



NGK BERYLCO

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Beryllium Copper Alloys

Meet tomorrow's technical challenges



NON-SPARKING Good formability
ELECTRICAL CONDUCTIVITY **HIGH FATIGUE LIFE**
Wear & abrasion resistance **MECHANICAL HIGH STRENGTH**
STRESS RELAXATION Wide temperature range Hardness
THERMAL CONDUCTIVITY Corrosion resistance **NON-MAGNETIC**

Security • Reliability • Performance



ADVANTAGES

- High strength
- High fatigue life
- Good conductivity
- Good formability
- Corrosion resistance
- Stress relaxation
- Wear & abrasion resistance
- Wide temperature range
- Non-magnetic
- Non-sparking



MARKETS

- Automotive
- Aerospace
- Electrical & Electronic
- Telecommunication
- Home appliances
- Nuclear energy
- Offshore
- Biomedical & Medical
- Photovoltaic
- Watch making
- Defence & Military
- Railway ...



Unique combinations of mechanical and electrical properties

The Berylco Beryllium Copper alloys are the most versatile of all copper alloys.

They combine a wide range of properties that make our alloys the ideal materials to meet the exacting requirements of many products demanding high specifications that are used in the most diverse markets.

The Berylco alloys offer a wide combination of mechanical and electrical properties, combining with excellent formability which is unique for copper alloys.

The mechanical strength achieved after a simple heat treatment, at low temperature, ranks highest amongst all the copper-based alloys, and combined with a high electrical conductivity outperforms any bronze alloys.

Our alloys exhibit a wide range of desired properties such as high fatigue strength, excellent corrosion, wear and abrasion resistance.

They are also non-magnetic and non-sparking.

All manufacturing technologies such as casting, forging, extrusion, cold drawing, cold rolling, stamping, machining, soldering, plating, and many others, can be used to produce any beryllium copper parts.

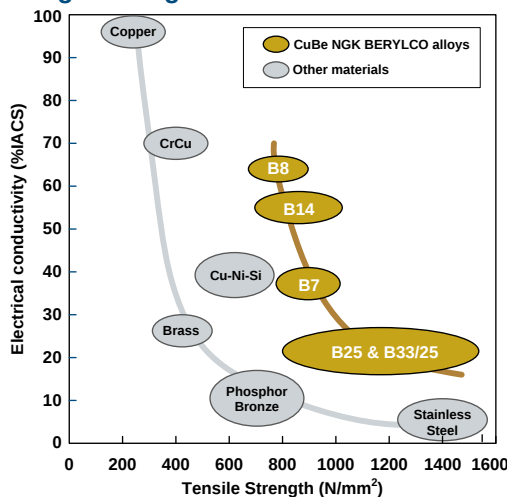
Meet tomorrow's technological challenges

Demands for cost, quality, miniaturisation, reliability, safety, environmental protection and high-end general performance require suitable high-performance alloys such as beryllium copper.

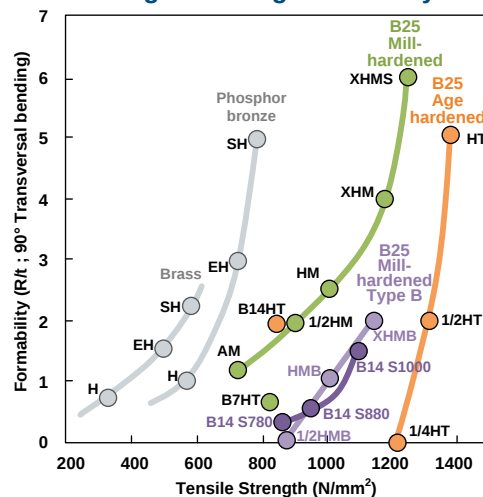
The available data is to be referred to by the user to select the correct alloy and temper and the alloy which will provide optimum properties and yet be compatible with the forming of the part.

