

# Heavy Duty Thermowell for the Oil & Gas Industry

Engineered solutions for  
optimized and dependable  
process measurements



**Constructed from durable, high-quality materials**

— for use in heavy duty applications

**Low cost of ownership**

— exchangeability of inserts while line or vessel is in service

**Wide range of applications covered**

— oil exploration and pipelines; offshore; petrochemical/  
chemical industries; machinery and protective measures

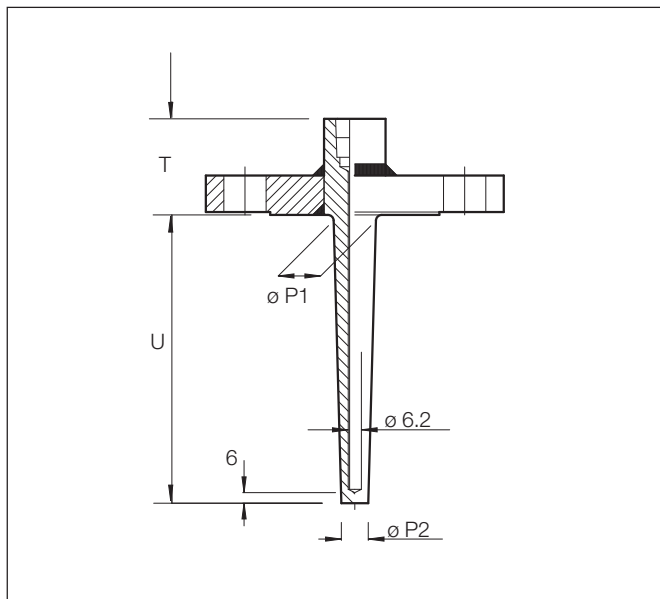
**Manufactured to ISO 19001**

— the latest standards

**Wave frequency calculation available**

— to suit customer requirements

## Thermowell Design



### Key

- U = Immersion length
- P1 = Stem diameter (see Table)
- P2 = Stem diameter at tip (see Table)
- T = Lagging length

Flange	Thread	P1	P2
1 in.	1/2 in...3/4 in.	20 mm	16 mm
1 1/2 in...2 in.	1 in.	25 mm	20mm

## Solid Drilled Thermowells

### Introduction

Thermowells manufactured by ABB are machined from solid bars or forgings. They can be used with all Resistance Thermometers, Thermocouples, Filled Systems and Dial Thermometer Indicators, as well as for test purposes.

They are used extensively throughout the Power, Process and Petrochemical industries to protect the sensors from the process fluid and to enable servicing, or replacement, of sensors without the need for plant shut down.

All thermowells are machined on special-purpose high-accuracy machines and, with careful quality control, ensure:

- perfect concentricity of the bore with respect to the outside diameter
- a consistent wall-thickness over the full length of the thermowell
- a wide selection of profiles are available from our vast CAD/CAM library.

Materials selected for the manufacture of solid-drilled thermowells are of the highest quality. Strict quality control is applied to both materials selection and the manufacturing processes. Full certification, including original mill and suppliers' materials certificates, is provided (to EN10204 3.1). The requirements of NACE Standard MR-01-75 can also be satisfied if specified.

### Design

Generally, thermowells supplied by ABB are designed to comply with the codes of practice as laid down by the British Standards Institution, DIN, ASME and other authorities. For more detailed advice the relevant code of practice, or standard, should be consulted.

All thermowells are manufactured to conform to the PED (97/23/EC SEP).

### Materials

ABB is experienced in the handling, machining and welding of all types of stainless steel and special alloys such as Monel, Inconel, Incolloy, Duplex, Super Duplex and Hastelloy, as well as Titanium, Nickel and other materials. Thermowells can be manufactured in all these materials from bar or forgings as appropriate.

Guidance on the selection of materials for a particular application is readily available from our Engineering Department.

### Surface Finish

Thermowells are normally supplied with a fine-machined surface finish, equal to RA 3.2 or better. Polished or other finishes can be supplied on request. Special corrosion or wear-resistant coatings can be applied to the immersed length of flanged thermowells, for example, Stellite, PTFE, Tungsten Carbide, Tantalum etc.

