

铠装热电偶 Sheathed thermocouple



铠装热电偶结构放大图

铠装热电偶电缆是讲偶丝穿在矿物绝缘材料氧化镁套柱内后一起装入金属保护套管里，经多道次压缩经退火加工成可弯曲的坚实组合体，是制造铠装热电偶的关键基础材料，它们广泛应用于需要测温的各个工农业部门和科技领域。

铠装热电偶具有体型细长、热相应快、耐振动、使用寿命长以及便于弯曲等优点，广泛应用于航空原子能、石油、化工、冶金、机械、电力等工业部门和科技领域，尤其适宜安装在管线狭窄、弯曲和要求快速反应、微型化的特殊测温场合。铠装热电偶通常由铠装偶元件、安装固定装置等主要部件组成。

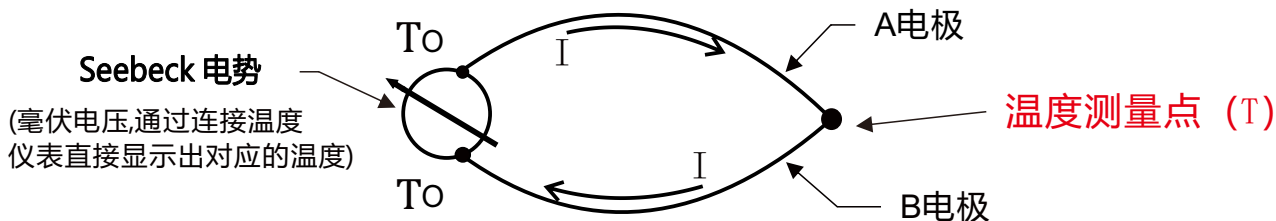
1. 特点

- ◆测温范围大◆反应速度快◆外径小◆安装方便◆使用寿命长
- ◆气密性好◆机械强度高，可在有震动、低温、高温条件下使用。

◆工作原理

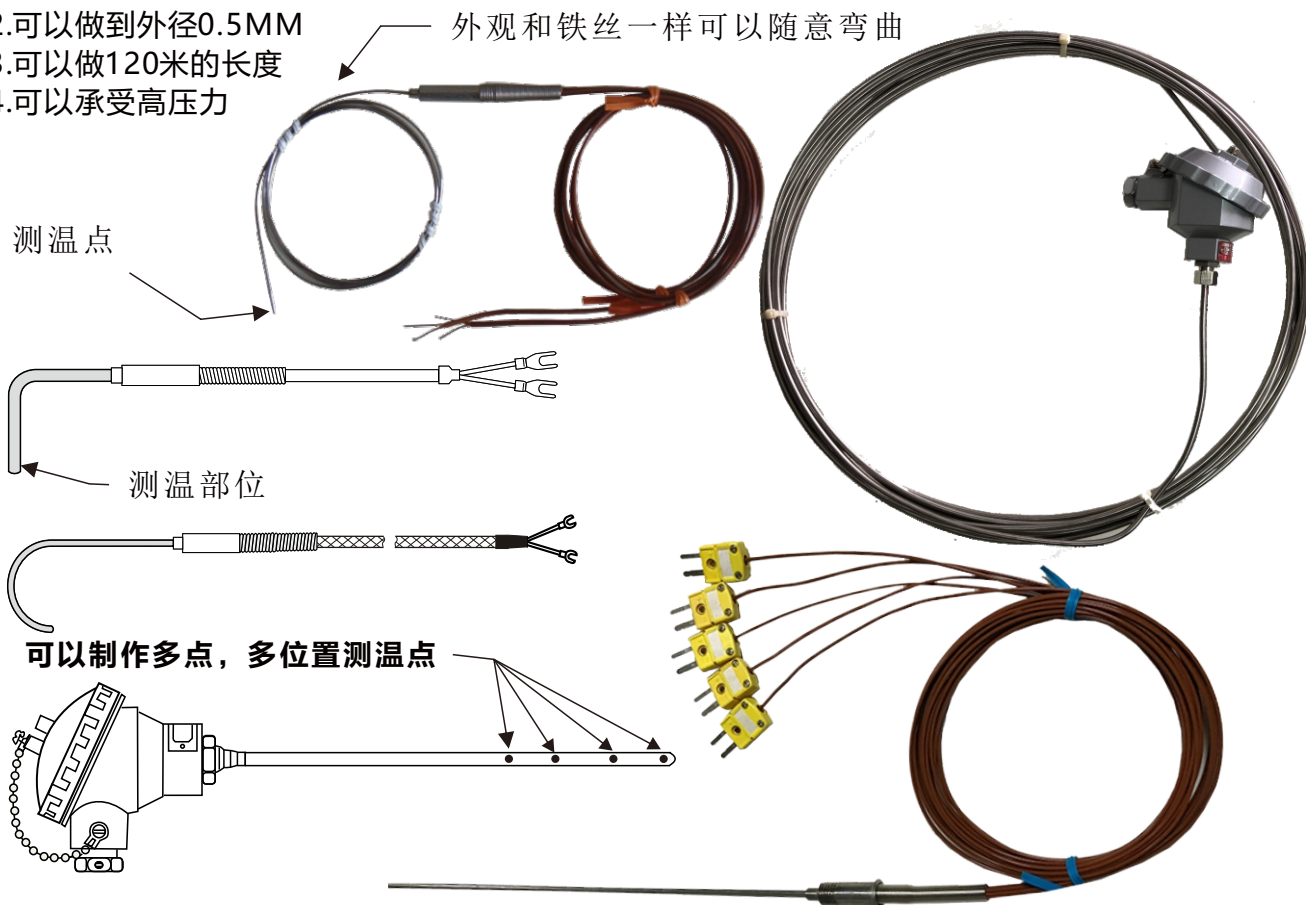
均质导体 (A 和 B) 组成闭合回路，当两个接点处于不同的温度 (T , T_0)，回路中就有电流通过，两接点之间就存在热电动势——Seebeck 电势，如图所示。该热电动势大小与均质导体材质和两端温差有关。