For a given problem we can investigate the possibility of improving the formability while retaining the desired mechanical properties. For these special investigations NGK Berylco offers the services of its engineers and technical advisors.

High Strength & Electrical Conductivity



High Bending Formability



Berylco CuBe Alloys Properties

	Designation	Chemical composition (%)	Product form	Characteristics
High Strength alloy	BERYLCO 25*	Be : 1.8 - 2.0 % Co : 0.3 % max. Co + Ni + Fe : 0.6 % max. Cu + additions : 99.5 % min	Strip Rod Wire	B25 alloy offers a wide combination of properties ranging from good electrical conductivity, good formability, and very high mechanical and electrical properties after heat treatment.
	ISO CuBe2 EN CW101C UNS C17200			
High Strength alloy	BERYLCO 33/25	Be : 1.8 - 2.0 % Co : 0.3 % max. Co + Ni + Fe : 0.6 % max. Pb : 0.2 % min. Cu + additions : 99.5 % min	Rod Wire	Free machining very high strength alloys. Its small addition of lead gives a very good machinability index. Its mechanical properties are identical to Berylco 25.
	ISO CuBe2Pb EN CW102C UNS C17300			
High Conductivity alloys	BERYLCO 14	Be : 0.2 - 0.6 % Ni : 1.8 - 2.2 % Cu + additions : 99.5 % min	Strip Rod Wire	B14 alloy combines good mechanical properties and high electrical conductivity. B14S mill hardened strip product offers an excellent formability superior to any other copper alloy.
	ISO CuNi2Be EN CW110C UNS C17510			
	BERYLCO 8	Be : 0.2 - 0.6 % Ni : 1.4 - 2.2 % Cu + additions : 99.5 % min	Strip	B8 alloy combines very high electrical conductivity (>60 %IACS) and good mechanical properties. It is recommended for products exposed to high temperature.
	ISO CuNi2Be EN CW110C UNS C17510			
High Conductivity alloys	BERYLCO 7	Be : 0.2 - 0.4 % Ni + Co : 1.8 - 2.5 % Al : 0.6 % max Cu+Be+Ni+Co+Al : 99.5 % min	Strip	B7 alloy offers an excellent combination of mechanical, formability and electrical properties, and are recommended for large production batch applications.
	ISO CuNi2Be UNS C17530			

*The chemical composition complies with EN 1654 and EN 1652 standards.

STRIP • ROD • WIRE • TUBE • PLATE • CHILL-VENT



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Physical properties after precipitation hardening		Berylco 25 & 33/25	Berylco 14	Berylco 8	Berylco 7
Melting point	°C	865	1004	1004	1050
Density	g/cm ³ at 20°C	8.36	8.82	8.82	8.71
Specific heat	J·kg ⁻¹ ·K ⁻¹ at 20°C	419	419	419	419
Coefficient of linear expansion	x10 ⁻⁶ /°C at 20° to 200°C	17.8	17.6	17.6	17.6
Electrical resistivity ρ (maxi)	10 ⁻⁸ Ω.m at 20°C	7.9	7.9	3.8	3.1
Electrical conductivity	% IACS at 20°C	21 - 25	55 - 67	60 - 70	41 - 45
Thermal conductivity	W/(m.K) at 20°C	85 - 100	220 - 270	280 - 300	170 - 200
Modulus of elasticity	N/mm ²	127 000	132 000	132 000	127 000
Modulus of rigidity	N/mm ²	49 000	52 000	52 000	49 000
Poisson's ratio		0.3	0.3	0.3	0.3
Magnetic permeability	μ (μ=1+4πk)	1.000042	1.000031	1.000031	1.000027
Fatigue resistance	N/mm ² for 10 ⁸ cycles	≥ 300	≥ 240	≥ 240	≥ 250

