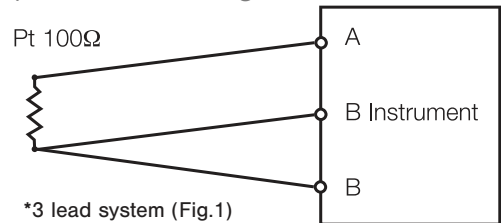


1. Operating Principles

Electric resistance of a metal changes at a fixed rate according to temperature changes. The resistance bulb uses this property to measure temperature. Theoretically, any metal may be used, but because of characteristics such as constant resistance change with temperature, interchangeability, and high temperature coefficient, there are few metals suitable for application. Only Platinum (Pt) is currently adopted by Japanese Industrial Standard (JIS), although nickel, copper and other metals are also used by other standards. The principle of measurement is shown in Fig.1. A constant current (1mA to 5mA) is flowed through a fixed resistance element (typically Pt100 Ω) and the change in resistance with temperature is measured. The common practice is to adopt a three-wire system to prevent lead resistance.



2. Allowable Error of Resistance Bulb (Table 1)

Nominal resistance	JLS C1604-1989				Former JIS C1604-1981				Nominal resistance
	Allowable error		Operating temperature range	Measuring temperature	Allowable error		Operating temperature range		
	Class A Temperature value °C	Class B Temperature value °C				Class 0.15 Temperature value °C		Class 0.2 Temperature value °C	Class 0.5 Temperature value °C
100 Ω	± 0.55	± 1.3	L M H	-200	H M L	± 0.45	± 0.55	± 1.3	100 Ω (50 Ω)
	± 0.35	± 0.8		-100		± 0.30	± 0.35	± 0.8	
	± 0.15	± 0.3		0		± 0.15	± 0.15	± 0.3	
	± 0.35	± 0.8		100		± 0.30	± 0.35	± 0.8	
	± 0.55	± 1.3		200		± 0.45	± 0.55	± 1.3	
	± 0.75	± 1.8		300		± 0.60	± 0.75	± 1.8	
	± 0.85	± 2.05		350		± 0.68	± 0.85	± 2.05	
	± 0.95	± 2.3		400		-	± 0.95	± 2.3	
	± 1.15	± 2.8		500		-	± 1.15	± 2.8	
	± 1.35	± 3.3		600		-	-	-	
	± 1.45	± 3.6		650		-	-	-	
	Resistance value Ω	Resistance value Ω		Resistance value Ω	Resistance value Ω	Resistance value Ω			
100 Ω	± 0.24	± 0.56	L M H	-200	H M L	± 0.19	± 0.24	± 0.56	100 Ω Resistance for 50 Ω elements are half these value
	± 0.14	± 0.32		-100		± 0.12	± 0.14	± 0.32	
	± 0.06	± 0.12		0		± 0.06	± 0.06	± 0.12	
	± 0.13	± 0.30		100		± 0.12	± 0.13	± 0.31	
	± 0.20	± 0.48		200		± 0.16	± 0.20	± 0.48	
	± 0.27	± 0.64		300		± 0.21	± 0.27	± 0.64	
	± 0.29	± 0.71		350		± 0.24	± 0.30	± 0.73	
	± 0.33	± 0.79		400		-	± 0.33	± 0.80	
	± 0.38	± 0.93		500		-	± 0.39	± 0.95	
	± 0.43	± 0.06		600		-	-	-	
	± 0.46	± 0.13		650		-	-	-	

Note: ① L = Low temperature, M = Medium temperature, H = High temperature ② Specified currents 5 mA and 10 mA do not apply to Class A

Calculation Formula of Allowable Error of Medium temperature (Table 2)

Former JIS C1604-1981		Former JIS C1604-1981	
Allowable error	Class	Class	Allowed error
-	-	Class 0.15	± (0.15 + 0.015 t)°C
± (0.15 + 0.002 t)°C	Class A	Class 0.2	± (0.15 + 0.002 t)°C
± (0.3 + 0.005 t)°C	Class B	Class 0.5	± (0.3 + 0.005 t)°C

where t is the absolute value of the measured temperature (°C)

3. Insulation Resistance and Withstand Voltage (JLS C1604-1989)(Table 3)

Operating temperature range	Test temperature	Insulation resistance	Withstand voltage, 1 minute
Low temperature	- 183°C	5M Ω / 500V	DC 500 V
	Normal temperature	10M Ω / 500V	" 500 V
	100°C	5M Ω / 500V	" 500 V
Medium temperature	Normal temperature	10M Ω / 500V	" 500 V
	350°C	1M Ω / 250V	" 250 V
High temperature	Normal temperature	10M Ω / 500V	" 500 V
	650°C	1M Ω / 250V	" 250 V

Note: ① Insulation resistance and withstand voltage are measured between the terminal and protecting tube with the temperature measuring section at the test temperature in Table 3. ② In withstand voltage testing of resistance bulbs with protecting tube ODs smaller than 4.8mm the test voltage must be reduced to 1/2 of the value in Table 3

4. Resistance Bulb Elements

CR Series (Ceramic Encapsulated Platinum Element) (Table 4)

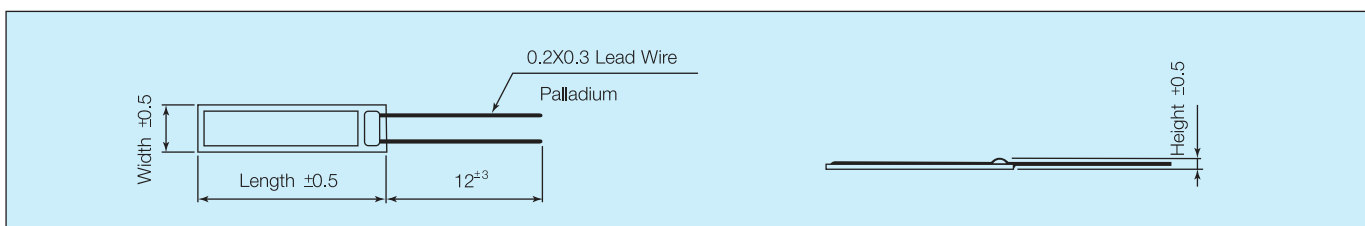
√ : Available

Appearance	Model No.	OD(φ)	Length (mm)	No. of elements		Resistance	Rated current	Class	Lead length (mm)	Operating temp. range
				1	2					
	※ CR-1010	1.0 ± 0.1	10 ± 2	√	-	Pt 100 Ω	1 mA max.	JIS DIN IEC CLASS A CLASS B	10 ± 3	-200°C to +500°C
	※ CR-1210	1.2 ± 0.1	10 ± 2	√	-		2 mA max.			
	※ CR-1215	1.2 ± 0.1	15 ± 2	√	-					
	※ CR-1615	1.6 ± 0.1	15 ± 2	√	-					
	CR-1620	1.6 ± 0.1	20 ± 0.1	√	√					
	CR-2010	2.0 ± 0.1	10 ± 2	√	-					
	※ CR-2015	2.0 ± 0.1	15 ± 2	√	√		5 mA max.			
	CR-2020	2.0 ± 0.1	20 ± 2	√	√					
	CR-2830	2.8 ^{+0.3} _{-0.1}	30 ± 2	√	√					
	※ CR-2020	2.0 ± 0.1	20 ± 2	√	-		500 Ω			

