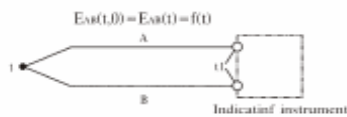


Thermocouple (T/C) Construction of thermocouple

The effect responsible for the action of thermocouple is the "Seebeck effect". If a temperature difference exists along a wire, this will cause a displacement of electrical charge. The amount of the charge displacement depends on the electrical characteristics of the chosen material.

If two wires of different materials are joined at one point and then subjected to a temperature, then a voltage difference will be generated between the open ends of the two wires. In order to be able to measure the temperature at the junction, the temperature at the open end must be known. If the temperature of the open end is not known, then it must be extended (by a compensating cable) into the zone of known temperature (reference junction, usually referred to as the "cold junction").

The temperature of the reference junction must be known and constant. The exact temperature is equal to the junction temperature plus cold junction temperature.






TYPE OF MEASURING JUNCTION

TYPE	SHAPE	FEATURE
Grounded		<ol style="list-style-type: none"> 1. This type can withstand 3500kg/cm² or more 2. It is not suitable for location with electromagnetic induction or radio frequency interference
Ungrounded		<ol style="list-style-type: none"> 1. This type has a slower response than the grounded type but is more commonly used since it is not restricted by the object to be measured 2. The element is covered with an insulator thereby ensuring a long life span.
Exposed		<ol style="list-style-type: none"> 1. Since the element is exposed response time is very fast 2. This type is suitable for temperature measurement of gases such as automotive exhaust. 3. This type is mechanically weaker than the other.

MINERAL INSULATED THERMOCOUPLE

1. wide application in measuring small diameter is very useful for the place where space is at premium .
2. quick response
3. easily bent for installation
4. long life span
5. excellent mechanical strength and pressure resistance

standard specification of AEROPAK[®] sheath thermocouple

	sheath (mm)		wire dia (mm)	maximum length (M)
	O.D	t		
SINGLE ELEMENT 	Ø 0.25	0.035	Ø 0.05	138
	Ø 0.5	0.08	Ø 0.1	95
	Ø 1.0	0.17	Ø 0.17	420
	Ø 1.6	0.27	Ø 0.27	185
	Ø 3.2	0.47	Ø 0.51	130
	Ø 4.8	0.72	Ø 0.76	142
	Ø 6.4	0.93	Ø 1.0	80
	Ø 8.0	1.16	Ø 1.3	50
DOUBLE ELEMENT 	Ø 3.2	0.47	Ø 0.51	130
	Ø 4.8	0.72	Ø 0.76	142
	Ø 6.4	0.93	Ø 1.0	80
	Ø 8.0	1.16	Ø 1.3	50
TRIPLE ELEMENT 	Ø 4.8	0.72	Ø 0.5	142
	Ø 6.4	0.93	Ø 0.72	80
	Ø 8.0	1.16	Ø 0.9	50

AEROPAK[®] OPERATING TEMPERATURE RANGE (IN AIR)

SHEATH O.D (mm)	SN	SK		SE	SE	SJ	ST
Ø 0.25	-	500 ^o C (*1)		-	-	-	-
Ø 0.5	-	600 ^o C (1)		-	-	-	-
Ø 1.0	900 ^o C (*3)	650 ^o C	900 ^o C (*3)	650 ^o C	450 ^o C	450 ^o C	300 ^o C
Ø 1.6	1200 ^o C (*3)	650 ^o C	1200 ^o C (*3)	650 ^o C	450 ^o C	450 ^o C	300 ^o C
Ø 3.2	1260 ^o C (*3)	750 ^o C	1260 ^o C (*3)	750 ^o C	650 ^o C	650 ^o C	350 ^o C
Ø 4.8	1260 ^o C (*3)	800 ^o C	1260 ^o C (*3)	800 ^o C	750 ^o C	750 ^o C	350 ^o C
Ø 6.4	1260 ^o C (*3)	1000 ^o C (*1)	600 ^o C (*1)	900 ^o C (*2)	800 ^o C	750 ^o C	350 ^o C
Ø 8.0	-	1050 ^o C (*1)	600 ^o C (*1)	1000 ^o C (*2)	800 ^o C	750 ^o C	350 ^o C

