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The Company promises to constantly improve product quality and therefore reserves the right to modify the contents of the Manual without notice.

使用说明书 Operation Instruction



THERMOCUPLE

热电偶



防爆/一体化温度变送器 Explosion-Proof/Integrated temperature transmitter

温度测量 Temperature measurement

- | | |
|--------|----------------------|
| • 石油 | Petroleum • |
| • 化工 | Chemical • |
| • 冶金 | Metallurgy • |
| • 电力 | Electricity • |
| • 食品 | Food • |
| • 药业 | Pharmaceutical • |
| • 建材 | Building materials • |
| • | • |



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关于本公司

About The Company

安徽天康（集团）股份有限公司是一家国内知名的仪器仪表设计与制造公司，产品用于流程工业、过程控制，实现温度测量、压力测量、流量测量、物位测量及控制系统集成。

作为工业现场参数测量仪表的主要生产商之一，我们为国内外的客户提供应用方面的专业知识、服务及支持。

公司产品的质量、精度及性能来自于四十年的经验，以及对于最新技术的创新设计与持久开发。

Anhui Tiankang (Group) Co., Ltd is a company famous for the manufacturing and design of instruments and meters at home, its products are applied to process industry, process control, achievement of temperature measurement, stress measurement, flow measurement, level measurement and control system integration.

As one of the main producers of industrial field parameter measuring instruments, we provide professional knowledge, service and support in the application for domestic and overseas clients.

The quality, accuracy and performance of the Company's products come from forty years of experience, as well as innovative design and sustainable development of the latest technology.

健康与安全

Health And Safety

为了确保我们的产品安全，不影响健康，务必注意以下各点：

1、使用前必须仔细阅读说明书的有关章节。

2、必须遵守容器或包装上的警示标签。

3、必须由经过培训的人员按照所列信息进行安装、操作、维护及保养。一切由于违反本说明书而造成的后果均由用户承担。

4、务必遵守一般的注意事项，以避免在高压或高温下运行时发生事故。

In order to ensure our product safety and do not affect the health, make sure to pay attention to the following points:

1. Make sure to read relevant chapters of the Instructions carefully before use.

2. Make sure to follow caution Label on the container or packaging.

3. Make sure that installation, operation, maintenance and preservation are performed by trained staff according to information listed. All consequences caused by violation of the Instructions shall be assumed by users.

4. Make sure to follow general notes to avoid accident in operation under high pressure and temperature.

有关本手册所述设备使用的安全事项或任何相关的危害数据表（适用时）可以从公司取得，地址如封底所示，同时提供保养及备件信息。

Safety precautions relevant to equipment use described in the Manual and any relevant hazard data table (where applicable) can be obtained from the Company. Address is shown as the back cover and information on maintenance and spare parts is provided at the same time.

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引言 Instruction

天仪®系列热电偶温度传感器是由安徽天康（集团）股份有限公司推出，采用现场安装方式，是一种适合测量低、中、高温的现场检测及过程控制工业仪表，可用来直接测量各种生产过程中的-40~1300℃范围内气体、液体和蒸汽介质及固体表面温度。安徽天康（集团）股份有限公司凭借40年的产品研发、改进和应用经验，凭借着原有的基础，并不断的引进先进技术和设备使热电偶产品性能，更可靠、性价比更高。

Tianyi® series thermocouple temperature sensor is released by Anhui Tiankang (Group) Co., Ltd, adopting the way of field installation. It's a industrial meter suitable for measuring the field inspection with low, middle and high temperature and process control; it also can directly measure the temperature of gas, liquid, steam media and the surface of solid with the temperature ranging from -40℃ to 1300℃ at various production processes. Forty years of R&D on product, improvement and application experience, Anhui Tiankang (Group) Co., Ltd depended on original basis continuously introduces the advanced technologies and devices to make the thermocouple products more reliable in performance and higher in cost performance.

热电偶温度传感器分为：铠装式、装配式、隔爆式和一体化式。其产品的特点如下：

1. 铠装式热电偶热响应时间少，减少动态误差；可弯曲安装使用；测量范围大；机械强度高，耐压性能好；
2. 装配式热电偶装配简单，更换方便；压簧式感温元件，抗震性能好；测温范围大；机械强度高，耐压性能好；
3. 隔爆式热电偶多种防爆形式，防爆性能好；压簧式感温元件，抗震性能好；测温范围大；机械强度高，耐压性能好；
4. 一体化式热电偶温度计二线制输出4~20mA，抗干扰能力强；节省补偿导线及安装温度变送器费用；安全可靠，使用寿命长；冷端温度自动补偿，非线性校正电路；
5. 带温度变送器热电偶通过SIL2功能安全认证；
6. 公司可提供现场定制温度传感器产品。

Thermocouple temperature sensor can provide: sheathed type, assembly type, explosion-proof type and integrated type. The characteristics of its products are as follows:

1. Sheathed-type thermocouple has less response time, reduces dynamic error; may be used under flexible installation; has large measurement range; has high mechanical strength and good pressure-resistant properties;
2. Assembly-type thermocouple is easily replaced and has simple assembly; pressure spring type temperature-sensing element and good anti-seismic property; large temperature measurement range; high mechanical strength and good pressure-resistant properties;
3. Explosion-proof type thermocouple has various kinds of explosion-proof types, good explosion-proof property; pressure spring type temperature-sensing element and good anti-seismic property; large temperature measurement range; high mechanical strength and good pressure-resistant properties;
4. Integrated-type thermocouple thermometer outputs 4-20mA with two-wire system and has strong anti-jamming property; saves compensating lead wires and expenses of temperature transmitter installed; is safe and reliable, has long service life; automatic compensation of cold-junction and nonlinearity correction circuit;
5. Thermocouple with temperature transmitter passed the safety certificate of SIL2.
6. Company can provide field-making products of temperature sensor.

运输 Transportation

包装成箱的热电偶温度传感器，在避免雨（雪）淋的条件下需遵守JB/T9329-1999《仪器仪表运输贮存基本环境条件》GB/T15464-1995《仪器仪表包装通用技术条件》运输标准；热电偶及其附件在运输前，必须贮存在不受震动和碰撞的地方。

The thermocouple temperature sensor packed with carton box shall abide by the transportation standard of JB/T9329-1999 Basic Environment Conditions for Instruments and Meters Transportation and Storage and GB/T15464-1995 General Technical Condition for Instruments and Meters Package under the condition of rain or snow; Before the transportation, thermocouple and its accessories shall be stored in the place without vibration and collision.

