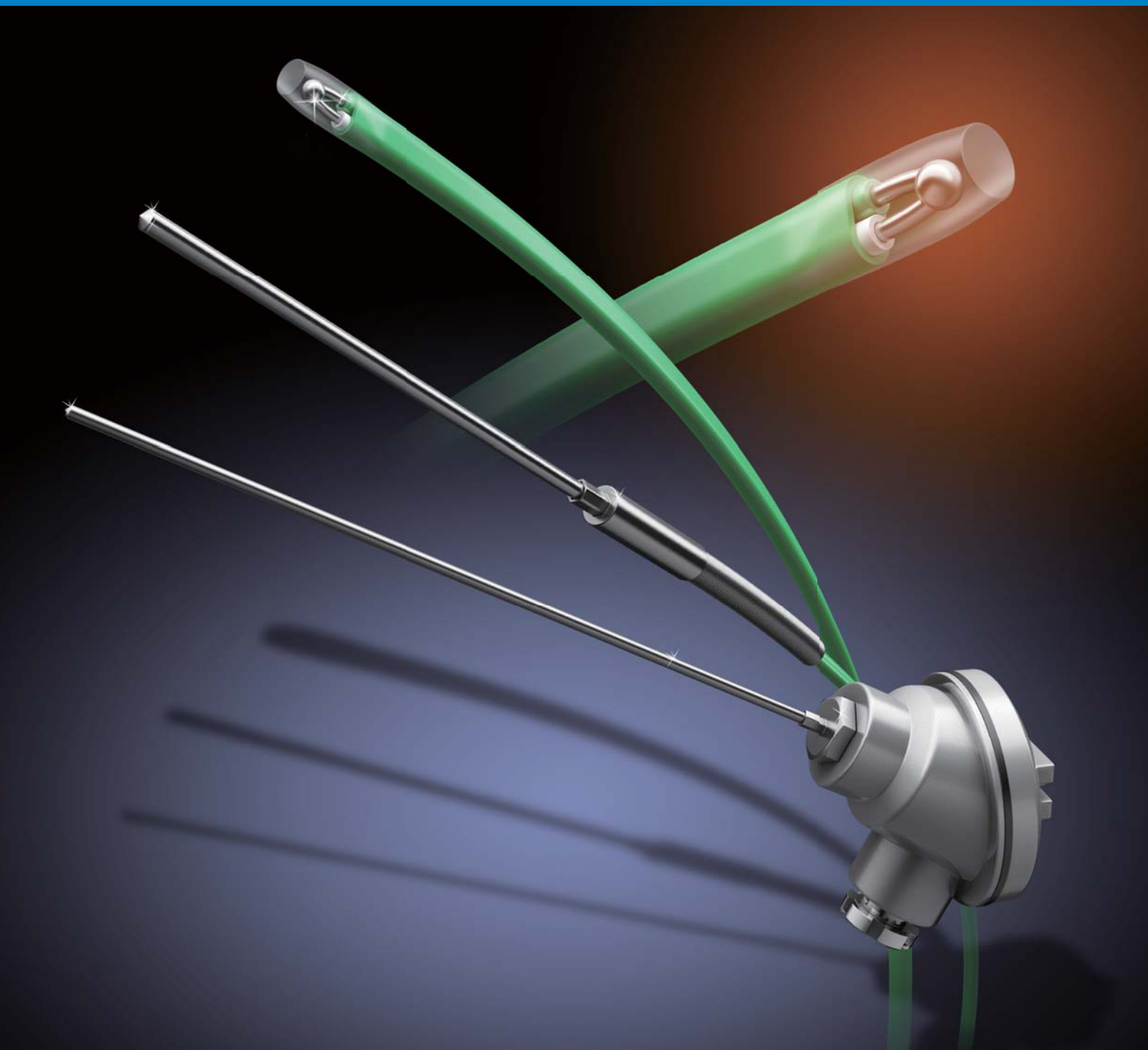
FUKUDEN
Products CATALOG
Thermocouple Sensors



In recent years, industrial technology has caused marvelous innovation in all industries. Moreover the environmental problems on the global scale have become a topic, the demand for the environmental preservation, resource conservation and energy saving and so forth is growing annually, in accompany with which advances the development and improvement of equipments. In order to support such technical innovation, the demand for the electric wires previously never used in inconceivably severe temperature and atmosphere has emerged.