(*1) sheath material : NCF 600 (*2) sheath material : SUS310 (*3) sheath material : H2300 OTHERS : SUS316

FEATURE OF THERMOCOUPLE

Type	feature
B	<p>Thermocouple which combines a positive wire of a platinum-rhodium alloy containing 70% platinum and 30% rhodium with a negative wire of platinum rhodium containing 94% platinum and 6% rhodium. Type B is more resistant to heat and mechanical stress than type R, and withstands 1800°C Max. Other features are the same as those of type R.</p>
R&S	<p>Thermocouple which combines a positive wire of a platinum and rhodium alloy containing 87% platinum and 13% rhodium with a negative wire of pure platinum. This thermocouple is highly accurate, excellent in heat resistance and stability, generally used in oxidizing atmospheres. It is not recommended for use in reducing atmospheres or where metal vapors are present.</p> <p>Thermocouple which combines a positive wire of a platinum rhodium alloy containing 90% platinum and 10% rhodium with a negative wire of pure platinum. Other features are the same as those of type R.</p>
N	<p>This is called Nicrosil (positive leg) / Nisil (negative leg) Thermocouple, and its composition and characteristics are very similar to those of type K Thermocouple. It is an improved type of Type K Thermocouple and has more Si additive, higher heat resistance.</p>
K	<p>Thermocouple which combines a positive wire of an alloy consisting mainly of nickel and chromium with negative wire of an alloy consisting mainly of nickel. This thermocouple widely used for many particularly should not be used in carbon monoxide, sulfuric acid gas or sulfur bearing hydrogen atmospheres.</p>
E	<p>Thermocouple which combines a positive wire of thermocouple K with a negative wire of thermocouple J. This thermocouple has a high thermal emf and is suitable for use in oxidizing atmosphere.</p>
J	<p>Thermocouple which combines a positive wire of iron with thermocouple is resistant in reducing atmospheres and is also resistant to hydrogen and carbon. However it should not be used in atmospheres that will oxidize iron. It is relatively low in cost and often used for medium temperature range applications.</p>
T	<p>Thermocouple which combines a positive wire of copper with a negative wire of an alloy mainly of copper and nickel. High accuracy is obtained at under 300°C, and it is suitable for low temperatures from -200°C to +100°C. It is suitable for use in weak oxidizing and reducing atmospheres.</p>

