Temperature Probe Technology

RESISTANCE THERMOMETERS (RTDs)			
Code	**Sensor**	**W_{100}**	**Norm**
RB	Pt50	1.385	IEC 751
RD	Pt100	1.385	IEC 751
RF	Pt500	1.385	IEC 751
RG	Pt1000	1.385	IEC 751
RH	Cu50	1.426	GOST 6651
RK	Cu100	1.426	GOST 6651
RP	PTC 1k (25 °C)	-	
RQ	PTC 2k (25 °C)	-	

Ptx Tolerance	Class 'A'	Class 'B'	Class '2xB'
-200 °C	± 0.55 °C	± 1.30 °C	± 2.60 °C
-100 °C	± 0.35 °C	± 0.80 °C	± 1.60 °C
0 °C	± 0.15 °C	± 0.30 °C	± 0.60 °C
100 °C	± 0.35 °C	± 0.80 °C	± 1.60 °C
200 °C	± 0.55 °C	± 1.30 °C	± 2.60 °C
300 °C	± 0.75 °C	± 1.80 °C	± 3.60 °C
400 °C	± 0.95 °C	± 2.30 °C	± 4.60 °C
500 °C	± 1.15 °C	± 2.80 °C	± 5.60 °C
600 °C	± 1.35 °C	± 3.30 °C	± 6.60 °C

THERMOCOUPLES (T/Cs)			
Code	**Sensor**	**Class**	**Norm**
B	Pt30Rh-Pt6Rh	standard	IEC 584
C	Wo5Re-Wo26Re	2	ASTM E988
E	NiCr-CuNi	1, 2	IEC 584
J	Fe-CuNi	1, 2	IEC 584
K	NiCr-Ni	1, 2	IEC 584
L	NiCr-CuNi	standard	GOST 3044
N	NiCrSi-NiSi	1, 2	IEC 584
R	Pt13Rh-Pt	1, 2	IEC 584
S	Pt10Rh-Pt	1, 2	IEC 584
T	Cu-CuNi	1, 2	IEC 584

Code	Class '1' Tolerance	Class '2' Tolerance
B	-	± 0.25% (from 600 to 1700 °C)
C	-	± 4.5 °C (to 450 °C);1.0% (to 2320 °C)
E	± 2.5 °C (to 333 °C); 0.75% (to 950 °C)	± 2.5 °C (to 333 °C); 0.75% (to 950 °C)
J	± 1.5 °C (to 375 °C); 0.4% (to 750 °C)	± 2.5 °C (to 333 °C); 0.75% (to 750 °C)
K	± 1.5 °C (to 375 °C); 0.4% (to 1000 °C)	± 2.5 °C (to 333 °C); 0.75% (to 1200 °C)
N	± 1.5 °C (to 375 °C); 0.4% (to 1000 °C)	± 2.5 °C (to 333 °C); 0.75% (to 1200 °C)
T	± 0.5 °C (to 125 °C); 0.4% (to 350 °C)	± 1.0 °C (to 133 °C); 0.75% (to 350 °C)
R / S	± 1.0 °C (to 1100 °C); 0.3% (to 1600 °C)	± 1.5 °C (to 600 °C); 0.25% (to 1600 °C)

TEMPERATURE RANGES			
Code	**Range**	**Code**	**Range**
T1	-50…400 °C	**T12**	-50…100 °C
T2	-200…600 °C	**T13**	0…1000 °C
T3	0…850 °C	**T14**	0…1600 °C
T4	0…800 °C	**T15**	0…1700 °C
T5	0…1500 °C	**T16**	0…1100 °C
T6	0…1200 °C	**T17**	-50…50 °C
T7	0…200 °C	**T18**	0…50 °C
T8	0…400 °C	**T19**	0…100 °C
T9	-50…200 °C	**T20**	0…150 °C
T10	-10…60 °C	**T21**	0…1300 °C
T11	-50…600 °C	**T22**	-200…200 °C