To meet the various needs of customers, FUKUDEN INCORPORATED is dedicated to the research and development of the cables which can comply with all the conditions required from customers. Now we can manufacture a kind of super heat-resistant wire temperature up to 500℃,far exceeding the former resistant temperature of 250℃ and another kind of heat-resistant wire which can withstand the temperature up to 260℃ even under acidity or an alkaline atmosphere. From now on we shall also make the contribution to the industry through the future-oriented dream-inspiring products on the accumulated technical capabilities and creativity.

OPERATIONAL PRINCIPLES OF THERMOCOUPLES

As shown in the Fig.No1, voltage is generated in a closed circuit made up of wires of two dissimilar metals such as “copper” and “iron” , and electric current will flow if the temperatures of two junctions, A and B, are held different as temperature T1, and T2.
This phenomenon is called “Seekbeck effect”, and the open circuit voltage caused by is Called “Thermal-EMF”. Thermocouple, thus, consists of two dissimilar metals.

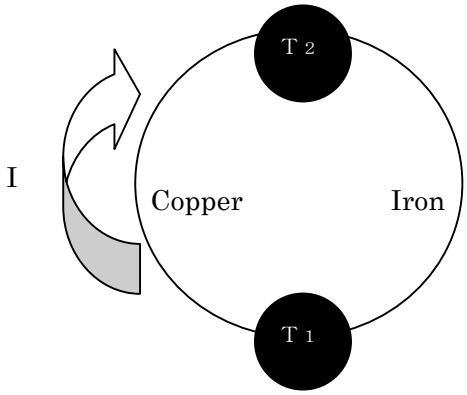


Fig. No.2 A loop circuit made up of two dissimilar metals

Of two junctions of thermocouple, the junction which is subjected to the temperature to be measured is called “Measuring junction” ,and the junction which is at known temperature is called “Reference junction(cold junction)”.

(a) in the Fig.2 is the case of a direct connection of a measuring instrument to thermocouple, and a display on the instrument shall be (Tx−T1), therefore, to know the actual temperature of Tx ℃ at the measuring junction , it is necessary to measure T1 ℃ for compensation.

(b) is the case of a general measuring circuit with thermocouple extension wire, and a reference junction system. A display on the measuring instrument shall be (Tx−T0)℃ in the case, however, when T0 is held at 0℃ as shown in the drawing, the display on the instrument shall automatically indicate Tx℃.

For general temperature measurements, the compensation type reference junction, at Which the temperature is electrically rectified, is more popular than the junction of an ice point room temperature.

In the case of a compensation type, temp, displays can be directly read out.