### Heat Treatment

All thermowells can be heat-treated to individual requirements.

### Quality Assurance – Inspection

Full traceability of all materials is maintained. Inspection is carried out at various stages from release of materials through manufacture, including material analysis checks and ultrasonic examination.

Final inspection includes the following:

- Full dimensional check
- Bore concentricity check
- Hydro testing to 1.5 x flange rating
- Dye penetrant test if required
- Radiography if required
- Ultrasonic testing if required
- Ferrite scope testing if required
- PMI (qualitative and quantitative) if required
- Thermowell calculations in accordance with Murdock are available.

All thermowells are thoroughly cleaned and degreased prior to despatch.

### Documentation

Each thermowell is supplied with 3.1 certification to EN10204 3.1 (wetted parts only) and a certificate of conformity and a Declaration of the Safe Conditions of Use.

Additional documentation to Customer's specification is available on request.

### Selection of Dimensions and Profiles

- 1) Process Connection (C), see overleaf, is selected to suit the particular application and plant standard being used.
- 2) Select a thermowell with a Lagging Length (T) where either the thermowell has to pass through an insulation or 'lagging' layer or where it is required to position the assembly connection head away from the pipe or tank whose temperature is being measured. Screwed thermowells may be supplied without lagging length (T).
- 3) The Immersion Profile selected should take account of the fluid flow characteristics, strength of thermowell required and depth of immersion.

Preferred profiles are:

- Parallel Profile
- Taper Profile
- Stepped Profile.

Use Taper Profile for short to medium length thermowells, Parallel Profile and Stepped Profile for longer thermowells. When selecting a thermowell with a Sensitive Tip, care should be taken to ensure that the reduction in metal thickness around the tip (P2) does not lead to permissible stresses being exceeded. Consult our Engineering Department for advice.

- 4) Choose Immersion Length (U) to ensure that the sensing element protrudes sufficiently into the medium whose temperature is to be detected to give a representative measurement and to ensure that the sensing element is sufficiently remote from outside influences as to be unaffected by them.

For pipes the sensing element should be positioned as near to the centre line as possible but at least  $\frac{1}{3}$  of the pipe diameter in from the outer skin.

- 5) Response Times  
EM 60751 describes response times in terms of a step change in temperature of water flowing at 0.4 m/s in the range of 25 to 35 °C. For solid-drilled stainless steel thermowells of the tapered design the response to T0.5 is of the order of 15 s and to T0.9 is in the order of 45 s. For parallel design thermowells the response to T0.5 and T0.9 is in the order of 30 s and 60 s respectively. A reduced tip design responds faster than the tapered design, T0.5 10 s (typically) T0.9 25 s (typically).

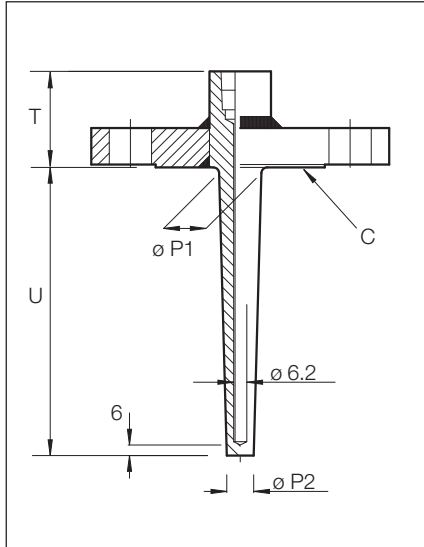
Response times in operation are affected by many factors including the conductivity of materials\*, the specific heat capacity of materials\*, the thermal gradient, the flow rate of the medium and the pressure of a gas.

\* Materials of construction and fluid under test.

- 6) Mechanical Stress and Vibration  
Solid-drilled thermowells are extremely strong devices designed for use in the most demanding and arduous environments. If there is concern regarding the sensitivity of a particular thermowell, consult our Engineering Department for advice. Calculations of the thermowell assemblies to withstand static, kinetic and harmonic stresses are available to the Murdock Standard.