We also produce former JLS standard models to order

※ Semi-standard product

CRZ Series (Thin Film Platinum Elements)



Model	Dimension of element (mm) Width x Length x Height	Number of Element		Resistance Value	Measurement Current	Dimension of Lead Wire (mm) Width x Length x Height	Class	Recommendable Operating Temperature Range
		S	D					
CRZ-1632-100	1.6x3.2x1.0	○	-	Pt 100 Ω	not exceeding 1mA	0.25x0.15x12	1/3B	1/3B -20 ~ +250°C
CRZ-2005-100	2.0x5.0x1.0	○	-	Pt 100 Ω	not exceeding 1mA	0.25x0.15x12	A	A -20 ~ +400°C
CRZ-2005-1000	2.0x5.0x1.0	○	-	Pt 500 Ω Pt 1000 Ω	not exceeding 1mA	0.25x0.15x12	B 2B	B, 2B -40 ~ +500°C

5. CRF Series (Ceramic Elements with Heat Sensitive Fins) (Table 6)

CRF series elements have heat sensing fins so shaped as to fit 6, 8 or 10mm diameter protecting tubes.

Appearance	Model No.	OD(ϕ)	Length (mm)	No. of elements		Resistance	Rated current	Class	Lead length (mm)	Operating temp. range
				1	2					
	CRF-6	6 to 9	32 \pm 1.5	✓	✓	Pt100 Ω	1 mA 2 mA 5 mA	CLASS A CLASS B JIS DIN IEC	30 \pm 3	-200°C to +500°C
	CRF-10	10 to 12	42 \pm 1.5	✓	✓					

We also produce former JIS standard models to order

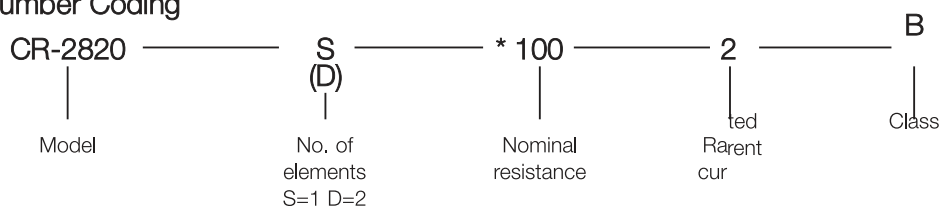
6. CRF Series (Glass Insulated Platinum Elements)(Table 7)

Appearance	Model No.	OD(ϕ)	Length (mm)	No. of elements		Resistance	Rated current	Class	Lead length (mm)	Operating temp. range	
				1	2						
	※GR-0705	0.7 \pm 0.1	5 \pm 1	✓	-	Pt 100 Ω	1 mA max.	JIS DIN IEC CLASS A CLASS B	10 \pm 3	-200°C to +350°C	
	GR-0708	0.7 \pm 0.1	8 \pm 1	✓	-						
	※GCR-1005	1.0 \pm 0.1	5 \pm 1	✓	-						
	GR-1010	1.0 \pm 0.1	10 \pm 1	✓	-		2 mA max.				
	※GR-1205	1.2 \pm 0.15	5 \pm 1	✓	-						
	GR-1210	1.2 \pm 0.15	10 \pm 2	✓	-		5 mA max.				
	GR-1610	1.6 \pm 0.15	10 \pm 1	✓	-						
	GR-2010	2.0 \pm 0.2	10 \pm 1	✓	-						
	GR-2015	2.0 \pm 0.2	15 \pm 1.5	✓	-		Pt 1000 Ω				1 mA max.
	GR-3030	3.0 \pm 0.2	30 \pm 1	✓	-						

We also produce former JIS standard models to order

※: Semi-standard product

Model Number Coding



* When ordering former JIS standards please specify JPT100 instead of 100



Resistance temperature detectors are designed for corrosive, high pressure, fast flowing medium with Thermowell. Resistance temperature detectors are temperature sensors that have elements which change their electrical resistance with change in temperature. RTDs with thermowell are suitable for high pressure and flow medium where there is a need for frequent change of sensor.

Type	Pt 100, 200, 500, 1000 etc
Element Diameter	Wire wound ceramic encapsulated, wire wound glass encapsulated, Thin film ceramic encapsulated
Standards	RTD PT 100 : IEC751-1995 RTD PT 100 : JIS C 1604-1997 Extension and Compensating cables IEC 60584-2:1982
Connection	2, 3, 4 Wire
Protection Sheath Material	SS304, SS321, SS316, SS310, Inconel 600/800, HRS 446, Hastalloy
Configuration	Simplex/Duplex/Others

Mineral Insulated RTDs



Mineral-insulated RTDs provide excellent performance, even when exposed to high levels of shock and vibration in tough industrial environments. Mineral Insulated Resistance Thermometers are made with Platinum-measuring resistors Pt100Ω to DIN IEC 751. The measuring resistor will be connected to the inner conductors, is also embedded and is surrounded by the metal sheath to form a hermetically sealed assembly.

Type	Pt 100, 200, 500, 1000 cu-50, 53 etc
Connection	2, 3, 4 wire
Element Diameter	1.5, 3.0, 4.5, 6.0, 8.0 mm
Standards	RTD PT 100 : IEC751-1995 RTD PT 100 : JIS C 1604-1997 Extension and Compensating cables IEC 60584-2:1982
Configuration	Simplex/Duplex/Others

MT 1001



RTD 3 wire type, complete with small aluminium enclosed head (IP65 rating). Constructed using 316 stainless steel sheath, maximum operating temperature 400°C

Standards :
 RTD PT 100 : IEC751-1995
 RTD PT 100 : JIS C 1604-1997
 Extension and Compensating cables IEC 60584-2:1982

Calibration	Diameter	Part No.	Ø	length
RTD Pt100	3mm	MT 1001 -	<input type="text" value="030"/>	- <input type="text"/>
RTD Pt100	6mm	MT 1001 -	<input type="text" value="060"/>	- <input type="text"/>
RTD Pt100	8mm	MT 1001 -	<input type="text" value="080"/>	- <input type="text"/>

Insert part number when ordering diameter and length, eg. 3mm diameter 250mm long = MT 1001 - -

MT 1001a



As for model 1001 complete with 1/2" BSP 316 stainless steel fixed nipple, sanitary weld.

Standards :
 RTD PT 100 : IEC751-1995
 RTD PT 100 : JIS C 1604-1997
 Extension and Compensating cables IEC 60584-2:1982

Calibration	Diameter	Part No.	Ø	length
RTD Pt100	3mm	MT 1001a -	<input type="text" value="030"/>	- <input type="text"/>
RTD Pt100	6mm	MT 1001a -	<input type="text" value="060"/>	- <input type="text"/>
RTD Pt100	8mm	MT 1001a -	<input type="text" value="080"/>	- <input type="text"/>

Insert part number when ordering diameter and length, eg. 3mm diameter 250mm long = MT 1001a - -

MT 1002



RTD 3 wire type, complete with large aluminium enclosed head (IP65 rating). Constructed using 316 stainless steel sheath, maximum operating temperature 400°C.