热电偶则利用这个原理来测量温度。



铠装热电偶的特性

1. 可以任意弯曲变形
2. 可以做到外径0.5MM
3. 可以做120米的长度
4. 可以承受高压



主要技术指标 Major technical indexes

铠装热电偶种类、温度范围及允差 Temperature measuring range and accuracy

类别 Category	代号 Code	分度号 Graduation Mark	套管外径 External diameter of tube (mm)	测量范围 Measuring range °C	最高使用温度 Maximum application temperature (°C)	允许偏差 Δt Tolerance	
						1	2
镍铬-铜镍 Nickel-chromium--cupronickel	WREK	E	≥ φ3	-40~700	700	±1.5°C或±0.4%t	±2.5°C或±0.75%t
镍铬-镍硅 Nickel-chromium--nisiloy	WRNK	K		-40~900	950	±1.5°C或±0.4%t	±2.5°C或±0.75%t
铁-铜镍 Ferrum--cupronickel	WRJK	J		-40~500	600	±1.5°C或±0.4%t	±2.5°C或±0.75%t
铜-铜镍 Cuprum--cupronickel	WRCK	T		-40~350	400	±0.5°C或±0.25%t	±1.0°C或±0.4%t
铂铑-铂 Rhodium Platinum--Platinum	WRPK	S	φ5~φ8	0~1100	1300	±1.5°C或±0.25%t	±1.5°C或±0.4%t

各种外径类型及热相应时间τ0.5

τ0.5 直径 测量端形式	Φ0.5	Φ1.0	Φ1.5	Φ2.0	Φ3.0	Φ4.0	Φ5.0	Φ6.0	Φ8.0
露端型	-	0.1	0.2	0.3	0.4	0.5	0.7	0.8	1.0
接壳型	0.2	0.2	0.3	0.4	0.6	0.8	1.2	2.0	4.0
绝缘型	0.4	0.6	0.8	1.0	2.0	2.5	4.0	6.0	8.0