■ The values given in the table above are just for information purpose

Standards of Reference

Authority	Strip	Rod and Wire
EN	1652, 1654	12163, 12164, 12165, 12166, 12167
ASTM	B194, B534	B196, B197, B442, B441
CDA and SAE	C17200, C17000, C17510, C17530	C17200, C17300, C17510
JIS	H3130 C1720 P.R, H3130 C1751 P.R	H3270 C1720 B.W
AFNOR ⁽¹⁾	A51.109 ⁽¹⁾	A51.114 ⁽¹⁾ , A51.414 ⁽¹⁾ , NFL14.709
DIN ⁽¹⁾	17666 ⁽¹⁾ , 17670 ⁽¹⁾ , 1777 ⁽¹⁾	17666 ⁽¹⁾ , 17672 ⁽¹⁾
British Standard ⁽¹⁾	BS 2870 ⁽¹⁾	BS 2873 ⁽¹⁾ , BS 2874 ⁽¹⁾
Federal USA ⁽²⁾	QQ-C-533 ⁽²⁾	QQ-C-530 ⁽²⁾

■ Specifications replaced by the EN ⁽¹⁾ and ASTM ⁽²⁾ specifications. Withdrawn and superseded specifications are listed for reference only and are not to be used for purchasing.

/! Any requirement must be specified at time of order placement.

Please contact NGK Berylco to determine the appropriate replacement specification

Strip – Standard Properties

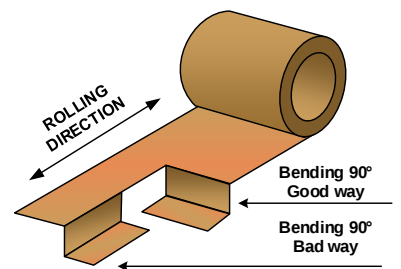
Alloy		Temper	TS (MPa)	YS 0.2% (MPa)	Elongation A ₅₀ mini (%)	Hardness (HV)	*Electrical Conductivity (% IACS)	Heat Treatment	*Formability R/t at 90° bending	
									Trans.	Long.
High Strength	B25	■ Age hardenable (delivered material temper)								
		A TB00	410 – 540	190 – 380	35	90 – 150	≥ 15	---	0.0	0.0
		1/4 H TD01	510 – 610	400 – 560	15	130 – 190	≥ 17		0.0	0.0
		1/2 H TD02	590 – 690	510 – 660	8	180 – 220	≥ 17		1.0	2.0
		H TD04	690 – 830	650 – 800	2	215 – 270	≥ 17		2.0	5.0
		■ Age hardened (heat treated by client)								
		AT TF00	1130 – 1350	960 – 1210	3	350 – 410	≥ 22	3h at 316°C	--	--
		1/4 HT TH01	1210 – 1400	1020 – 1280	3	360 – 430	≥ 22	2h at 316°C	--	--
		1/2 HT TH02	1260 – 1450	1090 – 1350	1	370 – 440	≥ 22		--	--
		HT TH04	1310 – 1520	1130 – 1420	1	380 – 450	≥ 22		--	--
		■ Mill hardened (delivered material temper)								
		1/4 HM TM01	750 – 870	550 – 760	15	235 – 280	≥ 17	M	1.3	1.8
		1/2 HM TM02	830 – 960	650 – 850	12	260 – 310	≥ 20		1.5	2.0
		HM TM04	930 – 1080	750 – 980	9	290 – 350	≥ 23		2.3	2.5
		SHM TM05	1030 – 1150	860 – 1020	9	310 – 360	≥ 23		2.5	3.0
		XHM TM06	1100 – 1250	930 – 1180	4	345 – 395	≥ 23		3.0	4.0
		XHMS TM08	1200 – 1320	1030 – 1230	3	365 – 420	≥ 23		4.0	6.0
		■ Mill hardened. high formability (delivered material temper)								
		1/2 HMB	830 – 930	660 – 860	12	255 – 310	≥ 17	M	0.0	0.0
		HMB	930 – 1030	760 – 930	9	280 – 340	≥ 20		1.0	1.0
		HMB-SHF	930 – 1030	760 – 930	9	280 – 340	≥ 20		0.8	0.8
		XHMB	1070 – 1210	930 – 1170	4	330 – 390	≥ 20		2.0	2.0
		XHMB-SHF	1070 – 1210	930 – 1170	4	330 – 390	≥ 20		1.5	1.5
High Conductivity	B14	■ Age hardenable (delivered material temper)								
		A TB00	250 – 380	140 – 300	20	60 – 130	≥ 22	---	0.0	0.0
		H TD04	480 – 600	370 – 560	2	140 – 185	≥ 22	---	2.0	3.0
		■ Age hardened (heat treated by NGK or by client)								
		AT TF00	680 – 750	550 – 690	8	190 – 250	≥ 55	M or 3h at 480°C	--	--
		HT TH04	750 – 950	670 – 900	5	220 – 270	≥ 55	M or 2h at 480°C	2.0	2.0
		■ Mill hardened. high formability (delivered material temper)								
		S780	780 – 930	680 – 850	12	220 – 270	≥ 60	M	0.3	0.3
		S880	880 – 1020	780 – 950	10	250 – 310	≥ 50		0.7	0.7
		SHC-S1000	930 – 1070	850 (min)	5	280 – 330	≥ 45		1.5	1.5
	B8	■ Mill hardened (delivered material temper)								
		1/2 HT TH02	650 – 800	550 – 690	10	180 – 230	≥ 60	M	0.8	0.8
		HT TH04	700 – 870	600 – 780	5	210 – 260	≥ 60		1.0	1.0
	B7	■ Mill hardened (delivered material temper)								
		1/2 HT TH02	670 – 800	550 – 760	10	195 – 250	≥ 38	M	0.0	0.0
		HT TH04	765 – 900	685 – 830	8	220 – 275	≥ 33		0.5	1.0
		EHT TH04	870 – 1000	750 – 930	4	250 – 310	≥ 30		1.0	1.5