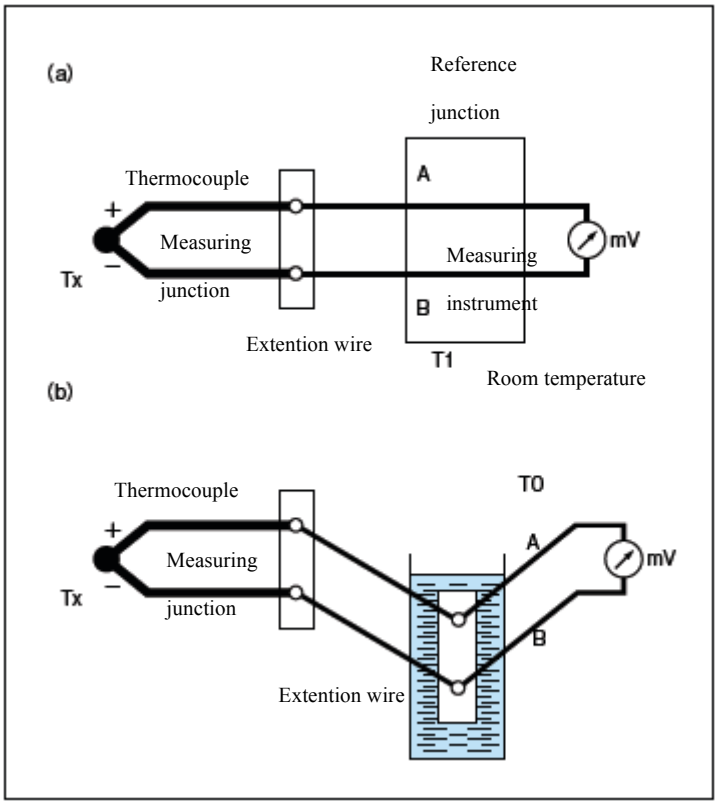


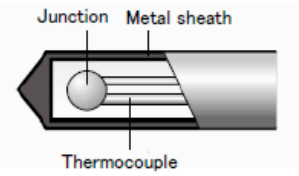
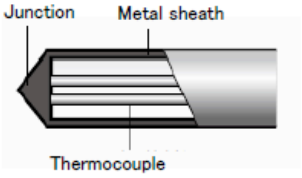
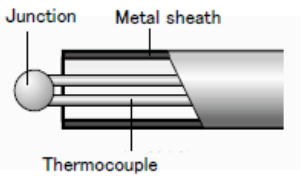
Fig. No.4 Temperature measuring Circuit with thermocouples

KINDS OF THERMOCOUPLES

The most general types of sheathed thermocouples are shown in the table, and depending on the type to be used, the thermal-EMF value differs, therefore, please choose the best selection to match the spec, of a measuring instrument.

Thermocouple Sensor	Polarity	
	+Leg (Red)	−Leg (White)
B	Platinum rhodium alloy 30% rhodium	Platinum rhodium alloy 8% rhodium
R	Platinum rhodium alloy 13% rhodium	Platinum
S	Platinum rhodium alloy 10% rhodium	Platinum
K	10% Chrome Bal. Nickel	2% Aluminum, Mn, Silica Bal. Nickel
E	10% Chrome Bal. Nickel	45% Nickel Bal. Copper
J	Iron	45% Nickel Bal. Copper
T	Copper	45% Nickel Bal. Copper
N	Nickel-Chromium-Silicon	Nickel-Silicon

HOT JUNCTION TERMINATION

UNGROUNDED (U)		Due to hot junction insulated from sheath,slower response than that of Grounded type to temp. changes, but useable to wide applications due to it's shielding effects and durability.
GROUNDED (G)		Faster response to temp.changes,and suitable for measurements at high pressure/temp, but not suitable in harmful electrical conductivity atmospheres.
EXPOSED (E)		Most fastest response time, and used in high humidity . atmospheres of up to 200℃, but not suitable in corrosive atmospheres.

QUALITY ASSURANCE

While observing the most rigid quality control criteria in both production and inspection, we assure you of the most reliable products. Tests carried out during manufacture include.

Visual Checks

Using a magnifier or micro-scope, any defects on the sheath surface such as scars, cracks, rust, oil etc, and any harmful abnormality such as unnatural bending shall be checked with eyes.

Dimensional Checks

Using an approved micro-meter, Nonius, or scales, the outer dia. Or length of thermocouples shall be measured according to the following criteria.

(1)Sheath length of thermocouple	:	Not more then 500m	±5mm
		More than 500mm	±1%
(2)Sheath Dia. of thermocouple	:	0.5～4.8φ	±0.05mm
		6.0～8.0φ	±0.10mm
(3)Length of extension wire	:	Not more then 1000m	±30mm
		More than 1000m	±3%

Thermal-EMF Tests

Tests are carried out at each manufacturing lot of sheathed thermocouples, comparing thermal-EMF with that of the reference thermocouple adjusted by the fixed-point method. All the measurement data shall be submitted on request. Measuring temperatures are shown in the table. However, in the case of smaller sized thermocouples , tests are not carried out at higher temperatures than the specified

.

Kind	Temperature (℃)				
K	100	200	400	650	(1000)
E	100	200	400	650	
J	100	200	400	650	
T	100	200	400		

Insulation Resistance Tests

Insulation resistance varies with insulation material used for extension wire connected to sheathed thermocouple, however, I the case of sole thermocouple with the hot junction of 'U' Or 'E', tests shall be carried out in the criteria specified in the table.

OD.of sheathed thermocouple	Measuring Voltage (V)	Insulation Resistance (MΩ)
0.5～2.3 ㎜φ	DC100	20 (More than)
3.2～8.0 ㎜φ	DC500	100 (More than)

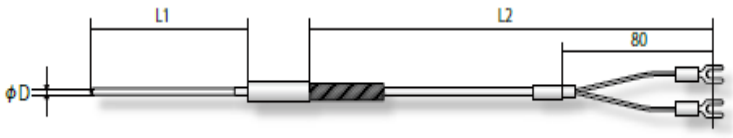
Charged Examination

X-ray projected non-destructive examination is carried out at each production lot, photographing the welding status of conductors, and sealing conditions of sheath. All the photographic date shall be submitted with charge upon request