Thermocouple tolerance and applicable standards

sta nda rd	COMPOSITION (+ / -)	JIS C 1602-1995			IEC 584-2-1982		ASTM E230-1996		
		TEMP RANGE	CLASS	TOLERANCE °C	CLASS	TOLERANCE °C	TEMP RANGE	CLASS	TOLERANCE °C
B	Pt-30Rh / Pt-6Rh	600°C ~ 1700°C	2	± 0.0025 t	2	± 0.0025 t	870°C ~ 1700°C	STD	± 0.5 %
		600°C ~ 800°C 800°C ~ 1700°C	3	± 4 ± 0.005 t	3	± 4 ± 0.005 t			
R & S	(R)Pt-13Rh / Pt	0°C ~ 1100°C	1	± 1	1	± 1	0°C ~ 1450°C	STD	± 1.5 OR ± 0.25 %
	(S)Pt-10Rh / Pt	0°C ~ 800°C 600°C ~ 1600°C	2	± 1.5 ± 0.0025 t	2	± 1.5 ± 0.0025 t		SP	± 0.6 OR ± 0.1 %
N & K	(N) Ni-Cr-Si / Ni-Si (K) Ni-Cr / Ni-Al	-40°C ~ +375°C	1	± 1.5 ± 0.004 t	1	± 1.5 ± 0.004 t	0°C ~ 1260°C	STD	± 2.2 OR ± 0.75 %
		+375°C ~ 1000°C	2	± 2.5 ± 0.0075 t	2	± 2.5 ± 0.0075 t		SP	± 1.1 OR ± 0.4 %
		-40°C ~ +333°C	2	± 2.5 ± 0.0075 t	2	± 2.5 ± 0.0075 t	-200°C ~ 0°C	STD	± 2.2 OR ± 2 %
		+333°C ~ +1200°C	3	± 2.5 ± 0.015 t	3	± 2.5 ± 0.015 t			
		-167°C ~ +40°C	3	± 2.5 ± 0.015 t	3	± 2.5 ± 0.015 t			
		-200°C ~ -167°C	3	± 2.5 ± 0.015 t	3	± 2.5 ± 0.015 t			
E	Ni-Cr / Cu-Ni	-40°C ~ +375°C	1	± 1.5 ± 0.004 t	1	± 1.5 ± 0.004 t	0°C ~ +870°C	STD	± 1.7 OR ± 0.5 %
		+375°C ~ 800°C	2	± 2.5 ± 0.0075 t	2	± 2.5 ± 0.0075 t		SP	± 1 OR ± 0.4 %
		-40°C ~ +333°C	2	± 2.5 ± 0.0075 t	2	± 2.5 ± 0.0075 t	-200°C ~ 0°C	STD	± 1.7 OR ± 1 %
		+333°C ~ +900°C	3	± 2.5 ± 0.015 t	3	± 2.5 ± 0.015 t			
		-167°C ~ +40°C	3	± 2.5 ± 0.015 t	3	± 2.5 ± 0.015 t			
		-200°C ~ -167°C	3	± 2.5 ± 0.015 t	3	± 2.5 ± 0.015 t			
J	Fe / Cu-Ni	-40°C ~ +375°C	1	± 1.5 ± 0.004 t	1	± 1.5 ± 0.004 t	0°C ~ +760°C	STD	± 2.2 OR ± 0.75 %
		+375°C ~ 750°C	2	± 2.5 ± 0.0075 t	2	± 2.5 ± 0.0075 t		SP	± 1.1 OR ± 0.4 %
		-40°C ~ +125°C	1	± 0.5 ± 0.004 t	1	± 0.5 ± 0.004 t	0°C ~ +370°C	STD	± 1.1 OR ± 0.4 %
		+125°C ~ +350°C	2	± 1.0 ± 0.0075 t	2	± 1.0 ± 0.0075 t		SP	± 0.5 OR ± 0.4 %
T	Cu / Cu-Ni	-40°C ~ +133°C	2	± 1.0 ± 0.0075 t	2	± 1.0 ± 0.0075 t	-200°C ~ 0°C	STD	± 1 OR ± 1.5 %
		+133°C ~ +350°C	3	± 1.0 ± 0.015 t	3	± 1.0 ± 0.015 t			

(1) Tolerance is referred to as the maximum allowable deviation between measuring junction temperature and the temperature derived from the emf table.






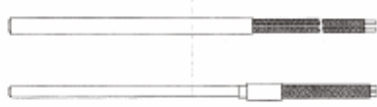
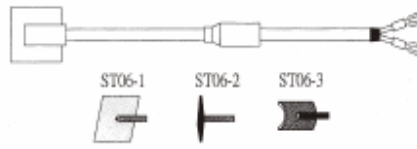


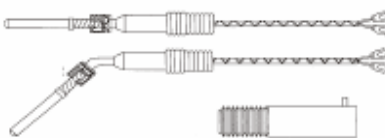
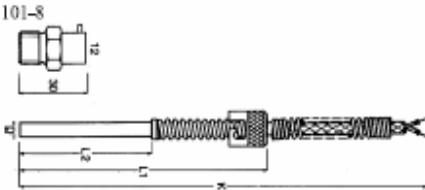
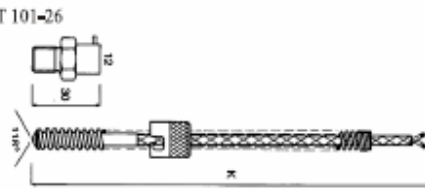
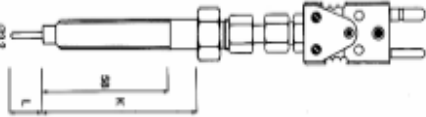


(2) ASTM tolerance is °C or % value for the measured temperature, whichever is greater



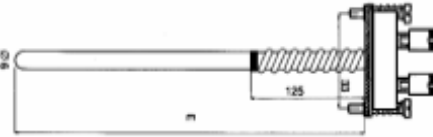

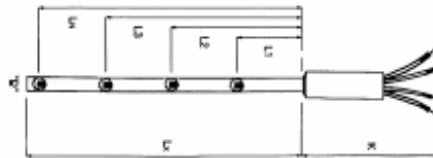


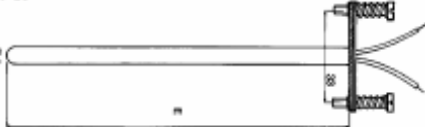
(3) |t| means measuring temperature indicated with the temperature (°C) having no connection with the positive or negative mark.

