

Songshan Silca 碳化硅电热元件 SiC Heating Elements

概述

General description

碳化硅电热元件是选用优质绿色碳化硅为主要原料，经加工制坯、高温硅化、再结晶而成的棒状非金属高温电热元件。该元件与金属电热元件相比，具有使用温度高、抗氧化、耐腐蚀、寿命长、变形微、安装维修方便等特点。因此它被广泛应用于磁性材料、粉末冶金、陶瓷、玻璃、冶金和机械等工业的多种高温电炉及其它电加热设备上。

The silicon carbide heating element is a kind of non-metal high temperature electric heating element. It is made of selected super quality green silicon carbide as main material, which is made into blank, silicided under high temperature and re-crystallized. Compared with metal electric heating element, this kind of element is characterized by high-applied temperature, anti-oxidization, anti-corrosion, long service life, little deformation, easy installation and maintenance. Therefore, it is widely used in various high temperature electric furnaces and other electric heating devices, such as in the industries of magnet, ceramics, powder metallurgy, glass, metallurgy and machinery, etc.

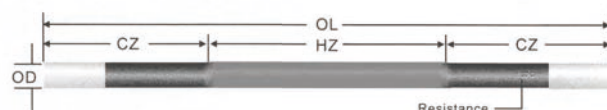
我们的碳化硅电热元件采用新的冷端部生产工艺，具有优良的热冷端电阻比，节能、寿命长，同时避免了因冷端部温度过高对炉体造成的损害。

We adopt new production process of cold ends so that our SiC heating elements have more excellent specific rate of heat zone resistance and cold end resistance, saving energy, long life, avoiding over-temperature of cold ends to damage the furnace body. The commercial name of our SiC heating elements is Songshan Silca heating elements.

碳化硅电热元件的产品型号

Specs and type of Songshan Silca heating elements

ED（直棒）型元件 ED (rod) type elements



型号Type: ED 外径Outer diameter: OD, mm

发热部长度Hot zone length: HZ, mm

冷端长度Cold end length: CZ, mm

全长Overall length: OL, mm

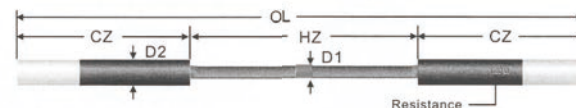
例如Examples:

ED型 Type, OD=54mm, HZ=1575mm, CZ=419mm, OL=2413mm, Resistance 0.90 Ω

表示为 Specify as:

Songshan Silca ED, 54 / 1575 / 2413 / 0.90 Ω

DB（粗端）型元件 DB (dumbbell) type elements



型号Type: DB 直径Diameter: D1/D2, mm

发热部长度Hot zone length: HZ, mm

冷端长度Cold end length: CZ, mm

全长Overall length: OL, mm

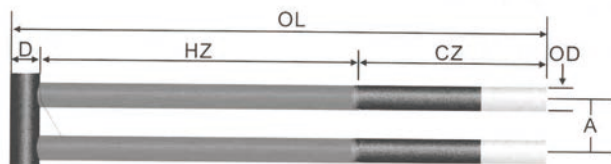
例如:

DB型, D1/D2=18/28mm, HZ=300mm, CZ=350mm, OL=1000mm, Resistance 1.70 Ω

表示为Specify as:

Songshan Silca DB, 18/ 300/ 350/ 1.7 Ω

U型元件 U type elements



型号Type: U 外径Outer diameter: OD, mm
 发热部长度Hot zone length: HZ, mm
 冷端长度Cold end length: CZ, mm
 全长Overall length: OL, mm
 间距Shank Spacing: A, mm
 连接桥Bridge: D, mm

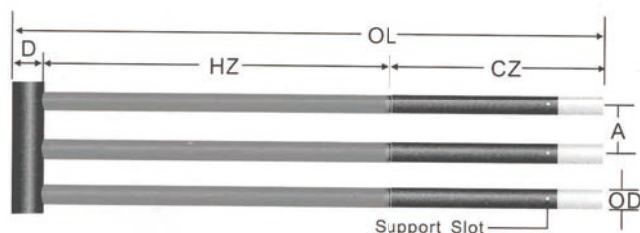
例如Examples:

U型Type, OD=20mm, HZ=300mm, CZ=400mm,
 OL=700mm, A=60mm, Resistance 2.24 Ω

表示为Specify as:

Songshan Silca U, 20 / 300 / 400 / 60 / 2.24 Ω

W(三相)型元件 W(three phase) type elements



型号Type: W 外径Outer diameter: OD, mm
 发热部长度Hot zone length: HZ, mm
 冷端长度Cold end length: CZ, mm
 全长Overall length: OL, mm
 间距Shank Spacing: A, mm
 连接桥Bridge: D, mm

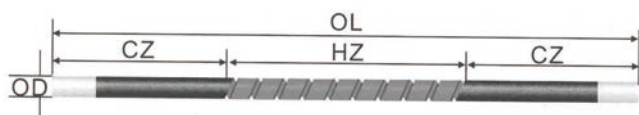
例如Examples:

W型Type, OD=20mm, HZ=250mm, CZ=350mm,
 OL=625mm, A=52mm, Resistance 0.90 Ω

表示为Specify as:

Songshan Silca W, 20 / 250 / 350 / 52 / 0.90 Ω

SC(单螺纹)型元件 SC (single spiral) type elements



型号Type: SC 外径Outer diameter: OD, mm
 发热部长度Hot zone length: HZ, mm
 冷端长度Cold end length: CZ, mm
 全长Overall length: OL, mm

例如Examples:

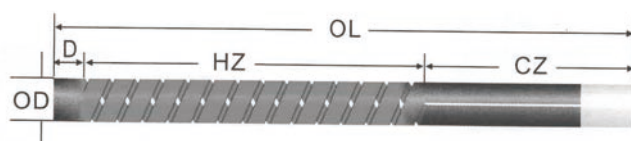
SC型Type, OD=25mm, HZ=300mm, CZ=200mm,
 OL=700mm, Resistance 1.59 Ω

表示为Specify as:

Songshan Silca SC, 25 / 300 / 700 / 1.59 Ω

SCR(双螺纹)型元件

SC(double spiral) type elements



型号Type: SCR 外径Outer diameter: OD, mm
 发热部长度Hot zone length: HZ, mm
 冷端长度Cold end length: CZ, mm
 全长Overall length: OL, mm

