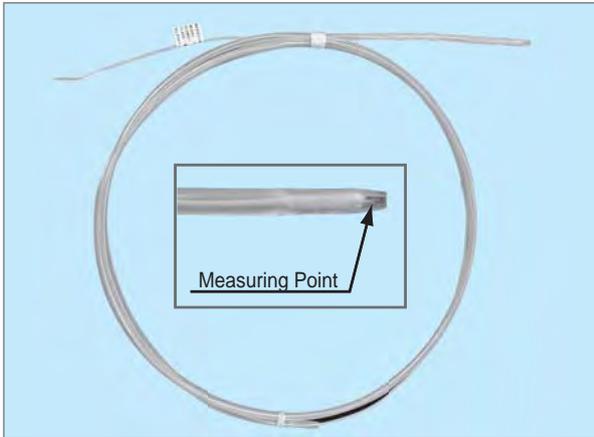
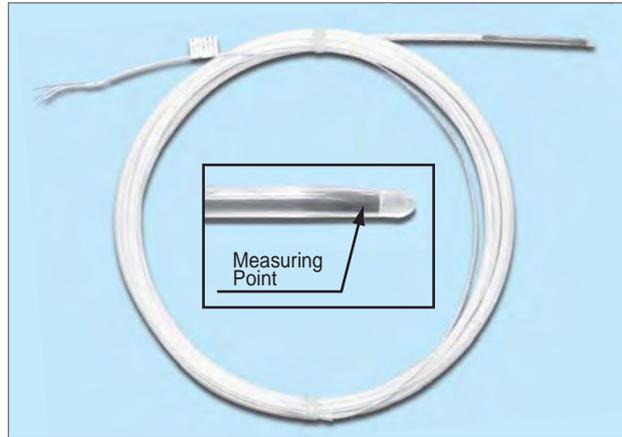


PFA (Fluororesin) coated temperature sensors FT-100 (Thermocouple) FR-100 (Resistance Temperature Detector)

Temperature sensor with perfluoroalkoxy polymer resin coating (PFA) excels in chemical and moisture resistance.



Thermocouple : FT-100



Resistance Temperature Detector : FR-100

Specifications

FT-100 (Thermocouple)

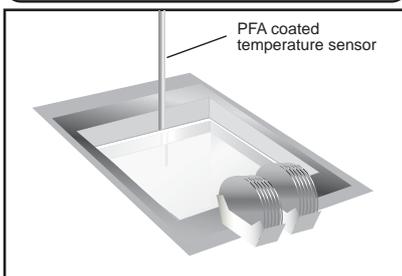
Type	Thermocouple K, Class 1
Measuring range	0 to 200°C Do not condensate except for the protection tube
Measuring accuracy	±2.5°C (Immersion length : 100mm or more)
Protection tube material	PFA (fluororesin)
Acceptable radius for protection tube bending	15mm (Except 90mm from tip)
Lead wire diameter	1.0x1.6mm
Lead wire configure	φ3.2mm X 1
Lead coating material	PFA (fluororesin), Green

FR-100 (Resistance Temperature Detector)

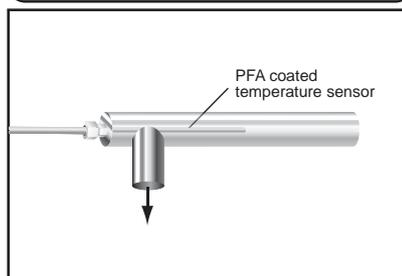
Type	Pt100, 3-wire system, Class A
Measuring range	0 to 200°C Do not condensate except for the protection tube
Measuring accuracy	±(0.15 + 0.002 t)°C (t:Measuring temperature) Specified current : 2mA (Immersion length : 100mm or more)
Protection tube material	PFA (fluororesin)
Lead wire diameter	φ1.7mm
Lead wire configure	φ0.1mm X 7
Lead coating material	PFA (fluororesin), Gray

