

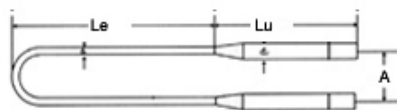
Zhen Zhou Chida Furnace Material Co.,Ltd

—Introduction of MoSi₂ Heating elements

General description

MoSi₂ heating element is a kind of resistance heating element basically made of high pure Molybdenum Disilicide .In oxidizing atmosphere ,on the surface of MoSi₂ element owing to the high temperature combustion a layer of compact quartz protective film is formed to prevent MoSi₂ from continuously oxidizing .In oxidizing atmosphere ,its Max temperature can reach 1800°C and its applicable temperature is 500—1700°C .It can be widely used in such applications as sintering and heat treatment on ceramics, magnet, glass, metallurgy, refractory, etc.We can offer different types of products-----ED type, W type, U type and L type to customers according to their needs.

U type Moly disilicide



Hot zone length:Le, mm

Cold end length:Lu, mm

Shank Spacing:A, mm

Diameter:D₁/D₂ , mm/mm (Le/Lu)

Specify as:

U D₁/D₂*Le*Lu*A

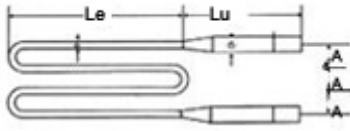
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W type Moly disilicide



Hot zone length: L_e , mm

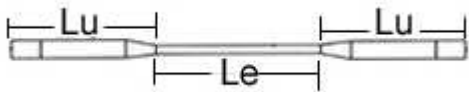
Cold end length: L_u , mm

Shank Spacing: A , mm

Diameter: D_1/D_2 , mm/mm (L_e/L_u)

Specify as: W $D_1/D_2 * L_e * L_u * 3A$

rod type moly disilicide



Hot zone length: L_e , mm

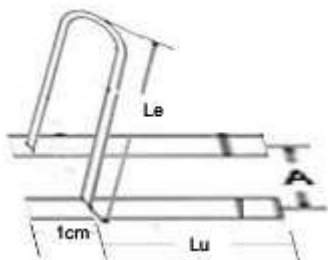
Cold end length: L_u , mm

Diameter: D_1/D_2 , mm/mm (L_e/L_u)

Specify as:

ED $D_1/D_2 * L_e * L_u$

L type Moly disilicide



Hot zone length: L_e , mm

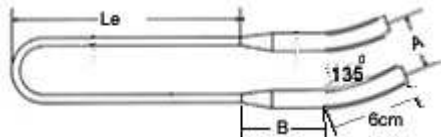
Cold end length: L_u , mm

Shank Spacing: A , mm

Diameter: D_1/D_2 , mm/mm (L_e/L_u)

Specify as: L $D_1/D_2 * L_e * L_u * A$

ARC type Moly disilicide



Hot zone length: L_e , mm

Cold end length: $L_u = B + 6$, mm

Shank Spacing: A , mm

Diameter: D_1/D_2 , mm/mm (L_e/L_u)

Specify as: ARC $D_1/D_2 * L_e * L_u * A$

Having the same mechanical character as other ceramic products, MoSi₂ heating elements belong to the brittleness material so that they are easy to rupture at the normal temperature, which brings some difficulty to transport and install, but it may be avoided if they were installed and used correctly.

physical property

Volume density	Bend strength	Vickers-nadness	Porosity rate	Water absorption	Hot extensibility
5.5— 5.6g/cm ³	15- 25kg/cm ²	(HV) 570kg/mm ²	7.4%	1.2%	4%

Chemical property

Oxygen-resistance under high temperature: in oxidizing atmosphere, on the surface of element owing to the high-temperature combustion a layer of compact quartz (SiO₂) protective film is formed to prevent MoSi₂ from continuously oxidizing. When the element temperature is higher than 1700°C, the SiO₂ protective film, whose fusing point

is 1710°C, is fused, and the SiO₂ is fused into molten drops owing to the action of its surface extension, so that it loses its protective ability. In the oxidizing atmosphere, when the element is continuously used, again the protective film forms. It should be pointed out that the element cannot be used for a rather long time in 400-700°C, or it will be powdered owing to the strong oxidizing action in low temperature.