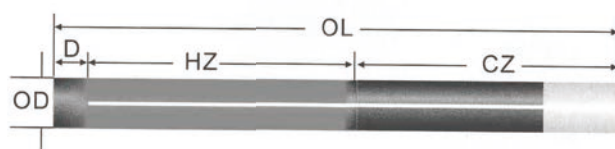
例如Examples:

SCR型Type, OD=31.7mm, HZ=305mm, CZ=241mm,
 OL=546mm, Resistance 4.46 Ω

表示为Specify as:

Songshan Silca SCR, 31.7 / 305 / 546 / 4.46 Ω

UX(槽)型元件 UX (slot) type elements



型号Type: UX 外径Outer diameter: OD, mm
 发热部长度Hot zone length: HZ, mm
 冷端长度Cold end length: CZ, mm
 全长Overall length: OL, mm

例如Examples:

UX型Type, OD=30mm, HZ=400mm, CZ=300mm,
 OL=700mm, Resistance 2.76 Ω

表示为Specify as:

Songshan Silca UX, 30 / 400 / 700 / 2.76 Ω

碳化硅电热元件的物理性质

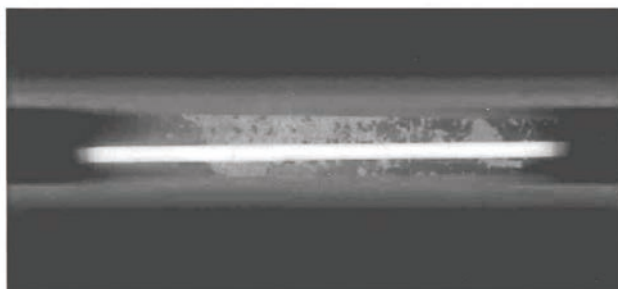
Physical properties of elements

比重 Specific gravity	2.6~2.8g/cm ³	抗折强度 Bend strength	>300Kg
硬度 Hardness	>9 MOH'S	抗拉强度 Tensile strength	>150Kg/cm ²
气孔率 Porosity rate	<30%	辐射率 Radiancy	0.85

碳化硅电热元件的线膨胀系数、热传导率和比热等随着温度的变化而变化，相关数据如下：

The linear expansion coefficient, heat conductivity and specific heat of element will change along with temperature change. And the relational data are the follows:

温度 Temperature (°C)	线膨胀系数 linear expansion coefficient (10 ⁻⁶ m/°C)	热传导率 Heat conductivity (Kcal/M hr °C)	比热 specific heat (cal/g°C)
0	/	/	0.148
300	3.8	/	/
400	/	/	0.255
600	4.3	14-18	/
800	/	/	0.294
900	4.5	/	/
1100	/	12-16	/
1200	4.8	/	0.325
1300	/	10-14	/
1500	5.2	/	/



碳化硅电热元件的化学性质

Chemical properties of elements

1. 元件的抗氧化性

Antioxidant property of elements

元件在空气中使用到800℃时开始氧化，温度达到1000-1300℃时，发热部表面生成一层二氧化硅保护膜，1300℃时结晶出方石英，在1500℃时，保护膜达到一定的厚度，从而使元件的氧化速度变得极为缓慢，趋于稳定。如果继续升温至1627℃以上时，则保护膜受到破坏，氧化速度显著增加，造成元件过早损坏。

The element start to being oxidized when heat to 800℃ in air; and a SiO₂ protect film will be generated on the surface of hot zone when temperature get to 1000~1300℃; cristobalite will be crystallized at 1300℃; the protect film get to a certain thickness when the temperature get to 1500℃, which make the oxidation speed being very slowly to stable. If continue to heat to over 1627℃, the protect film will be damaged and oxidation speed will be more rapid evidently and make the element damaged earlier.

元件在使用过程中虽然氧化极为缓慢，但长时间运行仍然会导致电阻值增大，这种现象叫做老化。为了减缓老化速度，我们在制造过程中以独特的技术，在发热部的表面涂上了保护层，明显的增强了元件的抗氧化性能，延长了使用寿命。

Though the element will be oxidized very slowly in course of application, it also will make the resistance increased following long time application, this phenomenon calls aging. In order to lower the aging speed, we use special technology to coat a protect film on the surface of hot zone in the course of production, which enhance the Antioxidant property of element evidently and lengthen the service life.

2. 碱和碱性金属氧化物对元件的影响

The effects of alkali and alkaline metal oxide to elements

在1300℃左右，碱和碱性金属氧化物与碳化硅发生反应，生成硅酸盐，称为碱化学侵蚀，会明显影响元件发热的红热程度。

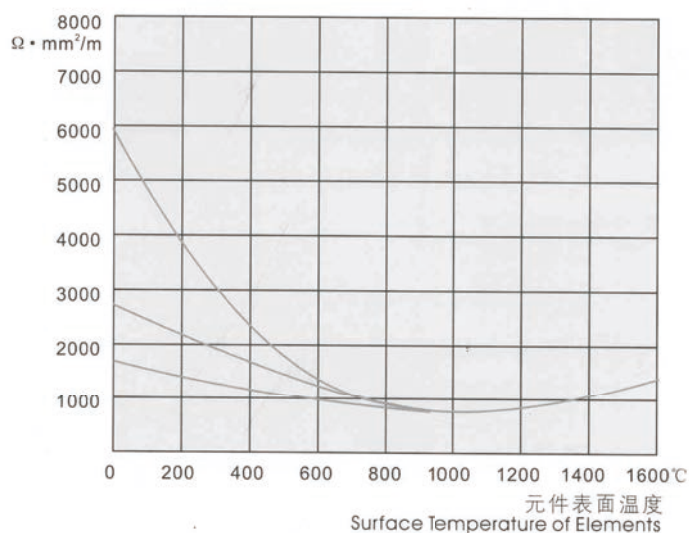
The alkali & alkaline metal oxide will react with SiC at about 1300℃ and generate silicate, which calls alkali-chemical corrosion, and can influence the glowing of element evidently.

3. 熔化金属对元件的影响

The effects to elements from melting metal

部分金属如钴、镍、铬等在高温熔化状态可以对元件造成侵蚀，影响元件的寿命。

Some metals, such as cobalt, nickel, chrome and so on, can corrade the element in high temperature melting state and affect the service life of element.