*Values given for reference only

■ Properties are applicable to thickness $0.1 \leq t < 1.0$ mm.

■ M ("Mill Hardened") indicates that the metal has been submitted to a heat treatment especially designed to give characteristics falling within a guaranteed range specific properties.

■ The formability R/t ratio allows a bending radius at 90° without cracking in the direction of rolling (transversal (good way) and longitudinal (bad way) bending ways). Typical R/t values are applicable for strip of 0.25 mm thick or less.
R = radius of bending ; t = thickness of the strip.



Strip Dimensional Tolerances

Tolerances on thickness (mm)		
Thickness	Standard	Precision
< 0.099	± 0.004	± 0.004
0.10 – 0.149	± 0.005	± 0.004
0.15 – 0.199	± 0.006	± 0.004
0.20 – 0.249	± 0.007	± 0.005
0.25 – 0.299	± 0.008	± 0.006
0.30 – 0.399	± 0.009	± 0.007
0.40 – 0.499	± 0.010	± 0.008
0.50 – 0.599	± 0.013	± 0.009
0.60 – 0.799	± 0.015	± 0.010
0.80 – 0.999	± 0.030	On demand
1.00 – 1.199	± 0.035	On demand
1.20 – 1.499	± 0.045	On demand
1.50 – 2.000	± 0.050	On demand

Tolerances on width (mm)				
Thickness	Width	from 3 to 49.9	from 50 to 100	> 100
≤ 0.80 mm	standard	± 0.08	± 0.10	± 0.20
	precision	± 0.05	± 0.06	± 0.20
> 0.80 mm	standard	± 0.10	± 0.15	± 0.20

Maximum Edgewise curvature	
Ratio : Nominal Width/Thickness	Tolerances
8 – 15	8
15.1 – 30	6
30.1 – 60	4
60.1 – 120	3
> 120	2

■ If supplied A temper, only standard tolerances are possible.