搬运 Handling

搬动仪表时无需任何特殊保护措施，但需遵守轻搬轻放等注意事项。

When handling instrument, no any special protective measure is needed, but follow notes of light moving and light placing.

储藏 Storage

热电偶温度计最合适的贮存场所条件为环境温度10~35℃，相对湿度不大于80%，周围空气中不应含有可能使仪表零件腐蚀的介质。

热电偶温度计如不立即安装，请不要打开包装，而且仪表应在储存期间受到保护，不要受到外界原因引起损害。

卸下的热电偶温度计应与湿气和灰尘隔离，推荐使用原有的包装材料。

Thermocouple thermometer shall be appropriately stored in the place where the environment temperature is 10-35℃ and the relative humidity is not more than 80%. In the ambient air, there shall be no medium which possibly makes instruments and parts corroded.

If the thermocouple thermometer is not installed immediately, do not open the package, and the instrument shall be protected during storage, not damaged by external reasons.

The disassembled thermocouple thermometer should be separated from moisture and

热电偶使用说明书

Operation Instruction For Thermocouple



工作原理

Working principle

热电偶的工作原理是由两种不同材质的导体连接在一起，形成一个闭合回路，当闭合回路两端存在温度差时，就会在回路中产生热电动势，此种现象称为热电效应，热电偶就是通过测量热电动势来测量温度的。而测量仪表（二次仪表）就是根据热电动势显示出对应的温度值。

The operating principle of thermocouple: the conductors made by two different materials connects with each other, forming a closed path; when the two ends of closed path have the temperature difference, it will generate thermopower, this is called thermo-electric effect. Thermocouple measures the temperature by measuring thermopower. While the measuring meter shows the corresponding temperature value according to thermopower.

热电偶性能概述

Performance overview of thermocouple

铠装热电偶

Sheathed thermocouple

产品执行标准: IEC60584

GB/T18404-2001《铠装热电偶电缆及铠装热电偶》

Product performance standard: IEC60584

GB/T18404-2001 Sheathed Thermocouple Cable and Sheathed Thermocouple

测温范围及允差

型号 Model	分度号 Indexing No.	允差等级 Tolerance grade			
		I		II	
		允差值 Tolerance value	测温范围℃ Measurement range (°C)	允差值 Tolerance value	测温范围℃ Measurement range (°C)
WRNK	K	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~1000	±0.0075 t	333~1200
WRMK	N	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~1000	±0.0075 t	333~1200
aaWREK	E	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~800	±0.0075 t	333~900
WRFK	J	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~750	±0.0075 t	333~750
WRCK	T	±0.5℃	-40~+125	±1.0℃	-40~+133
		±0.004 t	125~350	±0.0075 t	133~350
WRPK	S	±1.0℃	0~+1100	±1.5℃	0~600
		±0.003 t+1100	1100~1600	±0.0025 t	600~1600

常温绝缘电阻

铠装偶在环境温度20±15℃，相对湿度不大于80%，实验电压为500±50V（直流）电极与外套管之间的绝缘电阻≥1000MΩ。即1m长的试样的绝缘电阻为1000MΩ；10m长的试样的绝缘电阻为100MΩ。

Insulation resistance with normal temperature

When the environment temperature of sheathed thermocouple is 20±15℃; the relative humidity is not more than 80% and the experimental voltage is 500±50V (DC), the insulation resistance between electrode and outer sleeve will be ≥1000MΩ. It means that for sampling with 1m length, the insulation resistance will be 1000 MΩ, while for sampling with 10m length, the insulation resistance will be 100 MΩ.

热电偶使用说明书

Operation Instruction For Thermocouple



偶丝直径及材质

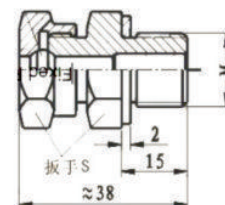
Diameter and material of thermocouple wire

偶丝形式 Form of thermocouple wire	单支式 Single type	双支式 Double type
套管直径 Sleeve diameter	Φ2、Φ3、Φ4、Φ5、Φ6、Φ8	Φ3、Φ4、Φ5、Φ6、Φ8
套管材质 Sleeve material	E、J、T	321
	K、N	321 GH3030 310S
	S	GH3039

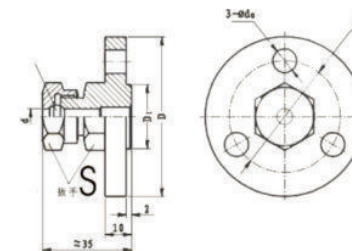
安装固定形式

Installation and fixing form

卡套螺纹接头 Sleeve thread joint



卡套法兰盘 Sleeve flange plate



代号和尺寸 Code and size	铠装偶外径 External diameter of sheathed thermocouple	
	Φ5Φ6Φ8	Φ2Φ3Φ4
M	M16*1.5	M12*1.5
S	22	19

代号和尺寸 Code and size	铠装偶外径 External diameter of sheathed thermocouple	
	Φ5Φ6Φ8	Φ2Φ3Φ4
D	Φ60	Φ50
Do	Φ42	Φ36
D1	Φ24	Φ20
S	Φ22	Φ19
do	Φ9	Φ7

测量端结构形式

Structural form of measuring terminal



接壳式 Casing contact type



绝缘式 Insulation type

中国驰名商标
China Famous Trademark

Technical drawing of a mechanical part, likely a valve or pump component, showing dimensions: 245, 5, 245, and 245.

Technical drawing of the front view of a mechanical component. The drawing shows a symmetrical design with a central shaft and various mounting points. Dimensions are indicated: a width of 26 and a length of approximately 129.

Technical drawing of a cable assembly. The drawing shows a cross-section of the cable with a diameter of 26x26. The length of the assembly is indicated as approximately 92 (~92).

A diagram of a bolt with a threaded section of length L_1 . The bolt has a hexagonal head on the right and a threaded shank. The threaded portion is indicated by a hatched pattern and is labeled L_1 with a dimension line below it.