温绝缘电阻 Insulation resistance at normal temperature

绝缘型铠装热电偶在环境温度为 $20 \pm 15^\circ\text{C}$ ，相对湿度不大于80%时，热电极与外套管之间的绝缘电阻应符合下表的规定：

Of the insulated sheathed thermocouple, the insulation resistance between thermode and outer tube shall, under the ambient temperature of $20 \pm 15^\circ\text{C}$ and relative humidity not more than 80%, comply with the stipulation as below:

铠装热电偶直径d(mm) Diameter of sheathed thermocouple	试验电压 (V · DC) Ecpperimental voltage	绝缘电阻 ($\text{M}\Omega \cdot \text{m}$) Insulation resistance
0.5~1.5	50 ± 5	≥ 1000
>1.5	500 ± 50	≥ 1000

注：绝缘电阻用 ($\text{M}\Omega \cdot \text{m}$) 表示。即1m长的试样的绝缘电阻为 $1000\text{M}\Omega$ ；10m长的试样的绝缘电阻为 $100\text{M}\Omega$ 。

Note: The insulation resistance shall be denoted as ($\text{M}\Omega \cdot \text{m}$), namely, the insulation resistance of 1m-long specimen is $1000 (\text{M}\Omega \cdot \text{m})$ and that of the 10m-long is $100\text{M}\Omega$.

铠装热电偶可绕半径 Windable radius of sheathed thermocouple

铠装热电偶的可绕半径不应小于其直径的5倍，并没有明显的损伤。

The windable radius of sheathed thermocouple shall not less than 5 times of its diameter, and bear no obvious damage.

高温绝缘电阻 High-temperature insulation resistance

绝缘型铠装热电偶高温绝缘电阻应符合下表的规定：

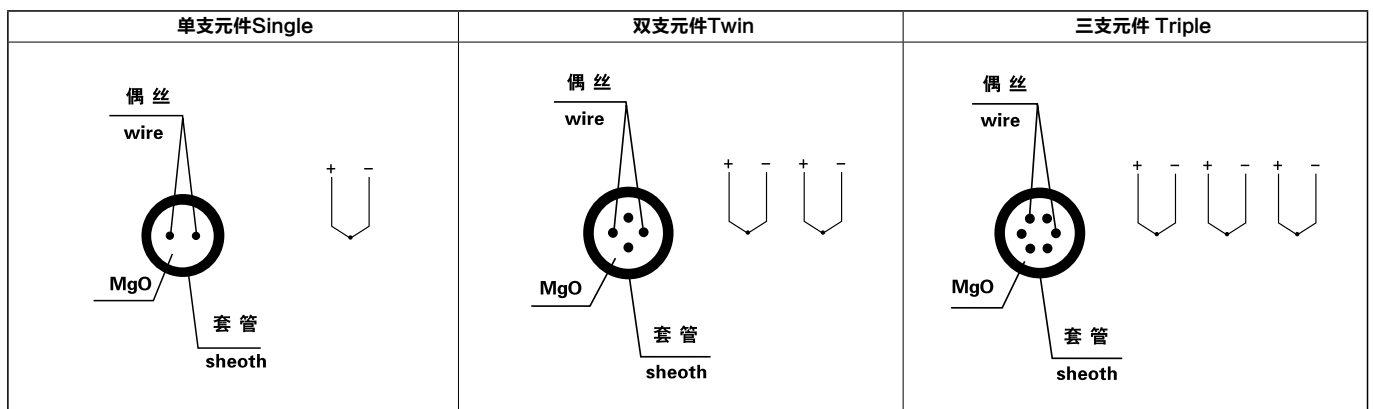
The high-temperature insulation resistance of insulated sheathed thermocouple shall comply with the provisions stated below:

分度号 Graduation Mark	试验温场 (mm) Experimental temperature range (mm)	试验温度 ($^\circ\text{C}$) Experimental temperature ($^\circ\text{C}$)	绝缘电阻 ($\text{M}\Omega \cdot \text{m}$) Insulation resistance ($\text{M}\Omega \cdot \text{m}$)
K, N, E, J	L=300	500 ± 15	≥ 5
T		300 ± 10	≥ 500

注：不同铠装直径的绝缘电阻试验电压，按常温绝缘电阻表中的规定。

Note: The experimental voltage of insulation resistance of different sheathed diameter shall comply with the standard specification shown in normal-temperature insulation resistance table.

