 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 600 RF | | | | | F09 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 600 RTJ | | | | | J09 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 900 RF | | | | | F21 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 900 RTJ | | | | | J21 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 1500 RF | | | | | F22 | | | | | | | | | | | | | | |
| Flanged 1 in. ASME B16.5 CL 1500 RTJ | | | | | J22 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 150 RF | | | | | F11 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 300 RF | | | | | F12 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 600 RF | | | | | F13 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 600 RTJ | | | | | J13 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 900 RF | | | | | F14 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 900 RTJ | | | | | J14 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 1500 RF | | | | | F25 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 1500 RTJ | | | | | J25 | | | | | | | | | | | | | | |
| Flanged 1 1/2 in. ASME B16.5 CL 2500 RTJ | | | | | J26 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 150 RF | | | | | F15 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 300 RF | | | | | F16 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 600 RF | | | | | F17 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 600 RTJ | | | | | J17 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 900 RF | | | | | F18 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 900 RTJ | | | | | J18 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 1500 RF | | | | | F19 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 1500 RTJ | | | | | J19 | | | | | | | | | | | | | | |
| Flanged 2 in. ASME B16.5 CL 2500 RTJ | | | | | J20 | | | | | | | | | | | | | | |
| Flanged DN 25 EN1092 PN 10 | | | | | D21 | | | | | | | | | | | | | | |
| Flanged DN 25 EN1092 PN 16 | | | | | D22 | | | | | | | | | | | | | | |
| Flanged DN 25 EN1092 PN 40 | | | | | D24 | | | | | | | | | | | | | | |
| Flanged DN 40 EN1092 PN 10 | | | | | D41 | | | | | | | | | | | | | | |
| Flanged DN 40 EN1092 PN 16 | | | | | D42 | | | | | | | | | | | | | | |
| Flanged DN 40 EN1092 PN 40 | | | | | D44 | | | | | | | | | | | | | | |
| Flanged DN 50 EN1092 PN 10 | | | | | D51 | | | | | | | | | | | | | | |
| Flanged DN 50 EN1092 PN 16 | | | | | D52 | | | | | | | | | | | | | | |
| Flanged DN 50 EN1092 PN 40 | | | | | D54 | | | | | | | | | | | | | | |
| Threaded M20 x 1.5 | | | | | S07 | | | | | | | | | | | | | | |
| Threaded M27 x 2 | | | | | S08 | | | | | | | | | | | | | | |
| Threaded 1/2 in. NPT | | | | | S04 | | | | | | | | | | | | | | |
| Threaded 3/4 in. NPT | | | | | S05 | | | | | | | | | | | | | | |
| Threaded 1 in. NPT | | | | | S06 | | | | | | | | | | | | | | |
| Others | | | | | Z99 | | | | | | | | | | | | | | |

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# TSW400 series
# Thermowells

| | Main code | | | | | | | | | | | Optional code | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TSW 400 series thermowells** | **TSW400** | **XX** | **XX** | **XX** | **XXX** | **X** | **XX** | **X** | **XX** | **XX** | **X** | **XXX** | **XX** | **XXX** | **XX** | **XX** | **XX** | **XX** | **XX** |
| | See pages 29 to 31 | | | | | | | | | | | | See page 34 | | | | | | |
| **Instrument connection** | | | | | | | | | | | | | | | | | | | |
| 1/2 in. NPT (standard) | | | | | | A | | | | | | | | | | | | | |
| M20 x 1.5 | | | | | | D | | | | | | | | | | | | | |
| 1/2 in. BSP | | | | | | E | | | | | | | | | | | | | |
| **External length (T)** | | | | | | | | | | | | | | | | | | | |
| 0 mm to... | | | | | | | 00 | | | | | | | | | | | | |
| 90 mm | | | | | | | 90 | | | | | | | | | | | | |
| **Instrument connection diameter (P3)** | | | | | | | | | | | | | | | | | | | |
| 32 mm | | | | | | | | A | | | | | | | | | | | |
| 35 mm | | | | | | | | B | | | | | | | | | | | |
| 40 mm | | | | | | | | C | | | | | | | | | | | |
| Others | | | | | | | | Z | | | | | | | | | | | |
| **Stem diameter (P2)** | | | | | | | | | | | | | | | | | | | |
| 16 mm to... | | | | | | | | | 16 | | | | | | | | | | |
| 38 mm | | | | | | | | | 38 | | | | | | | | | | |