中国驰名商标
China Famous Trademark

型号 Model	分度号 Indexing No.	允差等级 Tolerance grade			
		I		II	
		允差值 Tolerance value	测温范围℃ Measurement range (℃)	允差值 Tolerance value	测温范围℃ Measurement range (℃)
WRN	K	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~1000	±0.0075 t	333~1200
WRM	N	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~1000	±0.0075 t	333~1200
WRE	E	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~800	±0.0075 t	333~900
WRF	J	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~750	±0.0075 t	333~750
WRC	T	±1.5℃	-40~+125	±1℃	-40~+133
		±0.004 t	125~350	±0.0075 t	133~350

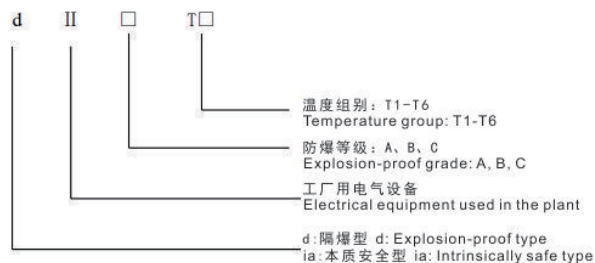
-8-

天仪
中国驰名商标
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Measurement range and tolerance

型号 Model	分度号 Indexing No.	允差等级 Tolerance grade			
		I		II	
		允差值 Tolerance value	测温范围℃ Measurement range (℃)	允差值 Tolerance value	测温范围℃ Measurement range (℃)
WRN	K	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~1000	±0.0075 t	333~1200
WRM	N	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~1000	±0.0075 t	333~1200
WRE	E	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~800	±0.0075 t	333~900
WRF	J	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004 t	375~750	±0.0075 t	333~750
WRC	T	±1.5℃	-40~+125	±1℃	-40~+133
		±0.004 t	125~350	±0.0075 t	133~350

Explosion-proof grouping form



Category of electrical equipment

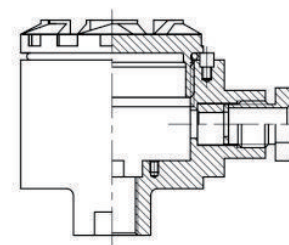
I——煤矿井下用电气设备
I--- electrical equipment for underground coal mine
II——工厂用电气设备
II --- electrical equipment for plant use

中国驰名商标
China Famous Trademark

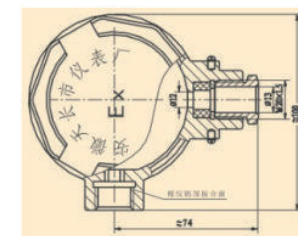
The explosion-proof grade of explosion-proof thermal resistance is divided into Grade A, B and C in accordance with maximum experimental safe gap of explosive gas mixture used.

类别 Category	级别 Grade	最大试验安全间隙 Maximum experimental safe gap
II	A	$0.9 \leq \text{MESG}$
	B	$0.5 < \text{MESG} < 0.9$
	C	$\text{MESG} \leq 0.5$

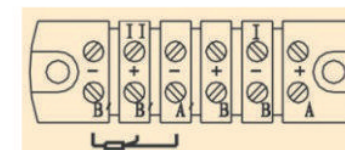
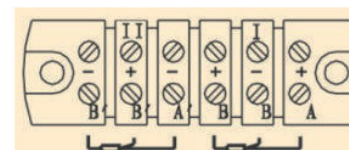
Junction box form



Class d II BT ☐

Class d II CT ☐

Terminal installed type



热电偶使用说明书

Operation Instruction For Thermocouple



一体化式防爆热电偶
Integrated-type explosion-proof thermocouple

产品执行标准
Product performance standard
IEC60584、GB/T26786-2011、JB/T7391-1994

测量范围及允差
Measurement range and tolerance

热电偶
Thermocouple

型号 Model	分度号 Indexing No.	允差等级 Tolerance grade			
		I		II	
		允差值 Tolerance value	测量范围 Measurement range	允差值 Tolerance value	测量范围 Measurement range
WRNB	K	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004t	375~1000	±0.0075t	333~1200
WRMB	N	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004t	375~1000	±0.0075t	333~1200
WREB	E	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004t	375~800	±0.004t	333~900
WRFB	J	±1.5℃	-40~+375	±2.5℃	-40~+333
		±0.004t	375~750	±0.004t	333~750
WRCB	T	±0.5℃	-40~+125	±1℃	-40~+133
		±0.004t	125~350	±0.0075t	133~350

工作环境
Working environment

安装场所等级 Installation site grade	温度 Temperature	相对湿度 Relative humidity	大气压力 Atmospheric pressure
CX1	-25~+55		
CX2	-25~+70	5-95	86-106
CX3	-40~+80		

精度等级

温度变送器精度等级：0.1；0.2；0.5。显示器精度等级：模拟指示式2.5级；数字显示式1.0级

Accuracy grade

Accuracy grade of temperature transmitter: 0.1, 0.2; 0.5

Accuracy grade of display: Grade 2.5 for simulative indicator type; Grade 1.0 for digital display

type

输出型号

4~20mA, 负载电阻250 1/2, 传输导线电阻100 1/2。

Output model

4~20mA, load resistance: 250 1/2 .Transmission conductor resistance: 100 1/2.

热电偶使用说明书

Operation Instruction For Thermocouple



绝缘电阻

仪表输出接线端子与外壳之间的绝缘电阻应不小于50 1/2

Insulation resistance

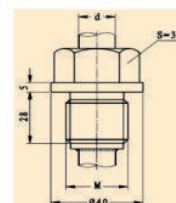
The insulation resistance between output connection terminal of instrument and case shall not be less than 50 1/2.