元件的电气性质

Electric properties of elements

碳化硅电热元件具有较大的比电阻，在空气中加热，元件发热部表面温度达到1050℃左右时，电阻率为600~1400Ω mm²/m。元件的电阻值随着温度的升高而变化，从室温到800℃为负值、800℃以上为正值特性曲线。

SiC heating elements has rather higher specific resistance. When it is heated in air and the surface temperature of the hot zone reaches 1050℃, its resistance rate is 600~1400Ω mm²/m. Its resistance value changes along with the temperature rising. From room-temperature to 800℃ is negative value, over 800℃ is positive value nature curve.

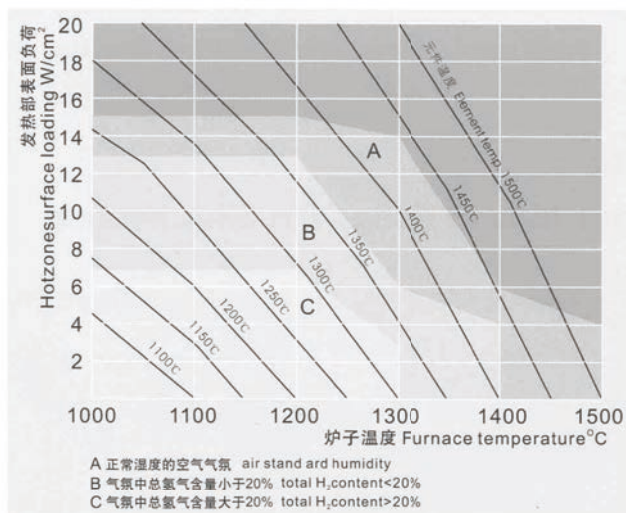
元件在不同气氛下使用温度和表面负荷的控制

Control of applied temperature and surface load of Songshan Silca heating elements under different atmosphere

气氛 Atmosphere	炉温 Furnace Temp(°C)	表面负荷 Surface Load (W/cm ²)	对元件的影响 Acting to the element	解决办法 Solve way
氨 Ammonia	1290	3.8	与SiC作用生成甲烷减少 SiO ₂ 保护膜 Acting on SiC to form thus decrease SiO ₂ protective film	露点激活 Active at dew point
CO ₂	1450	3.1	侵蚀碳化硅 Attack SiC	用石英管保护 Protecting by quartz tube
18%CO	1500	4.0	无影响 No action	
20%CO	1370	3.8	吸附碳粒影响SiO ₂ 保护膜 Adsorbing C grains to act on SiO ₂ protective film	
卤素 Halogen	704	3.8	侵蚀碳化硅减少SiO ₂ 保护膜 Attacking SiC and decreasing SiO ₂ protective film	用石英管保护 Protecting by quartz tube
碳氢化合物 Hydrocarbon	1310	3.1	吸附碳粒而致热污染，分解的碳沉积，易造成 电器故障 Adsorbing C grains causes hot pollution	送进充分的空气 Fill with enough air
氢 Hydrogen	1290	3.1	与SiC作用反应生成甲烷减少SiO ₂ 保护膜 Acting on SiC to form thus decrease SiO ₂ protective film	露点激活 Active at dew point
甲烷 Methane	1370	3.1	吸附碳粒而致热污染 Adsorbing C grains causes hot pollution	
N	1370	3.1	与SiC反应形成氮化硅绝缘层 Acting with SiC forms SiN insulating layer	
Na	1310	3.8	侵蚀碳化硅 Attack SiC	用石英管保护 Protecting by quartz tube
SO ₂	1310	3.8	侵蚀碳化硅 Attack SiC	用石英管保护 Protecting by quartz tube
真空 Vacuum	1204	3.8		
氧 Oxygen	1310	3.8	碳化硅被氧化 SiC is oxidized	
水 (不同含量) Water(different contents)	1090~1370	3.1~3.6	与SiC作用生成硅的水化物 Acting on SiC forms hydtrate of Silicon	

根据炉子的结构、气氛和温度正确地选择元件的表面负荷是达到最佳使用寿命的关键。下图示出了元件辐射在不受阻碍情况下的炉温、元件温度与表面负荷之间的关系。

The key factor to the optimum service life of the element is to select the surface load of the element correctly according to the furnace construction, atmosphere and temperature. Below figure shows the relation between furnace temperatures, element temperature and element surface load under the condition that the element radiation isn't obstructed.

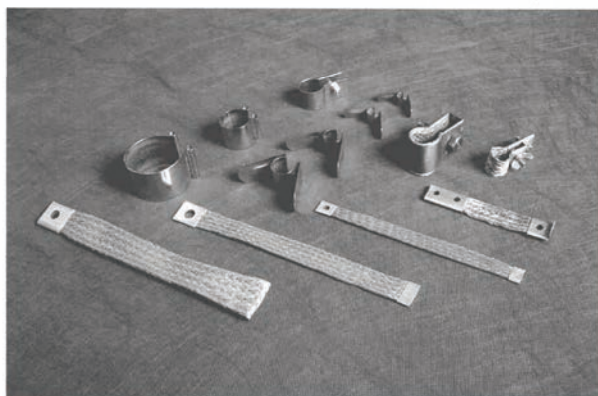


推荐的元件表面负荷 Recommend surface load:

炉温 °C Furnace Temp.	1100	1200	1300	1350	1400	1450
发热点表面负荷 Surface load of hot zone (W/cm ²)	<17	<13	<9	<7	<5	<4

碳化硅电热元件的附件

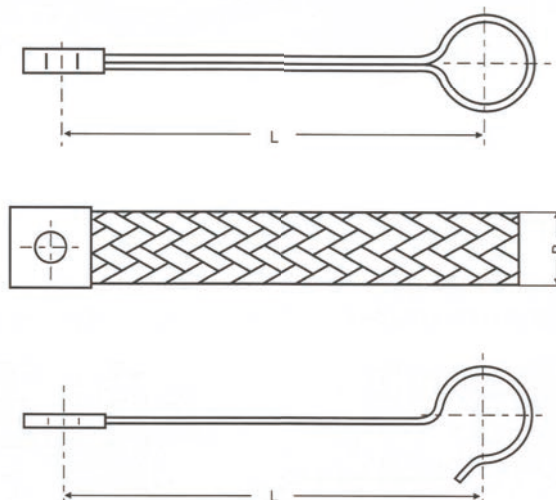
Accessories of elements



碳化硅电热元件的标准附件包括铝编织连接带和夹子，夹子的种类有H型，G型和C型。

The nominal accessories of SiC elements include aluminum braid connecting straps and clamps, the kinds of clamps have H type, G type and C type.

