TOYO TANSO CARBON PRODUCTS

Carbon Brush Products

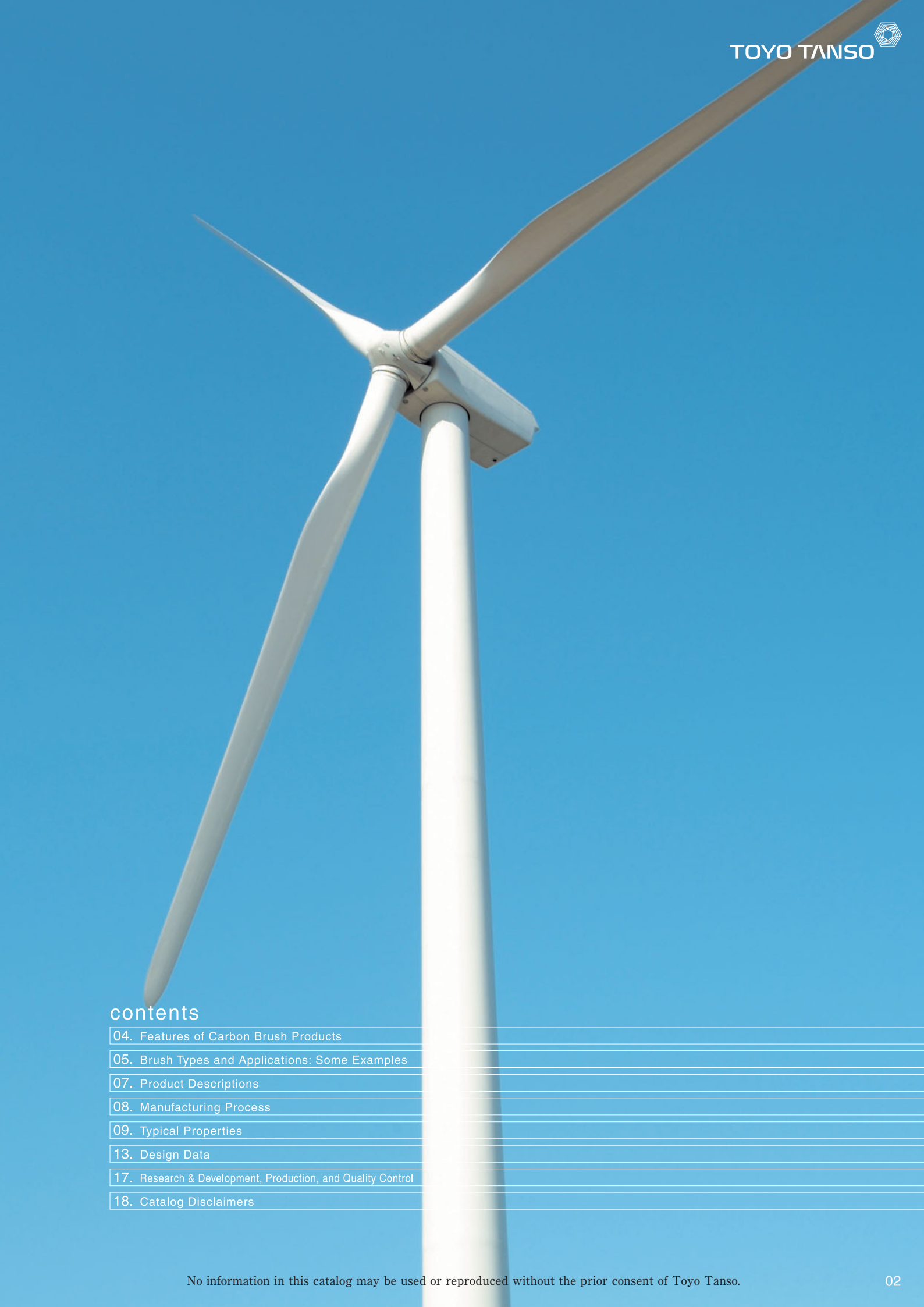
TOYO TANSO

Inspiration for Innovation

People and carbon
An everlasting relationship.