Continued on next page ...

| TSW 400 series thermowells | Main code | | | | | | | | | | | Optional code | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSW400 | XX | XX | XX | XXX | X | XX | X | XX | XX | X | XXX | XX | XXX | XX | XX | XX | XX | XX |
| | See pages 29 to 32 | | | | | | | | | | | | See page 34 | | | | | | |
| **Tip diameter (P1)** | | | | | | | | | | | | | | | | | | | |
| 12 mm | | | | | | | | | | A1 | | | | | | | | | |
| 12.5 mm | | | | | | | | | | A2 | | | | | | | | | |
| 13 mm | | | | | | | | | | A3 | | | | | | | | | |
| 13.5 mm | | | | | | | | | | A4 | | | | | | | | | |
| 14 mm | | | | | | | | | | A5 | | | | | | | | | |
| 14.5 mm | | | | | | | | | | A6 | | | | | | | | | |
| 15 mm | | | | | | | | | | A7 | | | | | | | | | |
| 15.5 mm | | | | | | | | | | A8 | | | | | | | | | |
| 16 mm | | | | | | | | | | A9 | | | | | | | | | |
| 16.5 mm | | | | | | | | | | B0 | | | | | | | | | |
| 17 mm | | | | | | | | | | B1 | | | | | | | | | |
| 17.5 mm | | | | | | | | | | B2 | | | | | | | | | |
| 18 mm | | | | | | | | | | B3 | | | | | | | | | |
| 18.5 mm | | | | | | | | | | B4 | | | | | | | | | |
| 19 mm | | | | | | | | | | B5 | | | | | | | | | |
| 19.5 mm | | | | | | | | | | B6 | | | | | | | | | |
| 20 mm | | | | | | | | | | B7 | | | | | | | | | |
| 20.5 mm | | | | | | | | | | B8 | | | | | | | | | |
| 21 mm | | | | | | | | | | B9 | | | | | | | | | |
| 21.5 mm | | | | | | | | | | C0 | | | | | | | | | |
| 22 mm | | | | | | | | | | C1 | | | | | | | | | |
| 22.5 mm | | | | | | | | | | C2 | | | | | | | | | |
| 23 mm | | | | | | | | | | C3 | | | | | | | | | |
| 23.5 mm | | | | | | | | | | C4 | | | | | | | | | |
| 24 mm | | | | | | | | | | C5 | | | | | | | | | |
| 24.5 mm | | | | | | | | | | C6 | | | | | | | | | |
| 25 mm | | | | | | | | | | C7 | | | | | | | | | |
| 25.5 mm | | | | | | | | | | C8 | | | | | | | | | |
| 26 mm | | | | | | | | | | C9 | | | | | | | | | |
| 26.5 mm | | | | | | | | | | D0 | | | | | | | | | |
| 27 mm | | | | | | | | | | D1 | | | | | | | | | |
| 27.5 mm | | | | | | | | | | D2 | | | | | | | | | |
| 28 mm | | | | | | | | | | D3 | | | | | | | | | |
| 28.5 mm | | | | | | | | | | D4 | | | | | | | | | |
| 29 mm | | | | | | | | | | D5 | | | | | | | | | |
| 29.5 mm | | | | | | | | | | D6 | | | | | | | | | |
| 30 mm | | | | | | | | | | D7 | | | | | | | | | |