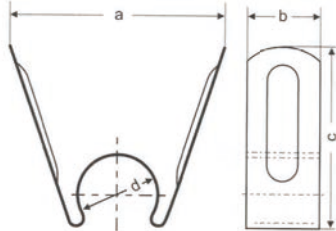
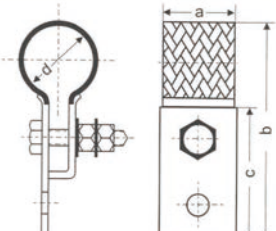
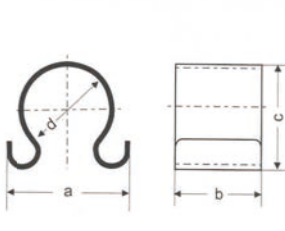
连接带 Connecting straps



元件直径 Element dia. mm	带宽 B Strap width mm	工作长度 L Working length mm	接线孔直径 Lug-hole dia. mm	最大电流 Max. current A
8.0	15	150	7	25
10.0				
12.0				
14.0				
16.0	15	140	7	50
18.0	20	130	7	60
20.0				
25.0	25	160	11	70
30.0	30	160	11	180
31.7				
35.0				
38.1				
40.0	30	140	11	240
44.4				
54.0				

夹子Clamps

元件直径 Element dia. mm	H型夹子 H type clamp			G型夹子 G type clamp			C型夹子 C type clamp		
	a	b	c	a	b	c	a	b	c
12.0		12	31						
14.0		14	35						
16.0		16	40						
20.0		20	45	20	60	40			
25.0		25	53	20	65	40			
30.0		30	58	30	83	53		30	
31.7		30	58	30	85	53		30	
35.0		35	65	30	88	53		35	
38.1		40	78	30	91	53		40	
40.0		40	78					40	
44.4		40	75					40	
54.0		40	70					40	

元件安装运行须知

Installation and operation of elements

1. 为保证炉温和每支元件的负荷均匀，安装前要对元件进行配阻，每组元件间的阻值误差应控制在 $\pm 5\%$ 以下。

In order to keep furnace temperature and the charges uniform of each element, before installation, resistance distribution must be carried out. The resistance deviation among elements of each set should be below $\pm 5\%$.

2. 由于碳化硅元件质脆，在安装维修时要小心，以免损坏。

As the element is very brittle, be careful while install and maintain to avoid any damage.

3. 炉子在开始通电运行时，要逐步缓慢升压，不可一次加满负荷，否则会因冲击电流过大造成元件损坏。

When start to operate the furnace, raise voltage slowly and gradually, never give full load at one time, otherwise, the heating element will be damaged by over current impulse.

4. 使用元件必须配备调压变压器或可控硅调压器及电压、电流表和温度自动控制仪表等。在使用过程中因元件氧化，电阻逐渐增加，为保持炉温正常，应提高使用电压。当电压提高到所用变压器最大限度仍不能满足要求时，可停炉改变元件的接线方式再继续使用。

To use the elements, you should prepare the adjustable transformer or SCR controller, voltage meter, current meter and auto-control temperature meter etc. During the working, the voltage should be increased to keep the furnace normal temperature because the resistance value will go up gradually caused by the oxidation of element. When the voltage get to the top limit of the transformer and the temperature is still low than the requirement, the furnace should be stopped, change the way of wire connection and then continue work.

5. 炉子在长期运行过程中，个别元件由于某种原因而损坏需更换时，要根据当时元件阻值增长情况，选补阻值适宜的元件，不可任意取新元件更换。若元件损坏较多或阻值增长过大，无法达到所需炉温时最好全部更换成新元件。换下来的元件重新（用压表、电流表）测标其电阻值，配阻

用在低温区。

In the course of long term operation, if any individual heating element is damaged owing to certain reasons, which should be changed, you should replace it with proper one whose resistance value corresponds to that of the old one, never use a new heating element random. If the heating element is much damaged or its resistance value increases too much and cannot reach the furnace temperature, it is better to replace all the heating elements with new ones. Test and mark the resistance value of the old elements having been replaced (with voltmeter and ammeter) and distribute them in low temperature area.

6. 新炉或长时间没有使用的炉子，在使用之前必须烘炉，烘炉时尽可能用旧元件或其它热源。

Before use the new furnace or the furnace that has not been used for a long time, they must be dried. When drying them, it is better to use old elements or other heat source.

7. 如果烧制器件或材料时，在加热过程中有水分排出，炉子要留有排气孔，以排除炉内的水分或其它有害气体，以免影响元件的使用寿命。

When firing products or materials, if there is water ejection, the furnace should have holes to eject water vapor or other waste gases in order to protect the elements service life.

间歇式碳化硅元件电炉设计参考数据

Reference data for the design of Batch-type electrical furnace

1. 加热功率 (KW) = 被加热物重量 (KG) × 被加热物比热 × 升温速率 (最高炉温℃ ÷ 总加热时间 h) ÷ 860 (860千卡 = 1 KW)

设：单位热损失为740千卡/M²小时。

Heating power (KW) = weight of the object to be heated (kg) × specific heat of the object to be heated × temperature-raising speed max furnace temp.(℃) ÷ [total heating time (hour) × 860] (860 kcal=1KW).

Suppose: unit heat-loss is 740 kcal/M²hour

2. 热损失 (KW) = 炉膛表面积 (M²) × 740 ÷ 860 (860 kcal=1KW).

设：炉墙厚10cm，炉温100℃为一个单位常数，此时炉膛每M²面积上的蓄热为635千卡。

Heat-loss (KW) = surface area of furnace chamber (M²) × 740 ÷ 860.

Suppose: furnace wall thickness 10cm and furnace temperature 100℃ is a unit constant, then the heat accumulation quantity on the furnace chamber is 635 kcal per M².

3. 蓄热功率 (KW) = {[(炉墙厚度cm ÷ 10cm) × (最高炉温℃ ÷ 100℃)] × 635} × 炉膛表面积 M² ÷ (总加热时间hr × 860) .

Heat accumulation power (KW)={[(furnace wall thickness cm ÷ 10cm) × (max. furnace temperature℃ ÷ 100℃)] × 635} × furnace chamber area M² ÷ (total heating time (hr) × 860).