Carbon has been a part of our life since ancient times. The benefits of carbon have never been far away from humans, making our lives more plentiful and comfortable. In 1974, we were the first company in Japan to successfully develop isotropic graphite, and thereafter rapidly expanding its possibilities. Isotropic graphite become a crucial material of state-of-the-art technologies in industries such as semi-conductors and aerospace. Currently, this material is being used in a wide range of applications over an ever-increasing number of fields. Toyo Tanso is dedicated to unlocking the unlimited potential of carbon and aims to ensure that the beneficial relationship between people and carbon is one that lasts forever.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.



contents

04. Features of Carbon Brush Products
05. Brush Types and Applications: Some Examples
07. Product Descriptions
08. Manufacturing Process
09. Typical Properties
13. Design Data
17. Research & Development, Production, and Quality Control
18. Catalog Disclaimers

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

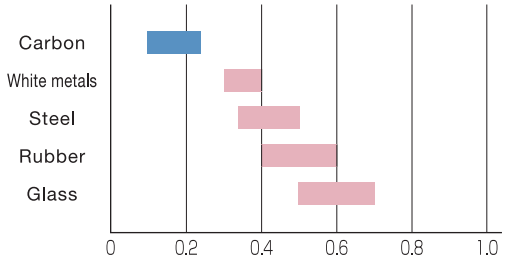
No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Features of Carbon Brush Products

The carbon brush plays the important role of sending electrical current between motionless and rotating parts by sliding contact. Since the performance of the brush has a significant impact of the performance of rotating machine, the choice of brush is a critical factor. At the Toyo Tanso Group, we develop and produce carbon brushes for a variety of customer needs and purposes, applying the superior technology and quality assurance know-how that we have developed over our many years of research in the field. Our products exude minimum impact on the environment, and can be used for many different applications.

Excellent self-lubrication and abrasion resistance

Carbon has self-lubricating properties and low coefficient of friction due to its layered crystal structure,making it highly abrasion resistant. The carbon is thus characterized by outstanding abrasion resistance and low friction under conduction, which is important for carbon brush.



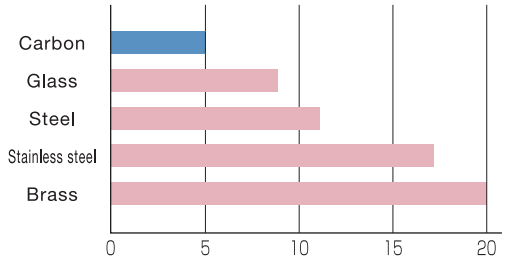
Coefficient of dynamic friction with steel surface
[in air room temperature]

Superior conductivity

With its excellent electrical conductivity, carbon can offer a stable, optimal level of electrical resistivity, which is enhanced by appropriate selection of materials and production process depending on the application.

Outstanding durability

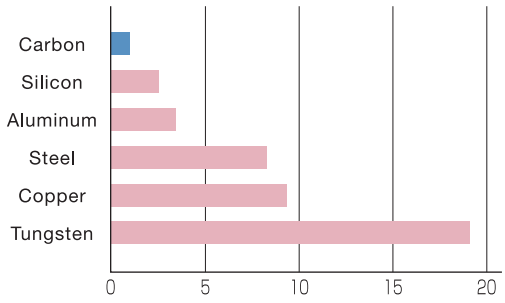
Carbon has low coefficient of thermal expansion, which means that it hardly has changes in shape or quality even at high temperatures. It is also resistant to the softening and melt-down that can occur due to sparking during operations, and does not fuse with other metals.



Coefficient of thermal expansion [10^{-6}/K]

Superior ridability during sliding contact

Compared to conductive metals in general, bulk density and the Young's modulus are small in carbon, hence carbon has superior ridability during sliding contact.



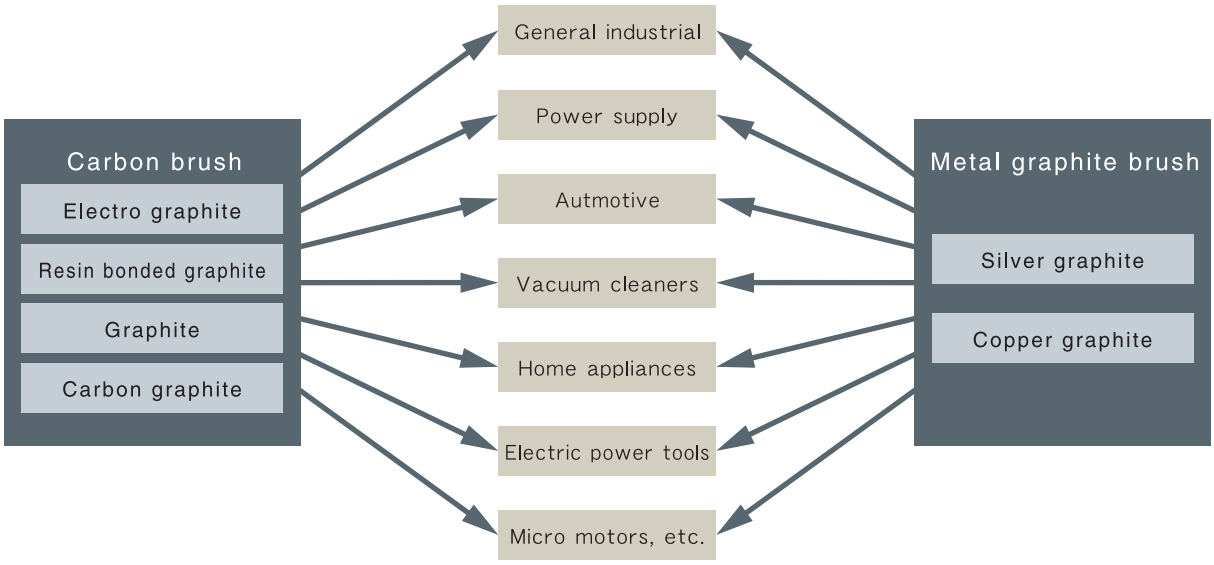
Bulk Density [g/cm³]