Application

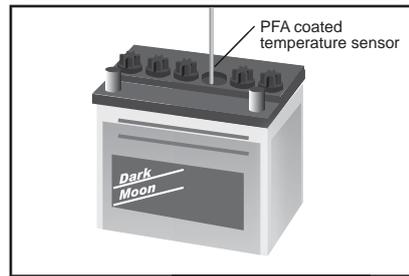
Cleaning Chemicals



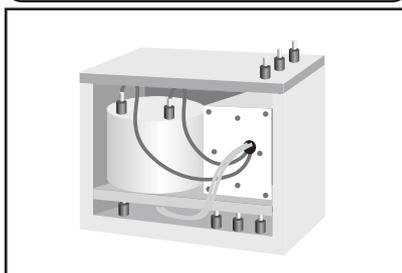
Gas Exhaust Pipe



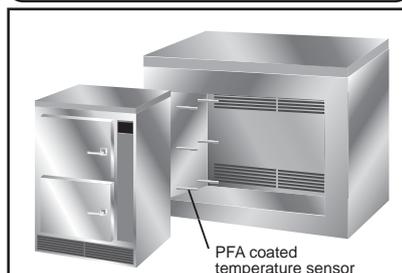
Battery electrolyte



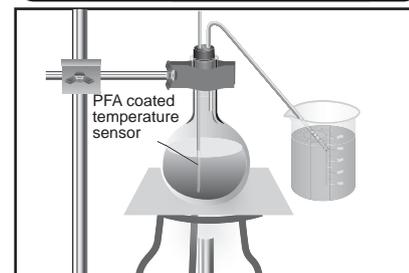
Chemical liquid supplying device



Environmental test chambers



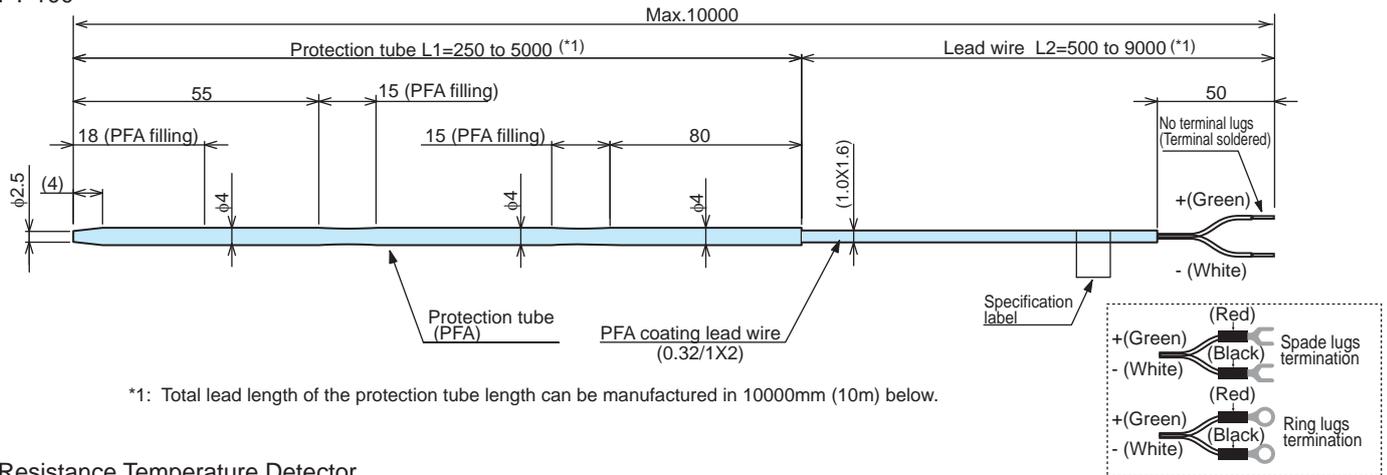
Thermal reaction



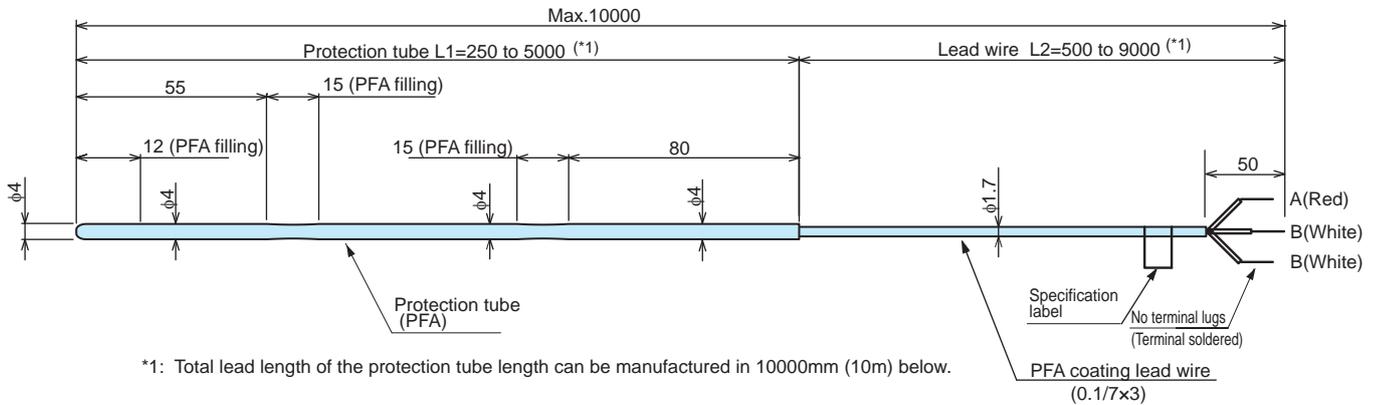
PFA (Fluororesin) coated temperature sensors FT-100 (Thermocouple) / FR-100 (Resistance Temperature Detector)

External Dimensions Unit : mm

Thermocouple
FT-100



Resistance Temperature Detector
FR-100



Model Code

Thermocouple
FT-100

Specifications	Model and Suffix Code			
	FT-100 - K- 42- A- □□□□-□□□□ - □-AW			
Thermocouple type	Thermocouple K, Class 1	K		
Diameter of protection tube	φ4	42		
Protection tube	PFA (Fluororesin)	A		
Length of protection tube (L1) *2	250mm to (Each 500mm) 5000mm		250 to 5000	
Lead wire length (L2) *2	500mm to (Each 500mm) 5000mm to (Each 1000mm) 9000mm		500 to 5000 5000 to 9000	
Lead wire termination	No terminal lugs *terminal soldered Spade lugs for JIS standard "M3" size screw Spade lugs for JIS standard "M4" size screw Ring lugs for JIS standard "M3" size screw Ring lugs for JIS standard "M4" size screw			W Y3 Y4 R3 R4
Pure water cleaning	Pure water cleaning & Clean packing			AW

Resistance Temperature Detector
FR-100

Specifications	Model and Suffix Code			
	FR-100 - DPA - 42- A- □□□□-□□□□ - □-AW			
Resistance temperature detector type	Pt100, Class A, Middle temperature type	DPA		
Diameter of protection tube	φ4	42		
Protection tube	PFA (Fluororesin)	A		
Length of protection tube (L1) *3	250mm to (Each 500mm) 5000mm		250 to 5000 5000	
Lead wire length (L2) *3	500mm to (Each 500mm) 5000mm to (Each 1000mm) 9000mm		500 to 5000 5000 to 9000	
Lead wire termination	No terminal lugs * terminal soldered			N
Pure water cleaning	Pure water cleaning & Clean packing			AW

*3 : Total length of Protection tube and lead wire can be up to 10000mm (10m).

*2 : Total length of Protection tube and lead wire can be up to 10000mm (10m).