Standards :
 RTD PT 100 : IEC751-1995
 RTD PT 100 : JIS C 1604-1997
 Extension and Compensating cables IEC 60584-2:1982

Calibration	Diameter	Part No.	Ø	length
RTD Pt100	3mm	MT 1002 -	<input type="text" value="030"/>	- <input type="text"/>
RTD Pt100	6mm	MT 1002 -	<input type="text" value="080"/>	- <input type="text"/>
RTD Pt100	8mm	MT 1002 -	<input type="text" value="080"/>	- <input type="text"/>

Insert part number when ordering diameter and length, eg. 3mm diameter 250mm long = MT 1002 - -

MT 1002a



As for model 1002 complete with 1/2" BSP 316 stainless steel fixed nipple, sanitary weld.

Standards :
 RTD PT 100 : IEC751-1995
 RTD PT 100 : JIS C 1604-1997
 Extension and Compensating cables IEC 60584-2:1982

Calibration	Diameter	Part No.	Ø	length
RTD Pt100	3mm	MT 1002a -	<input type="text" value="030"/>	- <input type="text"/>
RTD Pt100	6mm	MT 1002a -	<input type="text" value="060"/>	- <input type="text"/>
RTD Pt100	8mm	MT 1002a -	<input type="text" value="080"/>	- <input type="text"/>

Insert part number when ordering diameter and length, eg. 6mm diameter 250mm long = MT 1002a - -
 Remarks : Duplex version add

RTD Sensors 2000 Series

MT 2001



RTD 3 wire type, complete with screenfiber, silicon, PVC wire, constructed using 316 stainless steel sheath.

Standards :
 RTD PT 100 : IEC751-1995
 RTD PT 100 : JIS C 1604-1997
 Extension and Compensating cables IEC 60584-2:1982

Calibration	Diameter	Part No.	Ø	length
RTD Pt100	2mm	MT 2001 -	<input type="text" value="020"/>	- <input type="text"/>
RTD Pt100	3mm	MT 2001 -	<input type="text" value="030"/>	- <input type="text"/>
RTD Pt100	4mm	MT 2001 -	<input type="text" value="040"/>	- <input type="text"/>
RTD Pt100	6mm	MT 2001 -	<input type="text" value="060"/>	- <input type="text"/>

Insert part number when ordering diameter and length, eg. 2mm diameter 250mm long = MT 2001 - -
 Remarks : Duplex version add

RTD Sensors 3000 Series

MT 3001

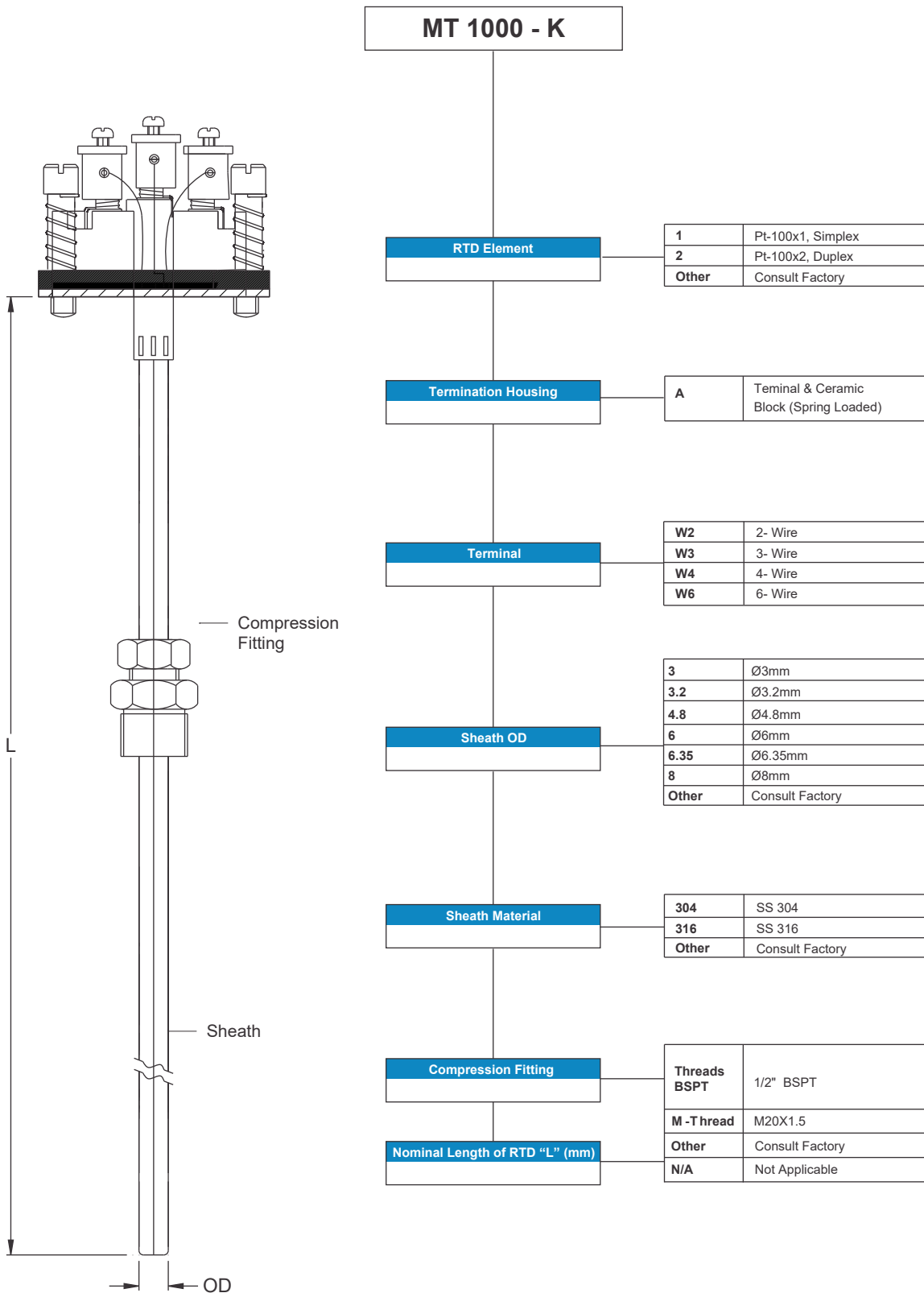


RTD 3 wire type industrial wall mounted.