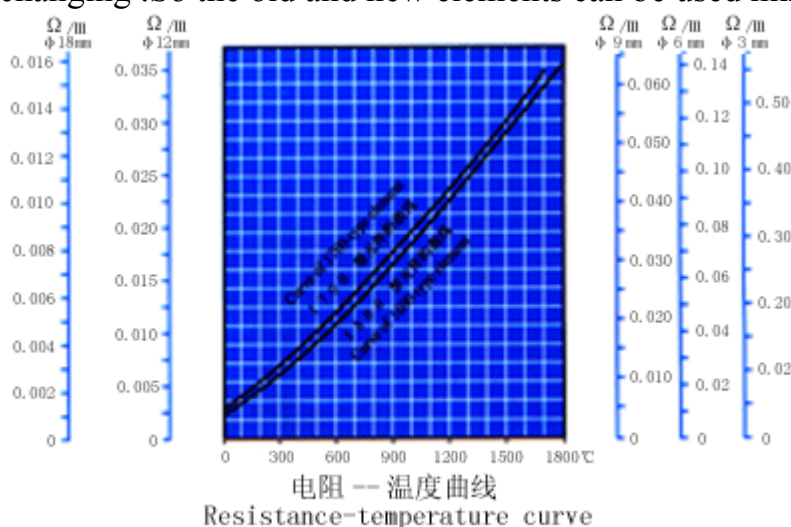
The Max temperature of elements in different atmospheres

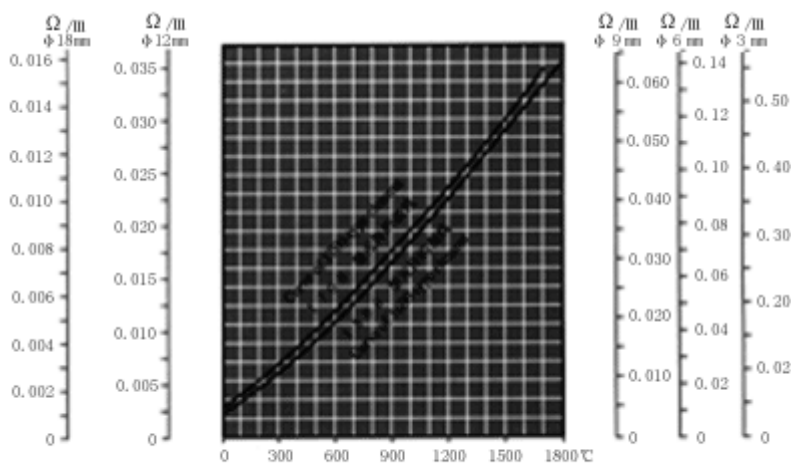
Atmosphere	Max element temperature	
	1700 type	1800 type
Air	1700	1800
Nitrogen	1600	1700
Argon, Helium	1600	1700
Hydrogen	1100—1450	1100—1450
N ₂ /H ₂ 95/5%	1250—1600	1250—1600
General applications	Most types of industrial furnace for heat treatment, forging, sintering, glass melting and refining and for use in radiant tubes.	Laboratory furnaces, testing equipment and high temperature sintering production furnace.

Electric property of elements

Resistance property

The resistivity of the element rapidly rises as the temperature rises, under normal operating conditions, generally the element resistance doesn't change with the service time changing. So the old and new elements can be used mixed.

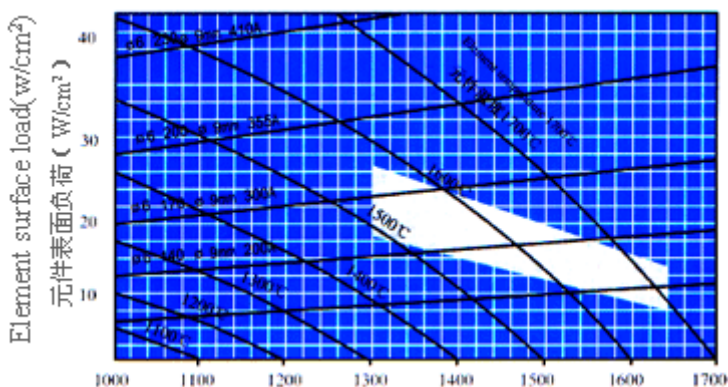




电阻—温度曲线
Resistance-temperature curve

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Surface load



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. Right figure shows the relation between the furnace temperature, the element temperature and the element surface load under the condition that the element radiation isn't obstructed. The shadow part in the figure shows the surface load-temperature range in common use. The figure still shows the reference current.