Reference information

● Thermocouple

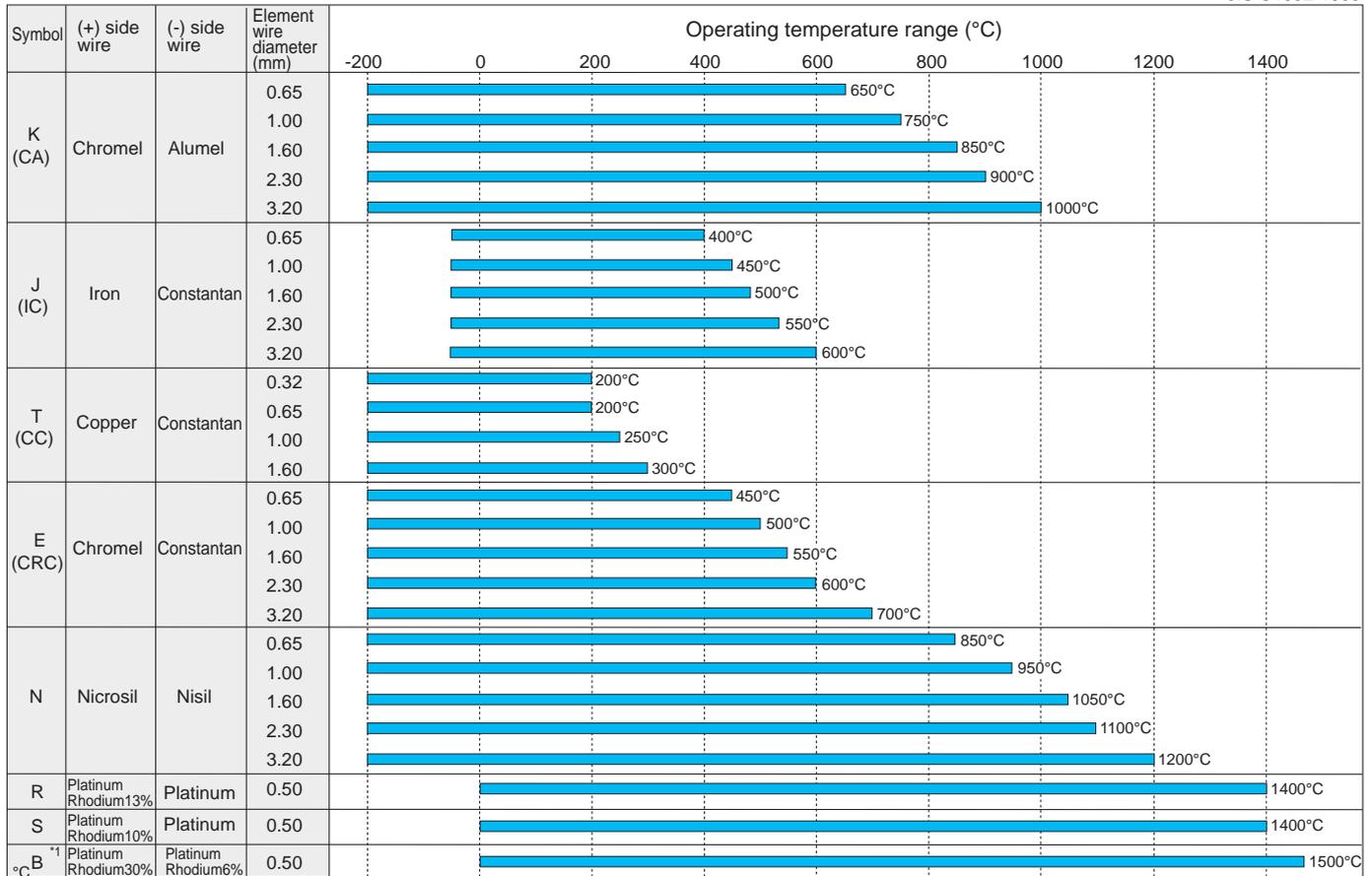
(1) Thermocouple element type

Thermocouple elements K(CA), J(IC), T(CC), E(CRC), N, R, S, B are available. Please find the below chart and choose them according to applications.

Thermocouple classes are standard as class 2 and an accurate type as class 1. (see the differences of temperature allowance section)

All standard types are class 2. (Only standard type for B is class 3)

JIS C1602-1995



*1 Maximum operating temperature is normal operating temperature limit (temperature limit for continuous operation). For overheating use limitation (temperature limitation for a short time use for an unavoidable situation), please find JIS standards (JIS C1602). Consider the above chart only as a guide. Operating temperature limit is subject to change dependent upon the types of the protection tube. For B type, measurement below 600°C is out of the tolerance range.