(4) Classes 1, 2, 3 correspond to former JIS Classes 0.4, 0.75, 1.5 respectively.

(5) JIS, BS, DIN standards are same as IEC standard.

(6) ASTM standard is former ANSI standard.

<p>Melt bolt thermocouple</p> <p>CMT 100</p> 	<p>thermocouple wire with ceramic insulato</p> <p>CMT 007</p>  <p>CMT 027</p> 
<p>armor thermocouple extension</p> <p>CMT 103</p> 	<p>screw Thermocouple</p> <p>CMT 101B</p> 
<p>flexible thermocouple extension</p> <p>CMT 101-6</p> 	<p>spade thermocouple</p> <p>ST 30-PAD</p> 
<p>Ring Thermocouple</p> <p>CMT 101R</p>  <p>CMT 201R</p> 	<p>spring adjustable immersion thermocouple</p> <p>CMT 105</p> 
<p>spring adjustable immersion T/C</p> <p>CMT 101-8</p> 	<p>spring adjustable immersion T/C</p> <p>CMT 101-26</p> 
<p>Plug T/C</p> <p>ST 70-1</p> 	<p>plug thermocouple</p> <p>CMT 101C1</p>  <p>CMT 101C2</p> 

plug T/C	Flexible fitting with D coector thermocouple
ST 70-FE 	ST 60 
DIN terminator T/C DIN	plug T/C
SF 70-S 	ST 70-M 
Muti points T/C	DIN terminator thermocouple DIN T/C
ST 703 	ST 70-DIN 
T terminator thermocouple	Round plate T/C
ST 70-T 	ST 70-R 

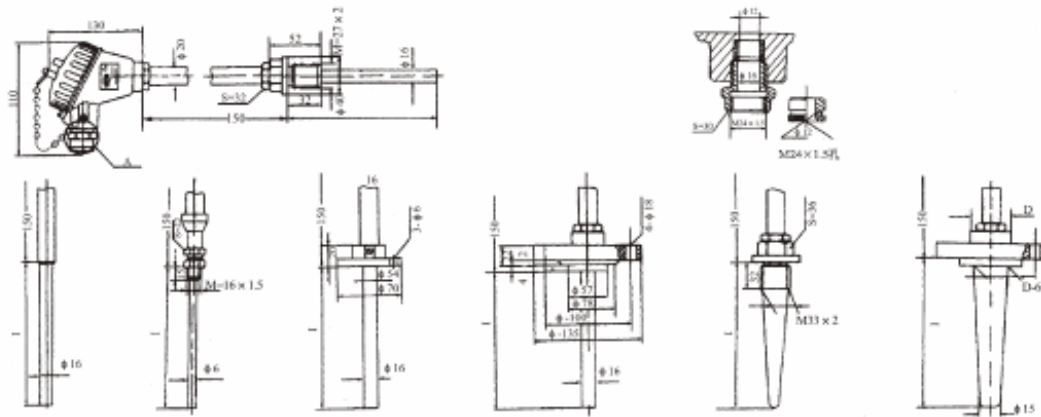
model CMT	100, 007, 103, 101B, 101-6, ST 30-PAD, 101R, 105, 101-26, 101-8, 101-C1, 101-C2, ST 60, ST 70-1, ST 70-M, ST 70-FE, ST 70-DIN, ST 70-S, ST 70-T, ST 703, ST 70-R
type of element	J=J type , K=K type ,E =E type , T=T type , R =R type ,S =S type , N =N type , B=B type
element quantity	S=Single , D=DUAL , O=OTHER
process connection parts	5 -None , 7-fixed type bushing , 8-compression fitting , 9-compression fitting with bushing 10-compression fitting with bayonet cap and spring (Page 20,21) if need connection parts , please note connection size : _____ inch (PT , NPT, G , R)
terminal connector	O=O type Y=Y type, T=T connector, S=standard connector, M=mini connector (Page 18,19)
probe material	S4=SUS304 , S6=SUS316, S10 = SUS310 , NCF=INCONEL 600 , CERA=ceramic
probe diameter	Ø1.0 mm , Ø1.6 mm , Ø2.3 mm , Ø3.2 mm , Ø4.8 mm , Ø6.4 mm , Ø 9 mm , Ø12.7 mm , Ø21.7 mm ,specify
probe length	_____ mm
lead wire length	flexible SUS316 tube armor length (if need) + leadwire length
lead wire insulated material	PVC, fiber glass, teflon (page 25,26,27)
measuring junction	G=Ground , UG=Ungrounded , EPS=Exposed type
CLASS	01=JIS0.4 , 02=JIS0.75 , 03=JIS1.5 , 04=ASTM standard , 05=ASTM special