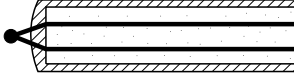
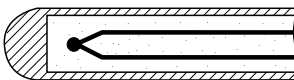
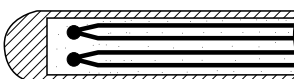
铠装热电偶结构型式 Structrue type of sheathed thermocouple material



铠装热电偶可供长度、热响应时间、测量端结构及特性 Available length and thermal response time of sheathed thermocouple

在温度发生阶跃变化时，热电偶的输出变化至相当于该阶跃变化的50%，所需要的时间称为热响应时间，用 $\tau_{0.5}$ 表示，试验介质通常为水。

When the temperature shown step changes, the output variation of the thermocouple shall be at least equivalent to 50% of the variation, and the time that needs is thermal response time, denoted as $T_{0.5}$. Usually, the experimental medium is water.

铠装热电偶直径d(mm) Diameter of sheathed thermocouple	可供长度 Available length (m)	保护管材料 Protection tube material	热响应时间 thermal response time τ 0.5(s)			测量端结构形式及特性 Structure shape of the measuring terminal
			露端式 Terminal-exposed type	接壳式 Shell-connecting type	绝缘式 Insulation type	
$\phi 2$	≤ 80	*1Cr18Ni9Ti	0.3	0.4	0.5	 <p>露端式 Exposed Junction</p> <ol style="list-style-type: none"> 1. 测量端接点外露响应速度很快。 2. 适合对温度快速感应的测量。 3. 气密性、抗腐蚀性、机械强度比其它形式差。 <p>1 The respond speed of exposed connection point on measurement terminal is very fast.</p> <p>2 It can be applicable to measure the temperature of fast induction.</p> <p>3 It is relatively poor in air impermeability, corrosion resistance and mechanical strength.</p>
$\phi 3$	≤ 50		0.4	0.6	1.2	
$\phi 4$	≤ 45		0.5	0.8	2.5	
$\phi 5$	≤ 40		0.7	1.2	4.0	
$\phi 6$	≤ 35		0.8	2.0	6.0	
$\phi 8$	≤ 20		1.0	4.0	8.0	
					 <p>绝缘式 Insulated Junction</p> <ol style="list-style-type: none"> 1. 响应速度比接壳式慢。 2. 绝缘物充实，热电势变小，寿命长。 3. 耐蚀、耐压、耐震、抗电磁感应干扰。 <p>1 Its respond speed is slower than the Ground Junction.</p> <p>2 It has firm insulating material, lower electric potential and longer length of life.</p> <p>3 It has the characteristic of corrosion proof, voltage withstand, shockproof and anti-electromagnetic-interference.</p>	
					 <p>双支分离绝缘式 Dual divided Insulated Junction</p> <ol style="list-style-type: none"> 1. 每对接点被分开，可分别测量或备用。 2. 可避免每对之间的信号干扰。 3. 其它特性同绝缘式。 <p>1 After each pairs of connection points are separated, the separate measurement can be conducted.</p> <p>2 It can avoid the mutual interference between two pairs.</p> <p>3 Its other advantages are same to the Insulated Junction.</p>	

注：“*” 常规供货为1Cr18Ni9Ti，如需其它材质另行注明。

Note: the normal delivery of goods is 1Cr18Ni9Ti, if other material is necessary, please note it separately.

铠装热电偶材料及使用温度 Material and application temperature of the sheathed thermocouple

分度号 Graduation Mark	套管材料 (牌号/代号) Tube Material (Brand and code)	直径 d (mm) Diameter	使用最高温度 (°C) Highest application temperature (°C)	
			长期 Long term	短期 Short term
S	GH3030	4.0, 4.5	1000	1100
		5.0, 6.0, 8.0	1100	1200
K/N	310S GH3030	3.0, 4.0, 5.0	1000	1100
		6.0, 8.0	1100	1200
	1Cr18Ni9Ti 304 316、316L	1.0	400	600
		1.5, 2.0	600	700
		3.0, 4.0, 5.0, 6.0, 8.0	800	900
E	1Cr18Ni9Ti 304 316、316L	1.5, 2.0	500	600
		3.0, 4.0, 5.0	600	700
		6.0, 8.0	700	800
J	1Cr18Ni9Ti 304 316、316L	1.5, 2.0	400	500
		3.0, 4.0, 5.0	500	600
		6.0, 8.0	600	750
T	1Cr18Ni9Ti 304、316、316L	1.5, 2.0, 4.0, 4.5, 5.0	300	350
		6.0, 8.0	300	400