安装固定形式

Installation and fixing form

固定螺纹式

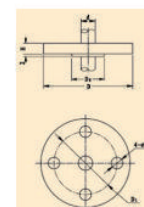
Fixing thread type



型号 Model	螺纹规格 Thread specification		d
	代号 Code	M	
WRNB-240		M27*2	Φ16
WRNB-240A	A	G3/4	
WRNB-240C	C	NPT3/4	
WRNB-240G		M27*2	Φ12
WRNB-240GA	A	G3/4	
WRNB-240GC	C	NPT3/4	

固定法兰式

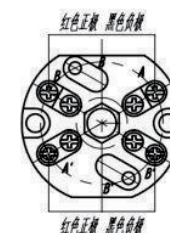
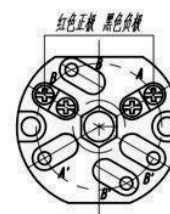
Fixed flange type



型号 Model	法兰规格 Flange specification				
	D	D ₁	D ₂	H	d
WRNB-420	Φ95	Φ65	Φ46	14	Φ16
WRNB-420G	Φ95	Φ65	Φ46		
WRNB-421	Φ95	Φ65	Φ46	14	Φ20
WRNB-421G	Φ95	Φ65	Φ46		

接线方式

Mode of connection



接线盒形式

Junction box type

热电偶使用说明书 Operation Instruction For Thermocouple



WRNK2功能安全型热电偶

WRNK2的SIL适用度

WRNK2型热电偶通过了中国功能安全中心的功能安全评估，符合：

- 1)GB/T20438.1-2006 idt IEC61508-1:1998;
 - 2)GB/T20438.2-2006 idt IEC61508-2:2000,
- 具有SIL2适用度。可用于SIL2及以下的安全控制回路。

安全功能

WRNK2系列热电偶能将温度测量范围(-400~1500℃)内的任意温度输入信号转换成对应的

热电势输出信号(0~54.807mV)，并可用于安全相关系统中的安全动作触发信号， $t_{0.5} < 90s$ 。

使用方法

WRNK2系列热电偶用于安全控制时支持以下触发方式：

High trip: 正常测温范围低于安全阈值，当测温值高于安全阈值时触发安全动作；

Low trip: 正常测温范围高于安全阈值，当测温值低于安全阈值时触发安全动作。

WRNK2接法及其SIL能力的关系

SIL=0: 将本产品的两个测温通道接入不同的控制回路；

SIL=2: 将本产品的两个测温通道形成1oo2表决关系接入同一个控制回路；

SIL=2: 将本产品的两个测温通道形成2oo2表决关系接入同一个控制回路。

产品年检的要求

本产品的设计使用寿命为3年，有关本产品日常维护，详见热电偶的维护章节。

使用注意事项和约束

详见热电偶的使用及注意事项章节

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SIL applicability of WRNK2

WRNK2-type thermocouple has passed the functional security evaluation of China Function Security Center and conforms to:

- 1)GB/T20438.1-2006 idt IEC61508-1:1998 ;
- 2)GB/T20438.2-2006 idt IEC61508-2:2000,

It possesses the SIL2 applicability and can be used into SIL2 and following security control loop.

Security functions

Thermocouple of WRNK2 series can switch any input signal of temperature under temperature measurement range (-400~1500℃) to corresponding output signal of thermoelectric force (0~54.807mV). It can be applied to trigger signal of safety action in relative system of security. $t_{0.5} < 90s$.

Use method

Thermocouple of WRNK2 series supports following trigger ways when it is applied to security control:

High trip: Normal temperature measurement range is smaller than safety threshold. When temperature measurement value is larger than safety threshold, safety action will be triggered.

Low trip: Normal temperature measurement range is larger than safety threshold. When temperature measurement value is smaller than safety threshold, safety action will be triggered.

Relation of WZPB2 connection and its SIL capacity

SIL=0: connect two temperature measurement channels of the product to the different control loops;

SIL=2: form two temperature measurement channels of the product as 1oo2 voting relation and then connect them to the same control loop;

SIL=2: form two temperature measurement channels of the product as 2oo2 voting relation and then connect them to the same control loop;

Requirement of product annual inspection

Design service life of the product is 3 years and the details related to daily maintenance of the product can be seen in the maintenance chapter of thermocouple.

Notes and restriction for use

See the chapter of usage and notes of thermocouple for more details.

热电偶使用说明书

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典型产品故障时的现象:

短路: 输出热电势为0mV;
断路: 无输出热电势;
漂移: 测温误差超出允差要求。

SIL验证信息

WRNK2的失效率 (依据IEC61508)

WRNK2	I_{high}	I_{low}	I_{SD}	I_{SU}	I_{DD}	IDU
通道A	0	950	0	0	0	50
通道B	0	950	0	0	0	50
当下级设备具有范围检测功能时	N/A	N/A	0	0	1900	100

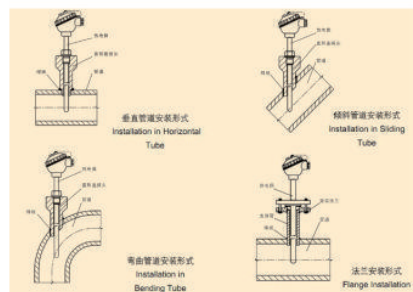
注: 有关表中的各项失效率定义详见IEC61508。

WRNK2的安全参数 (依据IEC61508)

检验测试间隔T(年)	0.25	0.5	1	1.5	2	3
$PFD_{avg}(T), 1002$	2.19E-05	4.38E-05	8.78E-05	1.32E-04	1.76E-04	2.65E-04
硬件故障裕度 (HFT) Hardware fault margin (HFT)	1					
安全失效分数 (SFF)	95%					
总失效率 (FIT)	2000					

热电偶的安装

安装形式



热电偶使用说明书

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Phenomenon when typical product has malfunction:

Short circuit: output thermoelectric force is 0mV.
Open circuit: there is no output thermoelectric force.
Drifting: temperature measurement error surpasses acceptable tolerance requirement.

SIL verification information

Failure rate of WRNK2 (based on IEC61508)

WRNK2	I_{high}	I_{low}	I_{SD}	I_{SU}	I_{DD}	IDU
Channel A	0	950	0	0	0	50
Channel B	0	950	0	0	0	50
When the subordinate device possesses the range check function $I_{high}=I_{SD}, I_{low}=I_{DD}$	N/A	N/A	0	0	1900	100

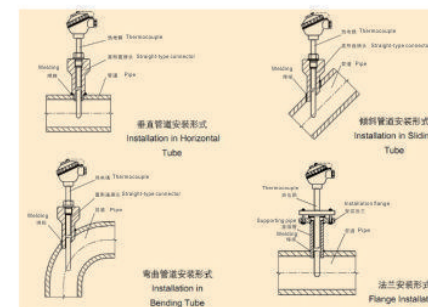
Note: see in IEC61508 for details of the definition of each failure rate related to the table.