4. 所需总功率 (KW)，是前三项之和。由于碳化硅电热元件长期在高温下工作，逐渐老化而阻值增大，功率下降。为能及时调整到所需功率，变压器功率应大于所需总功率的60~100%为宜。

The total power needed (KW) is the sum of the above three terms. Owing to the fact that the Songshan Silca heating elements work long-term under high temperature, it gradually ages and its resistance value increases, power decreases. In order to adjust it to the power needed in time, the power of transformer should be 60~100% larger than the total power needed.

5. 根据炉子尺寸选择元件的规格。

Select heating elements dimensions according to furnace sizes.

6. 确定最高炉温后，根据元件在此炉温下所规定的表面负荷，乘以所选元件发热部的表面积（从产品规格表中查出），求出单支元件的功率 (KW)。

After determining the max furnace temperature, calculate the power (KW) of a single element using

the way of multiplying the stipulated surface load of the elements under said furnace temperature (find it out from the above table) by the surface area of hot zone of the elements. (Find it out from the product dimension.)

7. 所需总功率 (KW) ÷ 单支元件功率 = 应安装元件数量。

Total power (KW) needed ÷ single element power = the quantity of elements that should be installed.

8. 设计线路图，确定单支元件的电阻。

Design the circuit diagram and determine the resistance of the single element.

9. 元件距炉墙及被加热物之间的距离

The distance between the element and the furnace wall and the object to be heated

元件直径 Element Dia(mm)	8	12	14	16	20	25	30
最小距离 Minimum distance (mm)	25	38	44	57	68	79	94

10. 炉墙上的元件插入孔的直径应为所安装元件直径的1.5倍，间隙处用石棉绳或硅酸铝纤维毡堵塞。

The diameter of the hole for heating element-inserting on the furnace wall should be 1.5 times of the element Dia to be installed. The space there is filled with asbestos cord or aluminum silicate fiber felt.

11. 两个元件插入孔之间的中心距为元件直径的3~5倍为宜。

The central distance between two heating element-inserting holes should be 3-5 times of the element diameter.

12. 为确保元件与导线夹具接触良好，最好在元件端部喷铝处包上2~3层纯铝箔，然后再安装导线夹具。

In order to keep the elements and the lead wire well contacting, better wrap the Al-sprayed heating element end with 2 to 3 layers of pure Al leaf. Then mount the lead wire clamp.

13. 为节省能源，建炉用的保温材料，最好选用保温性能好的轻质高铝砖和适量硅酸铝纤维砖。

In order to save energy resources, for the thermal insulation material applied to building furnace, better select well insulated high quality light aluminum bricks and proper quantity of aluminium silicate fibre felt or bricks.

连续式碳化硅元件电炉设计参考数据 (实践)

Reference data for the design of Continuous type electrical furnace (practice)

1. 炉车载物：变压器功率230KW/M³（炉膛体积），生产最高功率193KW/M³（炉膛体积）；推板载物：变压器功率194KW M³（炉膛体积），生产最高功率160KW/M³（炉膛体积）。

Material loaded on furnace car: transformer power 230 KW/M³, Max work power 193KW/M³; Material loaded on pushing plate: transformer power 194 KW/M³, Max work power 160KW/M³.

2. 每M³炉膛体积，可安装元件的发热部表面积为19620.7 cm²。

In each M³ of furnace chamber, the total area for element hot zone that can be installed is 19620.7cm².

3. 电炉应安装元件的数量 = 19620.7cm² ÷ 所选元件单支发热部表面积cm²。

The quantity of elements that should be installed in the electric furnace used = 19620.7cm² ÷ total surface area of the element hot zone selected (cm²).

4. 其它数据和要求参考间歇式炉子。

For other data, please refer to that of batch-type furnace.

几种常用接线方法的功率计算

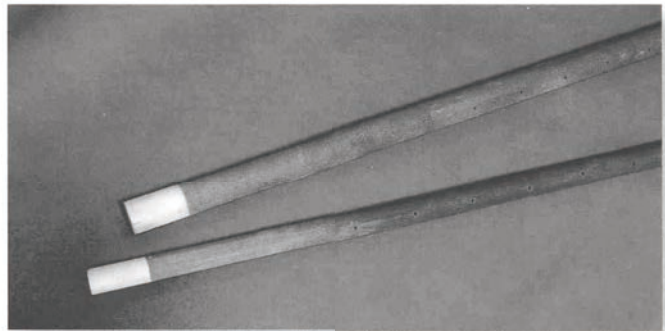
Several power calculation ways for wire connection in common use

接线方法 Connection way	示意符号 Symbol	元件数量 Element Qty (no.)	相电压 (V) Phase resistance	相电阻 (Ω) Phase resistance	相电流 (A) Phase current	总功率 Total power (KW)
单相串联 Single phase series connection	+	n	$U_x = U$	$R_x = nr$	$I_x = \frac{U}{nr}$	$N_x = \frac{U^2}{10^3 nr}$
并相并联 Parallel phase connection	=	n	$U_x = U$	$R_x = \frac{r}{N}$	$I_x = \frac{nU}{r}$	$N_x = \frac{nU^2}{10^3 r}$
角形连接 Angle connection	△	n	$U_x = U$	$R_x = r$	$I_x = \frac{U}{R}$	$N_x = \frac{3U^2}{10^3 r}$
星形连接 Star connection	Y	n	$U_x = \frac{U}{\sqrt{3}}$	$R_x = r$	$I_x = \frac{U_x}{R_x}$	$N_x = \frac{U^2}{10^3 r}$

注Note: U——线电压line voltage r——元件电阻element resistance

产品规格表

Dimensions of Songshan Silca heating elements



1、ED型元件 ED type elements

直径 Dia (mm)	发热部长 hot zone length (mm)	冷端部长 cold end length (mm)	全长 overall length (mm)	发热部 表面积 hot zone Surface Area (cm ²)	额定负荷 (1050 °C时测试) nominal loading(at 1050 °C)		
					电压 (V) Voltage	功率 (W) Power	电阻 (Ω) Resistance
12	150	150	450	56	41	896	1.85
	200	200	600	75	50	1200	2.10
	250	200	650	94	63	1504	2.62
	300	200	700	113	75	1808	3.15
14	200	200	600	88	41	1408	1.22
	250	250	750	110	51	1760	1.50
	300	250	800	132	62	2112	1.80
	350	200	750	154	73	2464	2.14
	400	250	900	176	82	2816	2.40
16 (5/8")	300	250	800	150	62	2400	1.60
	350	350	1050	176	70	2816	1.75
	400	350	1100	200	80	3200	2.00
	450	250	950	225	90	3600	2.25
	500	250	1000	250	100	4000	2.50
	600	250	1100	300	120	4800	3.00