Continued on next page …

# TSW400 series
# Thermowells

| TSW 400 series thermowells | Main code | | | | | | | | | | | Optional code | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSW400 | XX | XX | XX | XXX | X | XX | X | XX | XX | X | XXX | XX | XXX | XX | XX | XX | XX | XX |
| | | | | | | | | | | | | See pages 29 to 33 | | | | | | | |
| **Internal bore** | | | | | | | | | | | | | | | | | | | |
| 3.5 mm | | | | | | | | | | | A | | | | | | | | |
| 6.5 mm | | | | | | | | | | | B | | | | | | | | |
| 7.0 mm | | | | | | | | | | | C | | | | | | | | |
| 8.0 mm | | | | | | | | | | | D | | | | | | | | |
| 9.0 mm | | | | | | | | | | | E | | | | | | | | |
| 9.5 mm | | | | | | | | | | | F | | | | | | | | |
| 10 mm | | | | | | | | | | | G | | | | | | | | |
| 13 mm | | | | | | | | | | | H | | | | | | | | |
| **Step position** | | | | | | | | | | | | | | | | | | | |
| None | | | | | | | | | | | | 000 | | | | | | | |
| 50 mm to... | | | | | | | | | | | | 050 | | | | | | | |
| 150 mm | | | | | | | | | | | | 150 | | | | | | | |
| **Usage certifications** | | | | | | | | | | | | | | | | | | | |
| 3.1 cert materials traceability report | | | | | | | | | | | | | C2 | | | | | | |
| Certificate of conformity | | | | | | | | | | | | | C4 | | | | | | |
| Dimensional report | | | | | | | | | | | | | C6 | | | | | | |
| NACE material certification | | | | | | | | | | | | | CN | | | | | | |
| **Other usage certifications** | | | | | | | | | | | | | | | | | | | |
| Russia, Metrological and GOST-R certificate | | | | | | | | | | | | | | CG1 | | | | | |
| NORSOK | | | | | | | | | | | | | | CN2 | | | | | |
| **Plug and chain** | | | | | | | | | | | | | | | | | | | |
| Plug and chain (stainless steel) | | | | | | | | | | | | | | | H8 | | | | |
| **Documentation language** | | | | | | | | | | | | | | | | | | | |
| German | | | | | | | | | | | | | | | | M1 | | | |
| Spanish | | | | | | | | | | | | | | | | M3 | | | |
| French | | | | | | | | | | | | | | | | M4 | | | |
| English | | | | | | | | | | | | | | | | M5 | | | |
| **Non-destructive tests** | | | | | | | | | | | | | | | | | | | |
| X-ray fluorescence PMI | | | | | | | | | | | | | | | | | N1 | | |
| Dye penetration of weld integrity | | | | | | | | | | | | | | | | | N2 | | |
| Ultrasonic tip concentricity | | | | | | | | | | | | | | | | | N3 | | |
| Helium leak testing | | | | | | | | | | | | | | | | | N4 | | |
| Pressure test external (water) | | | | | | | | | | | | | | | | | N5 | | |
| Pressure test internal (water) | | | | | | | | | | | | | | | | | N6 | | |
| Radiograph process connection | | | | | | | | | | | | | | | | | N7 | | |
| Radiograph tip concentricity | | | | | | | | | | | | | | | | | N8 | | |

Continued on next page …

| TSW 400 series thermowells | Main code | | | | | | | | | | | Optional code | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSW400 | XX | XX | XX | XXX | X | XX | X | XX | XX | X | XXX | XX | XXX | XX | XX | XX | XX | XX |
| | | | | | | | See pages 29 to 34 | | | | | | | | | | See page 34 | | |
| **Reporting options** | | | | | | | | | | | | | | | | | | | |
| Weld location report | | | | | | | | | | | | | | | | | | ND | |
| Weld qualification report | | | | | | | | | | | | | | | | | | NE | |
| Wake frequency calculation | | | | | | | | | | | | | | | | | | NG | |
| Hardness report | | | | | | | | | | | | | | | | | | NH | |
| **Operations options** | | | | | | | | | | | | | | | | | | | |
| De-pip, to produce a flat bore end | | | | | | | | | | | | | | | | | | | SB |
| Non standard flange to stem weld radius | | | | | | | | | | | | | | | | | | | SW |
| Non Standard tip thickness | | | | | | | | | | | | | | | | | | | ST |
| Non Standard tip profile (chamfered) | | | | | | | | | | | | | | | | | | | SH |
| Non Standard tip profile (domed) | | | | | | | | | | | | | | | | | | | SR |
| Pickling and passivation | | | | | | | | | | | | | | | | | | | SC |
| Material source limitations apply | | | | | | | | | | | | | | | | | | | SD |
| European only materials | | | | | | | | | | | | | | | | | | | SE |

**Added characteristics**

Actual immersion length (mm)
Velocity collar diameter (mm)
Velocity collar position (mm)
Tag number
Material source limitations
Non standard flange to stem weld radius
Non standard tip thickness

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