■S10 Basic metal sheathed thermocouple

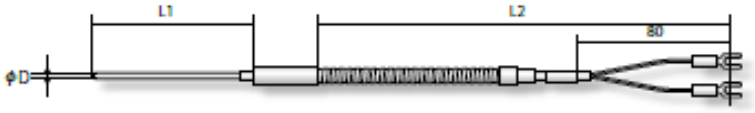
S10-SK-II-S316-1.6-U-300
① ② ③ ④ ⑤ ⑥ ⑦

■S20 Metal sheathed thermocouple with sleeve (with extension wire)



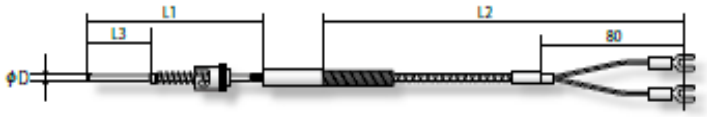
S20-SK-II-S316-3.2-U-500-VVF-3,000
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

■S30 Metal sheathed thermocouple with flex tube (with extension wire)



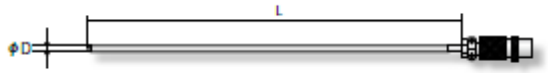
S30-SK-II-S316-4.8-U-200-GGBF-OBS-2,000
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

■S40 Spring loaded bayonet type metal sheathed thermocouple



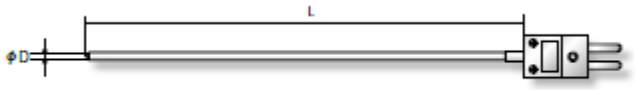
S40-SK-II-S316-3.2-U-150-GGBF-1,000-50
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑪

■S50 Metal sheathed thermocouple with metal connector



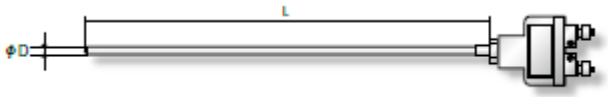
S50-SK-Ⅱ-S316-4.8-U-500-NCS162P
① ② ③ ④ ⑤ ⑥ ⑦ ⑫

■S60 Metal sheathed thermocouple with plastic connector



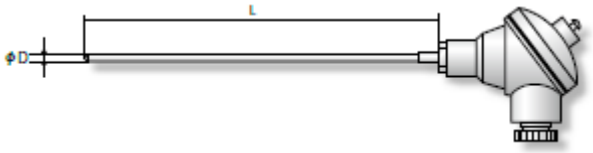
S60-SK-Ⅱ-S316-3.2-U-600-OST-K-M
① ② ③ ④ ⑤ ⑥ ⑦ ⑫

■S70 Metal sheathed thermocouple with T open type terminal head



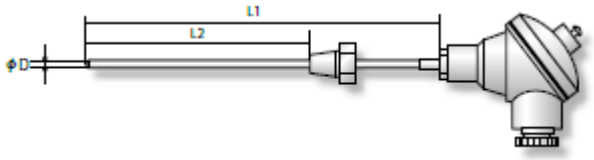
S70-SK-Ⅱ-S316-4.8-U-700-TS
① ② ③ ④ ⑤ ⑥ ⑦ ⑩

■S80 Metal sheathed thermocouple with K type terminal head



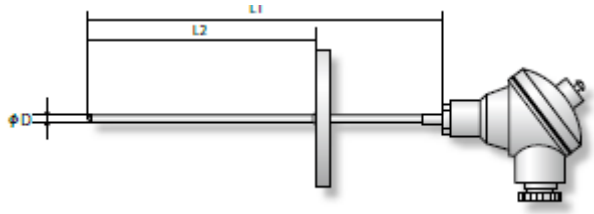
S80-SK-Ⅱ-S316-6.4-U-800-KL
① ② ③ ④ ⑤ ⑥ ⑦ ⑩