卡套螺栓 Ferrulebolt

铠装热电偶外径 External diameter of sheathed thermocouple	φ8	φ6	φ5	(φ4.5)	φ4	φ3	φ2
固定装置代号和尺寸 Code and dimension of fixed device	M16×1.5				M12×1.5		
M							
S	22				19		

注：(1) 参见90页，图141，括号内的数字这一挡规格一般不予采用，如果需要作特殊规格订货。

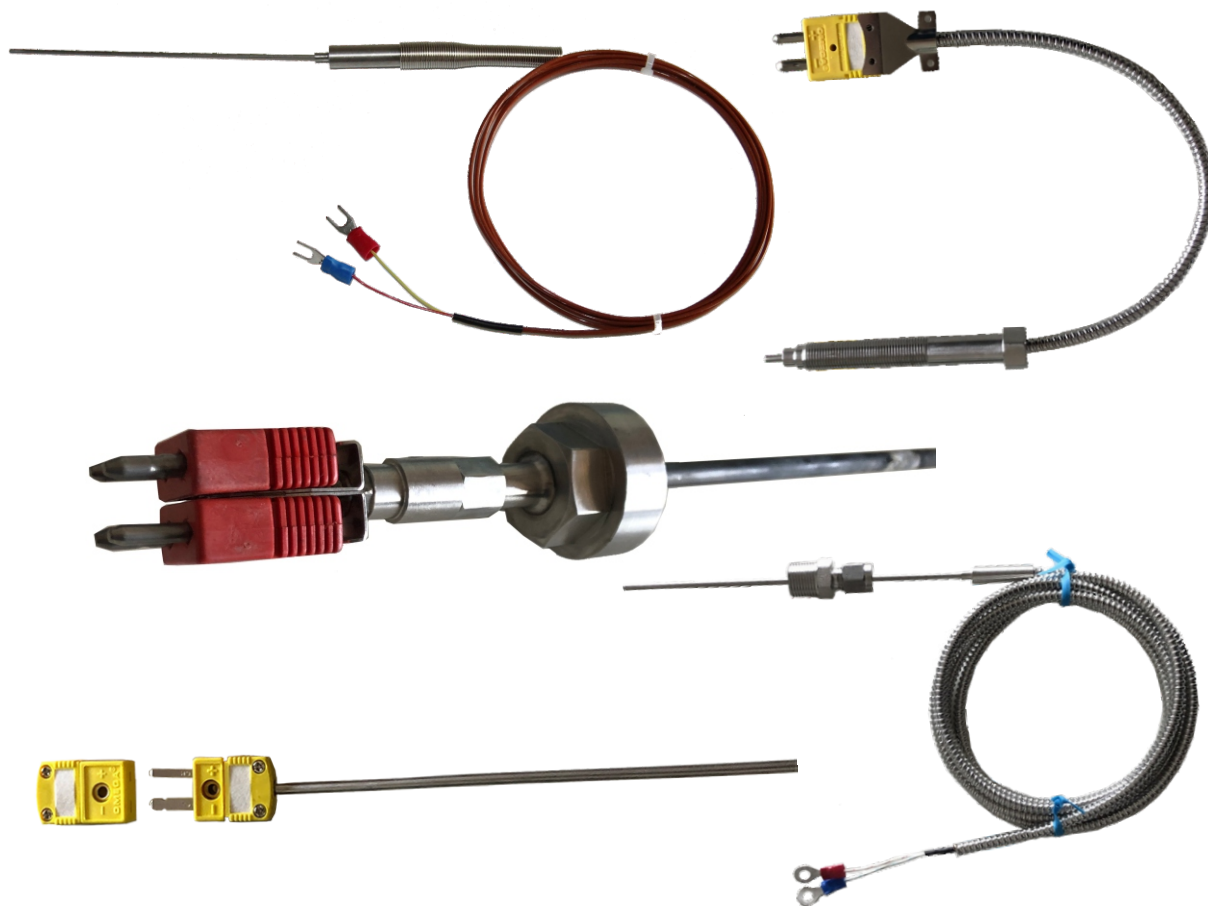
Note: (1) refer to page 90, Fig 141. The specification in the column within numbers in parentheses usually will not be adopted, if considered to be special order specification.