① Carbon brushes for general industrial application
② Carbon brushes for power supply application
③ Carbon brushes for autmotive application
④ Carbon brushes for home appliances
⑤ Carbon brushes for micro motor
⑥ Carbon brushes for electric power tool
⑦ Carbon brushes for vacuum cleaner

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

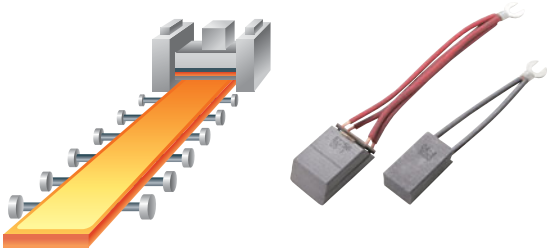
Brush Types and Applications:Some Examples

At Toyo Tanso group, we offer an entire array of brushes, including for general industrial use, vacuum cleaners, automotive, home electronic appliances, power tool motors, electrical supply, micro motors, and more.



General industrial

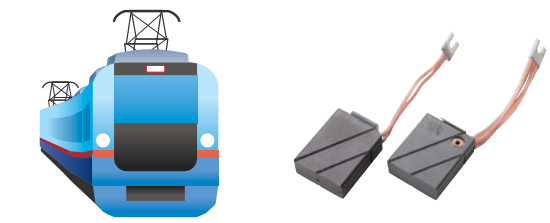
DC motors



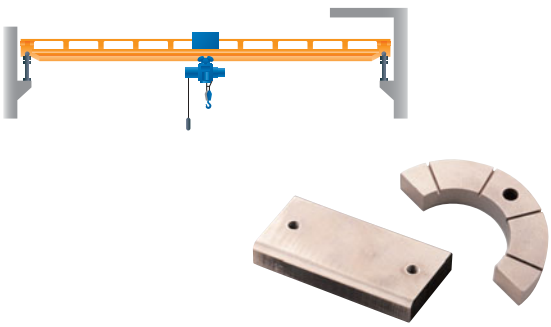
Wind-generated power

Power supply

Electrical trains



Cranes



No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

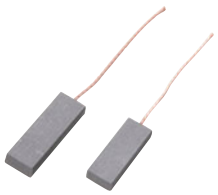
Automotive application

Automobiles

Forklifts

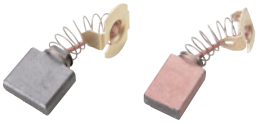
Home appliances

Washing machines



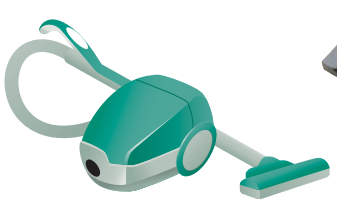
Power tools

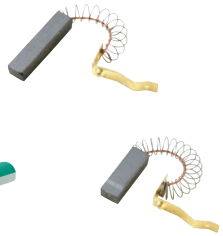
Disk grinders



Vacuum cleaners

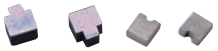
Vacuum cleaners





Micro motors, etc.

Printers



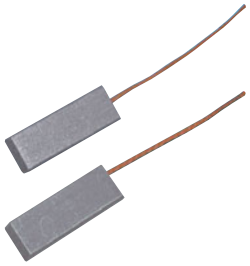
No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Product Descriptions

The Toyo Tanso Group is constantly researching ways to achieve top performance with our brushes for each of their various purposes. We have successfully developed a range of new products up through the present time, including special coated brushes, carbon brush with cut-off device, vehicle fuel pump brushes and carbon discs, and more. In addition, we also engage in lead-less product development in consideration of the environment.

The washing machine brush new product

Extremly long life brushes are required for commutator motor for drum-type washing machine. Toyo Tanso offers a long-lasting brush that performs well even during the machine's reverse cycle.