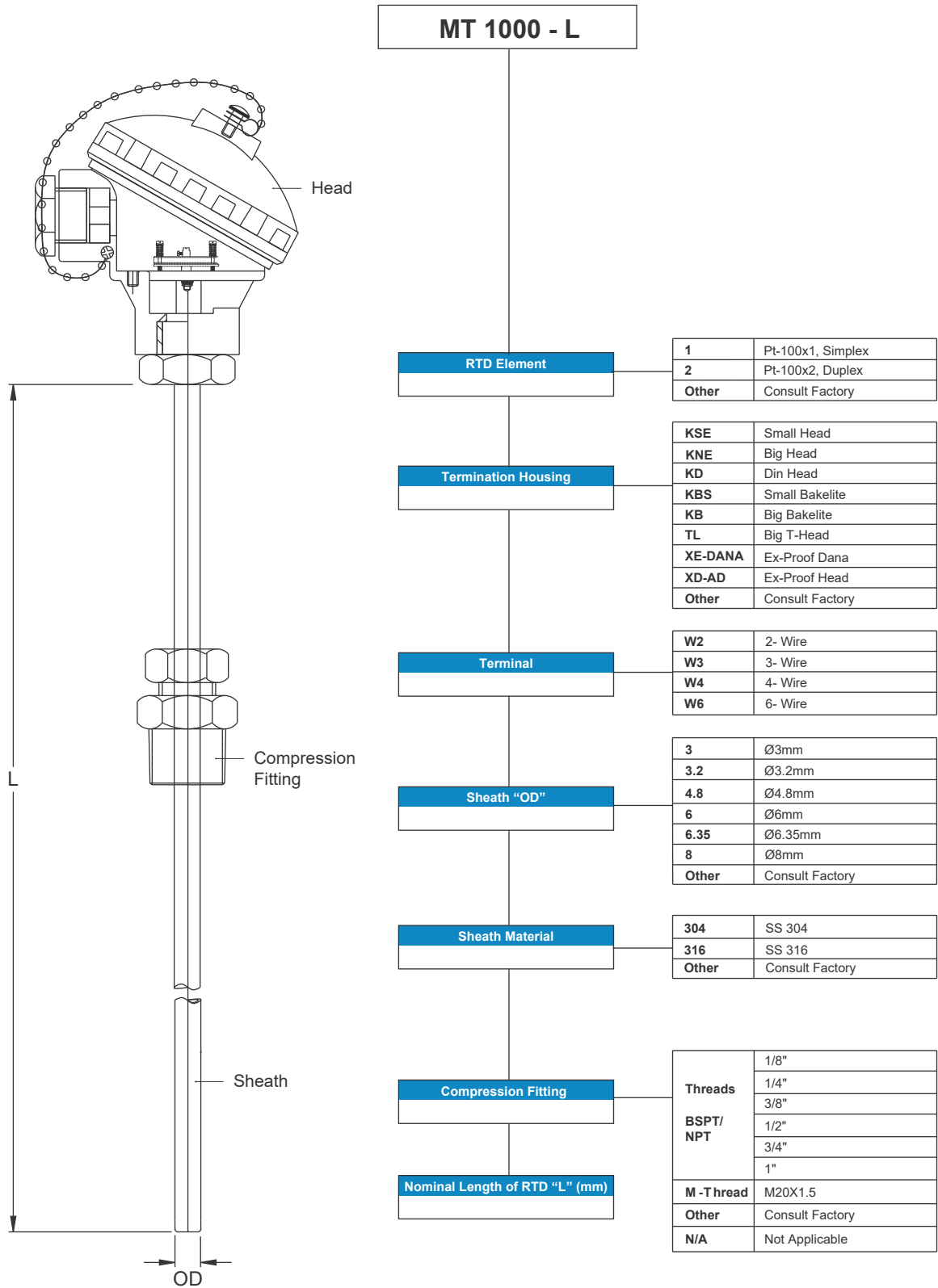
Standards :
 RTD PT 100 : IEC751-1995
 RTD PT 100 : JIS C 1604-1997
 Extension and Compensating cables IEC 60584-2:1982

Calibration	Box Size	Part No.
RTD Pt100	75mm x 55mm x 28mm	MT 3001 - S
RTD Pt100	100mm x 80mm x 28mm	MT 3001 - B