■S90 Thrust type metal sheathed thermocouple with thread fitting

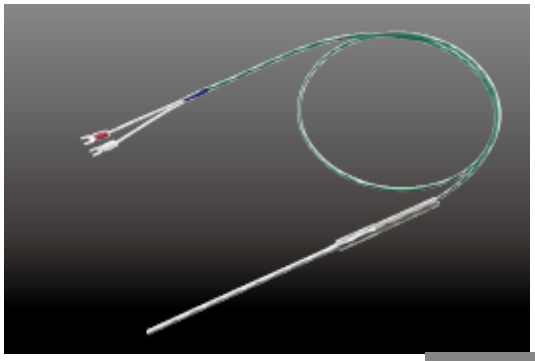


S90-SK-II-S316-8.0-U-800-KL-700-R4/1
① ② ③ ④ ⑤ ⑥ ⑦ ⑩ ⑪ ⑫

■S100 Metal sheathed thermocouple with flange



S100-SK-II-S316-8.0-U-900-KL-800-10K20AFF
① ② ③ ④ ⑤ ⑥ ⑦ ⑩ ⑪ ⑫



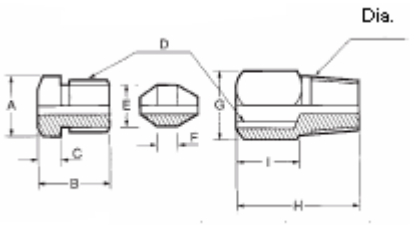
COMON ACCESSORIES & PARTS

Accessories shall be chosen according to required applications.

■Compression Fittings

This is to fix the insertion of thermocouple at any length.
(Clew type is available on request.)

①Compression Fittings(Push Type)

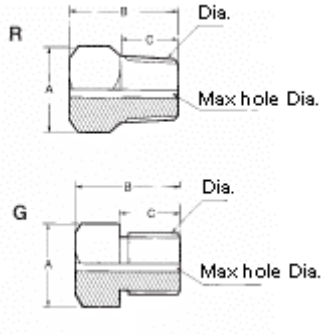


Sizes	Dimensions (φ)						
1/8″	1.0	1.6	2.3	3.2	4.8	–	–
1/4″	1.0	1.6	2.3	3.2	4.8	6.4	8.0
3/8″	–	1.6	2.3	3.2	4.8	6.4	8.0
1/2″	–	–	2.3	3.2	4.8	6.4	8.0
3/4″	–	–	2.3	3.2	4.8	6.4	8.0

Sizes	Dimensions (㎜)								
	A	B	C	D	E	F	G	H	I
1/8″	13	14	5	G1/8	8.0	3	13	21	12
1/4″	17	17	7	G1/4	11.0	5	17	26	14
3/8″	17	17	7	G1/4	11.0	5	19	28	15
1/2″	19	23	10	G3/8	14.0	5	23	32	15
3/4″	26	31	13	G1/2	18.0	6	29	40	20

※Dimensions may differ applied sheath dia. Material:SUS304

②Fixing Nipples (Tapered:PT. Straight:PF)



Sizes	Dimensions							
	R (PT)				G (PF)			
	A	B	C	D	A	B	C	D
1/8″	13	15	10	6	13	15	10	6.4
1/4″	17	20	13	6.5	17	20	13	8.0
3/8″	19	23	15	6.5	21	23	15	12
1/2″	23	25	17	18	26	25	17	18

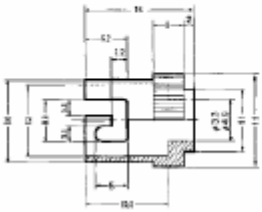
Material:SUS304

■Bayonets Fittings

① For Sheathed Thermocouples Bayonets Parts

● Bayonets Cap (Both 1 & 2-slot type available)

●Bayonets Cap
(Both 1 & 2-slot type available)



●Spring

●Spring stopper

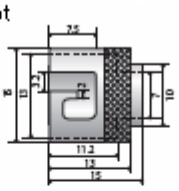
Sheath Dia.	Spring Dia.	OD.	Length	No. of coils
for 3.2φ	0.5φ	4.5	35	20
for 4.8φ	0.8φ	6.5	40	17

Sheath Dia.	ID.	OD.
for 3.2φ	3.3φ	4.5φ
for 4.8φ	4.9φ	6.5φ

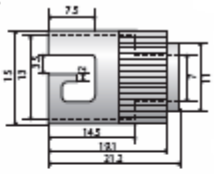
② For Thermocouple for General Use Bayonets Parts

●Byonets Cap
(Both 1& 2-slot type available)

For one-slot



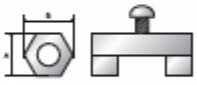
For two-slot



●Spring
(Material:SUS304)

(mm)