## Sensor Design

### Example



#### Key

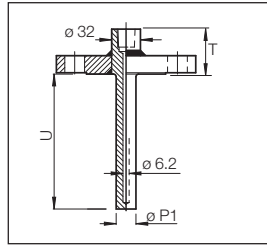
K = Extension length

U = Immersion length

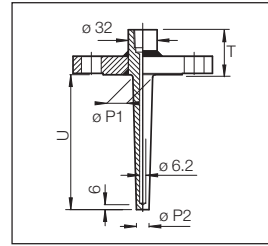
T = Lagging Length

C = Process Connection

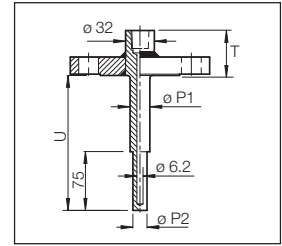
### Thermowell



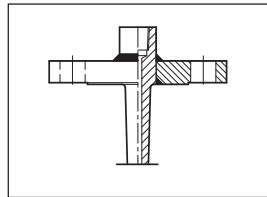
*Type F1 Straight Profile Flanged*



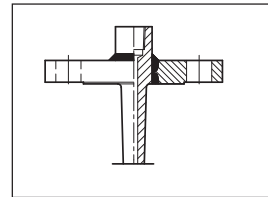
*Type F2 Taper Profile Flanged*



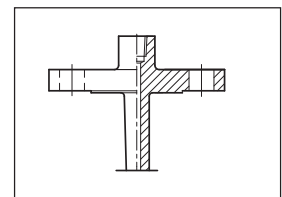
*Type F3 Stepped Profile Flanged*



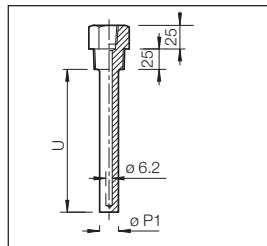
*Welded-on Flange Fillet & Groove*



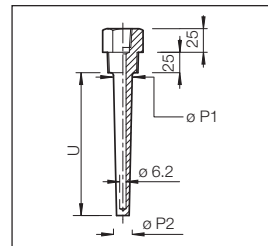
*Welded-on Flange Full Penetration Weld*