Recommend surface load

°C Furnace temp.	1400	1500	1600	1650	1700
Surface load of hotzone(W/cm ²)	< 18	< 15	< 12	< 10	< 8

Installation of MoSi₂ heating elements

Vertically hanging

Under normal temperature, MoSi₂ element is very brittleness, while under high temperature it is plasticity. So the better way for installation is the U shape element is to hang it vertically, to the furnace top through the support clamping chuck H. The aim of such way is to avoid putting the

mechanical stress directly to the element heat-generation end, or the element will easily be broken.

Support clamp

Support clamp are applied to $\Phi 9/18$ and $\Phi 6/12$ two kind of elements respectively. The support clamp supports the whole weight of the element and the position of the element is also determined by it. Therefore, it must be installed carefully to assure that the element is vertically hung. In order to prevent the element from being over heated locally, the taper part of the element lower end must put into the furnace chamber.

Wire clip

The wire connection clamp connecting MoSi₂ element is made of aluminum woven wire or multilayer aluminum foil. The steel plate outside it only acts as a clamp and isn't used for electric conduction. For $\Phi 6/12$ element, single rowing wire is used, and for $\Phi 9/18$ element, double-rowing wire is used. The end of the lead wire should be a little larger than linear distance between the element and bus.

When the element is installed, the thread fixing the wire clip shouldn't be screwed too much at one time, it can be tightened when the element rises to high temperature, as the element has some plastic and isn't easily broken. The temperature of the wire clip generally shouldn't be higher than 200°C. Therefore, the contact voltage between the clip wire and element should be lowered to 0.1V. In order to avoid that the radiation heat is conducted to the clip, the distance between the lower end of the clip and upper surface of the through brick should not less than 500mm. Generally for $\Phi 6/12$ element, 170A should not be used for a long time and for $\Phi 9/18$ element, 300A shouldn't be used.

Operation of MoSi₂ furnace

Drying of the furnace

The new built furnace or the furnace that haven't been used for a long time should be dried before use. The drying temperature will cause low-temperature oxidation. For the small-sized furnace, as its drying is long, it should be dried carefully. You'd better open the furnace gate to make it ventilated. The gate may be half-opened with the rising of temperature and fully closed when the temperature rises above 1000°C.

starting of the furnace

If the furnace has been dried or needn't to be dried, then it may be started to raise temperature. In order to avoid that it is impacted by over current and the electric device is overload, the following steps should be adapted:

Small furnace (power<100KW)		Large furnace (power100-500KW)	
Furnace temp.	Voltage	Furnace temp.	Voltage
20-150	1/3working voltage	20—300	1/3working voltage
150-500	2/3working voltage	300—700	2/3working voltage
500—Working temp.	Full working voltage	700—Working temp.	Full working voltage

Replacing of element

If it is found that one element is damaged during operating ,firstly ,you should determine where it is , at the same time prepare a made up one .Then loosen the thread which links the lead wire of the damaged element and the bus ,clear out the ceramic cotton and pull out the through-brick. Afterward, insert the new element from the furnace top ,link the lead wire ,block the gap with ceramic cotton and start raising temperature.