(2) Tolerance to temperature

JIS C1602-1995

Type		Class 1	Class 2	Class 3
K	Temperature range	-40°C to +375°C	-40°C to +333°C	-167°C to +40°C
	Tolerance	±1.5°C	±2.5°C	±2.5°C
J	Temperature range	+375°C to +1000°C	+333°C to +1200°C	-200°C to -167°C
	Tolerance	±0.004• t	±0.0075• t	±0.015• t
T	Temperature range	-40°C to +375°C	-40°C to +333°C	—
	Tolerance	±1.5°C	±2.5°C	—
E	Temperature range	+375°C to +750°C	+333°C to +750°C	—
	Tolerance	±0.004• t	±0.0075• t	—
N	Temperature range	-40°C to +125°C	-40°C to +133°C	-67°C to +40°C
	Tolerance	±0.5°C	±1°C	±1°C
R,S	Temperature range	+125°C to +350°C	+133°C to +350°C	-200°C to -67°C
	Tolerance	±0.004• t	±0.0075• t	±0.015• t
B	Temperature range	-40°C to +375°C	-40°C to +333°C	-167°C to +40°C
	Tolerance	±1.5°C	±2.5°C	±2.5°C
R,S	Temperature range	+375°C to +800°C	+333°C to +900°C	-200°C to -167°C
	Tolerance	±0.004• t	±0.0075• t	±0.015• t
N	Temperature range	-40°C to +375°C	-40°C to +333°C	-167°C to +40°C
	Tolerance	±1.5°C	±2.5°C	±2.5°C
R,S	Temperature range	+375°C to +1100°C	+333°C to +1200°C	-200°C to -167°C
	Tolerance	±0.004• t	±0.0075• t	±0.015• t
B	Temperature range	0°C to +1100°C	0°C to +600°C	—
	Tolerance	±1°C	±1.5°C	—
R,S	Temperature range	—	+600°C to +1600°C	—
	Tolerance	—	±0.0025• t	—
B	Temperature range	—	—	+600°C to +800°C
	Tolerance	—	—	±4°C
B	Temperature range	—	+600°C to +1700°C	+800°C to +1700°C
	Tolerance	—	±0.0025• t	±0.005• t

• |t| is a value which represents regardless of + or - symbols of temperature (°C).

Reference information

● Resistance Temperature Detector

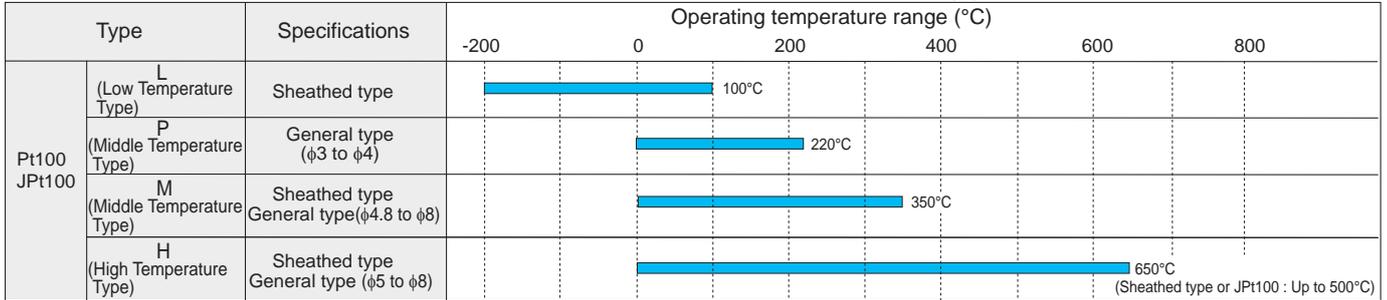
(1) Resistance Temperature Detector Type

Platinum RTD (resistance temperature detector) can be divided into either Pt100 or JPt100 (former). It is more often used for low temperature applications than thermocouples, and has a high accuracy.

On the other hand, it is not suitable in a situation where the responsiveness and measurement of surface or tiny spaces are required.

Pt100 classes are either B as standard or A as accurate. For standard type, its class is B and its specified current is 2mA.

Elements L, M, and H meet JIS C1604-1997 whereas "P" doesn't.



Consider the above chart only as a guide.

(2) Tolerance to temperature JIS C 604-1997

Class	Tolerance (°C)
Class A	±(0.15+0.002 t)
Class B	±(0.3+0.005 t)

• |t| is a value which represents regardless of + or - symbols of temperature (°C).