卡套法兰 Ferrulelange

铠装热电偶外径 External diameter of sheathed thermocouple d	φ8	φ6	φ5	(φ4.5)	φ4	φ3	φ2
固定装置代号和尺寸 Code and dimension of fixed device							
D	φ60			φ50			
D0	φ42			φ36			
D1	φ24			φ20			
S	22			19			
d	φ9			φ7			

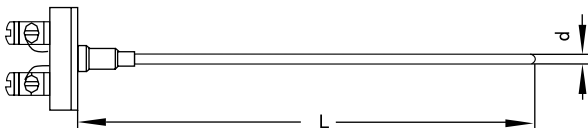
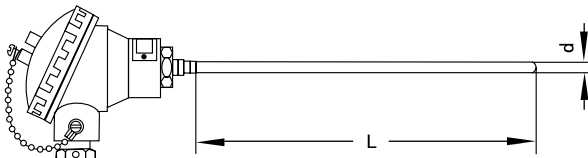
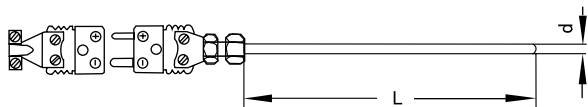
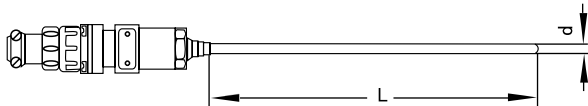
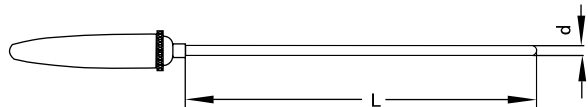
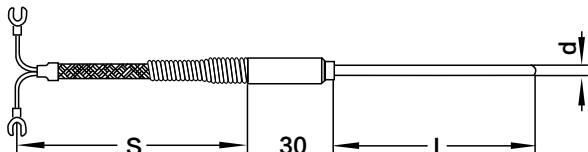
注：(1) 参见92页，图149。括号内的数字这一挡规格一般不予采用，如果需要作特殊定货。

Note: (1) refer to page 92, Fig 149. The specification in the column within numbers in parentheses usually will be not adopted, if considered to be special order specification.



型号规格Type specification

无固定装置式铠装热电偶 Non-fixed device sheathed thermocouple

接线端形式 Connection box type	型号Model	示意图Schematic diagram
简易式 Simple type	WR□K-101 WR□K ₂ -101	
防水式 Water-proof type	WR□K-131 WR□K ₂ -131	
快速接头式 Quick coupling type	WR□K-151 WR□K ₂ -151	
航空插座式 Aviation jack type	WR□K-161 WR□K ₂ -161	
手柄式 Handle type	WR□K-187 WR□K ₂ -187	
带补偿导线式 Extension wiretype	WR□K-191 WR□K ₂ -191	

注：(1) WRNK-101可用于装配式热电偶铠装内芯的更换。(2) 带补偿导线式常规附带500mm引线，如需增加请注明长度。
 (3) 测量端常规供货为绝缘式，如需接壳，型号尾数“1”改为“2”；“7”改为“8”。例：131改为132；187改为188。
 (4) 铠装热电偶的分度号、测量范围、热响应时间、直径、可供长度参见18-20页，表6、图24。

Note: (1) WRNK-101 can be used to replace the inner core of assembly thermocouple. (2) Extension wiretype usually is attached with 500mm lead wire, if need to add, please indicate the length. (3) The measuring terminal is supplied with insulation type. If it needs to be connected with the shell, change the model mantissa "1" to "2", "7" is changed to be "8". for example 131 is changed to be 132; 187 is changed to be 188. (4) Refer to Page 18-20, Table 6 and Fig 24 for the graduation mark, measurement range. Response time, diameter and available length of the sheathed thermocouple.