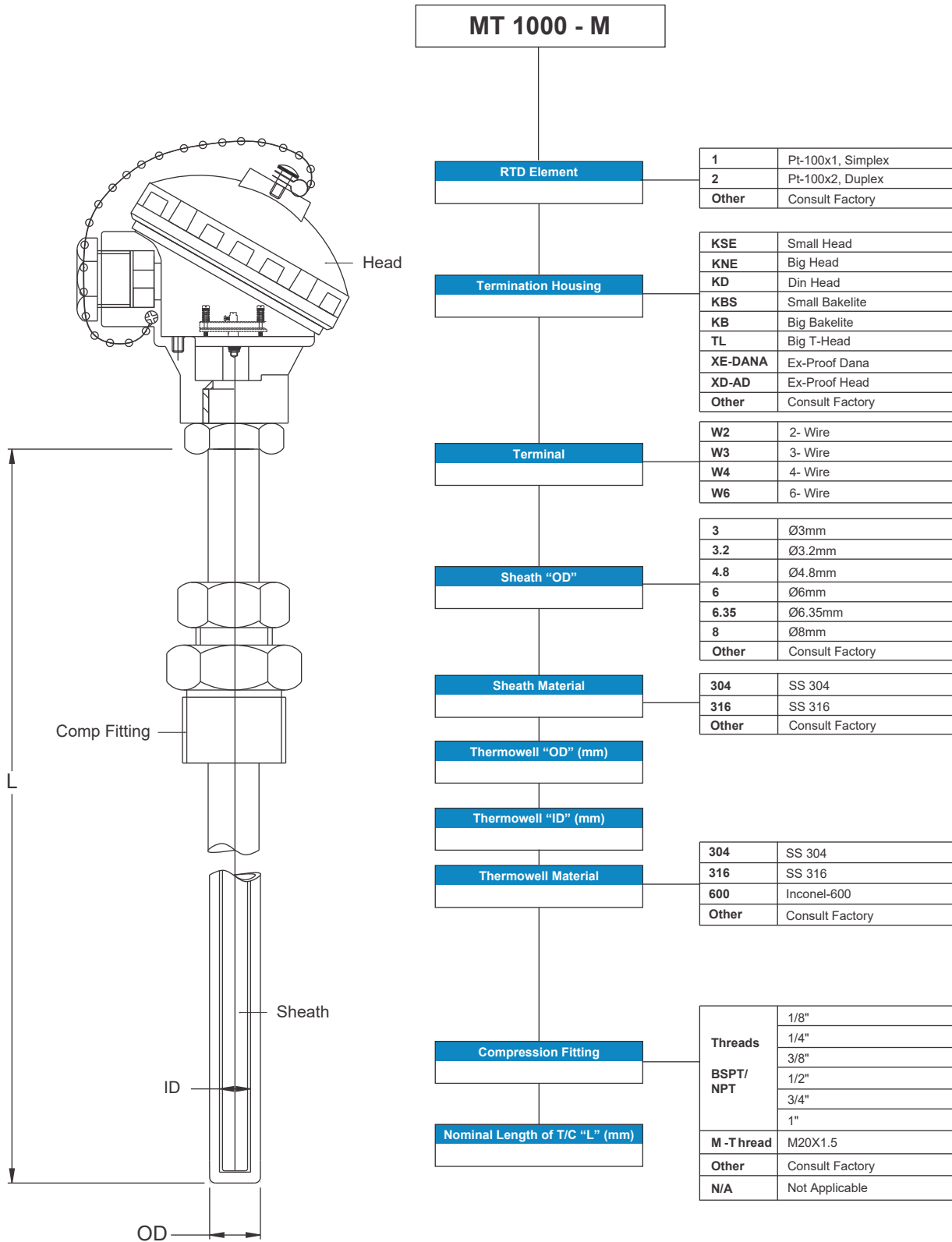
RTD INSERT WITH COMPRESSION FITTING



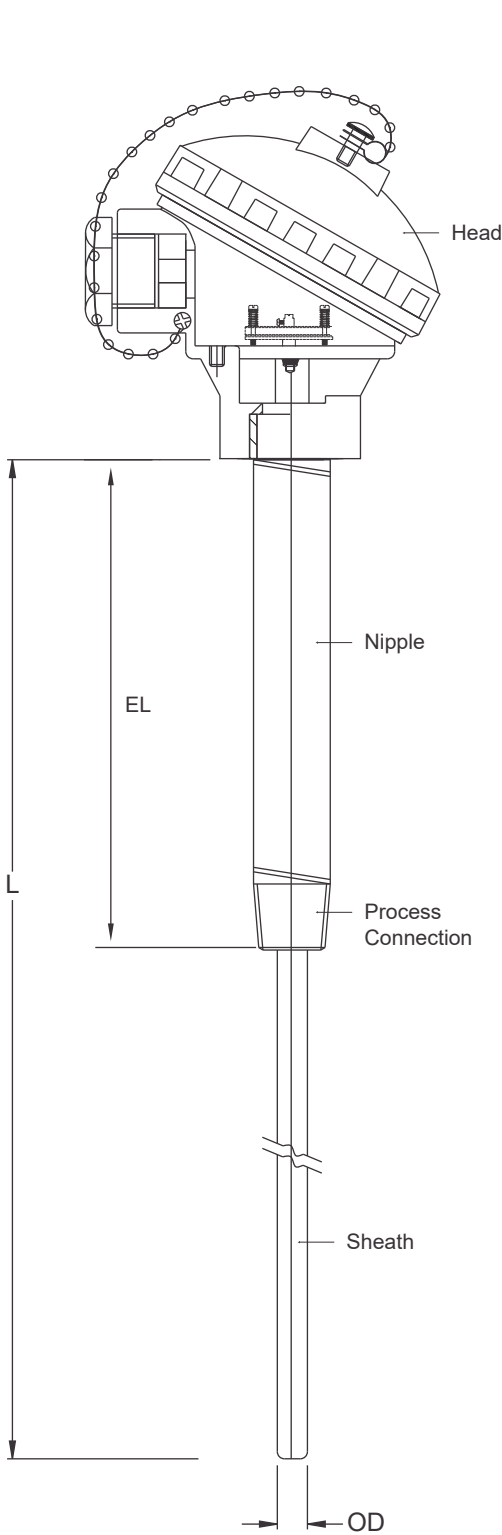
RTD WITH COMPRESSION FITTING



RTD WITH THERMOWELL & COMPRESSION FITTING

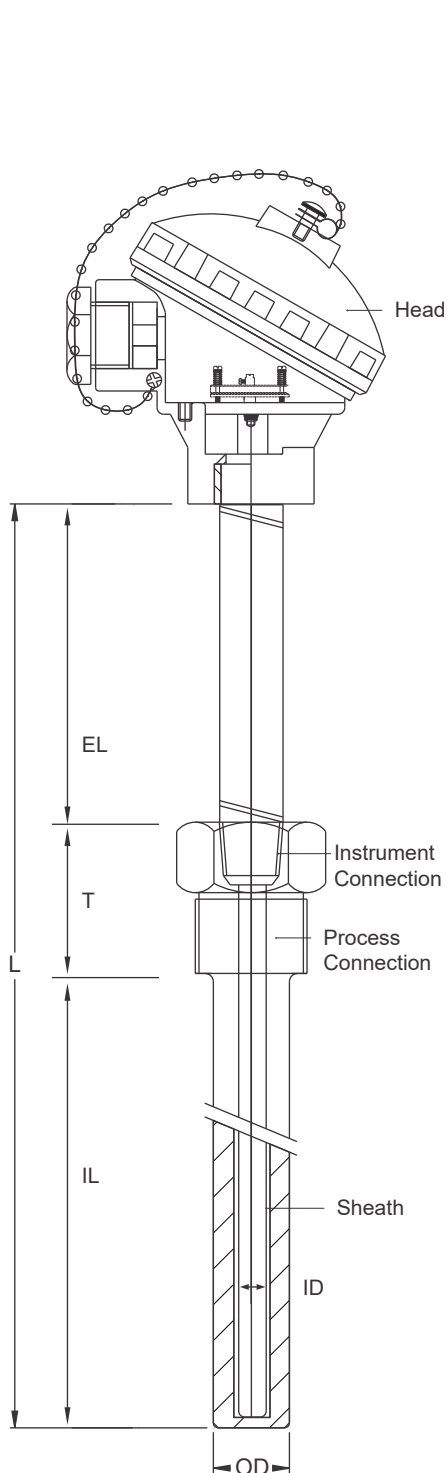


RTD WITH NIPPLE



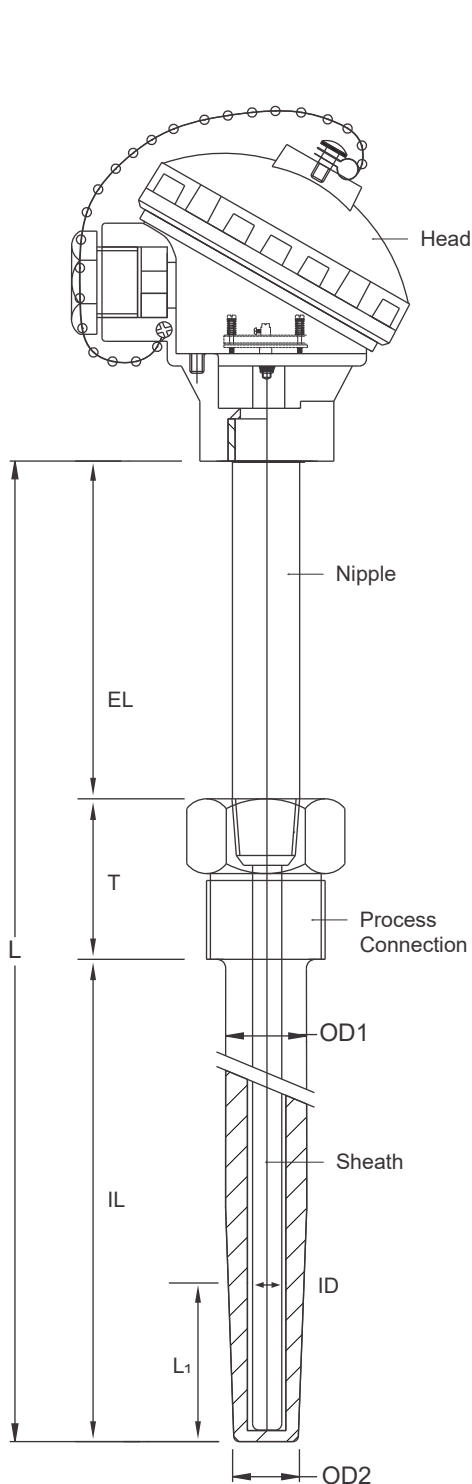
MT 1000 - N																			
RTD Element	<table border="1"> <tr><td>1</td><td>Pt-100x1, Simplex</td></tr> <tr><td>2</td><td>Pt-100x2, Duplex</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	1	Pt-100x1, Simplex	2	Pt-100x2, Duplex	Other	Consult Factory												
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Termination Housing	<table border="1"> <tr><td>KSE</td><td>Small Head</td></tr> <tr><td>KNE</td><td>Big Head</td></tr> <tr><td>KD</td><td>Din Head</td></tr> <tr><td>KBS</td><td>Small Bakelite</td></tr> <tr><td>KB</td><td>Big Bakelite</td></tr> <tr><td>TL</td><td>Big T-Head</td></tr> <tr><td>XE-DANA</td><td>Ex-Proof Dana</td></tr> <tr><td>XD-AD</td><td>Ex-Proof Head</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	KSE	Small Head	KNE	Big Head	KD	Din Head	KBS	Small Bakelite	KB	Big Bakelite	TL	Big T-Head	XE-DANA	Ex-Proof Dana	XD-AD	Ex-Proof Head	Other	Consult Factory
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Terminal	<table border="1"> <tr><td>W2</td><td>2- Wire</td></tr> <tr><td>W3</td><td>3- Wire</td></tr> <tr><td>W4</td><td>4- Wire</td></tr> <tr><td>W6</td><td>6- Wire</td></tr> </table>	W2	2- Wire	W3	3- Wire	W4	4- Wire	W6	6- Wire										
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Sheath "OD"	<table border="1"> <tr><td>3</td><td>Ø3mm</td></tr> <tr><td>3.2</td><td>Ø3.2mm</td></tr> <tr><td>4.8</td><td>Ø4.8mm</td></tr> <tr><td>6</td><td>Ø6mm</td></tr> <tr><td>6.35</td><td>Ø6.35mm</td></tr> <tr><td>8</td><td>Ø8mm</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	3	Ø3mm	3.2	Ø3.2mm	4.8	Ø4.8mm	6	Ø6mm	6.35	Ø6.35mm	8	Ø8mm	Other	Consult Factory				