Safety parameter of WRNK2 (according to IEC61508)

Check test interval T (year)	0.25	0.5	1	1.5	2	3
$PFD_{avg}(T), 1002$	2.19E-05	4.38E-05	8.78E-05	1.32E-04	1.76E-04	2.65E-04
Hardware fault margin (HFT)	1					
Safe failure fraction (SFF)	95%					
Full failure rate (FIT)	2000					

Mounting of thermocouple

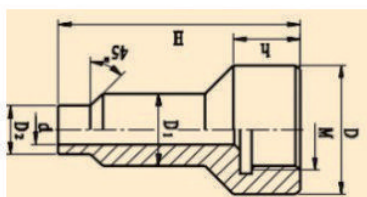
Mounting form



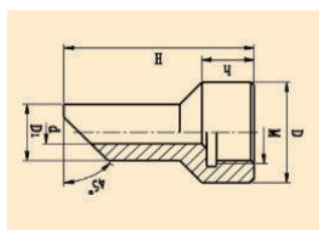
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直行连接头 Straight-type connector



代号 Code	M	D	D ₁	D ₂	d	h	H
TH48A	M12*1.5	Φ32	Φ18	Φ12	Φ7	27	60.12
TH48B	M16*1.5	Φ36	Φ18	Φ14	Φ7	27	80
TH48C	M20*1.5	Φ40	Φ18	Φ14	Φ7	27	60
TH48D	M27*2	Φ47	Φ28	Φ22	Φ17	32	60
TH48E	M33*2	Φ55	Φ36	Φ30	Φ21	34	120
TH48F	NPT1/2	Φ39	Φ27	Φ21	Φ16	35	60 120
TH48G	NPT3/4	Φ47	Φ31	Φ25	Φ20	40	
TH48H	NPT1	Φ47	Φ41	Φ35	Φ30	45	



代号 Code	M	D	D ₁	d	h	H
TH48A	M27*2	Φ47	Φ28	Φ18	30	90
TH48B	M33*2	Φ55	Φ36	Φ24	30	150
TH48C	NPT1/2	Φ39	Φ27	Φ16	30	90
TH48D	NPT3/4	Φ47	Φ31	Φ20	35	90
TH48E	NPT1	Φ47	Φ41	Φ30	40	150

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Use and notes

(1) Thermoelectric properties of WRR thermocouple is most stable at high temperature and is suitable for being used in oxidation and neutral medium. The produced thermoelectric force is the minimum.

(2) WRR thermocouple is suitable for being used in oxidation and neutral medium with high temperature resistance and it is not easy to be oxidized and corroded. It has good chemical stability and high measuring accuracy, which can be used for precision temperature measurement.

(3) WRN thermocouple is suitable for being used in oxidation and neutral medium. Within low temperature range below 500 , it can also measure in reducing medium. Its prominent feature is great thermoelectric force, high sensitivity, fast response speed, good linearity and wide measurement range.

(4) WRR thermocouple is suitable for being used in reducing or neutral media with thermal electromotive force and high sensitivity. The upper limit of temperature measurement is not high. In the model selection of the thermocouple, in addition to pay attention to usage environment, measurement range, measurement accuracy, sensitivity and response speed of the above thermocouples, attention shall also be paid to the structure, material and compressive strength of the thermocouple protective pipe and insertion depth of protective pipe etc.

Mounting of thermocouple

(1) Mounting of thermocouple shall keep in vertical as much as possible to avoid the protective pipes from being deformation under the high temperature; but in the case with of flow velocity, the thermocouple must be inserted towards the flow direction of the measured mediums to ensure the sufficient contact of temperature measurer and flows.

(2) Thermocouple shall be installed into the pipeline which has protective layer to avoid the heat loss.

(3) Sealing at the measuring area shall be guaranteed when the thermocouple is installed into the negative pressure pipeline to avoid the entering of the cold air from the outside world which will lead to the lower reading.

(4) Cover of the junction box of thermocouple shall be upward and the wire-entering opening shall be downward to prevent the rainwater and dust from entering into the junction which will influence the measuring accuracy.

(5) When the output signal of thermocouple is required to be simultaneously introduced to basic process control system (BPCS) and safety instrument system (SIS), the signal should be first introduced to SIS and then should be introduced to BPCS from SIS.

使用及注意事项

- (1) WRR热电偶的热电特性在高温下最为稳定，适宜于在氧化性和中性介质中使用，产生的热电势极小。
- (2) WRP热电偶适宜于在氧化性和中性介质中使用，耐高温，不易氧化和腐蚀，有较好的化学稳定性和较高的测量精度，可用于精密温度测量。
- (3) WRN热电偶适宜于在氧化性中性介质中使用。500℃以下低温范围内，也可在还原性介质中进行测量。其突出特点是热电势大，灵敏度高，响应速度快，线性度好，测量范围宽。
- (4) WRE热电偶适宜在还原性或中性介质中使用，其热电势比较大，灵敏度高，测温上限不高。在进行热电偶的选型时，除要注意上述热电偶的使用环境、测量范围、测量精度、灵敏度和响应速度之外，还有注意热电偶保护管的结构、材料、耐压强度及保护管的插入深度等。

热电偶的安装

- (1) 热电偶的安装应尽可能保持垂直，以防止保护管在高温下产生变形，但在有流速的情况下，则必须迎着被测介质的流向插入，以保证测温元件与流体的充分接触。
- (2) 热电偶应安装在有保护层得管道内，以防止热量散失
- (3) 热电偶安装在负压管道中时，必须保证测量处的密封性，以防止外界冷空气进入，使读数偏低
- (4) 热电偶的接线盒面盖应向上，入线口应向下，以避免雨水或灰尘进入接线盒，影响测量精度
- (5) 当需将热电偶输出信号同时引入基本过程控制系统（BPCS）和安全相关系统（SIS）时，应先将其信号引入SIS，再从SIS引出至BPCS。

Thermocouple maintenance

1. Repair must be carried out by the manufacturer or trained personnel.
2. Instrument should always be tested (should be in each 6 month), if any malfunction is found, it should be repaired in time.
3. Instrument should be cleaned by the wet clothe with cleaning liquid; there is no need to clean the instrument inside under the condition of normal use.
4. Instrument in the use of the project should always be dry and clean.