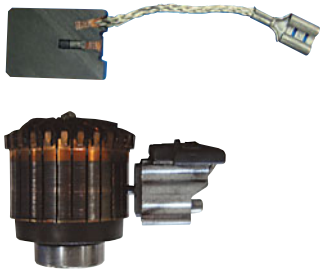


The Specially Coated Brush

This brush features a thin conductive metal film coating on the surface. The coating serves to cut loss associated with electrical resistance and rises in temperatures without sacrificing life time and commutation properties of the brush. These brushes are used in small high-speed vacuum cleaners, power tool motors, and more.

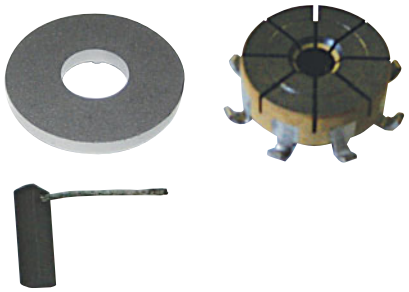
Carbon brush with cut-off device

At the end of their lifespan, brushes tend to incur greater sparking from commutation, as the spring pressure deteriorates. The brush with cut-off device quickly cuts electric current when brush is worn out to reduce commutator loss. Toyo Tanso offers cut-off design depend on brush type and application.



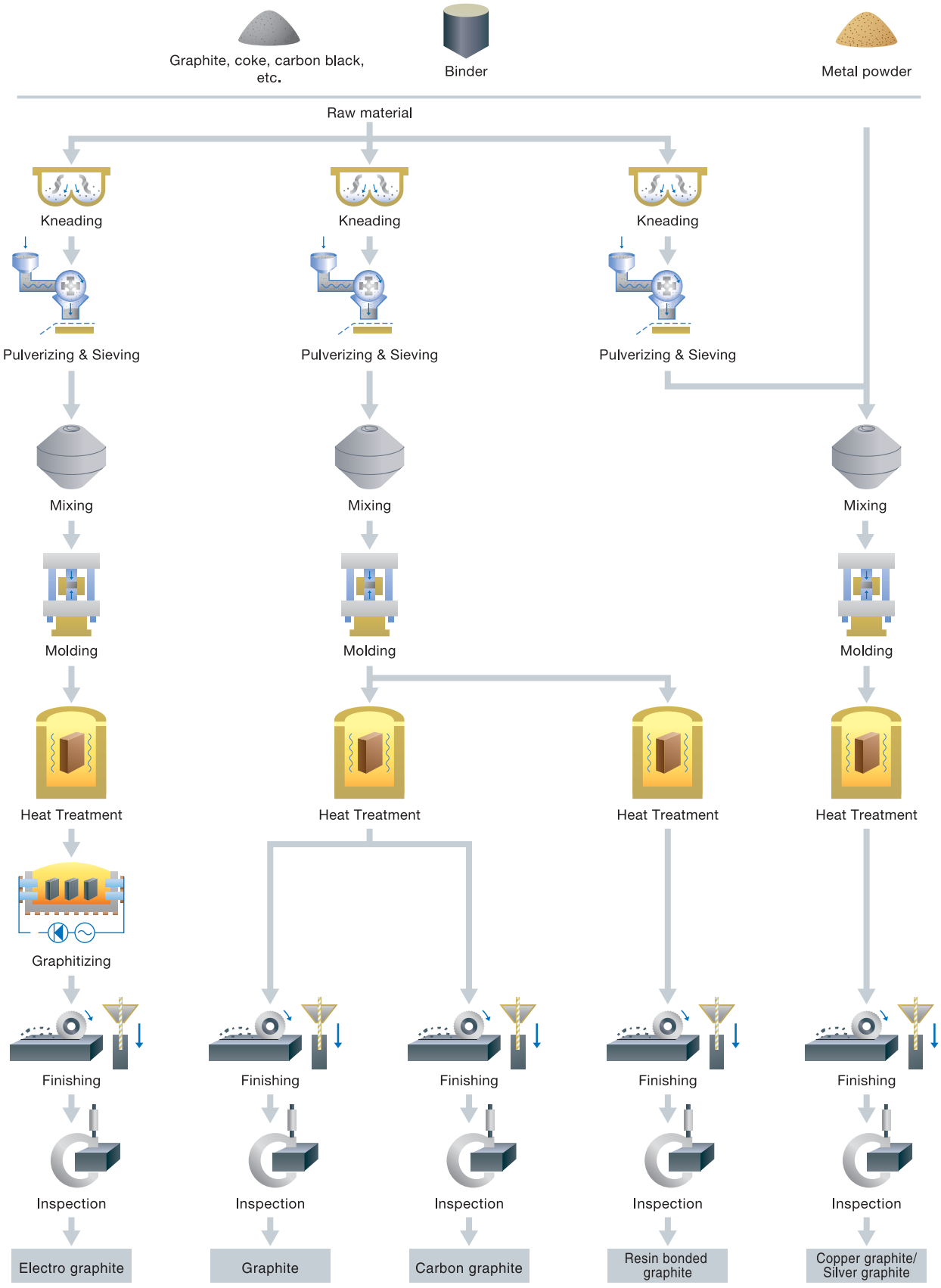
Brushes and Carbon Disks for Vehicle Fuel Pumps

Carbon is the answer to the many conditions required for the commutator for vehicle fuel pumps. Toyo Tanso has developed optimal brush materials and low-wear carbon disc for commutator.