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316	SS 316																		
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Nipple	<table border="1"> <tr><td>A</td><td>1/2" SCH 40</td></tr> <tr><td>B</td><td>1/2" SCH 80</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	A	1/2" SCH 40	B	1/2" SCH 80	Other	Consult Factory												
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Process Connection	<table border="1"> <tr><td>Threads</td><td>1/2" BSPT</td></tr> <tr><td>M - Thread</td><td>M20X1.5</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	Threads	1/2" BSPT	M - Thread	M20X1.5	Other	Consult Factory												
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Extension Length (E.L)(mm)																			
Nominal Length of RTD "L"(mm)																			

RTD WITH NIPPLE & STRAIGHT THERMOWELL



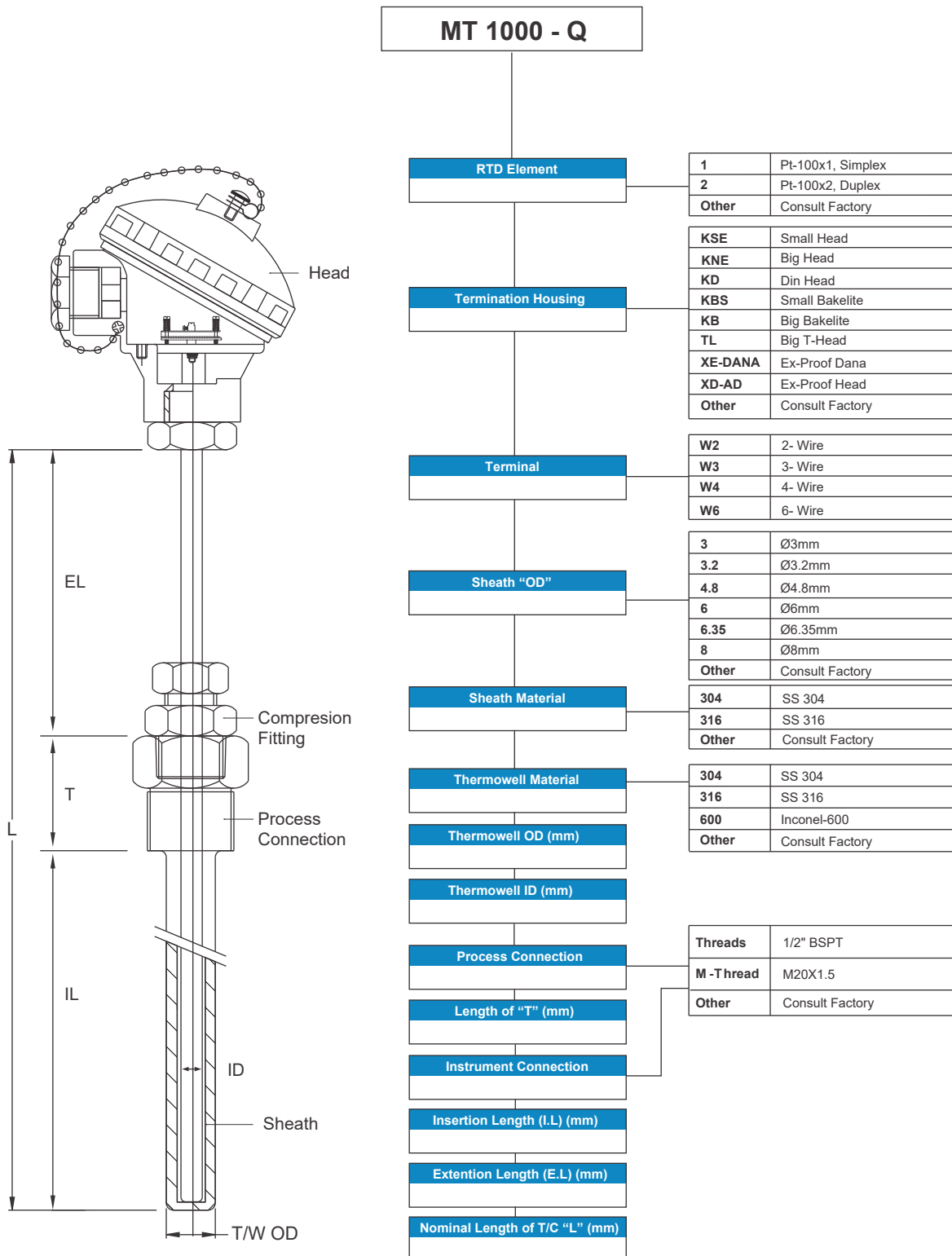
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Thermowell OD1 (mm)																			
Thermowell OD2 (mm)																			
Thermowell ID (mm)																			
Length of "T" (mm)																			
Process Connection	<table border="1"> <tr><td>Threads</td><td>1/2" BSPT</td></tr> <tr><td>M - T thread</td><td>M20X1.5</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> <tr><td>N/A</td><td>Not Applicable</td></tr> </table>	Threads	1/2" BSPT	M - T thread	M20X1.5	Other	Consult Factory	N/A	Not Applicable										
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Extension Length (I.L.) (mm)																			