直径 Dia (mm)	发热部长 hot zone length (mm)	冷端部长 cold end length (mm)	全长 overall length (mm)	发热部 表面积 hot zone Surface Area (cm ²)	额定负荷 (1050 °C时测试) nominal loading(at 1050 °C)		
					电压 (V) Voltage	功率 (W) Power	电阻 (Ω) Resistance
20 (3/4")	300	400	1100	188	59	3008	1.14
	400	350	1100	251	76	4016	1.45
	500	400	1300	314	97	5056	1.85
	600	400	1400	376	114	6016	2.15
	700	400	1500	439	138	7024	2.70
	800	300	1400	502	148	7530	2.90
	900	300	1500	565	162	8475	3.10
25 (1")	300	300	900	236	53	3776	0.75
	400	450	1300	314	71	5024	1.00
	500	400	1300	392	90	6272	1.30
	600	400	1400	470	108	7520	1.55
	700	400	1500	550	120	8250	1.75
	800	400	1600	627	134	9405	1.90
	900	300	1500	705	151	10575	2.16
30	1000	300	1600	785	168	11775	2.40
	400	300	1000	380	63	5700	0.70
	500	300	1100	470	80	7050	0.90
	600	400	1400	570	92	8550	1.00
	700	450	1600	660	109	9900	1.20
	800	500	1800	750	125	11250	1.40
	900	400	1700	850	140	12750	1.53
31.7 (1.25")	1000	300	1600	940	153	14100	1.65
	1100	300	1700	1035	168	15525	1.82
	356	280	916	355	52	5315	0.50
	406	280	965	405	59	6060	0.57
	457	280	1016	456	66	6820	0.64
	508	280	1067	507	73	7585	0.71
	559	280	1118	557	80	8345	0.78
	610	280	1168	608	88	9110	0.85
	660	280	1219	659	95	9855	0.92
	711	280	1270	709	103	10615	0.99
	762	280	1321	760	110	11380	1.06
	813	394	1600	811	117	12140	1.13
	864	394	1651	861	124	12900	1.20
	914	394	1702	912	131	13650	1.27
	1016	394	1803	1013	145	15170	1.40
35	1067	394	1854	1063	153	15930	1.47
	1118	394	1905	1115	160	16690	1.54
	1448	406	2260	1442	217	21620	2.17
	1499	381	2260	1493	224	22380	2.25
	400	400	1200	440	67	6600	0.68
	500	400	1300	550	84	8250	0.85
	600	400	1400	660	100	9900	1.02
	700	400	1500	770	117	11550	1.19
	800	400	1600	880	134	13200	1.36
	900	400	1700	990	151	14850	1.53
35	1000	400	1800	1100	167	16500	1.69
	1100	400	1900	1210	184	18150	1.87
	1200	400	2000	1320	201	19800	2.04
	1300	400	2100	1430	218	21450	2.21
	1400	400	2200	1540	234	23100	2.38
	1500	400	2300	1650	251	24750	2.55
	1600	300	2200	1760	263	25520	2.72
	1700	300	2300	1870	280	27115	2.89

直径 Dia (mm)	发热部长 hot zone length (mm)	冷端部长 cold end length (mm)	全长 overall length (mm)	发热部 表面积 hot zone Surface Area (cm ²)	额定负荷 (1050 °C 时测试) nominal loading(at 1050 °C)		
					电压 (V) Voltage	功率 (W) Power	电阻 (Ω) Resistance
38.1 (1.5")	406	280	965	487	54	7285	0.40
	457	280	1016	547	61	8200	0.45
	508	280	1067	608	67	9115	0.49
	559	280	1118	669	74	10030	0.54
	610	280	1168	730	80	10950	0.59
	660	280	1219	791	86	11840	0.63
	711	280	1270	851	93	12760	0.68
	762	280	1321	912	100	13675	0.73
	813	394	1600	973	106	14590	0.78
	864	394	1651	1034	113	15505	0.83
	914	394	1702	1095	119	16400	0.87
	965	280	1524	1155	126	17320	0.92
	990	358	1705	1185	131	17775	0.96
	1016	394	1803	1216	132	18230	0.97
	1118	394	1905	1338	146	20060	1.07
	1219	394	2007	1459	159	21875	1.16
	1312	394	2108	1581	172	23705	1.26
	1422	394	2210	1702	186	25520	1.36
40	500	400	1300	628	75	9420	0.60
	600	400	1400	753	90	11295	0.72
	700	400	1500	880	105	13200	0.84
	800	400	1600	1005	118	14573	0.96
	900	400	1700	1130	133	16385	1.08
	1000	400	1800	1255	148	18198	1.20
	1100	400	1900	1381	163	20025	1.32
	1200	400	2000	1506	177	21837	1.44
	1300	400	2100	1630	192	23635	1.56
	1400	400	2200	1760	207	25520	1.68
	1500	400	2300	1880	222	27260	1.80
	1600	300	2200	2010	236	29145	1.91
	1700	300	2300	2140	250	31030	2.02
44.4 (1.75")	508	280	1067	708	61	10625	0.36
	559	394	1346	780	68	11690	0.40
	610	305	1219	851	74	12760	0.43
	660	293	1245	921	81	13805	0.47
	711	394	1499	992	87	14970	0.51
	762	394	1549	1063	93	15935	0.55
	813	394	1600	1134	99	17000	0.59
	864	394	1651	1205	104	18070	0.61
	914	394	1702	1275	112	19115	0.65
	965	394	1753	1346	118	20180	0.70
	991	419	1829	1382	120	20725	0.69
	1016	394	1803	1417	122	21250	0.70
	1118	419	1956	1560	136	23380	0.80
	1219	432	2083	1700	148	25490	0.87
	1270	394	2057	1772	155	26560	0.92
	1295	381	2057	1806	155	27082	0.89
	1321	394	2108	1843	161	27625	0.95
	1372	394	2159	1914	168	28690	1.00
	1422	394	2210	1984	173	29740	1.03
	1473	394	2261	2055	180	30805	1.07
	1524	394	2311	2126	186	31870	1.10
	1575	419	2413	2197	192	32940	1.15
	1626	394	2413	2268	197	34005	1.17
	1676	420	2515	2338	205	35050	1.24
	1829	280	2388	2551	218	38250	1.24
	2438	420	3277	3401	291	50985	1.66