Reference data for MoSi2 heating elements

1,1800Grade U shape 3/6mm elements

Lu\Le	150mm	180	200	250	300	350
150 mm	397W 0.196Ω 8.8V	466 0.230 10.4	510 0.252 11.3	626 0.309 13.9	741 0.366 15.5	855 0.422 19.0
200	409 0.202 9.1	478 0.236 10.6	522 0.258 11.6	638 0.315 14.2	753 0.372 16.7	867 0.428 19.3
250	421 0.208 9.4	490 0.242 10.9	535 0.264 11.9	650 0.321 14.5	765 0.378 17.0	879 0.434 19.5
280	427 0.211 9.5	496 0.246 11.0	543 0.268 12.1	658 0.325 14.6	772 0.381 17.1	887 0.438 19.7
300	433 0.214 9.6	502 0.248 11.2	547 0.270 12.2	662 0.327 14.7	778 0.384 17.3	891 0.440 19.8
Condition: Power:W Element temp. 1700℃ Resistance: Ω Furnace temp. 1600℃ Working Voltage:V Current :45A Surface load:11.4W/cm ²						

2,1800Grade U shape 4/9mm elements

Lu\ Le	150mm	180	200	250	300	350
150 mm	459 0.111 7.2	549 0.130 8.5	604 0.143 9.3	739 0.175 11.4	875 0.207 13.5	1006 0.238 15.5
200	486 0.115	566 0.134	617 0.145	752 0.178	887 0.210	1022 0.242

	7.5	8.7	9.5	11.6	13.6	15.7
250	503	579	634	769	900	1035
	0.119	0.137	0.150	0.182	0.213	0.245
	707	8.9	9.8	11.8	13.8	15.9
280	507	587	642	777	908	1044
	0.120	0.139	0.152	0.184	0.215	0.247
	7.8	9.0	9.9	11.9	14.0	16.1
300	511	592	645	782	921	1052
	0.121	0.140	0.153	0.185	0.2184	0.249
	7.9	9.1	10.0	12.0	14.2	15.2
Condition: Power:W						
Element temp. 1700°C			Resistance: Ω			
Furnace temp. 1600°C			Working Voltage:V			
Current :65A						
Surface load:11.4W/cm ²						

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3, 1700Grade U shapeφ6/12mm MoSi2 Elements

Lu\Le	150	180	200	250	300	350	400	450	500	550	600
150	975	1155	1260	1560	1875	2160		Power:w Resistance:Ω Voltage:V			
	0.043	0.051	0.056	0.069	0.083	0.096					
	6.5	7.7	8.4	10.4	12.5	14.4					
200	1202	1200	1305	1605	1920	2205	2505				
	0.045	0.053	0.058	0.071	0.085	0.098	0.111				
	6.8	8.0	8.7	10.7	12.8	14.7	16.7				
250	1065	1245	1350	1650	1965	2250	2550	2853	3150		
	0.047	0.055	0.060	0.073	0.087	0.100	0.113	0.126	0.140		
	6.9	8.3	9.0	11.0	13.1	15.0	17.0	18.9	21.0		
270	1080	1260	1380	1665	1980	2265	2565	2850	3165		
	0.048	0.056	0.061	0.074	0.088	0.101	0.114	0.127	0.141		
	7.1	8.4	9.1	11.1	13.2	15.1	17.1	19.0	21.1		
300	1110	1290	1395	1695	2010	2295	2595	2880	3195	3495	3780
	0.049	0.057	0.062	0.075	0.089	0.102	0.115	0.128	0.142	0.155	0.168
	7.4	8.6	9.3	11.3	13.4	15.3	17.3	19.2	21.3	23.3	25.2
350	1155	1335	1440	1740	2055	2340	2640	2925	3240	3540	3825
	0.051	0.059	0.064	0.077	0.091	0.104	0.117	0.130	0.144	0.157	0.170
	7.7	8.9	9.6	11.6	13.7	15.6	17.6	19.5	21.6	23.6	25.5
400	1200	1380	1485	1785	2100	2385	2685	2970	3285	3585	3870
	0.053	0.061	0.066	0.079	0.093	0.106	0.119	0.132	0.146	0.159	0.172
	8.0	9.2	9.9	11.9	14.0	15.9	17.9	19.8	21.9	23.9	25.8
450		1425	1530	1830	2145	2430	2730	3015	3330	3630	3915
		0.063	0.068	0.081	0.095	0.108	0.121	0.134	0.148	0.161	0.174
		9.5	10.2	12.2	14.3	16.2	18.2	20.1	22.2	24.2	26.1
				1875	2190	2475	2775	3060	3375	3675	3960