No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Manufacturing Process



No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Typical Properties

Composition	Grade	Bulk Density g/cm³	Hardness HSC	Electrical Resistivity μΩ·m	Flexural Strength MPa	Coefficient of friction	Contact voltage drop V	Max. peripheral speed m/s	Max. current density A/cm²	Features/applications
Electrographite	401	1.68	18	9	10	M	M	30	10	Good film formation. Applicable for slip rings that easily generate streaking.
	502	1.77	51	11	37	M	M	25	10	Good roughing resistance because of fine grain isotropic structure. Applicable for low speed, small capacity DC motors and slip rings.
	503	1.68	46	13	29	M	M	30	10	Same as 502,good roughing resistance because of fine grain isotropic structure. Applicable for small/med capacity motors of faster speed than 502.
	176	1.62	28	14	16	M	M	45	12	Good film formation,Good commutation performance. Applicable for DC motors up to medium capacity.
	BZ-229	1.6	23	22	11	M	M	40	12	Moderate film adjusting function. Applicable for medium and higher capacity mill motors
	BZ-256	1.61	28	19	14	M	M	40	12	Better film formation than BZ-229. Applicable for medium and higher capacity mill motors.
	213	1.61	32	23	16	M	M	40	12	Better film adjusting effect than 176. Applicable for DC motors up to medium capacity.
	321	1.74	62	34	31	M	M	35	10	Good wear resistance. Applicable for traction motors.
	TH-03	1.75	68	40	35	M	M	35	10	
	351A	1.63	49	47	22	H	M	40	10	Standard material for commutation brushes. Applicable for medium capacity DC motors.
	641	1.64	59	75	12	H	M	40	10	Applicable for difficult commutation high capacity DC motors and universal motors.
	803	1.46	40	80	12	H	M	40	10	Applicable for difficult commutation high capacity DC motors.
Graphite	402	1.71	24	10	18	M	M	25	10	Has film adjusting effect. Applicable for thick film slip rings.
	801	1.65	30	35	19	M	M	45	15	Good wear resistance. Applicable for pump motors for power steering.
	TR-50	1.76	30	14	18	M	M	40	12	Better commutation performance than 788. Applicable for forklifts of 48V or more.
	TR-19	1.51	33	200	19	M	M	40	12	Good wear resistance. Applicable for 3-phase commutator motor.
	BY-14	1.29	18	25	9	H	M	62	8	Applicable for high speed slip rings such as turbine generators.

※Coefficient of friction: H···0.25 or greater M···0.20-0.25 (Measuring conditions/Slip ring: Copper; Speed: 9.3 m/second; Current: 0 A)
※Contact voltage drop: M···0.5-1.0 V/unit (Measuring conditions/Slip ring: Copper; Speed: 9.3 m/second; Current: DC10 A/cm sq.)
※The above figures are typical values, and are not guaranteed.