直径 Dia (mm)	发热部长 hot zone length (mm)	冷端部长 cold end length (mm)	全长 overall length (mm)	发热部 表面积 hot zone Surface Area (cm ²)	额定负荷 (1050 °C时测试) nominal loading(at 1050 °C)		
					电压 (V) Voltage	功率 (W) Power	电阻 (Ω) Resistance
50	1000	400	1800	1570	127	21980	0.73
	1500	400	2300	2360	191	33040	1.10
	1700	400	2500	2670	216	37520	1.24
	2000	400	2800	3140	253	43960	1.46
54 (2.125")	508	305	1118	862	62	12920	0.30
	533	229	991	904	66	13555	0.32
	559	305	1168	948	69	14220	0.33
	610	305	1219	1035	75	15515	0.36
	660	305	1270	1120	80	16785	0.38
	686	280	1245	1164	84	17450	0.40
	711	305	1321	1206	88	18085	0.42
	762	305	1372	1293	93	19380	0.44
	813	419	1651	1379	99	20675	0.49
	864	419	1702	1466	105	21975	0.51
	914	420	1753	1551	112	23250	0.54
	965	419	1803	1637	116	24545	0.57
	1016	419	1854	1724	123	25840	0.60
	1067	419	1905	1810	129	27140	0.63
	1118	419	1956	1897	135	28435	0.66
	1143	394	1930	1939	139	29070	0.67
	1168	420	2007	1982	142	29710	0.69
	1219	458	2134	2068	147	31005	0.71
	1270	419	2108	2155	153	32300	0.74
	1321	419	2159	2241	159	33600	0.77
	1372	419	2210	2328	166	34895	0.80
	1422	420	2261	2412	171	36170	0.82
	1473	419	2311	2499	179	37465	0.85
	1499	229	1956	2543	175	38125	0.80
	1524	394	2311	2585	184	38760	0.89
	1575	419	2413	2671	189	40060	0.90
	1626	419	2464	2758	196	41355	0.94
	1651	267	2184	2801	198	41990	0.93
	1676	420	2515	2843	202	42630	0.97
	1727	419	2565	2930	207	43925	0.99
	1778	419	2616	3016	213	45220	1.01
	1880	305	2489	3189	225	47815	1.06
	1981	254	2489	3361	238	50385	1.12
	2032	242	2515	3447	244	51680	1.15
	2083	330	2743	3534	250	52980	1.18
	2108	267	2642	3576	253	53615	1.19
	2134	241	2616	3620	255	54275	1.20
	2159	445	3048	3663	260	54910	1.23
	2286	343	2972	3878	274	58140	1.29
	2311	420	3150	3921	279	58780	1.32
	2413	267	2946	4094	290	61370	1.37
	2438	420	3277	4136	295	62010	1.40

注: 1. 电阻公差 Resistance tolerance: $\pm 20\%$.

2. 也可以根据用户的不同要求生产特殊规格。

Products with special specifications are manufactured upon customer's request.