Measuring temperature (°C)	-200	-100	0	100	200	300	400	500	600	650	700	800	850
Tolerance (°C) Class A	±0.55	±0.35	±0.15	±0.35	±0.55	±0.75	±0.95	±1.15	±1.35	±1.45			
Class B	±1.3	±0.8	±0.3	±0.8	±1.3	±1.8	±2.3	±2.8	±3.3	±3.6	±3.8	±4.3	±4.6

● Protection Tube

SUS304, SUS316(for sheath), and Nichrome are available as materials for the protection tube for standard type. It is available to select its material based on measured objects and measurement conditions.

<Normal operating temperature limits> <Sheathed type> JIS C 1605,(Nichrome is out of JIS standard)

Thermocouple	Diameter	φ1.0	φ1.6	φ3.2	φ4.8	φ6.4	φ8.0
	Protection tube						
K	SUS316	650°C	650°C	750°C	800°C	800°C	900°C
	SUS310S	650°C	650°C	750°C	800°C	800°C	900°C
	Inconel				900°C	1000°C	1050°C
	Nicrobell	900°C	1000°C	1100°C	1100°C	1150°C	1200°C
J	SUS316	450°C	450°C	650°C	750°C	750°C	750°C
	SUS316	300°C	300°C	350°C	350°C	350°C	350°C
T	SUS316	300°C	300°C	350°C	350°C	350°C	350°C
N	Nicrobell		1000°C	1100°C	1100°C	1150°C	1200°C

(1) Special Protection Tube

Metal protection tube

Material	Operating temperature for regular use (°C)	Maximum temperature (°C)	Features
Sandvik P4 (SUH446)	1000°C	1200°C	Excellent heat resistance and contained 27% chromium steel. Excellent salt-bath, melted metal, and acid resistance under high temperature. It can be used for sulfate containing reducing flame.
Titanium	250°C	500°C	Extremely excellent corrosion resistance, however this feature will be fragile under high temperature by oxidation.
Cast Iron	700°C	800°C	Extreme mechanical resistance.
Fluor resin coating	180°C	200°C	Fluor resin (FEP) coating with SUS316 sheath. Incredible chemical resistance under low temperature.

Non-metal protection tube

Material	Operating temperature for regular use (°C)	Maximum temperature (°C)	Features
Hard glass	500°C	600°C	Heatproof temperature limit is low. Fragile to thermal and mechanical shock and has a resistance to alkaline and acid.
Silica glass	1000°C		Has a resistance to sudden cooling and heating, Meanwhile, its strength is small. Vulnerable to alkaline, and resistant to acidity. Airtightness is deteriorated in hydrogen and reducing atmosphere.
High alumina Ceramic tube	1400°C 1500°C	1450°C 1550°C	Incredible air proof. Melted metal and combustion gas resistance. Vulnerable to metallic oxide and alkaline.
Pure sintering alumina	1700°C	1900°C	Incredible air proof. It is a neutral refractory. Melted metal, glass, and lead slag resistant. Vulnerable to thermal shock.
Zirconia	1900°C	2100°C	It is thermal resistant and air proof. Excellent resistance to corrosion from glass and metallic slag.
Silicon carbide	1500°C	1700°C	Good electrical and thermal conductivity. Withstand sudden heating, cooling, and oxidizing for its massive thermal strengths.
Silicon nitride	1200°C	1600°C	Excellent corrosion resistance to non-ferrous metals. Its thermal shock resistance is also excellent.
Ceramic JIS Special	1600°C		Available to be stable measurement in a oxidized, reducing atmosphere, and high vacuum ambient environment.
Ceramic JIS Type 1	1500°C		Excellent thermal and corrosion resistance. Good thermal characteristics.
Ceramic JIS Type 2	1400°C		Less thermal softening and good thermal shock resistant.

• Temperature for regular use and maximum temperature vary dependent upon the diameter of the protection tube.

Reference information

● Lead Wire : Compensation cable (Thermocouple), Copper wire (Resistance temperature detector)

Compensation cable is used for thermocouple. Copper wire is used for RTD. There are other types of the lead wire such as glass fiber (EXB), vinyl coating(EXD) and so on. Please specify its type.

To use the copper lead wire for thermocouple result in inaccurate temperature measurement. Characteristics of lead wire should be same as the element of thermocouple.

Copper lead wire is used for RTD. Pay attention for wiring due to three-wires. Make sure that a resistance value of each wire is balanced.

Below chart is the plain specification for each compensation lead wire.