Strip – Properties as per EN 1654 standard

Alloy		Temper		TS (MPa)	YS 0.2% (MPa)	Hardness (HV)	Elongation A ₅₀ mini (%)
High Strength	B25 (CW101C)	■ Age hardenable (delivered material temper)					
		R410	Y190	410 – 530	190	90 – 150	35
		R510	Y410	510 – 610	410	120 – 190	15
		R580	Y510	580 – 690	510	170 – 220	8
		R680	Y620	680 – 830	620	210 – 290	2
		■ Age hardened (heat treated by client)					
		R1130	Y960	1130 – 1350	960	350 – 410	3
		R1190	Y1020	1190 – 1420	1020	360 – 430	3
		⁽¹⁾ R1270	⁽¹⁾ Y1100	1270 – 1490	1100	370 – 440	--
		R1310	Y1130	1310 – 1520	1130	380 – 450	--
		■ Mill hardened (delivered material temper)					
		⁽¹⁾ R750	⁽¹⁾ Y550	750 – 830	550	230 – 280	15
		R820	Y650	820 – 930	650	250 – 310	12
		⁽¹⁾ R930	⁽¹⁾ Y750	930 – 1040	750	280 – 350	9
R1060	Y930	1060 – 1250	930	310 – 400	4		
R1200	Y1030	1200 – 1320	1030	360 – 420	3		
High Conductivity	B14 (CW110C)	■ Age hardenable (delivered material temper)					
		R240	Y130	240 – 380	130	60 – 130	20
		⁽¹⁾ R480	⁽¹⁾ Y370	480 – 590	370	140 – 180	2
		■ Mill hardened (delivered material temper)					
		R750	Y550	750 – 940	650	200 – 290	5
		⁽¹⁾ R820	⁽¹⁾ Y750	820 – 1040	750	210 – 290	--

⁽¹⁾ on request, after study on the feasibility.

■ Properties – The above table is valid for thicknesses between 0.1 and 1 mm; according to EN 1654 standard.

Strips supplied to EN 1654

Strip Dimensional Tolerances as EN 1654

Tolerances on thickness (mm)		
Thickness	Class A	Class B
0.1 – 0.2	± 0.010	± 0.007
0.201 – 0.3	± 0.015	± 0.010
0.301 – 0.4	± 0.018	± 0.012
0.401 – 0.299	± 0.020	± 0.015
0.501 – 0.8	± 0.025	± 0.018
0.801 – 0.9	± 0.030	± 0.022

Tolerances on width (mm)			
Class	3 – 50	50.1 – 100	100.1 – 200
A	+0.2 , -0	+0.3 , -0	+0.4 , -0
B	+0.1 , -0	+0.15 , -0	--

Edgewise curvature for strip condition “as rolled” (N)		
Nominal width (mm)	Up to and including 0.5	over 0.5
3 – 6	12	--
6.1 – 10	8	10
10.1 – 20	4	6
20.1 – 220	2	3

Notes

- The product designation must mention material condition designation, dimensions and tolerances classes for thickness and width (A or B).
- Tolerance on width for class B only available for t<0.6 mm.
- Only the edgewise curvature is measured as standard. Possible to deliver the strip “as rolled” (“N” with measurement of edgewise curvature and transverse cross bow) or “as flattened” (“G”, with measurement of edgewise curvature, transverse cross bow, coil set, waviness) : on request.