500				0.083 12.5	0.097 14.6	0.110 16.5	0.123 18.5	0.136 20.4	0.150 22.5	0.163 24.5	0.176 26.4
550	Condition: Element temp. 1500°C Furnace temp. 1300°C				2235 0.099 14.9	2520 0.112 16.8	2820 0.125 18.8	3105 0.138 20.7	3420 0.152 22.8	3720 0.165 24.8	4005 0.178 26.7
600	Amperage 150A Surface load 15w/cm ²				2280 0.101 15.2	2565 0.114 17.1	2865 0.127 19.1	3150 0.140 21.0	3465 0.154 23.1	3765 0.167 25.1	4050 0.180 27.0
650							2910 0.129 19.4	3195 0.142 21.3	3510 0.156 23.4	3810 0.169 25.4	4095 0.182 27.3
700								3240 0.144 21.6	3555 0.158 23.7	3855 0.171 25.7	4140 0.184 27.6

4,1700Grade U Shape 9/18mm MoSi2 Elements

Lu/Le	150	180	200	250	300	350	400	450	500	550	600	650	700	750
250	1440 0.019 5.2	1740 0.023 6.3	1890 0.025 6.9	2340 0.031 8.5	2800 0.037 10.2	3250 0.043 11.8	3700 0.049 13.5	4160 0.061 16.8	4610 0.061 16.8	5070 0.067 18.4	5520 0.073 20.1	5970 0.079 21.7	6430 0.085 23.4	6880 0.091 25.0
300	1510 0.020 5.5	1810 0.024 6.6	1960 0.026 7.2	2420 0.032 8.8	2870 0.038 10.5	3330 0.044 12.1	3780 0.050 13.8	4240 0.056 15.4	4690 0.062 17.1	5140 0.068 18.7	5600 0.074 20.4	6050 0.080 22.0	6500 0.086 23.7	6960 0.092 25.3
350	1590 0.021 5.8	1890 0.025 6.9	2040 0.027 7.5	2500 0.033 9.1	2950 0.039 10.7	3400 0.045 12.4	3850 0.051 14.1	4310 0.057 15.7	4760 0.063 17.3	5220 0.069 19.0	5670 0.075 20.6	6130 0.081 22.3	6580 0.087 23.9	7030 0.093 25.6
400	1670 0.022 6.1	1970 0.026 7.2	2120 0.028 7.8	2570 0.034 9.4	3030 0.040 11.0	3480 0.046 12.7	3930 0.052 14.3	4390 0.058 16.0	4840 0.064 17.6	5290 0.070 19.3	5750 0.076 20.9	6200 0.082 22.6	6660 0.088 24.2	7110 0.094 25.9
450		2040 0.027 7.4	2190 0.029 8.0	2650 0.035 9.6	3100 0.041 11.3	3550 0.047 12.9	4010 0.053 14.6	4460 0.059 16.2	4920 0.065 17.9	5370 0.071 19.5	5820 0.077 21.2	6280 0.083 22.8	6730 0.089 24.5	7180 0.095 26.1
500			2270 0.030 8.3	2720 0.036 9.9	3180 0.042 11.6	3630 0.048 13.2	4080 0.054 14.9	4540 0.060 16.5	4990 0.066 18.2	5450 0.072 19.8	5900 0.078 21.5	6350 0.084 23.1	6800 0.090 24.8	7260 0.096 26.4
550				2800 0.037 10.2	3250 0.043 11.8	3700 0.049 13.5	4160 0.055 15.1	4610 0.061 16.8	5070 0.067 18.4	5520 0.073 20.0	5970 0.079 21.7	6430 0.085 23.4	6880 0.091 25.0	7340 0.097 26.7
600				2870 0.037 10.2	3250 0.043 11.8	3700 0.049 13.5	4160 0.055 15.1	4610 0.061 16.8	5070 0.067 18.4	5520 0.073 20.0	5970 0.079 21.7	6430 0.085 23.4	6880 0.091 25.0	7340 0.097 26.7
	Power:W				3400	3860	4310	4760	5220	5670	6050	6500	6960	7410