RTD WITH NIPPLE & TAPPER THERMOWELL

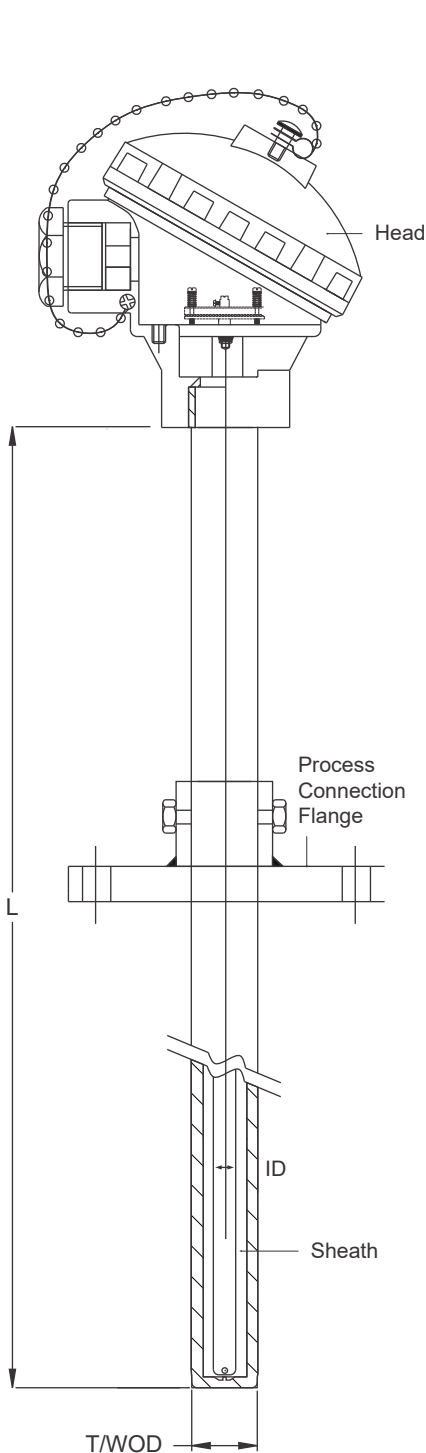


MT 1000 - P																			
RTD Element	<table border="1"> <tr><td>1</td><td>Pt-100x1, Simplex</td></tr> <tr><td>2</td><td>Pt-100x2, Duplex</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	1	Pt-100x1, Simplex	2	Pt-100x2, Duplex	Other	Consult Factory												
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Sheath "OD"	<table border="1"> <tr><td>3</td><td>Ø3mm</td></tr> <tr><td>3.2</td><td>Ø3.2mm</td></tr> <tr><td>4.8</td><td>Ø4.8mm</td></tr> <tr><td>6</td><td>Ø6mm</td></tr> <tr><td>6.35</td><td>Ø6.35mm</td></tr> <tr><td>8</td><td>Ø8mm</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	3	Ø3mm	3.2	Ø3.2mm	4.8	Ø4.8mm	6	Ø6mm	6.35	Ø6.35mm	8	Ø8mm	Other	Consult Factory				
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Sheath Material	<table border="1"> <tr><td>304</td><td>SS 304</td></tr> <tr><td>316</td><td>SS 316</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	304	SS 304	316	SS 316	Other	Consult Factory												
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Thermowell OD1 (mm)																			
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Thermowell ID (mm)																			
Nipple	<table border="1"> <tr><td>A</td><td>1/2" SCH 80</td></tr> <tr><td>B</td><td>1/2" SCH 40</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	A	1/2" SCH 80	B	1/2" SCH 40	Other	Consult Factory												
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B	1/2" SCH 40																		
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Length of "T" (mm)																			
Process Connection	<table border="1"> <tr><td>Threads</td><td>1/2" BSPT</td></tr> <tr><td>M-T thread</td><td>M20X1.5</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	Threads	1/2" BSPT	M-T thread	M20X1.5	Other	Consult Factory												
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Instrument Connection																			
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Tapered Length (L1) (mm)																			
Extension Length (E.L.) (mm)																			
Nominal Length of T/C "L" (mm)																			

