Table relating to Diameter, Temperature and Current

In case of SILVER No.1 / Ampere　Table 8

Dia. mm	Temp. ℃									
	200	300	400	500	600	700	800	900	1000	1100
0.10	0.28	0.37	0.45	0.52	0.59	0.68	0.78	0.88	0.98	1.07
0.11	0.31	0.42	0.50	0.58	0.67	0.77	0.88	1.00	1.10	1.20
0.12	0.35	0.46	0.56	0.64	0.74	0.86	1.00	1.10	1.23	1.35
0.13	0.38	0.50	0.61	0.71	0.82	0.95	1.09	1.22	1.38	1.50
0.14	0.42	0.55	0.67	0.78	0.90	1.05	1.20	1.34	1.50	1.65
0.15	0.45	0.59	0.73	0.84	0.98	1.12	1.30	1.46	1.63	1.80
0.16	0.49	0.64	0.79	0.91	1.06	1.23	1.40	1.60	1.79	1.98
0.18	0.56	0.74	0.92	1.06	1.25	1.42	1.62	1.85	2.0	2.3
0.20	0.64	0.84	1.05	1.21	1.42	1.63	1.85	2.1	2.4	2.6
0.23	0.76	1.00	1.25	1.45	1.70	1.90	2.2	2.5	2.8	3.2
0.26	0.88	1.13	1.45	1.70	2.0	2.3	2.6	2.9	3.3	3.7
0.29	1.00	1.30	1.65	1.90	2.3	2.6	3.0	3.4	3.8	4.3
0.32	1.13	1.45	1.86	2.2	2.6	2.9	3.4	3.9	4.4	4.9
0.35	1.26	1.60	2.1	2.5	2.9	3.3	3.7	4.3	4.8	5.5
0.40	1.50	1.92	2.5	2.9	3.4	3.9	4.5	5.2	5.9	6.7
0.45	1.75	2.3	2.9	3.3	4.0	4.6	5.2	5.9	6.7	7.6
0.50	2.0	2.6	3.4	3.8	4.6	5.3	6.3	7.1	8.2	9.2
0.55	2.3	2.9	3.8	4.3	5.2	6.0	7.0	8.0	9.2	10.5
0.60	2.5	3.2	4.2	4.8	5.8	6.8	7.8	9.0	10.3	12.0
0.65	2.8	3.6	4.7	5.4	6.5	7.5	8.7	10.0	11.6	13.2
0.70	3.0	3.9	5.1	5.9	7.1	8.3	9.7	11.0	12.9	14.7
0.75	3.3	4.3	5.6	6.5	7.8	9.0	10.7	12.4	14.0	16.0
0.80	3.5	4.7	6.1	7.0	8.5	10.0	11.8	13.5	15.5	17.5
0.85	3.9	5.1	6.6	7.7	9.3	10.8	12.8	14.8	17.0	19.3
0.90	4.1	5.5	7.1	8.2	10.0	11.8	14.0	16.0	18.2	21
1.0	4.7	6.1	8.0	9.4	11.5	13.5	15.5	17.5	20	23
1.1	5.2	7.0	9.0	10.8	13.0	15.4	18.2	21	24	27
1.2	5.9	7.8	10.5	11.8	14.0	16.1	20	23	27	31
1.3	6.4	8.7	11.3	13.3	16.2	19.0	23	26	30	35
1.4	7.0	9.5	12.5	14.6	18.0	21	26	29	34	39
1.5	7.6	10.4	13.6	16.0	19.5	23	28	32	37	42
1.6	8.2	11.3	15.0	17.5	21	26	31	35	41	46
1.8	9.7	13.2	17.3	21	25	30	33	42	48	55
2.0	11.0	15.0	20	24	29	35	41	49	56	64
2.3	13.2	18.1	24	29	35	42	52	60	69	79
2.6	15.5	22	28	34	42	50	62	72	83	93
2.9	18.8	26	34	40	49	59	72	84	98	111
3.2	22	30	39	46	57	68	83	98	114	130
3.5	25	34	44	53	66	78	96	113	130	150
4.0	31	42	54	65	80	94	113	133	159	180
4.5	36	50	64	77	94	115	140	160	190	215
5.0	43	59	75	90	112	135	164	190	220	250
5.5	49	69	97	105	130	155	190	220	255	290
6.0	56	78	98	119	147	175	210	250	290	325
6.5	63	88	112	135	165	198	242	282	325	365
7.0	71	99	125	150	180	220	270	315	360	410
8.0	86	120	150	183	225	270	325	380	440	500

Note (1) Currents listed in the Table 8 shows that of straightened wires horizontally tensioned in air.
(2) How to use the current figures listed above is on papg 17.
(3) To convert the SILVER No. 1 value in Table 8 to those of other classes, multiply by the appropriate conversion factor shown below.