Maximum peripheral speed and maximum current density differ depending on the commutator and slip ring conditions and conditions of use. The information listed to the right and above represents general examples. Before choosing a product, consult with our staff about your particular needs.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Composition	Grade	Bulk Density	Hardness	Electrical Resistivity	Flexural Strength	Coefficient of friction	Contact voltage drop	Max. peripheral speed	Max. current density	Features/applications
		g/cm³	HSC	μΩ·m	MPa		V	m/s	A/cm²	
Copper Graphite I	M-90	6.30	15	0.32	108	M	VL	20	25	High strength copper alloy type. Applicable for contacts and grounds.
	M-1T	6.19	13	0.27	108	M	VL	22	22	
	M-2T	5.70	15	0.50	80	M	VL	25	20	
	M-1H	6.83	6	0.04	87	M	VL	25	20	High copper content. Very low temperature rise and contact voltage drop. Applicable for high electrical capacity generators and motors.
	M-1	5.41	12	0.08	42	L	VL	30	25	
	M-1F	5.30	18	0.15	49	L	VL	30	25	
	M-2H	4.93	13	0.10	34	L	VL	30	20	
	M-2HF	4.80	18	0.33	44	M	VL	30	20	
	M-2	4.40	15	0.50	29	L	VL	30	20	The copper content amount is next to M1. M-2H class and has good wear resistance. Applicable for large capacity generators and slip rings for general rotary machine.
	M-2F	4.35	15	0.50	44	M	VL	30	20	
	M-3H	4.04	16	0.70	29	M	VL	30	18	
	M-3HF	4.05	20	0.60	44	M	VL	30	18	
	M-3	3.78	17	1.00	29	L	VL	30	18	
	M-4	3.48	17	2.00	25	L	L	30	18	Middle grade between graphite and metal graphite and has features of both. In particular, it is superior in roughing resistance. It is applicable for small/med capacity generators and motors.
	M-550	2.96	25	2.50	39	M	L	35	15	Good wear resistance. Particularly applicable for stainless steel slip rings.
	M-750	2.32	23	6.00	32	M	L	35	15	
	788	2.02	23	9.00	23	M	M	45	12	Good dementional stability in high temperature. Applicable for forklifts of 48V or less.
	M-2TB	5.74	12	0.48	65	M	VL	25	20	Same application as the above M-1 and M-2. But does not contain lead.
	M-1B	5.30	10	0.10	43	L	VL	30	25	
	M-2B	4.34	13	0.28	31	L	VL	30	20	
Copper Graphite II	MF-302	2.65	18	3.00	23	M	L	30	20	Applicable for automobile DC12V fan.
	MF-501	3.00	20	0.90	28	L	L	30	20	Applicable for automobile DC12V winch.
	MF-101	2.90	18	2.20	28	M	L	30	20	Applicable for DC19.2V cleaners.
	MF-202	2.05	10	38.0	23	H	M	30	15	
	MF-203	2.05	10	30.0	23	L	M	30	15	
	MF-301	2.40	15	10.0	23	M	M	30	20	Applicable for DC24V cleaners.
	MF-401	2.67	18	10.0	21	M	M	30	20	Applicable for DC19.2V cleaners.
	MF-204	3.78	15	0.30	40	M	L	30	25	Applicable for DC7.2V power tools.
	MF-205	3.00	20	0.80	28	M	L	30	20	Applicable for DC24V power tools.
	MF-701	2.26	18	10.0	30	M	M	30	20	Applicable for DC22-36V power tools.
	MF-201	2.25	10	30.0	23	M	M	30	15	Applicable for household coffee mills.
	MF-601	2.05	10	50.0	23	M	M	30	15	Applicable for electric wheelchair.

※Coefficient of friction: H···0.25 or greater M···0.20-0.25 L/0.20 or less (Measuring conditions/Slip ring: Copper; Speed: 9.0 m/second; Current: 0A)
※Contact voltage drop: M···0.5-1.0 V/unit, L····.0.25-0.50 V/unit; VL: 0.25 or less/unit
(Measuring conditions/Slip ring: Copper; Speed: 9.0 m/second; Current: DC10 A/cm sq.)
※The above figures are typical values, and are not guaranteed.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Composition	Grade	Bulk Density	Hardness	Electrical Resistivity	Flexural Strength	Coefficient of friction	Contact voltage drop	Max. peripheral speed	Max. current density	Features/applications
		g/cm³	HSC	μΩ·m	MPa		V	m/s	A/cm²	
Silver graphite	SX-50	3.20	15	2.70	29	M	VL	20	12	Very low temperature rise and contact voltage drop. Applicable for low current tachometers and grounds contacts.
	SX-70	4.45	15	0.25	40	M	VL	20	15	
	SX-90	6.85	18	0.05	84	M	VL	20	22	

※Coefficient of friction: M···0.20-0.25 (Measuring conditions/Slip ring: Copper; Speed: 9.0 m/second; Current: 0A)
※Declining contact voltage: VL···.Less than 0.25 V/unit (Measuring conditions/Slip ring: Copper; Speed: 9.0 m/s; Current: DC10 A/cm sq.)
※The above figures are typical values, and are not guaranteed.