650	Resistance: Ω		0.045	0.051	0.057	0.063	0.069	0.074	0.080	0.086	0.092	0.098
	Voltage:V		12.4	14.0	15.7	17.3	19.0	20.3	22.0	23.7	25.3	27.0
700	Condition: Element	temp.	3480	3860	4310	4760	5220	5670	6130	6580	7030	7490
			0.045	0.051	0.057	0.063	0.069	0.075	0.081	0.087	0.093	0.099
750	Furnace	temp.		4010	4460	4920	5370	5820	6280	6730	7180	7640
				0.053	0.059	0.065	0.071	0.077	0.083	0.089	0.095	0.101
800	Amperage:275A Surface load:15W/cm ²			14.6	16.2	16.2	19.5	21.2	22.8	24.5	26.1	27.8
				4080	4540	4990	5450	5900	6350	6800	7260	7710
				0.054	0.060	0.066	0.072	0.078	0.084	0.090	0.096	0.102
				14.9	16.5	18.2	19.8	21.5	23.1	24.8	26.4	28.1

5. 1800Grade U shape ϕ 6/12mm MoSi2 Elements

Lu\Le	150	180	200	250	300	350	400	450	500	550	600	
150	750	890	990	1240	1490	1730	Power:W					
	0.048	0.057	0.063	0.079	0.095	0.110	Resistance: Ω					
	6.0	7.1	7.9	9.9	11.9	13.8	Working voltage:V					
200	790	930	1010	1260	1510	1750	1980					
	0.050	0.059	0.065	0.081	0.097	0.112	0.126					
	6.3	7.4	8.1	10.1	12.1	14.0	15.8					
250	810	950	1050	1300	1550	1790	2000	2200	2440			
	0.052	0.061	0.067	0.083	0.099	0.114	0.128	0.141	0.156			
	6.5	7.6	8.4	10.4	12.4	14.3	16.0	17.6	19.5			
270	850	990	1080	1330	1580	1810	2040	2240	2480			
	0.054	0.063	0.069	0.085	0.101	0.116	0.130	0.143	0.158			
	6.8	7.9	8.6	10.6	12.6	14.5	16.3	17.9	19.8			
300	880	1010	1110	1360	1610	1850	2060	2260	2500	2690	2930	
	0.056	0.065	0.071	0.087	0.103	0.118	0.132	0.145	0.160	0.172	0.187	
	7.0	8.1	8.9	10.9	12.9	14.8	16.5	18.1	20.0	21.5	23.4	
350	910	1050	1140	1390	1640	1880	2100	2300	2540	2730	2950	
	0.058	0.067	0.073	0.089	0.105	0.120	0.134	0.147	0.162	0.174	0.189	
	7.3	8.4	9.1	11.1	13.1	15.0	16.8	18.4	20.3	21.8	23.6	
400	940	1080	1180	1430	1680	1910	2130	2330	2560	2750	2990	
	0.060	0.069	0.075	0.091	0.107	0.122	0.136	0.149	0.164	0.176	0.191	
	7.5	8.6	9.4	11.4	13.4	15.3	17.0	18.6	20.5	22.0	23.9	
450		1110	1200	1450	1700	1940	2170	2360	2600	2790	3010	
		0.071	0.077	0.093	0.109	0.124	0.138	0.151	0.166	0.178	0.193	
		8.9	9.6	11.6	13.6	15.5	17.3	18.9	20.8	22.3	24.1	
500				1490	1740	1980	2190	2390	2630	2810	3050	
				0.095	0.111	0.126	0.140	0.153	0.168	0.180	0.195	
				11.9	13.9	15.8	17.5	19.1	21.0	21.0	24.6	
550	Condition:				1760	2000	2230	2430	2660	2850	3080	
	Element temp. 1700°C				0.113	0.128	0.142	0.155	0.170	0.182	0.197	
					14.1	16.0	17.8	19.4	21.3	22.8	24.6	

600	Furnace temp. 1600°C Current:125A	1800	2040	2250	2450	2690	2880	3110
		0.115 14.4	0.130 16.3	0.144 18.0	0.157 19.6	0.172 21.5	0.184 23.0	0.199 24.9
650	Surface load:11.4w/cm ²			2290	2490	2730	2910	3140
				0146 18.3	0.159 19.9	0.174 21.8	0.186 23.3	0.201 25.1
700					2510	2750	2940	3180
					0.161 20.1	0.176 22.0	0.188 23.5	0.203 25.4