Bar and Rod Properties

Alloy	Temper		Diameter (mm)	TS (MPa)	Ys 0.2% (MPa)	Elongation A ₅₀ mini (%)	Hardness (HV)	Electrical Conductivity (% IACS)	Heat Treatment	
High Strength	B25	■ Age hardenable (delivered material temper)								
		A	TB00	1 ≤ Ø ≤ 13.3	420 – 600	170 – 270	35	90 – 160	15 – 19	--
				Ø ≥ 12.7	410 – 590	≥ 140	35	90 – 170	--	--
		1/2 H	TD02	1 ≤ Ø ≤ 13.3	580 – 820	520 – 720	10	175 – 240	15 – 19	--
		H	TD04	1 ≤ Ø ≤ 13.3	620 – 800	550 – 800	8	200 – 250	15 – 19	--
				Ø ≥ 12.7	590* – 900*	≥ 520	8	180* – 275*	--	--
		■ Age hardened (heat treated by NGK or by client)								
		AT	TF00	1 ≤ Ø ≤ 13.3	1150 – 1350	1000 – 1250	4	390 – 410	21 – 28	Mill hardened or 3h at 316 °C
				Ø ≥ 12.7	≥ 1140	≥ 965*	3	355 – 390	21 – 38	
		1/2 HT	TH02	1 ≤ Ø ≤ 13.3	1180 – 1450	1050 – 1300	2	365 – 430	21 – 28	
	HT	TH04	1 ≤ Ø ≤ 13.3	1300 – 1500	1150 – 1400	2	390 – 430	21 – 28	Mill hardened or 2h at 316 °C	
			Ø ≥ 12.7	≥ 1220*	≥ 1035*	3	365* – 445*	21 – 38		
B33/25	■ Age hardenable (delivered material temper)									
	H	TD04	1 ≤ Ø ≤ 25	620 – 860	550 – 800	8	200 – 250	15 – 19	--	
			25 < Ø < 28	600 – 800	520 – 750	8	180 – 240	15 – 19	--	
	■ Age hardened (heat treated by client)									
	HT	TH04	1 ≤ Ø ≤ 25	1300 – 1500	1150 – 1400	2	390 – 430	21 – 28	Mill hardened or 2h at 316 °C	
25 < Ø < 28			1240 – 1480	1070 – 1400	4	380 – 430	21 – 28			
High Conductivity	B14	■ Age hardenable (delivered material temper)								
		A	TB00	Ø ≥ 12.7	240 – 380	≥ 170	30	≤ 95	≥ 20	--
		H	TD04	1 ≤ Ø ≤ 13.3	490 – 635	--	--	130 – 190	≥ 30	--
				Ø ≥ 12.7	450 – 550	≥ 380	10	105 – 155	≥ 20	--
		■ Age hardened (heat treated by client)								
		AT	TF00	1 ≤ Ø ≤ 13.3	760 – 965	--	--	230 – 280	≥ 50	Mill hardened or 3h at 450 °C
				Ø ≥ 12.7	690 – 900	≥ 550		200 – 250	≥ 45	
HT	TH04	1 ≤ Ø ≤ 13.3	760 – 965	--	--	230 – 280	≥ 50	Mill hardened or 2h at 450 °		
		Ø ≥ 12.7	760 – 965	≥ 690	10	220 – 270	≥ 48			

* Value according to the diameter (see ASTM B196)

■ Possibility to produce B33/25 alloy as wire coils with the same mechanical properties as rods

Bar and Rod

B14 (CuNi2Be)

B25 (CuBe2)

B33/25 (CuBe2Pb)

Rod Dimensional Tolerances

Dimensional tolerances (Age hardenable)				Length / Diameter			
Berylco 14 and 25		Berylco 33/25		Berylco 14 and 25		Berylco 33/25	
Ø (mm)	± (mm)	Ø (mm)	± (mm)	Ø (mm)	L ± (mm)	Ø (mm)	L ± (mm)
1.0 – 3.0	+0/-0.025 (h9)	1.0 – 3.0	+0/- 0.014 (h8)	1.0 – 5.9*	2000 ±100	1.0 – 3.0	3000 +50/-10
3.1 – 6.0	+0/-0.030 (h9)	3.1 – 6.0	+0/- 0.018 (h8)	6.0 – 12.7*	3000 ±100	3.1 – 18.0	3000 ±50
6.1 – 10.0	+0/-0.036 (h9)	6.1 – 10.0	+0/- 0.022 (h8)	15.88 – 44.45	3505 ±457	18.1 – 28.0	3000 ±100
10.1 – 13.0	+0/-0.070 (h10)	10.1 – 13.0	+0/- 0.027 (h8)	44.46 – 53.95	3048 ±508		
12.7 – 25.4	±0.076	13.1 – 18.0	+0/- 0.043 (h9)	53.96 – 63.50	2438 ±610		
25.41 – 44.45	+0.508/-0 (or ±0.127)	18.1 – 26.0	+0/- 0.052 (h9)	63.51 – 87.33	2006 ±788		
44.46 – 63.49	+0.762/-0 (or ±0.127)	26.1 – 28.0	+0/- 0.084 (h10)	87.34 – 152.40	1524 ±610		
63.5 – 76.2	+1.270/-0			152.41 – 304.80	1524 ±610		
76.21 – 127	+1.524/-0						
>127	+3.175/-0						