Composition	Grade	Bulk Density	Hardness	Electrical Resistivity	Flexural Strength	Coefficient of friction	Contact voltage drop	Max. peripheral speed	Max. current density	Features/applications
		g/cm³	HSC	μΩ·m	MPa		V	m/s	A/cm²	
Resin bonded graphite	X-03	1.50	12	200	15	L	H	54	20	Good ridability. Applicable for 100-120V high efficiency cleaners.
	X-09	1.52	14	260	15	L	H	54	20	
	X-17	1.54	15	330	18	L	H	54	20	
	X-72	1.47	19	380	14	L	H	48	20	
	X-87	1.50	17	380	22	L	H	54	20	
	X-88	1.52	14	360	20	L	H	54	20	
	X-05	1.48	15	400	18	L	H	50	20	Good ridability. Applicable for 100-240V high input cleaners.
	X-10	1.52	15	270	17	L	H	50	20	
	X-78	1.51	17	370	22	L	H	48	20	
	X-80	1.51	17	360	22	L	H	48	20	
	X-07	1.53	22	760	25	L	H	50	15	Good commutation performance. Applicable for 120-240V cleaners.
	X-85	1.48	20	400	14	L	H	48	20	
	X-89	1.53	19	350	21	L	H	48	20	
	X-93	1.50	18	640	27	L	H	50	15	
	X-95	1.51	19	640	24	L	H	50	15	
	X-97	1.45	19	430	14	L	H	50	20	
	X-11	1.35	15	1100	14	L	VH	54	13	Good commutation performance. Applicable for 200-240V cleaners.
	X-73	1.52	24	920	24	L	VH	40	13	
	X-91	1.35	15	1100	17	L	VH	54	13	
	X-94	1.36	14	1200	17	L	VH	54	13	
	X-04	1.36	17	1600	11	L	VH	54	10	Good commutation performance. Applicable for 200-240V cleaners, small motors.
	X-08	1.29	14	1600	14	L	VH	54	10	
	X-96	1.31	14	1600	16	L	VH	54	10	
	B-2	1.75	25	390	24	L	H	25	8	Applicable for juicers,dryers. Moldable by press to size up to 18mm length max.

※Coefficient of friction: L···Less than 0.20 (Measuring conditions/Current density: AC10 A/cm sq.; Speed: 20 m/second; Spring pressure: 50 kPa)
※Contact voltage drop: VH···Greater than 3.0V/unit; H···2.0-3.0 volts/unit (Measuring conditions/Current density: AC10 A/cm sq.; Speed: 20 m/second; Spring pressure: 50 kPa) ※The above figures are typical values, and are not guaranteed.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Composition	Grade	Bulk Density	Hardness	Electrical Resistivity	Flexural Strength	Coefficient of friction	Contact voltage drop	Max. peripheral speed	Max. current density	Features/applications
		g/cm³	HSC	μΩ·m	MPa		V	m/s	A/cm²	
Carbon graphite	C-3	1.62	35	240	24	L	H	35	13	Comparative low resistivity. Applicable for 100-120V power tools.
	107	1.62	34	100	29	L	H	35	13	
	113	1.58	37	290	27	L	H	35	13	
	C-1	1.49	30	330	13	L	H	35	12	Applicable for 100-120V and 200-240V cleaners.
	TX-174	1.55	36	390	24	L	H	35	18	Good commutation performance, wear resistance. Good breaking action. Applicable for 100-120V and 200-240V power tools and cleaners.
	105S	1.55	36	390	24	L	H	35	18	
	108	1.55	36	390	24	L	H	35	18	
	110	1.54	37	350	20	L	H	35	13	
	118	1.64	34	390	23	L	H	35	18	
	129	1.64	34	620	20	L	H	35	18	
	106	1.52	33	680	15	M	VH	35	13	Good commutation performance and wear resistance. Applicable for 200-240V cleaners.
	111	1.61	37	600	23	M	VH	35	13	
	114	1.62	35	900	20	M	VH	35	13	Good commutation performance. Applicable for 200-240V power tools and washing machines.
	122	1.62	42	840	22	M	VH	35	13	
	124	1.60	47	790	26	M	VH	35	13	
	116	1.62	35	900	20	M	VH	35	13	Good commutation performance and wear resistance. Applicable for 200-240V power tools.
	119	1.59	44	1300	20	M	VH	35	13	Good commutation and sliding performance. Applicable for 200-240V power tools and washing machines.
	B-1	1.75	18	450	13	L	H	25	8	Applicable for small power tools and juicers. Moldable with lead wire by press to size up to L12mm max.
	C-2	1.55	32	660	17	L	H	25	10	Applicable for small power tools and juicers. Moldable with lead wire by press to size up to L15mm max.
	C-2N	1.58	34	660	14	L	H	25	10	Applicable for small power tools and juicers. Moldable with lead wire by press to size up to L15mm max. Better noise prevention and film adjusting effect than C-2.
	FX-08	1.66	31	590	19	L	H	25	10	Applicable for small power tools and juicers. Moldable with lead wire by press to size up to 18mm max Better noise prevention and film adjusting effect than C-2.

※Coefficient of friction: M···0.20-0.25, L···Less than 0.20
(Measuring conditions/Current density: AC10 A/cm sq.; Speed: 20 m/second; Spring pressure: 50 kPa)
※Contact voltage drop: VH···Greater than 3.0V/unit; H···2.0-3.0 volts/unit
(Measuring conditions/Current density: AC10 A/cm sq.; Speed: 20 m/second; Spring pressure: 50 kPa)
※The above figures are typical values, and are not guaranteed.