<p>Non-fixed Type TC With Metallic Protection Tube</p> <p>CMT 107</p>	<p>Fixed Screw-In Type T/C</p> <p>CMT 106</p>
<p>Fixed Screw-In Type T/C</p> <p>CMT 106-1</p>	<p>Movable Screw-In T/C</p> <p>CMT 106-M</p>
<p>Extensio Type TC</p> <p>CMT 106-UN</p>	<p>Movable Flange Type TC</p> <p>CMT 107-MF</p>
<p>Fixed Flange Type Tc</p> <p>CMT 107-F</p>	<p>Fixed Screw-in type T/C With Variable diameter</p> <p>CMT 106-IV1</p>
<p>Fixed Screw-in type T/C With Variable diameter</p> <p>CMT 106-IV2</p>	<p>Right angle Type T/C</p> <p>CMT 106-L</p>
<p>Extensio sheath Type T/C</p> <p>CMT 106-UN-SH</p>	<p>Fixed Screw-In Type TC With Tapered Drilled Thermowell</p> <p>CMT 107-TW</p>

Non-Metalic protection tube

<p>Fixed Screw-In Type TC With Protection Type</p> <p>CMT 106cer</p>	<p>Non-Fixing Type TC With ceramic Protection Tube</p> <p>CMT 107cer</p>
	<p>Movable Flange Type TC With Ceramic Protection Tube</p> <p>CMT 107MFcer</p>

TYPE	Non-Fixed Type Multiple Point	TYPE	Fixed Flange Type Multiple Point
CMT 307	<p>Quartz Protection Tube Provided By User</p>	<p>Note: Length and / or measuring points can be chosen as needed. Regular multiple TC has four specifications: 3 · 4 · 5 and 6 points.</p>	



model CMT	106, 107, 106-1, 106M, 106UN, 107MF, 107F, 106-IV1, 106-IV2, 106-L, 106-UNSH, 106-ITW, 106 cer, 107 cer, 107MF cer, 307, 307F		
type of element	J=J type , K=K type , E =E type , T=T type , R =R type , S =S type , N =N type B=B type		
element quantity	S=Single , D=DUAL , O=OTHER		
probe extension & connection type	5 =None , 6NUN=nipple-union-nipple , 6N=Nipple, 6NU=nipple-union 7=fixed type bushing , 8=compression fitting , 9=compression fitting with bushing (Page 19,20,21) if need extension parts , please note extension length = ____ mm & connection size : ____ inch PT (or other) ,		
spring loaded	0=with , 1=without		
terminal head	KB , KNC , KI , KD , KT , LS, 1080AE(explosion), 1080SE(explosion) Page(18)		
PROBE MATERIAL	S4=SUS304 , S6=SUS316, S10 = SUS310 , NCF=INCONEL 600 CERA : Ceramic, other		
probe diameter	Ø1.0 mm , Ø1.6 mm , Ø2.3 mm , Ø3.2 mm , Ø4.8 mm , Ø6.4 mm , Ø9 mm , Ø12.7 mm , Ø21.7 mm ,specific		
probe length	____ mm		
measuring junction	G=Ground , UG=Ungrounded , EPS=Exposed type		
CLASS	01=JIS0.4 , 02=JIS0.75 03=JIS1.5 , 04=ASTM standard , 05=ASTM special		
THERMOWELL	TW=with thermowell NTW=without thermowell (see page 22,23,24)		