Common fault and processing method of the thermocouple

See the form below about common failure causes and processing methods of thermocouple

Common Failure Causes and Processing Method of Thermocouple

Failure phenomena	Possible cause	Processing method
Thermoelectric force is smaller than the actual value(indicated value of display is relatively low)	Thermode short circuit	Find out the reason of short circuit. If it is due to dampness, it is necessary to dry. If it is damaged by insulator, there is a need to replace insulator.
	Dust stratification on binding post of thermocouple causes short circuit	Clean the dust stratification
	Short circuit between compensating lead wire	Find out the short dot; reinforce insulation or replace the compensation lead wire.
	Thermocouple thermode is metamorphic	In the circumstances of allowable length, shear metamorphism section and re-weld or replace a new thermocouple.
	Compensating lead wire inversely connects with thermocouple polarity.	Connect correctly again.
	Compensating lead wire does not match with thermocouple.	Replace the matched compensating lead wire.
	Installation site of thermocouple does not record or insertion depth does not meet the requirements.	Reinstall by rule.
	Cold junction compensation of thermocouple does not meet the requirements.	Adjust cold junction compensation.
	Thermocouple does not match with display instrument.	Replace thermocouple or display instrument to make it match.

热电偶的维护

- 1、修理必须由制造商或经过培训的人员进行。
- 2、仪表应经常进行检定（应每六个月一次）；如发现故障应及时修理。
- 3、仪表应用有清洗液的湿布清洁，仪表内部在正常使用情况下无需清洁。

热电偶常见故障及其处理方法

热电偶常见故障原因及处理方法见下表

热电偶常见故障原因及处理方法

故障现象	可能原因	处理方法
热电势比实际值小（显示仪表指示值偏低）	热电极短路	找出短路原因，如因潮湿所致，则需进行干燥；如因绝缘子损坏所致，则需更换绝缘子
	热电偶的接线柱处积灰，造成短路	清扫积灰
	补偿导线线间短路	找出短路点，加强绝缘或更换补偿导线
	热电偶热电极变质	在长度允许的情况下，剪去变质段重新焊接，或更换新热电偶
	补偿导线与热电偶极性接反	重新接正确
	补偿导线与热电偶不配套	更换相配套的补偿导线
	热电偶安装位置不录或插入深度不符合要求	重新按规定安装
	热电偶冷端温度补偿不符合要求	调整冷端补偿器
	热电偶与显示仪表不配	更抽热电偶或显示仪表使之相配套

Thermoelectric force is bigger than the actual value(indicated value of displayer is relatively high)	Thermocouple does not match with display instrument.	Replace thermocouple or display instrument to make it match.
	Compensating lead wire does not match with thermocouple	Replace compensation lead wire to make it match.
	There is DC interference signal entering.	Exclude DC interference.
Thermoelectric force output is not stable.	Thermocouple binding post has poor contact with thermode.	Screw down the binding post.
	Insulation damage of measuring circuit of thermocouple causes intermittent short circuit or ground connection.	Find out the fault point and repair the insulation.
	Thermocouple installation is not strong or external vibration.	Fasten the thermocouple and eliminate vibration or take vibration reduction measures.
	Thermode is almost broken.	Repair or replace the thermocouple
Thermoelectric force of thermocouples has great error	External disturbance (AC leakage, electromagnetic induction, etc.)	Find out the interference source and adopt shielding measures.
	Thermode is metamorphic	Replace the thermode.
	Installation site of thermocouple is improper.	Change the installation site.
	Dust stratification on protective pipe surface.	Clear away the dust stratification.

Proper use of thermocouples

The correct use of thermocouples can not only get the accurate numerical value of temperature and ensure the product qualification but also it can save the material consumption of thermocouple so as to save money and ensure product qualification. If it is not installed correctly, heat conductivity, time lag and other errors are the main errors in the use of thermocouples.

1. Error caused by improper installation

If thermocouple installation location and insertion depth can not reflect the true temperature of the furnace etc, in other words, thermocouples should not be mounted too close to the door and the heated places. The insertion depth should be at least 8 to 10 times of the diameter of the protective pipe. There is no thermal insulating material to be filled between protective cased pipe and wall spacing of thermocouple, which cause the heat in the furnace to overflow or cold air intrusion. Therefore, gap between thermocouple protective pipe and wall hole of furnace should be plugged with insulating materials such as refractory mortar or asbestos rope so as to avoid the cold and hot air convection affecting the accuracy of temperature measurement. cold side of thermocouple is too close to the furnace body to make the temperature exceed 100°C; the installation of thermocouples should avoid the strong magnetic field and strong electric field as far as possible, so don't install the thermocouple and the power cable line in the same conduit so as to avoid the interference to cause error; thermocouple can not be installed in a region in which measured medium rarely flows; when measuring the temperature of the gas in the tube with a thermocouple, the thermocouple must be installed against the direction of flow velocity and is fully contacted with the gas.

2. Error caused by poor insulation

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热电势比实际值大（显示仪表指示值偏高）	热电偶与显示仪表不配套	更抽热电偶或显示仪表使之相配套
	补偿导线与热电偶不配套	更换补偿导线使之相配套
	有直流干扰信号进入	排除直流干扰
热电势输出不稳定	热电偶接线柱与热电极接触不良	将接线柱螺丝拧紧
	热电偶测量线路绝缘破损，引起断续短路或接地	找出故障点，修复绝缘
	热电偶安装不牢或外部震动	紧固热电偶，消除震动或采取减震措施
	热电极将断未断	修复或更换热电偶
	外界干扰（交流漏电，电磁场感应等）	查出干扰源，采用屏蔽措施
热电偶热电势误差大	热电极变质	更换热电极
	热电偶安装位置不当	改变安装位置
	保护管表面积灰	清除积灰

热电偶的正确使用

正确使用热电偶不但可以准确得到温度的数值，保证产品合格，而且还可节省热电偶的材料消耗，既节省资金又能保证产品质量。安装不正确，热导率和时间滞后等误差，它们是热电偶在使用中的主要误差。

1、安装不当引入的误差

如热电偶安装的位置及插入深度不能反映炉膛的真实温度等，换句话说，热电偶不应装在太靠近门和加热的地方，插入的深度至少应为保护管直径的8~10倍；热电偶的保护管与壁间的间隔未填绝热物质致使炉内热溢出或冷空气侵入，因此热电偶保护管和炉壁孔之间的空隙应用耐火泥或石棉绳等绝热物质堵塞以免冷热空气对流而影响测温的准确性；热电偶冷端太靠近炉体使温度超过100℃；热电偶的安装应尽可能避开强磁场和强电场，所以不应把热电偶和动力电缆线装在同一根导管内以免引入干扰造成误差；热电偶不能安装在被测介质很少流动的区域内，当用热电偶测量管内气体温度时，必须使热电偶逆着流速方向安装，而且充分与气体接触。

2、绝缘变差而引入的误差

热电偶使用说明书

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If thermocouple is insulative, protective pipe and tailpiece dirt or error caused by thermal inertia too much salt slag result in poor insulation between the thermoelectric interelectrode and the furnace wall. It is more serious at high temperature, which will not only cause the loss of thermoelectric force but also lead to interference. The caused error sometimes is up to 100℃.