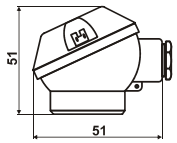
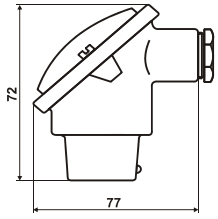
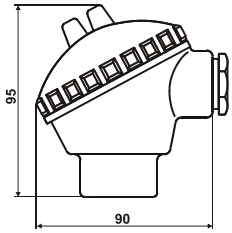
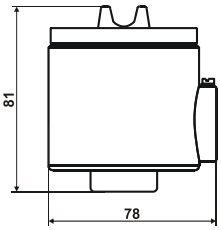
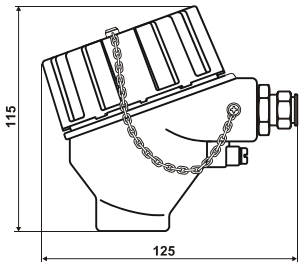
CONNECTION THREADS					
Code	**Thread**	**Code**	**Thread**	**Code**	**Thread**
Q0 / U0	M16x1.5	**Q12 / U12**	G1"	**Q24 / U24**	NPT 1/4"
Q1 / U1	M18x1.5	**Q13 / U13**	G1½"	**Q25 / U25**	M33x2
Q2 / U2	M20x1.5	**Q14 / U14**	G2"	**Q26 / U26**	M8x1
Q3 / U3	G3/8"	**Q15 / U15**	NPT 1"	**Q27 / U27**	G1¼"
Q4 / U4	G1/2"	**Q16 / U16**	NPT 1½"	**Q28 / U28**	NPT 1¼"
Q5 / U5	M27x2	**Q17 / U17**	NPT 2"	**Q29 / U29**	M8x1.25
Q6 / U6	G3/4"	**Q18 / U18**	G1/8"	**Q30 / U30**	M10x1.5
Q7 / U7	M12x1.5	**Q19 / U19**	NPT 1/8"	**Q31**	M6x1
Q8 / U8	M14x1.5	**Q20 / U20**	M10x1		
Q9 / U9	NPT 3/8"	**Q21 / U21**	G3"	**Q35 / U35**	7/16-20 UNF
Q10 / U10	NPT 1/2"	**Q22 / U22**	NPT 3"		
Q11 / U11	NPT 3/4"	**Q23 / U23**	G1/4"	**F**	flange

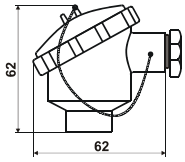
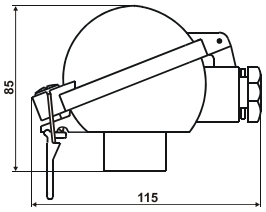
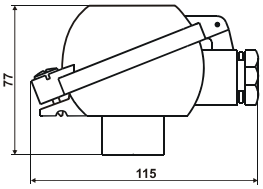
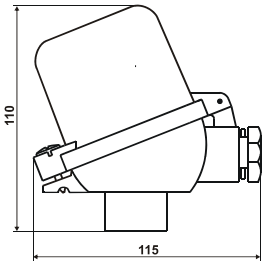
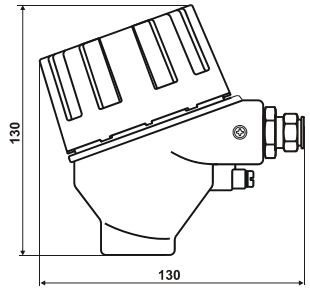
Q - male thread (nipple); U - female thread (union nut)

COMPATIBILITY FOR MINERAL-INSULATED THERMOCOUPLES									
	d [mm]	**1.0**	**1.5**	**2.0**	**3.0**	**4.5**	**6.0**	**8.0**	**10.0**
MATERIAL	**1.4541 (321)**	1x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N
	1.4571 (316Ti)	1x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N
	1.4404 (316L)	1x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	call
	2.4816 Inconel 600	1x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N
	1.4841 (310)	1x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	call
	1.4762 (446)	call	call	call	call	call	1x: J, K, E, N 2x: J, K, E, N	1x: J, K, E, N 2x: J, K, E, N	call
	1.4876 Incolloy 800	call	call	call	call	call	call	call	call
	Nicrobell®	call	call	call	1x: J, K, E, N	1x: J, K, E, N	1x: J, K, E, N	call	call