JIS C 1610-1995

Type	Applications	Code (JIS)	Composition of core *1		Sheath		Contact point compensation temperature (°C)	Error (μV) *3
			(+) Side	(-) Side	Material *2	Color		
K	Standard	KCC-G	Copper 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Vinyl	Blue	0 to 100	±100
	For heat-resistive	KCB-H	Iron 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Fiberglass		0 to 150	
J	Standard	JX-G	Iron 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Vinyl	Yellow	-25 to 200	±140
	For heat-resistive	JX-H			Fiberglass			
T	Standard	TX-G	Copper 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Vinyl	Brown	-25 to 100	±60
	For heat-resistive	TX-H			Fiberglass			
E	Standard	EX-G	Alloy of Nichel and Chrome 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Vinyl	Purple	-25 to 200	±200
	For heat-resistive	EX-H			Fiberglass			
N	Standard	NX-G	Alloy of Nichel and Chrome 0.3 × 7	Alloy of Nichel and Silicon 0.3 × 7	Vinyl	Pink	-25 to 200	±100
	For heat-resistive	NX-H			Fiberglass			
R	Standard	RCM-G	Copper 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Vinyl	Black	0 to 100	±30
	For heat-resistive	RCM-H			Fiberglass			
S	Standard	SCA-G	Copper 0.3 × 7	Alloy of Copper and Nichel 0.3 × 7	Vinyl	Black	0 to 100	±30
	For heat-resistive	SCA-H			Fiberglass			
B	Standard	BC-G	Copper 0.3 × 7	Copper 0.3 × 7	Vinyl	Gray	0 to 100	— *4

*1:0.65 x4 wires is available for both (+) and (-).

*2:Codes and types for external material (Coating) is based on JIS. Please refer to the below chart for the other types.

*3:It is concerning temperature of the junction with element and compensation cable.

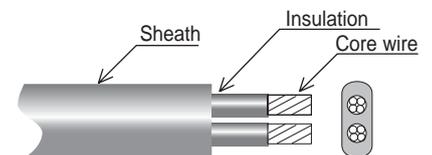
*4:Tolerance value is not specified since a material for + core wire and - core wire is identical.

● Compensation cable

JIS C 1610-1995 (EXE, EXF is out of JIS standard)

Code	Details	Operating temperature
EXA	For heat-resistive, Fiberglass with stainless steel	0 to 150°C
EXB	For heat-resistive, Fiberglass	
EXC	For standard, PVC (polyvinyl chloride) with copper wire braided	-20 to +90°C (KCB,RCA,SCA,BC : 0 to 90°C)
EXD	For standard, PVC (polyvinyl chloride)	
EXE	For heat-resistive, Silicone rubber	-55 to +180°C
EXF	For heat-resistive, Fluorocarbon polymers (FEP)	0 to 200°C

Composition of Compensation cable



● Responsiveness of sensors

It takes a certain time for measuring junction of thermocouple or element of RTD to reach the same temperature with measuring object. The shorter the pipe is, the faster the response is. Meanwhile mechanical resistance becomes weaker. It is important to select a sensor according to purpose and condition. Please refer to following chart as a guide.

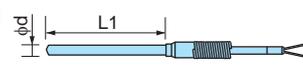
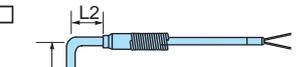
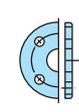
Response time (Atmospheric temperature to boiling water)

Type		Reference values	
		63.2%	95.0%
Thermocouple (General type)	φ3.2	0.3 sec	0.9 sec
	φ5.0	0.8 sec	2.6 sec
Sheathed Thermocouple	φ1.0	0.05 sec	0.2 sec
	φ1.6	0.15 sec	0.6 sec
	φ3.2	0.5 sec	1.8 sec
	φ4.8	1.0 sec	2.6 sec
	φ8.0	2.7 sec	10.7 sec

Type		Reference values	
		63.2%	95.0%
Resistance temperature detector (General type)	φ3.0	3.6 sec	9.2 sec
	φ5.0	5.5 sec	15 sec
	φ6.0	7.1 sec	19 sec
	φ8.0	11.8 sec	33 sec
Sheathed resistance temperature detector (General type)	φ3.2	3.2 sec	8.7 sec
	φ4.8	4.2 sec	11.5 sec
	φ8.0	8.7 sec	21 sec

Temperature sensor specification check sheet (For General type and Sheathed type)

● Please make a copy of this specification check sheet and send it to our distributors.