●Spring Stopper
(Material:Brass,Nickel,Plating)



(mm)

Protection tube Dia.	Spring Dia.	ID.	Length
for 4.0φ	0.8φ	4.9	90
for 4.8φ	0.8φ	4.9	90

Protection tube Dia.	Outer Dia. (A×B)	Dia.	Length
for 4.0φ	12.0×14.0	4.9	20
for 4.8φ	12.0×14.0	4.9	20

COMMON ACCESSORIES & PARTS

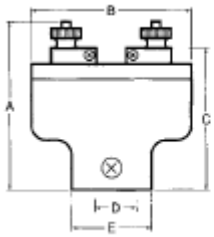
■Connectors(Terminal Heads)

Open type

●TS Type Open Terminal Head (Small type)

● TL Type Open Terminal Head (Large type)

Model	No. of terminal	A	B	C	D	E
TS Type	2P	58	45	50	G1/4	19
TL Type	2P	77	70	63	G1/2	30

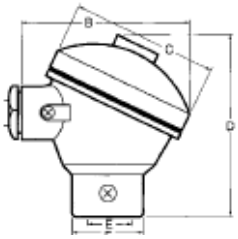


Water-proof type

●KM Type Terminal Head (Middle type)

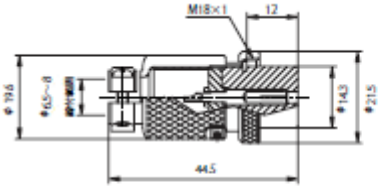
● KL Type Terminal Head (Large type)

Model	No. of terminal	A	B	C	D	E	F
KM Type	2P	G3/8	70	65	72	G1/4	28
KL Type	2P	G1/2	87	76	86	G1/2	34

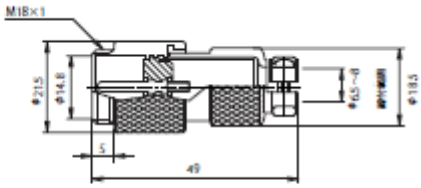


■Connectors

●Metal Connecotors

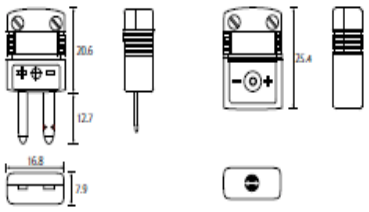


Plug NCS-162P

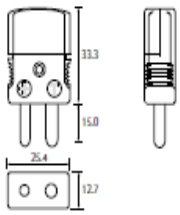


Adaptor NCS-162Ad

●Omega Connectors



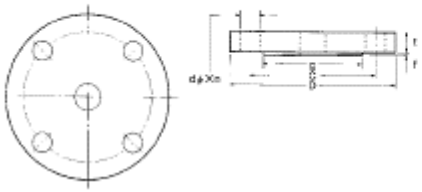
Type:SMP-〔K,T,J,E,R〕-〔M/F〕



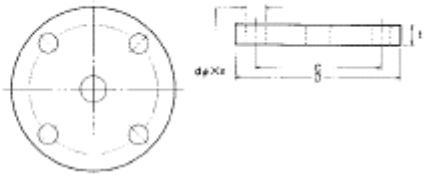
Type:OST-〔K,T,J,E,R〕-〔M/F〕

■FLANGES

RF Pressure Flanges



FF Pressure Flanges



Withstand Pressure	Sizes A	Sizes B	D	C	g	t	f	Dia. of hole	No. of hole
5K	10	3/8	75	55	42	9	1	12	4
	15	1/2	80	60	48	9	1	12	4
	20	3/4	85	65	52	10	1	12	4
	25	1	95	75	62	10	1	12	4
	32	5/4	115	90	72	12	2	15	4
	40	3/2	120	95	78	12	2	15	4
	50	2	130	105	88	14	2	15	4
10K	10	3/8	90	65	48	12	1	15	4
	15	1/2	95	70	52	12	1	15	4
	20	3/4	100	75	58	14	1	15	4
	25	1	125	90	70	14	1	19	4
	32	5/4	135	100	80	16	2	19	4
	40	3/2	140	105	85	16	2	19	4
	50	2	155	120	100	16	2	19	4
20K	10	3/8	90	65	48	14	1	15	4
	15	1/2	95	70	52	14	1	15	4
	20	3/4	100	75	58	16	1	15	4
	25	1	125	90	70	16	1	19	4
	32	5/4	135	100	80	18	2	19	4
	40	3/2	140	105	85	18	2	19	4
	50	2	155	120	100	18	2	19	4