3. Error caused by thermal inertia

Thermal inertia of thermocouple causes the indicator value of the instrument to be behind the change of the measured temperature. This effect is particularly prominent in rapid measurement. So thermocouple with relatively fine thermode and smaller diameter of protective pipe should be used as far as possible. With the permission of temperature measurement environment, the protective pipe can even be taken out. Due to the existence of measurement lag, the amplitude of temperature fluctuation detected by thermocouple is smaller than that of the furnace temperature fluctuation. The greater the lag measurement is, the smaller the amplitude of the thermocouple fluctuation is; the bigger difference from the actual temperature is. In order to accurately measure temperature, a thermocouple with a small time constant should be selected. The time constant is inversely proportional to the heat transfer coefficient and is proportional to the diameter of the hot end of thermocouple, the density of the material and the specific heat. If the time constant is required to be reduced, in addition to increasing heat transfer coefficient, the most effective way is to minimize the size of the hot end. In use, protective cased pipe of which materials have good thermal conductivity, thin tube wall and small inner diameter is usually used. In a more precise temperature measurement, bare wire thermocouple without protective cased pipe is used. However, the thermocouple is easy to be damaged, so it should be promptly corrected and replaced.

4. Thermal resistance error

When it is in high temperature, if there is a layer of coal ash in the surface of protective pipe, thermal resistance will increase because ash recovers on the surface to obstruct the transmission of heat. At this time, indicator value of temperature is lower than true value of measured temperature. Therefore, external of thermocouple protective pipe of shall be kept clean to decrease error.

Remember not to connect oppositely compensating lead wire of thermocouple

All staff engaged in works of temperature measuring know working principle of thermocouple—closed loop circuit made off two kinds of conductors. When the temperature of two sides is equal, thermal electromotive force of loop circuit is zero. When the temperature between working end of thermocouple and backlog end is different, thermoelectric force will be produced in rebellion and closed loop. Amount of thermoelectric force is related to temperature difference of two ends. Temperature of free end of thermocouple is not a steady state value. Manufactures all adopt private wire of thermocouple—compensating lead wire. Extend thermocouple to a steady temperature to supplement thermoelectric force of thermocouple, namely $E = e_{AB}(t) + e_{2B}(t_0)$.

In daily detection process, many users do not know functions of compensating lead wire and only know that compensating lead wire is private wire of thermocouple and meters connection. They do not know there are positive and negative poles of compensating lead wire and arbitrarily connect compensating lead wire and meters of thermocouple, which is wrong and will lead to big error.

热电偶使用说明书

Operation Instruction For Thermocouple



如热电偶绝缘了, 保护管和拉线板污垢或盐渣过多致使热电偶极间与炉壁间绝缘不良, 在高温下更为严重, 这不仅会引起热电势的损耗而且还会引入干扰, 由此引起的误差有时可达上百度。

3、热惰性引入的误差

由于热电偶的热惰性使仪表的指示值落后于被测温度的变化, 在进行快速测量时这种影响尤为突出。所以应尽可能采用热电极较细、保护管直径较小的热电偶。测温环境许可时, 甚至可将保护管取去。由于存在测量滞后, 用热电偶检测出的温度波动的振幅较炉温波动的振幅小。测量滞后越大, 热电偶波动的振幅就越小, 与实际炉温的差别也就越大。当用时间常数大的热电偶测温或控温时, 仪表显示的温度虽然波动很小, 但实际炉温的波动可能很大。为了准确的测量温度, 应当选择时间常数小的热电偶。时间常数与传热系数成反比, 与热电偶热端的直径、材料的密度及比热成正比, 如要减小时间常数, 除增加传热系数以外, 最有效的办法是尽量减小热端的尺寸。使用中, 通常采用导热性能好的材料, 管壁薄、内径小的保护套管。在较精密的温度测量中, 使用无保护套管的裸丝热电偶, 但热电偶容易损坏, 应及时校正及更换。

4、热阻误差

高温时, 如保护管上有一层煤灰, 尘埃附在上面, 则热阻增加, 阻碍热的传导, 这时温度示值比被测温度的真值低。因此, 应保持热电偶保护管外部的清洁, 以减小误差。

切勿将热电偶补偿导线接反

从事温度计量工作的同志都知道, 热电偶的工作原理-两种不同导体组成闭合回路, 当它的两端温度相等时, 其回路热电势为零。当热电偶工作端与积压由端温度不相等时, 叛乱合回路中产生热是势。热电势的大小与两端温度差有关。热电偶的自由端温度不是一个恒定值。厂家都采用热电偶专用线--补偿导线。将热电偶延长到一个恒定的温度处, 补偿了热电偶的热电势, 即 $E = e_{AB}(t) + e_{DB}(t_0)$ 。

在日常检测过程中, 有不少用户对补偿导线的作用不了解, 只知道补偿导线是热电偶与仪表连接的专用线。而不知道补偿导线有正负极之说, 随意将补偿导线与热电偶仪表连接, 这是错误的, 会引起很大误差。