卡套螺栓式铠装热电偶 Ferrule bolt type sheathed thermocouple

接线端形式 Connection box type	型号Model	示意图Schematic diagram
防水式 Water-proof type	WR□K-231 WR□K ₂ -231 WR□K-331 WR□K ₂ -331	
快速接头式 Quick coupling type	WR□K-251 WR□K ₂ -251 WR□K-351 WR□K ₂ -351	
航空插座式 Aviation jack typ	WR□K-261 WR□K ₂ -261 WR□K-361 WR□K ₂ -361	
带补偿导线式 Extension wiretype	WR□K-291 WR□K ₂ -291 WR□K-391 WR□K ₂ -391	
带补偿导线式 (不锈钢软管) Extension wiretype(stainless steel flexible tube)	WR□K-291G WR□K ₂ -291G WR□K-391G WR□K ₂ -391G	

- 注：(1) 带补偿导线式常规附带500mm引线，如需增加请注明长度。
 (2) 测量端常规供货为绝缘式，如需接壳，型号尾数“1”改为“2”。例：231改为232；291改为292。
 (3) 铠装热电偶直径 $\geq \phi 5$ 卡套螺栓的螺栓常规供货为M16 \times 1.5； $\leq \phi 4$ 为M12 \times 1.5。
 (4) 固定卡套螺栓公称压力：2.5MPa。活动卡套螺栓公称压力为常压。
 (5) 铠装热电偶的分度号测量范围、热响应时间、直径、可供长度参见18-20页，表6，图24。

- Note: (1) 500mm lead wire is usually attached to the extension wiretype, if need to add, please indicate the length.
 (2) The measuring terminal is supplied with insulation type. If it needs to connect with the shell, change the model mantissa "1" to "2", for example 231 is changed to be 232; 291 is changed to be 292.
 (3) The diameter of the sheathed thermocouple is not less than $\phi 5$. The general supply for screw bolt of ferrule bolts is M16 \times 1.5 and $\leq \phi 4$ is M12 \times 1.5.
 (4) The fixed ferrule flang's nominal pressure is 2.5MPa. The movable ferrule flang's nominal pressure is normal pressure.
 (5) Refer to Page 18-20, table 6 and fig 24 for the graduation mark, measurement range. Response time, diameter and available length of the sheathed thermocouple.

卡套法兰式铠装热电偶 Ferrule flange type sheathed thermocouple

接线端形式 Connection box type	型号 Model	示意图 Schematic diagram
防水式 Water-proof type	WR□K-431 WR□K ₂ -431 WR□K-531 WR□K ₂ -531	
快速接头式 Quick coupling type	WR□K-451 WR□K ₂ -451 WR□K-551 WR□K ₂ -551	
航空插座式 Aviation jack typ	WR□K-461 WR□K ₂ -461 WR□K-561 WR□K ₂ -561	
带补偿导线式 Extension wiretype	WR□K-491 WR□K ₂ -491 WR□K-591 WR□K ₂ -591	
带补偿导线式 (不锈钢软管) Extension wiretype (stainless steel flexible tube)	WR□K-4911G WR□K ₂ -4911G WR□K-5911G WR□K ₂ -5911G	

注：(1) 带补偿导线式“S”常规附带500mm引线，如需增加请注明长度。

(2) 测量端常规供货为绝缘式，如需接壳，型号尾数“1”改为“2”。例：431改为432。

(3) 铠装热电偶直径 ≥ φ 5卡套法兰盘常规供货为 φ 60；≤ φ 4为 φ 50。

(4) 固定卡套法兰公称压力：2.5MPa。活动卡套法兰公称压力为常压。

(5) 铠装热电偶的分度号测量范围、热响应时间、直径、可供长度参见18-20页，表6，图24。

Note: (1) 500mm lead wire is usually attached to the extension wiretype “S”, if need to add, please indicate the length separately.