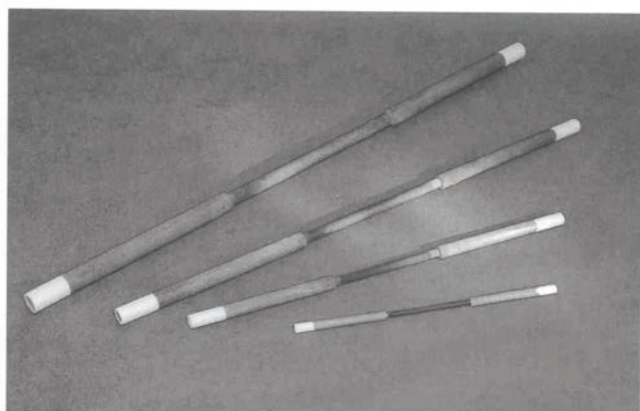
2. DB 型元件 DB type elements

发热部 Hot Zone			冷端部 Cold end		全长 Overall length (mm)	电阻 Resistance at 1400℃ (Ω)	不同温度时最大允许的负荷值, 功率W, 电压V, 电流A Max loads value Watts (over the dash), Voltage (V) Current (A) at temperature of					
直径 Dia (mm)	长度 Length (mm)	表面积 Surface (cm ²)	直径 Dia (mm)	长度 Length (mm)			1100℃	1200℃	1250℃	1300℃	1350℃	1400℃
8	150	38	14	150	450	3.60	900 57/15.8	790 53/14.7	675 49/13.8	520 43/12.0	380 37/10.3	190 26/7.2
8	180	45	14	60	300	4.40	1080 69/15.7	950 65/14.7	815 60/13.8	635 53/12.0	460 45/10.2	230 32/2.7
8	180	45	14	150	480	4.40	1080 69/15.7	950 65/14.7	815 60/13.8	635 53/12.0	460 45/10.2	230 32/2.7
14	200	88	22	250	700	1.80	2110 62/34.0	1850 58/32.0	1570 53/29.6	1230 47/26.6	880 40/22.0	440 28/15.7
14	250	11	22	250	750	2.20	2640 76/34.7	2310 71/32.6	1980 66/30.0	1540 58/26.6	1100 49/22.4	550 35/15.8
14	250	11	22	350	950	2.20	2640 76/34.7	2310 71/32.6	1980 66/30.0	1540 58/26.6	1100 49/22.4	550 35/15.8
14	300	132	22	250	800	2.60	3160 90/34.8	2770 85/32.6	2370 78/30.4	1850 69/26.7	1320 59/22.4	650 41/15.8
14	300	132	22	350	1000	2.60	3160 90/34.8	2770 85/32.6	2370 78/30.4	1850 69/26.7	1320 59/22.4	650 41/15.8
14	400	176	22	250	900	3.50	4200 121/34.7	3680 113/32.5	3150 105/30.0	2450 93/26.4	1750 78/22.5	875 55/15.9
14	400	176	22	350	1100	3.50	4200 121/34.7	3680 113/32.5	3150 105/30.0	2450 93/26.4	1750 78/22.5	875 55/15.9
18	250	141	28	250	750	1.30	3370 66/51.2	2960 62/47.8	2540 57/44.5	1970 51/38.8	1410 43/32.8	700 30/23.3
18	250	141	28	350	950	1.30	3370 66/51.2	2960 62/47.8	2540 57/44.5	1970 51/38.8	1410 43/32.8	700 30/23.3
18	300	170	28	250	800	1.70	4080 83/49.2	3570 78/45.8	3060 72/42.5	2380 64/37.2	1700 54/31.5	850 38/22.4
18	300	170	28	350	1000	1.70	4080 83/49.2	3570 78/45.8	3060 72/42.5	2380 64/37.2	1700 54/31.5	850 38/22.4
18	400	226	28	250	900	2.30	5400 111/48.6	4740 104/45.6	4060 97/41.9	3160 85/37.2	2260 72/31.4	1130 51/22.2
18	400	226	28	350	1100	2.30	5400 111/48.6	4740 104/45.6	4060 97/41.9	3160 85/37.2	2260 72/31.4	1130 51/22.2
18	500	283	28	350	1200	2.70	6800 135/50.4	5960 127/47.0	5100 117/43.6	3840 102/37.6	2860 88/32.5	1420 62/23.0
18	600	339	28	250	1100	3.40	8150 166/49.0	7140 156/45.7	6130 144/42.7	4760 127/37.6	3400 107/31.8	1700 76/22.4
18	600	339	28	350	1300	3.40	8150 166/49.0	7140 156/45.7	6130 144/42.7	4760 127/37.6	3400 107/31.8	1700 76/22.4
18	800	452	28	250	1300	4.60	10800 222/48.8	9500 208/45.7	8140 193/42.1	6340 171/37.1	4530 144/31.5	2260 102/22.1
18	800	452	28	350	1500	4.60	10800 222/48.8	9500 208/45.7	8140 193/42.1	6340 171/37.1	4530 144/31.5	2260 102/22.1
25	300	236	35	400	1100	1.00	6040 77.8/77.8	4880 66.9/66.9	4080 64/64	3150 56.2/56.2	2180 46.7/46.7	1175 34.3/34.3
25	400	314	35	400	1200	1.34	7350 99/76	6920 95/73	5660 86/66	4400 76/58	3140 64/49	1760 48/36.5
30	500	472	45	400	1300	1.10	10800 109/99	9870 104/95	8450 96/88	6570 85/77.3	4700 72/65.4	2350 51/46.2
30	600	566	45	600	1400	1.28	13500 132/102	11800 123/96	10300 116/89	7900 102/77.5	5660 86/66	2820 61/46.5
30	1000	942	45	500	2000	2.10	22000 214/103	19800 204/97	17000 189/90	13200 160/79	9400 140/67	4700 100/47

* 电阻公差Resistance tolerance: ±20%

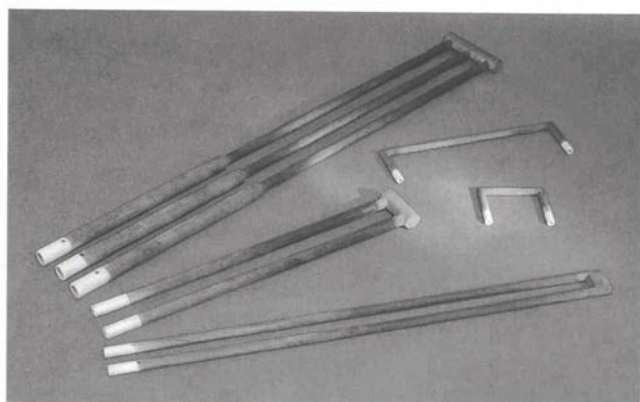


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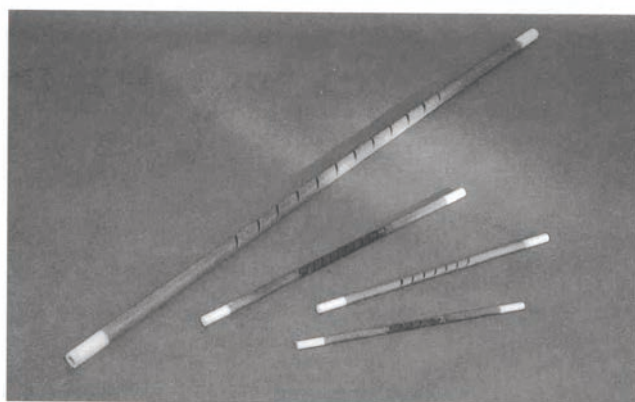


DB 型元件 DB type elements

3. U型元件 U type elements



4. SC型元件 SC type elements



元件 直径 Element Dia mm	额定负荷 (1050℃ 时测试) Nominal loading (at 1050℃)			
	发热部Hot Zone		冷端Cold End	
	Ω /mm	W/mm	Ω /mm	W/mm
12.0	0.01684	11.30	0.00110	0.60
14.0	0.01360	13.19	0.00090	0.80
16.0	0.00993	15.07	0.00080	1.00
20.0	0.00652	18.84	0.00040	1.10
25.0	0.00432	23.55	0.00030	1.20
30.0	0.00298	28.26	0.00020	1.30
31.7	0.00256	29.86	0.00013	1.40
35.0	0.00271	32.97	0.00015	1.50
38.1	0.00173	35.89	0.00009	1.60
40.0	0.00212	37.68	0.00010	1.70
44.4	0.00114	41.82	0.00007	1.80

* 电阻公差Resistance tolerance: $\pm 20\%$

元件 直径 Element Dia mm	额定负荷 (1050℃ 时测试) Nominal loading (at 1050℃)			
	发热部Hot Zone		冷端Cold End	
	Ω /mm	W/mm	Ω /mm	W/mm
12.0	0.02660	5.65	0.00576	0.25
14.0	0.02567	6.59	0.00450	0.30
16.0	0.02094	7.54	0.00387	0.50
20.0	0.01677	9.42	0.00291	0.60
25.0	0.01365	11.78	0.00174	0.93
30.0	0.01020	14.13	0.00120	0.95
31.7	0.00942	14.93	0.00114	0.97
35.0	0.00669	16.49	0.00096	0.98
38.1	0.00642	17.95	0.00075	0.99
40.0	0.00624	18.84	0.00072	1.00
44.4	0.00546	20.91	0.00066	1.02

* 电阻公差Resistance tolerance: $\pm 20\%$