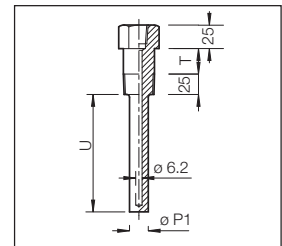
*Forged Thermowell*



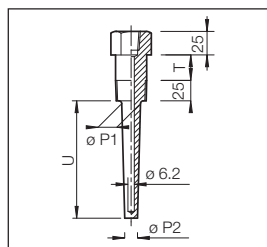
*Type S1 Straight Profile Screwed*



*Type S2 Taper Profile Screwed*



*Type S4 Straight Profile Screwed*



*Type S5 Taper Profile Screwed*

**Ordering Information**

CODE No. PART 1

Thermowell/Test Well only (Solid Drilled)	Model No. V10685/	X	XX	XX
<b>Material</b>				
316 Stainless Steel UNSS31603/ASME IX (Standard)		L		
304 Stainless Steel UNSS30403/ASME IX		H		
321 Stainless Steel UNSS32103/ASME IX		M		
Hastelloy C276 UNSN10276/ASME IX	(Note 6)	P		
Hastelloy B2 UNSN10665/ASME IX	(Note 6)	B		
Monel Alloy 400 UNSN04400/ASME IX	(Note 6)	A		
Inconel Alloy 600 UNSN06600/ASME IX	(Note 6)	U		
Incoloy Alloy 800 UNSN08800/ASME IX	(Note 6)	C		
Duplex UNSNOS31803/ASME IX	(Note 6)	D		
Super Duplex UNSNOS32550/ASME IX	(Note 6)	S		
Other Materials		X		
<b>Process Connection</b>				
1 in. 150 lb RF Flange – Fillet and Seal Weld			F1	
1 in. 300 lb RF Flange – Fillet and Seal Weld			F2	
1 1/2 in. 150 lb RF Flange – Fillet and Seal Weld			F3	
1 1/2 in. 300 lb RF Flange – Fillet and Seal Weld			F4	
1 1/2 in. 600 lb RF Flange – Fillet and Seal Weld			F5	
1 1/2 in. 150 lb RF Flange – Full Penetration Weld	(Note 7)		P3	
1 1/2 in. 300 lb RF Flange – Full Penetration Weld	(Note 7)		P4	
1 1/2 in. 600 lb RF Flange – Full Penetration Weld	(Note 7)		P5	
1 1/2 in. 900 lb RF Flange – Full Penetration Weld	(Note 7)		P6	
1 1/2 in. 600 lb RTJ Flange – Full Penetration Weld	(Note 7)		R1	
1 1/2 in. 900 lb RTJ Flange – Full Penetration Weld	(Note 16)		R2	
2 in. 150 lb RF Flange – Fillet and Seal Weld			F7	
2 in. 300 lb RF Flange – Fillet and Seal Weld			F8	
2 in. 600 lb RF Flange – Fillet and Seal Weld			F9	
2 in. 150 lb RF Flange – Full Penetration Weld	(Note 7)		P7	
2 in. 300 lb RF Flange – Full Penetration Weld	(Note 7)		P8	
2 in. 600 lb RF Flange – Full Penetration Weld	(Note 7)		P9	
2 in. 600 lb RTJ Flange – Full Penetration Weld	(Note 7)		R3	
Other Flanged			FX	
1/2 in. BSP Screwed Thread Parallel			S1	
1/2 in. NPT Screwed Thread Tapered			S2	
3/4 in. BSP Screwed Thread Parallel			S3	
3/4 in. NPT Screwed Thread Tapered			S4	
1 in. BSP Screwed Thread Parallel			S5	
1 in. NPT Screwed Thread Tapered			S6	
Other Screwed			SX	
<b>Stem Design</b>				
Solid Drilled – Straight Flanged	(Note 1)			F1
Solid Drilled – Tapered Flanged	(Note 1)			F2
Solid Drilled – Reduced Tip Flanged	(Note 1)			F3
Solid Drilled – Screwed Straight No Lagging	(Note 2)			S1
Solid Drilled – Screwed Tapered No Lagging	(Note 2)			S2
Solid Drilled – Screwed Straight, Lagging Length 'T'	(Note 2)			S4
Solid Drilled – Screwed Tapered, Lagging Length 'T'	(Note 2)			S5

**Notes.**

1. Not available with Screwed Process Connection.
2. Not available with Flanged Process Connection.
3. Not available with Stem Design code F1, F2, F3, S4, S5.
4. Not available with Stem Design code S1, S2.
5. Not available with Stem Design code F1, F2, F3, S1, S2.
6. Wetted Parts only – Stainless Steel flange with Raised Face disc of material selected.
7. Full Penetration weld Stainless Steel flanges only.

Continued on next page

**...Ordering Information**

Thermowell/Test Well only (Solid Drilled)	CODE No. PART 1			PART No. 2			
	Model No. V10685/	X	XX	XXX	X	X	X
<b>Immersion Length (mm) 'U' to be stated in 10 mm increments</b>							
Length 100 (Example 100 = 100 mm)				100			
↓				↓			
Length 990 (Example 990 = 990 mm)				990			
Length 999 (Example 999 = 1000 mm)				999			
<b>Lagging Length 'T' (mm)</b>							
0			(Note 3)		0		
50 mm (Standard up to 600 lb flange)			(Notes 4)		5		
10 mm			(Notes 5)		1		
20 mm			(Notes 5)		2		
30 mm			(Notes 5)		3		
40 mm			(Notes 5)		4		
60 mm			(Note 4)		6		
70 mm (Standard 900 lb flange)			(Note 4)		7		
80 mm			(Note 4)		8		
90 mm			(Note 4)		9		
<b>Bore</b>							
6.50 mm dia. (Standard)							C
Stepped 8... 3.30 mm							B
Stepped 8... 6.5 mm							D
9 mm							E
10 mm							F
13 mm							G
<b>Plug and Chain</b>							
Not required							0
1/2 in. NPT Carbon Steel							1
1/2 in. NPT Brass							2
1/2 in. NPT Stainless Steel							3

**Notes.**

1. Not available with Screwed Process Connection.
2. Not available with Flanged Process Connection.
3. Not available with Stem Design code F1, F2, F3, S4, S5.
4. Not available with Stem Design code S1, S2.
5. Not available with Stem Design code F1, F2, F3, S1, S2.
6. Wetted Parts only – Stainless Steel flange with Raised Face disc of material selected.
7. Full Penetration weld Stainless Steel flanges only.