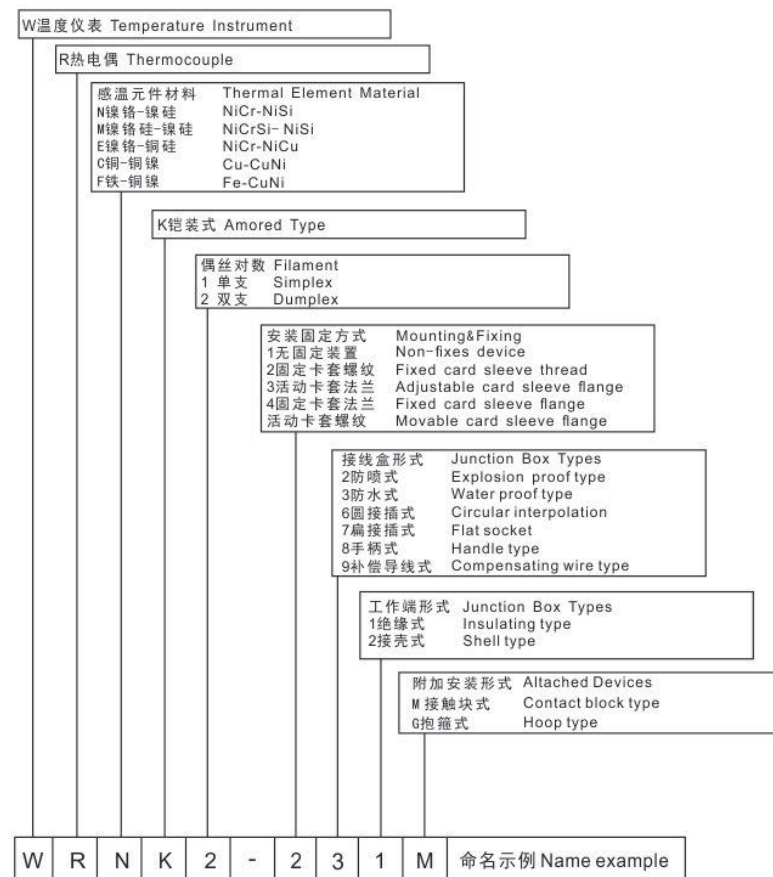
热电偶使用说明书

Operation Instruction For Thermocouple



产品型号 Products model

铠装热电偶 Sheathed thermocouple



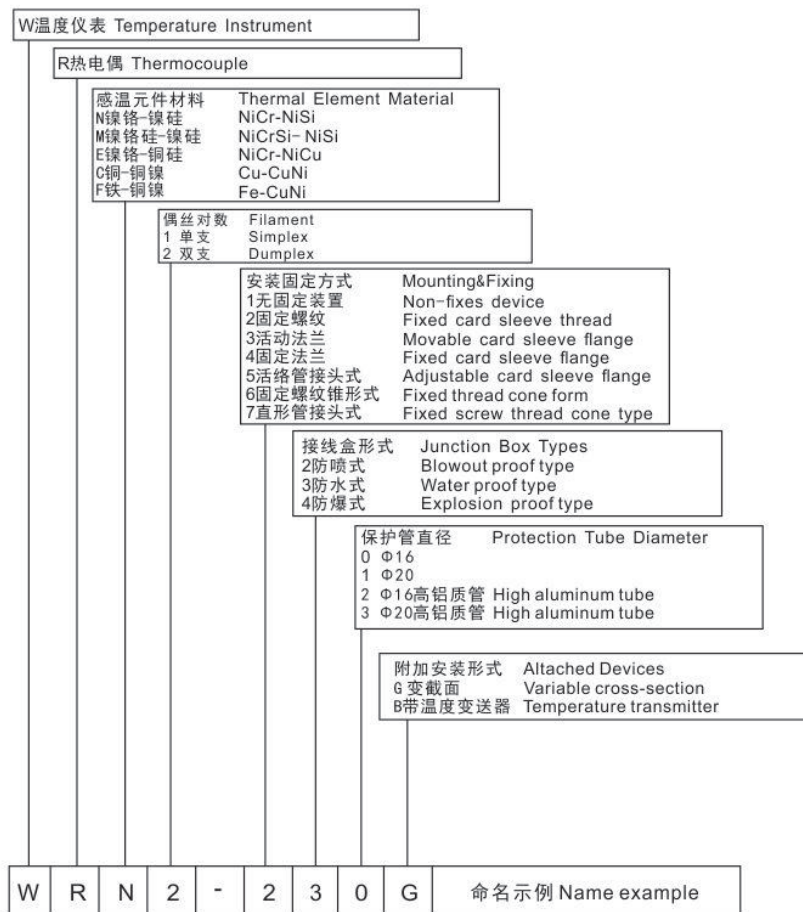
热电偶使用说明书

Operation Instruction For Thermocouple



装配热电偶

Assembled thermocouple



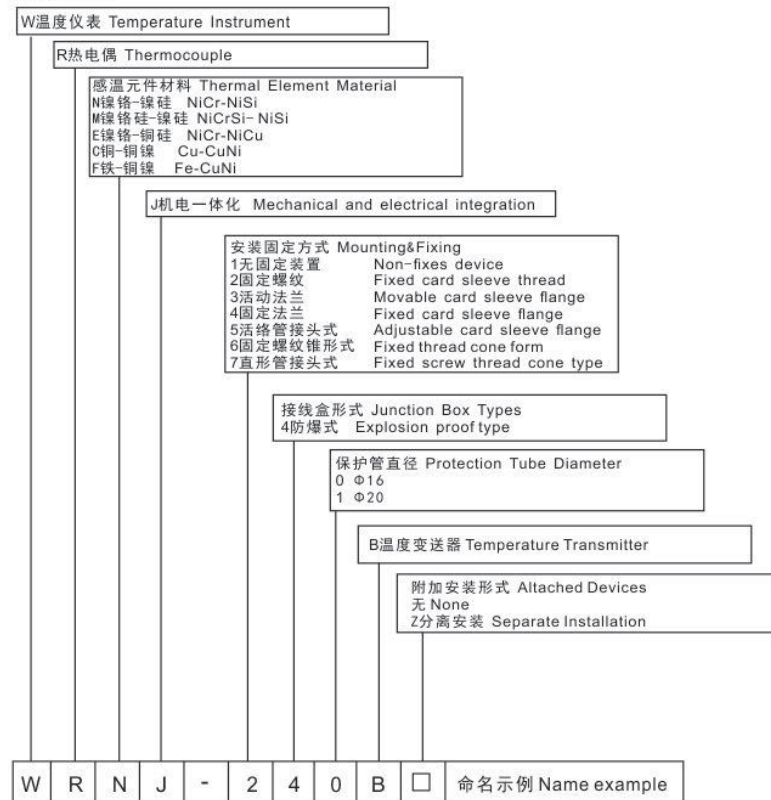
热电偶使用说明书

Operation Instruction For Thermocouple



一体化式

Integrated



订货须知

Ordering instruction

- 订货时须写明产品的型号、测量范围、安装方式、保护管长度、直径、材质、精度等级等技术参数。
 - 用户有特殊要求时，须注明。
- The parameters such as model, measurement range, way of installation, length of protective tube, diameter, material and accuracy class shall be specified when ordering.
 - Special requirements of users shall be indicated.