6, 1800 U shapeφ9/18mm MoSi2 Elements

Lu\Le	150	180	200	250	300	350	400	450	500	550	600	650	700
250	1110	1320	1470	1820	2180	2480	2840	3190	3540	3900	4200	4560	4910
	0.022	0.026	0.029	0.036	0.043	0.049	0.056	0.063	0.070	0.077	0.083	0.090	0.09
	5.0	5.9	6.5	8.1	9.7	11.0	12.6	14.2	15.8	17.3	18.7	20.3	21.8
300	1160	1370	1520	1870	2230	2530	2890	3240	3590	2950	4250	4610	4960
	0.023	0.027	0.030	0.037	0.044	0.050	0.057	0.064	0.071	0.078	0.084	0.091	0.09
	5.2	6.1	6.8	8.3	9.9	11.3	12.8	14.4	16.0	17.6	18.9	20.5	22.1
350	1220	1420	1570	1920	2280	2580	2940	3290	3650	4000	4300	1660	5010
	0.0247	0.028	0.031	0.038	0.045	0.051	0.058	0.065	0.072	0.079	0.085	0.092	0.09
	5.4	6.3	7.0	8.6	10.1	11.5	13.1	14.6	16.2	17.8	19.1	20.7	22.3
400	1270	1470	1620	1970	2330	2630	2990	3340	3700	4050	4350	4710	5060
	0.025	0.029	0.032	0.039	0.046	0.052	0.059	0.066	0.073	0.080	0.086	0.093	0.10
	5.6	6.5	7.2	8.8	10.4	11.7	13.3	14.9	16.4	18.0	19.4	20.9	22.5
450	1320	1520	1670	2030	2380	2680	3040	3390	3750	4100	4400	4760	5110
	0.026	0.030	0.033	0.040	0.047	0.053	0.060	0.067	0.074	0.081	0.087	0.094	0.10
	5.9	6.8	7.4	9.0	10.6	11.9	13.5	15.1	16.7	18.2	19.6	21.2	22.7
500			1720	2080	2430	2730	3090	3440	3800	4150	4460	4810	5160
			0.034	0.041	0.048	0.054	0.061	0.068	0.075	0.082	0.088	0.095	0.10
			7.7	9.2	10.8	12.2	13.7	15.3	16.9	18.5	19.8	21.4	23.0
550				2130	2480	2780	3140	3490	3850	4200	4510	4860	5210
				0.042	0.049	0.055	0.062	0.069	0.076	0.083	0.089	0.096	0.10
				9.5	11.0	12.4	14.0	15.5	17.1	18.7	20.0	21.6	23.2
600				2180	2530	2830	3190	3540	3900	4250	4560	4910	5270
				0.043	0.050	0.056	0.063	0.070	0.077	0.084	0.090	0.097	0.10
				9.7	11.3	12.6	14.2	15.8	17.3	18.9	20.3	21.8	23.4
650					2580	2880	3240	3590	3950	5300	4610	4960	5320
					0.051	0.057	0.064	0.071	0.078	0.085	0.091	0.098	0.10
					11.5	12.8	14.4	16.0	17.6	19.1	2.05	22.1	23.6
700	Power:w				2630	2940	3290	3650	4000	4350	4660	5010	5370
	Resistance: Ω				0.052	0.058	0.065	0.072	0.079	0.086	0.092	0.099	0.10
	Working Voltage:V				11.7	13.1	14.6	16.2	17.8	19.4	20.7	22.3	23.9
750	Condition:					2990	3340	3700	4050	4400	4710	5060	5420
						0.059	0.066	0.073	0.080	0.087	0.093	0.100	0.10

	Element temp.1700°C		13.3	14.9	16.4	18.0	19.6	20.9	22.5	24.1
800	Furnace temp.1600°C		3040	3390	3750	4100	4460	4760	5110	5470
	Current:22.5A		0.060	0.067	0.074	0.081	0.088	0.094	0.101	0.10
	Surfaceload:11.4 w/cm ²		13.5	15.1	16.7	18.2	19.8	21.2	22.7	24.3

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