Heavy Duty Forged Thermowell/Test Well	Model No. V10686/	X	XX	XX	XXX	X	X	X
<b>Material</b>								
316 Stainless Steel UNSS31603/ASME IX (Standard)		L						
304 Stainless Steel UNSS30403/ASME IX		H						
321 Stainless Steel UNSS32103/ASME IX		M						
Hastelloy C276 UNSN10276/ASME IX		P						
Hastelloy B2 UNSN10665/ASME IX		B						
Monel Alloy 400 UNSN04400/ASME IX		A						
Inconel Alloy 600 UNSN06600/ASME IX		U						
Incoloy Alloy 800 UNSN08800/ASME IX		C						
Duplex UNSNOS31803/ASME IX		D						
Super Duplex UNSNOS32550/ASME IX		S						
Other Materials		X						
<b>Process Connection</b>								
1 in. 150 lb RF Flanged			A1					
1 in. 300 lb RF Flanged			A3					
1 1/2 in. 150 lb RF Flanged			B1					
1 1/2 in. 300 lb RF Flanged			B3					
1 1/2 in. 600 lb RF Flanged			B6					
1 1/2 in. 600 lb RTJ Flanged			B7					
2 in. 150 lb RF Flanged			C1					
2 in. 300 lb RF Flanged			C3					
2 in. 600 lb RF Flanged			C6					
2 in. 600 lb RTJ Flanged			C7					
<b>Stem Design</b>								
Forged Flanged Thermowell – Straight				F1				
Forged Flanged Thermowell – Tapered				F2				
Forged Flanged Thermowell – Reduced Tip				F3				
<b>Immersion Length (mm) 'U' to be stated in 10 mm increments</b>								
Length 100 (Example 100 = 100 mm)					100			
↓					↓			
Length 390 (Example 390 = 390 mm)					390			
Length 400 (Example 400 = 400 m)					400			
<b>Lagging Length (mm)</b>								
50 mm (Standard)	(Note 1)					5		
60 mm						6		
70 mm						7		
80 mm						8		
90 mm						9		
<b>Bore</b>								
6.50 mm dia. (Standard)							C	
Stepped 8... 3.30 mm							B	
Stepped 8... 6.5 mm							D	
9 mm							E	
10 mm							F	
13 mm							G	
<b>Plug and Chain</b>								
Not required								0
1/2 in. NPT Carbon Steel								1
1/2 in. NPT Brass								2
1/2 in. NPT Stainless Steel								3

**Notes.**

1. Not available with Screwed Process Connection.
2. Not available with Flanged Process Connection.
3. Not available with Stem Design code F1, F2, F3, S4, S5.
4. Not available with Stem Design code S1, S2.
5. Not available with Stem Design code F1, F2, F3, S1, S2.
6. Wetted Parts only – Stainless Steel flange with Raised Face disc of material selected.
7. Full Penetration weld Stainless Steel flanges only.

# Contact us

## **ABB Limited**

### **Process Automation**

Salterbeck Trading Estate  
Workington, Cumbria  
CA14 5DS  
UK

Tel: +44 (0)1946 830 611

Fax: +44 (0)1946 832 661

## **ABB Inc.**

### **Process Automation**

125 E. County Line Road  
Warminster  
PA 18974  
USA

Tel: +1 215 674 6000

Fax: +1 215 674 7183

**[www.abb.com](http://www.abb.com)**

## Note

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents in whole or in parts – is forbidden without prior written consent of ABB.

Copyright© 2011 ABB

All rights reserved

3KXT111401R1001