■ Rods can be delivered after centerless grinding down to h5 subject to feasibility by our subcontractor.

* For 1.0 ≤ Ø ≤ 12.6 mm, age-hardened rods are delivered as 1 m +100/-0 mm.

■ Berylco 33/25 rods are pointed and chamfered.

Out of these specifications, please inquire NGK Berylco for specific fabrication

Wire Properties

Alloy		Temper		Diameter (mm)	TS (MPa)	YS 0.2% (MPa)	Elongation A ₅₀ mini (%)	Hardness (HV)	Electrical Conductivity (% IACS)	Heat Treatment
High Strength	B25	■ Age hardenable (delivered material temper)								
		*A	TB00	0.8 ≤ Ø ≤ 1.4	390 – 540	140 – 250	35	--	--	--
		1/2H	TD02	0.8 ≤ Ø ≤ 10	550 – 780	470 – 750	10	--	--	--
		H	TD04		750 – 1140	610 – 960	2	--	--	--
		■ Age hardened (heat treated by client)								
		*AT	TF00	0.8 ≤ Ø ≤ 1.4	1150 – 1300	1000 – 1200	3	350 – 420	≥ 22	2h at 316°C
		1/2HT	TH02	0.8 ≤ Ø ≤ 10	1200 – 1450	1100 – 1350	2	--		
		HT	TH04	1300 – 1550	1200 – 1460	2	370 – 440			
High Conductivity	B14	■ Age hardenable (delivered material temper)								
		*A	TB00	0.8 ≤ Ø ≤ 1.4	300 – 450	--	10 – 40	--	≥ 20	--

* The surface of A temper is finished as continuous solution annealing without acid pickling (remaining oxide layer).

- Elongation, electrical conductivity, and hardness are for design guidance only.
- Other wire diameter available on request.



Dimensional Tolerances

Diameter (mm)	0.10<Ø≤0.25	0.25<Ø≤0.30	0.30<Ø≤0.50	0.50<Ø≤1.00	1.00<Ø≤2.00	2.00<Ø≤4.00	4.00<Ø≤6.00	6.00<Ø≤10.00
Standard Tolerances	± 0.005	± 0.008	± 0.010	± 0.015	± 0.020	± 0.030	± 0.040	± 0.060

- For the Ø>4 mm, thank you to inquire NGK Berylco for a study on the feasibility.

Coil Diameter and Weight

Diameter (mm)	< 0.3	0.3 – 0.5	0.51 – 0.7	0.71 – 1.0	1.1 – 3.5	3.6 – 7.5	7.6 – 10
Coil Diameter (mm)	--	300 – 400	300 – 400	300 – 400	400 – 500	750 – 850	800 – 1000
Coil Weight (kg)	1 – 3	1 – 3	1 – 3	3 – 19	6 – 35	12 – 70	10 – 35

- For wire Ø<0.3 mm, delivery only possible on a bobbin

Visual Inspection of Wire

Ø ≤ 1.0 mm	Ø > 1.0 mm
Shiny surface (drawing with liquid lubricant by diamond die)	Slightly shiny surface (drawing with powder lubricant by carbide die)

Out of these specifications, please inquire NGK Berylco for specific fabrication



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