Check Item	Reference page	Check Specifications		
Protection tube type		<input type="checkbox"/> General type <input type="checkbox"/> Sheathed type <input type="checkbox"/> NICROBELL sheathed type		
Type	Page 3 to Page 4 Page 11 to Page 27 (Thermocouple) Page 45 to Page 54 (Resistance temperature detector)	<input type="checkbox"/> Thermocouple <input type="checkbox"/> K <input type="checkbox"/> J <input type="checkbox"/> T <input type="checkbox"/> E <input type="checkbox"/> N <input type="checkbox"/> R <input type="checkbox"/> B <input type="checkbox"/> S <input type="checkbox"/> PLII <input type="checkbox"/> W5Re/W26Re <input type="checkbox"/> Grounded (Standard) <input type="checkbox"/> Ungrounded <input type="checkbox"/> Exposed <input type="checkbox"/> Single element (Standard) <input type="checkbox"/> Double element <input type="checkbox"/> Class 2 (Standard) <input type="checkbox"/> Class 1 <input type="checkbox"/> Class 3 (Type B) <input type="checkbox"/> Resistance Temperature Detector (RTD) <input type="checkbox"/> Single element (Standard) <input type="checkbox"/> Double element <input type="checkbox"/> Class B (Standard) <input type="checkbox"/> Class A <input type="checkbox"/> <input type="checkbox"/> Grounded (Standard) <input type="checkbox"/> Ungrounded		
Operating temperature		Normal : _____ °C Maximum : _____ °C		
Shape	Page 11 to Page 27 (Thermocouple) Page 45 to Page 54 (Resistance temperature detector)	<input type="checkbox"/> Straight type (Please check one out of 6 from the following pictures) Length of protection tube (L1) _____ mm Diameter of protection tube (ϕ d) ϕ _____	<input type="checkbox"/> 90° bend type (Please check one out of 2 from the following pictures) Length of protection tube (L1) _____ mm (L2) _____ mm Diameter of protection tube (ϕ d) ϕ _____	
		<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <input type="checkbox"/>  <input type="checkbox"/> With spring loaded </div> <div style="text-align: center;"> <input type="checkbox"/>  <input type="checkbox"/> With spring loaded </div> </div> <input type="checkbox"/> Other: please draw external view	<div style="text-align: center;"> <input type="checkbox"/>  <input type="checkbox"/> With spring loaded </div> Optional <input type="checkbox"/> With stainless flexible lead wire <input type="checkbox"/> Fluor resin coating <input type="checkbox"/> Other	
Mounting Bracket	Page 6	<input type="checkbox"/> No bracket	<input type="checkbox"/> Fixed flange JIS __K __A or __B 	<input type="checkbox"/> Fixed nipple (nut) (Check either parallel or taper screw) <input type="checkbox"/> Rotary nipple (nut) (Check either parallel or taper screw) Parallel screw __G (P.F) Taper screw __R (P.T)  
		<input type="checkbox"/> Compression fitting Taper screw __R (P.T) 	Other	
Lead protection	Page 59	<input type="checkbox"/> Fiberglass with stainless steel <input type="checkbox"/> Fiberglass <input type="checkbox"/> PVC (polyvinyl chloride) with copper wire braided <input type="checkbox"/> PVC (polyvinyl chloride) <input type="checkbox"/> Silicone rubber <input type="checkbox"/> Fluorocarbon polymers (FEP)		
Lead wire length	Page 11 to Page 54	_____ mm		
Lead wire termination	Page 7 to Page 8	<input type="checkbox"/> No terminal lugs *terminal soldered		
		<input type="checkbox"/> Spade lugs (M3 size) 	<input type="checkbox"/> Ring lugs (M4 size) 	
Other requests or environments of usage		<input type="checkbox"/> Metal connector Plug Receptacle 	<input type="checkbox"/> Thermocouple connector Plug Jack 	
		<input type="checkbox"/> Other		
Measuring object or application (for reference)		Company Name		
		Name		
		Country		
		Address		
		E-mail Address		
		Phone Number		