(2) The measuring terminal is supplied with insulation type. If it needs to connect with the shell, change the model mantissa “1” to be “2”, for example, 431 is changed to be 432.

(3) The diameter of the sheathed thermocouple is not less than φ 5. The general supply for ferrule flange is φ 60 and ≤ φ 4 is φ 50.

(4) The fixed ferrule flange's nominal pressure is 2.5 MPa. The movable ferrule flange's nominal pressure is normal pressure.

(5) Refer to page 18-20, table 6 and fig 24 for the graduation mark, measurement range. Response time, diameter and available length of the sheathed thermocouple.

多点型铠装热电偶 Multipoint sheathed thermocouple

多点型铠装热电偶有非防爆型和防爆型。适用于测量合成塔、反应罐等设备，可同时测量不同层面或同一层面各个点不同的气态或液态等介质的温度。各点的长度可按用户要求分别制作。

Multipoint sheathed thermocouples cover non-explosion-suppression ones and explosion-suppression ones. They are applicable to measuring equipment such as synthesizing tower and reaction pot, being able to measure the temperature of different mediums (such as gaseous mediums or liquid mediums) at the same layer or the different points in the same layer. The length of such points may manufactured by the users' needs.

无固定装置多点式铠装热电偶 Non-fixed device multipoint sheathed thermocouple without device

型号 Model	分度号 Graduation Mark	示意图 Schematic diagram
WRNK-1313 WRNK-1314 WRNK-1315 WRNK-1316	K	
WREK-1313 WREK-1314 WREK-1315 WREK-1316	E	
WRJK-1313 WRJK-1314 WRJK-1315 WRJK-1316	J	
WRTK-1313 WRTK-1314 WRTK-1315 WRTK-1316	T	

注：(1) 多点式铠装热电偶外径d (mm) 为 $\phi 3$ 、 $\phi 4$ 、 $\phi 5$ 、 $\phi 6$ 四种。

(2) 常规多点式热电偶分三点、四点、五点、六点四种规格。

Note: (1) Multipoint sheathed thermocouple's external diameter d (mm) is divided into four classes: $\phi 3$, $\phi 4$, $\phi 5$ and $\phi 6$.

(2) The ordinary multipoint thermocouple covers four specifications: thiple-point, four-point, five-point and six-point.

固定法兰多点式铠装热电偶 Fixed flange multipoint sheathed thermocouple

型号 Model	分度号 Graduation Mark	示意图 Schematic diagram
WRNK-4313 WRNK-4314 WRNK-4315 WRNK-4316	K	
WREK-4313 WREK-4314 WREK-4315 WREK-4316	E	
WRJK-4313 WRJK-4314 WRJK-4315 WRJK-1316	J	
WRTK-4313 WRTK-4314 WRTK-4315 WRTK-4316	T	
带补偿导线式 Extension wiretype	WR□K-291 WR□K ₂ -291 WR□K ₃ -291 WR□K ₄ -291 WR□K ₅ -291 WR□K ₆ -291	

注：(1) 多点式铠装热电偶外径d (mm) 为 $\phi 3$ 、 $\phi 4$ 、 $\phi 5$ 、 $\phi 6$ 四种。

(2) 常规多点式热电偶分三点、四点、五点、六点四种规格。

Note: (1) Multipoint sheathed thermocouple's external diameter d (mm) is divided into four classes: $\phi 3$, $\phi 4$, $\phi 5$ and $\phi 6$.

(2) The ordinary multipoint thermocouple covers four specifications: thiple-point, four-point, five-point and six-point.

长度规格Length specification

序号Serial No.	L1	L2	L3	L4	L5	L6
1	830	2220	2420	3500	4940	7320
2	890	2320	2470	3600	6080	7370

注：以上长度供参考，各点长度均可任意选择，点数可根据需要增减。

Note: The length mentioned above is for information only. The length at any point can be chosen at will and the point number can be increase or reduce as required.

铠装热电偶安装示意图

Scheme of information of thermal resistance of sheathed thermocouple