RTD WITH STRAIGHT THERMOWELL & COMPRESSION FITTING

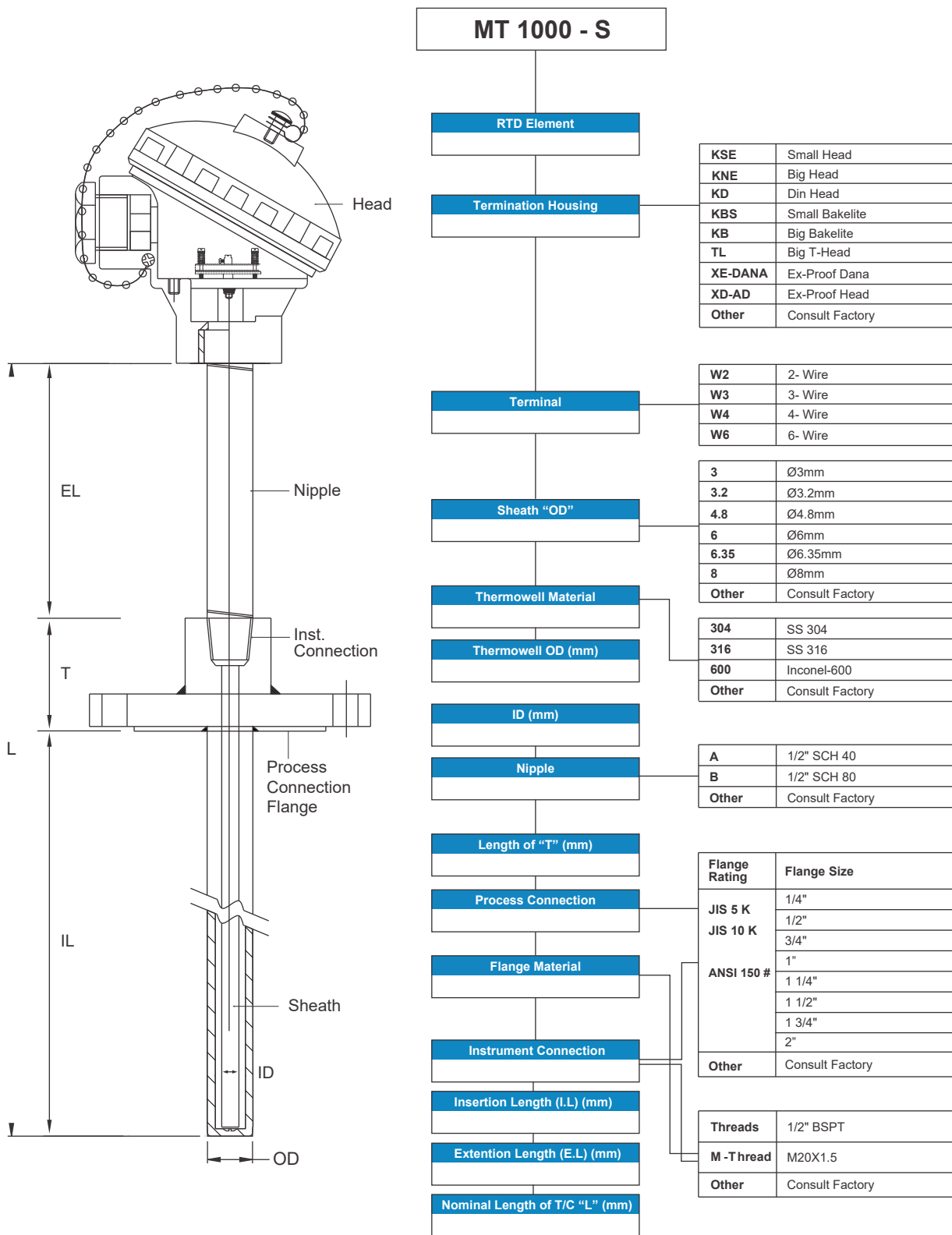


RTD WITH ADJUSTABLE FLANGE THERMOWELL

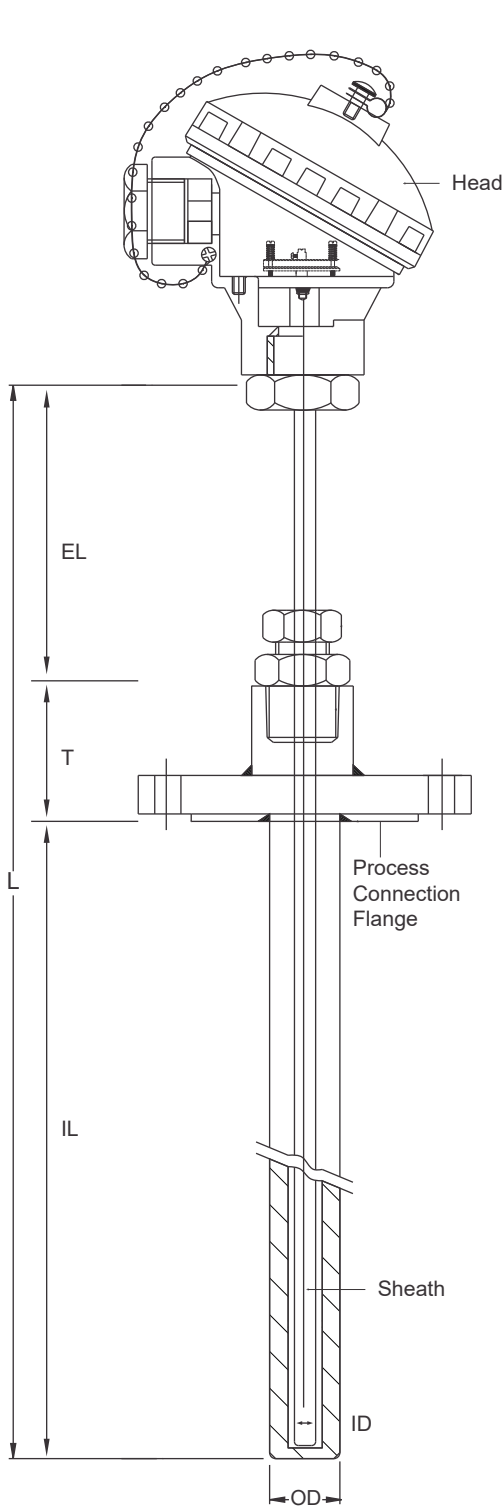


MT 1000 - R																			
RTD Element	<table border="1"> <tr><td>1</td><td>Pt-100x1, Simplex</td></tr> <tr><td>2</td><td>Pt-100x2, Duplex</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </table>	1	Pt-100x1, Simplex	2	Pt-100x2, Duplex	Other	Consult Factory												
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Thermowell Material																			
Process Connection	<table border="1"> <thead> <tr> <th>Flange Rating</th> <th>Flange Size</th> </tr> </thead> <tbody> <tr><td rowspan="2">JIS 5 K</td><td>1/4"</td></tr> <tr><td>1/2"</td></tr> <tr><td rowspan="2">JIS 10 K</td><td>3/4"</td></tr> <tr><td>1"</td></tr> <tr><td rowspan="4">ANSI 150 #</td><td>1 1/4"</td></tr> <tr><td>1 1/2"</td></tr> <tr><td>1 3/4"</td></tr> <tr><td>2"</td></tr> <tr><td>Other</td><td>Consult Factory</td></tr> </tbody> </table>	Flange Rating	Flange Size	JIS 5 K	1/4"	1/2"	JIS 10 K	3/4"	1"	ANSI 150 #	1 1/4"	1 1/2"	1 3/4"	2"	Other	Consult Factory			
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RTD WITH FLANGE STRAIGHT THERMOWELL



RTD WITH NIPPLE & FLANGE STRAIGHT THERMOWELL



MT 1000 - T

RTD Element

Termination Housing

Terminal

Sheath "OD"

Sheath Material

Thermowell Material

Thermowell "OD" (mm)

ID (mm)

Process Connection

Flange Material

Instrument Connection

Compression Fitting

Insertion Length (I.L) (mm)

Extension Length (E.L) (mm)

Nominal Length of T/C "L" (mm)

KSE	Small Head
KNE	Big Head
KD	Din Head
KBS	Small Bakelite
KB	Big Bakelite
TL	Big T-Head
XE-DANA	Ex-Proof Dana
XD-AD	Ex-Proof Head
Other	Consult Factory

W2	2- Wire
W3	3- Wire
W4	4- Wire
W6	6- Wire

3	Ø3mm
3.2	Ø3.2mm
4.8	Ø4.8mm
6	Ø6mm
6.35	Ø6.35mm
8	Ø8mm
Other	Consult Factory

304	SS 304
316	SS 316
Other	Consult Factory

304	SS 304
316	SS 316
600	Inconel-600
Other	Consult Factory

Flange Rating	Flange Size
JIS 5 K	1/4"
JIS 10 K	1/2"
	3/4"
ANSI 150 #	1"
	1 1/4"
	1 1/2"
	1 3/4"
	2"
Other	Consult Factory

Threads	1/8"
	1/4"
	3/8"
BSPT/ NPT	1/2"
	3/4"
	1"
M -T thread	M20X1.5
Other	Consult Factory
N/A	Not Applicable