Conversion factor

Table 9

Class	Conversion factor
SILVER No.2	0.96
SILVER No.3, No.30	0.87
SILVER No.4	0.93

Some technical advice in designing heating elements

1. Selection of suitable class

Electrical heating wires or rolled wires have their own characteristics depending on their classes, and the most important thing for users is how to select suitable class in operating conditions.

2.Selection of wire diameter

To prolong the service life of electrical heating wire, watts density should be reduced to a extent as small as possible. When the element temperature is more than 900°C, line voltage and type of line commection should be selected so that the sectional area of wire becomes as large as possible.

By given powers (W) and voltage (V), currents (A) can be calculated. Thus, the proper wire diameter is determined using the Table 8. For the closed type electric furnaces, furnace temperature, amperes and wire diameters are shown in Table 10.

Table 10

Furnace temperature °C	Applicable amperes and wire diameter
800～1000	Select wire diameter corresponding to amperes at about 500°C on Table 8.
900～1100	Select wire diameter corresponding to amperes at about 400°C on Table 8.
1000～1200	Select wire diameter corresponding to amperes at about 300°C on Table 8.

When wire diameter is determined by watt density, select the wire diameter corresponding to the density of 1–5W/cm2 for a closed type electric furnace, and 6~15W/cm2 for an open type.

3.Shape of spiral

Generally speaking, wire is used in a shape of spiral.
In this case, inner diameter of spirals should be less than 10 times the wire diameter, and the pitch of them should be kept to 2~3 times the wire diameter.

4.Materials of terminals

Attention should be paid to the material of terminals.
In general, terminals made from brass or nickel-plated iron are available. But brass will cause the zinc (a chemical component of brass) to oxidize and form an insulating film when heated at more than approx. 150°C. This may happen to lose electric contact.

As a material for terminals, austenitic stainless steel is the most satisfactory and recommendable ones due to its good resistant properties to heat and corrosion.

5.Sectional area of terminal

Terminals frequently cause malfunction from overheating. Accordingly, sectional area of terminal rod is successfully recommended about 3 times larger than that of element.

6.Coefficient of Resistance with temperature

Coefficient of resistance with temperature shown in P14 Chart 1 varys depending on their chemical compositions or diameters, Therefore, wattage modifications applying the result derived from the actual device is important.

Operating temperature and Service life

The clear corelations between operating temperature and service life of : elements can not be briefly estimated because atmospheres used or device's specification varys case by case. Therefore in Japan, as like to abroad, an accelarated oxidation test is carried out on JIS C 2524 which is tested under settled conditions of intermittent heating.
Generally speaking, the life of element in intermittent heating operation is shorter than that of continuous heating operation.

The reason is why the scaling out of element protective film in intermittent heating is faster and severer as comparaed with the case of continuous heating.
Our long experience is telling the ratio of life value between the intermittent heating and continuous heating is as Tabel 11.

Table 11　The ratio of life value (Reference)

Class	Ratio	
	Intermittent heating	Continuous heating
Ni-Cr series	1	1.5～2.0
Fe-Cr series	1	3.0～4.0

Diameter and maximum operating temperature

For reference to our customer's, rough relations between diameter of element and its maximum operating temperature is shown on Table 12. Thinner the diameter of wire, lower the maximum operating temperature.
Table 12 shows the maximum operating temperature when the service life of elements fabricated in device is supposed to be about 1000 hours in open air.
However, this does not mean the guarantee of our customer's expectant service life of elements.

Table 12　Class, diameter and maximum operating temp. (Reference) (°C)

Class	Dia. mm				
	0.1 \ 0.2	0.3 \ 0.5	0.6 \ 1.0	1.2 \ 2.9	3.0 以上
SILVER No.1	850	950	1050	1100	1150
SILVER No.2	700	800	900	950	1000
SILVER No.3	900	1000	1100	1200	1250
SILVER No.30	950	1050	1150	1250	1300
SILVER No.4	750	850	950	1050	1100