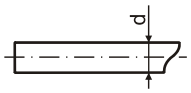
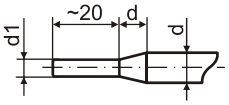
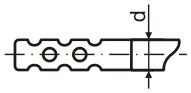
SHEATH MATERIALS						
Material	**Code**	**Type**	**A.K.A.**	**Max. Temp.**	**Specifications**	**Applications**
Stainless steel	**M1**	DIN 1.4301	AISI 304 (L)	450 °C	good resistance to inter-crystal corrosion, oil products, and vapor; high conductivity; excellent resistance to low temp. from -200°C; not recommended for long-term use from 425 to 860 °C	general purpose applications in machine and apparatus construction; cryogenic and non-aggressive food and chemical processing
Stainless steel	**M2**	DIN 1.4541	AISI 321	850 °C	good resistance to inter-crystal corrosion, oil products, vapor, exhaust gases, and oxidation; high conductivity	nuclear power and reactor construction; chemical apparatus & furnaces; paper, textile, crude oil, and petrochemical industry; food processing
Stainless steel	**M3**	DIN 1.4571	AISI 316 TI	850 °C	same as above plus: increased resistance to acids thanks to the addition of molybdenum; resistant to pitting, salt water, and other aggressive influences; high conductivity	nuclear power and reactor construction; furnace construction; chemical and pharmaceutical industries
Stainless steel	**M4**	DIN 1.4762 (1.4749)	AISI 446 (SS 2322)	1150 °C	extremely high resistance to sulfuric atmospheres; resistant to oxidation and corrosion caused by incinerator slag, copper, lead, and tin smelts	petrochemical industry; metallurgy; power technology; heat treatment kilns; vortex firing installations; waist incinerators
Stainless steel	**M5**	DIN 1.4841	AISI 310	1150 °C	excellent resistance to corrosion at high temperatures; suitable for atmospheres containing carbon and sulfur; not recommended for long-term continuous use within 425...860 °C temp. range	boilers and blast furnaces; cement and brick kilns; glass industry; crude oil and petrochemical industry; furnace construction; power plants
Stainless steel	**M6**	DIN 1.4845	AISI 310 S	1100 °C	good resistance to oxidation and sulfurization; also resistant to hydrous solvents due to the high content of chromium; resistant to chlorine-induced tension crack corrosion as well as cyanide	
Nickel alloy	**M7**	DIN 1.4876	Incolloy 800	1100 °C	provides superior thermal stability thanks to the addition of titanium and aluminum; suitable for applications requiring high non-scaling property and highest performance; excellent resistance to carburization and renitrogenization	power stations; crude oil and petrochemical industry; furnace construction
Nickel alloy	**M8**	DIN 2.4816	Inconel 600	1100 °C	resistant to corrosion and tension crack corrosion; excellent resistance to oxidation; not recommended for CO_2 and sulfur gases above 550 °C, with sodium above 750 °C	power & nuclear power stations; furnace construction; fiber industry; heat treatment; paper and food processing; boilers; aircraft engines
Stainless steel	**M9**	DIN 1.4404	AISI 316 L	850 °C	good resistance to inter-crystal corrosion, oil products, vapor, exhaust gases, and oxidation; resistance to mild acids and alkalies; high conductivity	food and diary industry; chemical apparatus & furnaces; paper, textile, crude oil, and petrochemical industry; grease, soap
Nickel alloy	**M10**	Ni84-Cr14 (+Nb+Mg)	Nicrobell®	1250 °C	superior resistance to high temperature corrosion atmospheres; the addition of niobium has the effect of improving the thermomechanical properties and ultimate tensile strength, rupture stress and ductility as a function of temperature to 1250°C are superior to Inconel and AISI 310	boilers and blast furnaces; cement and brick kilns; glass industry; crude oil and petrochemical industry; furnace construction; power & nuclear power stations; heat treatment; paper and food processing; aircraft engines
Pure Iron (Fe)	**M11**			1300 °C	excellent malleability, weldability, and corrosion resistance; holds heat about 40% longer than mild steel; suitable for salt, cyanide, or chloride baths	chemical processes including molten salts treatment
Cast Iron	**M12**	DIN 0.60xx	ASTM A48	700 °C	suitable for gas ducts and some chemical solutions; fair compatibility with molten aluminum	withstands sulphur and caustic solutions
Black steel	**M13**	DIN 1.0305	ASTM A106	550 °C	suitable for non-aggressive and low-oxidation gaseous media; suitable for molten babbitt, tin, lead, and magnesium	low-cost general applications
FeCrAl alloy	**M14**	Cr22-Al5	Kanthal® AF	1300 °C	supperior oxidation resistance in dry air up to 1300 °C; excellent oxidation resistance to CO, CO_2, N_2, SO_2, SO_3, and other sulfur-containing gases; very good resistance to cracked ammonia; also suitable for molten Cu, Zn, and Mg	high-temperature processes in metallurgy; power plants; chemical and petrochemical industry; furnace construction; heat treatment; cement and brick kilns, etc.
Titanium alloy	**M20**	DIN 3.70xx	ASTM B348	600 °C	very high tensile strength even at high temperatures; light weight, high corrosion resistance, and low toxity; suitable for high-aggressive chemical solvents and gas mixtures	chemical and electrochemical industry; pipes for power plants, armour plating; naval ships, aircraft, spacecraft and missiles; medicine and medical apparatus
Gas-tight alumina ceramic	**C1**	Al_2O_3 60%	Pythagoras 610	1500 °C	an irreplaceable material for usage above 1300 °C; depending on the purity of Al_2O_3, the highest operating temperatures can reach 1750 °C; suitable for applications in atmospheres with CO_2 and sulfur gases; provides an excellent electric isolation; not suitable for non-gas media, increased vibrations, and shocks	glass and ceramic industries; black and color metallurgy; power stations; high-temperature furnaces and other high-temperature applications
	C2	Al_2O_3 95%	Oxal 710	1600 °C		
	C3	Al_2O_3 99.7%	Alsint 799	1700 °C		
Metal-ceramic	**C4**	Cr+Al_2O_3	Ucar®	1370 °C	excellent mechanical strength (like metal); suitable for ferrous metals baths (steels) and non-ferrous metal baths like brass, copper, zinc, and lead; not suitable for molten aluminum	black and color metallurgy; forging iron and steel; forging non-ferrous metals
Silicon ceramic	**C5**	SiC	Silicon carbide	1500 °C	high temperature strength; suitable for aluminum and most of non-ferrous metal baths	aluminum industry; forging non-ferrous metals
	C6	SiC	Hexoloy®	1650 °C	very high temperature strength; high thermal conductivity - equal to metal, five times alumina; superior oxidation resistance; suitable for most corrosive and erosive environments	almost everywhere to protect thermocouples from corrosive and erosive influences
	C7	SiN_4+AlO_4	Syalon	1250 °C	high mechanical strength and thermal shock resistance; high corrosion resistance; suitable for aluminum and most of non-ferrous metal baths	aluminum industry; forging non-ferrous metals