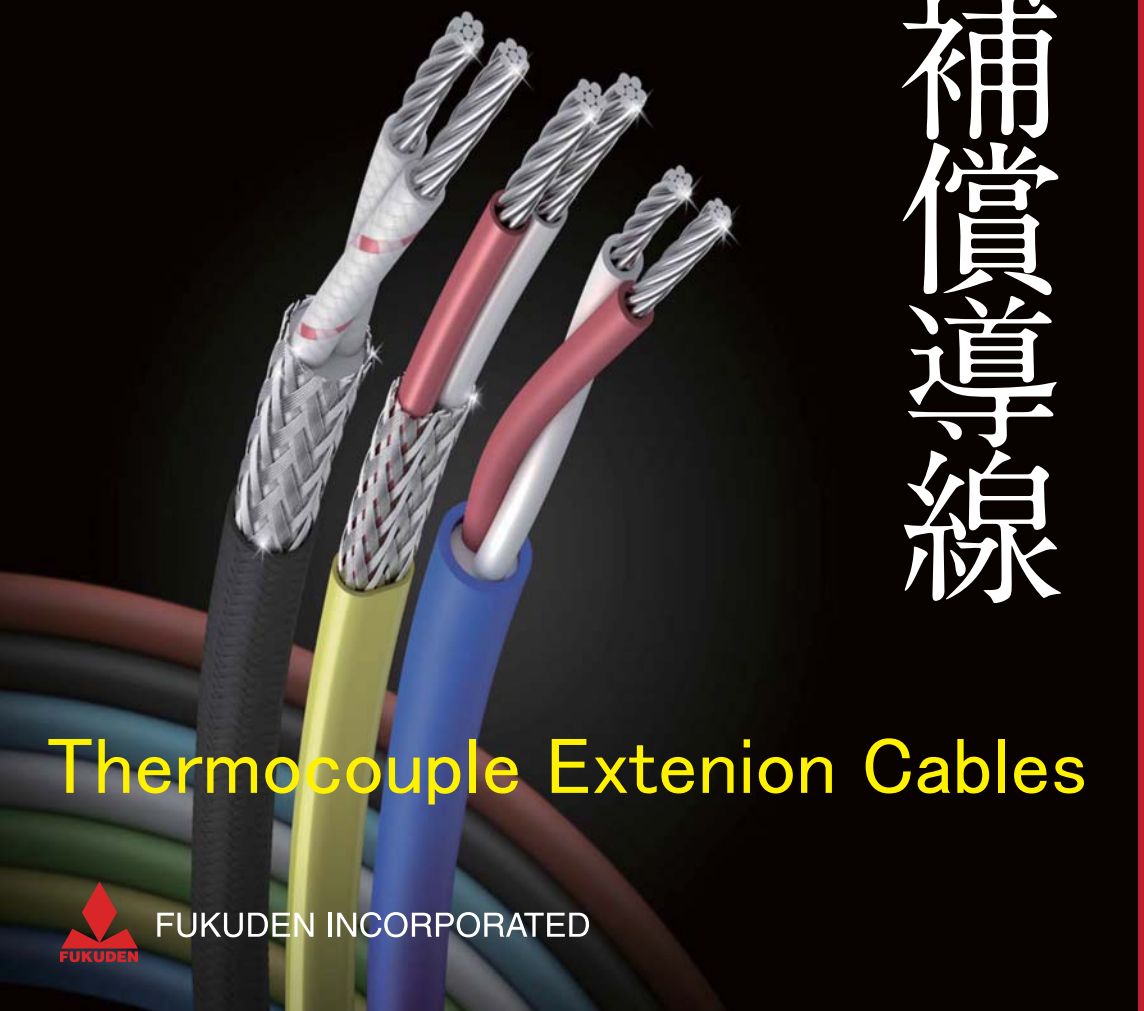
(Unit:mm)

熱を知り 熱を制す

Measuring & Controlling Temperature

熱電対

Thermocouples



補償導線

Thermocouple Extenion Cables

FUKUDEN INCORPORATED

耐える電線
Resistant Wire

熱 Proof Heat

寒 Proof Cold

薬 Proof Chemical

油 Proof Oil

耐熱電線
Heat Resistant Wire

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