PROTECTION HEADS

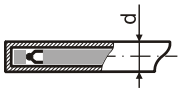
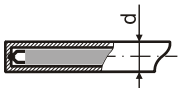
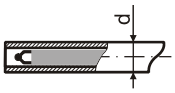
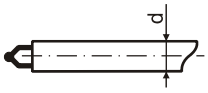
MA	B	G	E	EG
				
IP55	IP55	IP65	IP65	IP68 ATEX - IIGD EEx d IIC

MB	D	DW	DHW	EGW
				
IP65	IP65	IP65 windowed head type "D"	head type "DW" with high cap	IP68 windowed head type "EG"

RTD PROBE TIP SHAPES

Code	Shape Design	Description	Specifications	Applications
X		standard closed shape	- straight and even tube - IP68 - standard operating pressure	general applications
N		narrowed closed shape	- d1 = 4 (d6/8); 5 (d10/12); 6 (d≥14) - IP68 - standard operating pressure	suitable for liquid environments requiring faster response
P		pitted tip shape	- straight and even tube - IP20 - 0 bar operating pressure	fast-response measurements in non-pressurized gaseous environments

T/C PROBE TIP SHAPES

Code	Shape Design	Description	Specifications	Applications
X		standard closed shape	- thermocouple "hot junction" is isolated from the metal sheath - IP68 - standard operating pressure	general applications with electrically isolated thermocouple
G		grounded shape	- "hot junction" is connected to the metal sheath end cap - IP68 - standard operating pressure	suitable for applications, where faster response is needed and the electrical grounding is acceptable
O		open-tube shape	- straight tube without end cap and hidden "hot junction" - IP00 - 0 bar operating pressure	fast-response measurements in non-pressurized gaseous environments
E		shape with exposed "hot junction"	- straight tube without end cap - IP00 - 0 bar operating pressure	suitable for non-pressurized gaseous environments, where very fast-response measurements is required