Maximum peripheral speed and maximum current density differ depending on the commutator and slip ring conditions and conditions of use. The information listed to the left and above represents general examples. Before choosing a product, consult with our staff about your particular needs.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Design Data

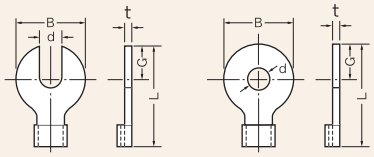
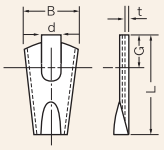
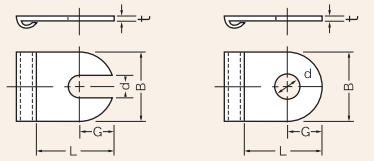
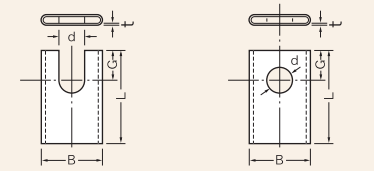
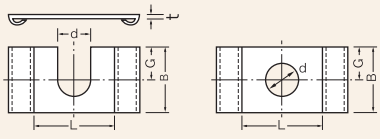
Reference: methods to mount lead wire and shape of carbon brush (JIS C2802)

C1 No lead wire	 C1-1	 C1-2	 C1-3	 C1-4	 C1-5	 C1-6	 C1-7	 C1-8	 C1-9	 C1-10
C2 Copper powder tamped soldering	 C2-1	 C2-2	 C2-3	 C2-4	 C2-5	 C2-6	 C2-7	 C2-8	 C2-9	 C2-10
	 C2-11	 C2-12								
C4 Copper pipe (one) Ribetting	 C4-1	 C4-2	 C4-3	 C4-4	 C4-5	 C4-6	 C4-7	 C4-8	 C4-9	 C4-10
	 C4-11	 C4-12	 C4-13	 C4-14	 C4-15	 C4-16	 C4-17	 C4-18	C4-19	C4-20
	C4-21									
C5 Copper pipe (two) Ribetting	C5-1	C5-2	C5-3	C5-4	C5-5	C5-6	C5-7	C5-8	C5-9	C5-10
	C5-11	C5-12	C5-13	C5-14	C5-15	C5-16	C5-17	C5-18		
C6 Segmented rhomboid	C6-1	C6-2	C6-3	C6-4						

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Terminal shape and dimensions (JIS C2802)

Unit:mm

Number	Dimensional diagrams	Installation screw (meter screw)	Dimensions				
			d	B	G	L	t
T-1 T-2	 T-1 T-2	3	3.5 $^{+0.2}_{-0.2}$	8 ± 0.3	4	12 ± 1	0.5 0.8
		4	4.5 $^{+0.3}_{-0.1}$	10 ± 0.3	5	15 ± 1	0.8
		5	5.5 $^{+0.3}_{-0.1}$	13 ± 0.4	6.5	20 ± 1	0.8 1.0
		6	6.5 $^{+0.3}_{-0.1}$	16 ± 0.4	8	24 ± 1	1.0
		8	8.5 $^{+0.3}_{-0.1}$	19 ± 0.5	9.5	29 ± 1	1.0 1.2
		10	10.5 $^{+0.3}_{-0.1}$	23 ± 0.5	12	40 ± 1	1.2
T-3	 T-3	5	5.5 $^{+0.3}_{-0.1}$	13 ± 0.8	6.5	20 ± 1.5	0.4 0.5
		6	6.5 $^{+0.3}_{-0.1}$	16 ± 0.8	8	24 ± 1.5	0.4 0.5
		8	8.5 $^{+0.3}_{-0.1}$	19 ± 1	9.5	29 ± 1.5	0.4 0.5
T-4 T-5	 T-4 T-5	3	3.5 $^{+0.2}_{-0.2}$	8 ± 0.3	4	> 8	0.5 0.8
		4	4.5 $^{+0.3}_{-0.1}$	10 ± 0.3	5	> 10	0.8
		5	5.5 $^{+0.3}_{-0.1}$	13 ± 0.4	6.5	> 13	0.8 1.0
		6	6.5 $^{+0.3}_{-0.1}$	16 ± 0.4	8	> 16	1.0
		8	8.5 $^{+0.3}_{-0.1}$	19 ± 0.5	9.5	> 19	1.0 1.2
		10	10.5 $^{+0.3}_{-0.1}$	23 ± 0.5	12	> 25	1.2
T-6 T-7	 T-6 T-7	5	5.5 $^{+0.3}_{-0.1}$	13 ± 0.8	6.5	20 ± 1	0.4 0.5
		6	6.5 $^{+0.3}_{-0.1}$	16 ± 0.8	8	24 ± 1	0.4 0.5
		8	8.5 $^{+0.3}_{-0.1}$	19 ± 1	9.5	29 ± 1	0.6 0.8
		10	10.5 $^{+0.4}_{-0.1}$	23 ± 1	11.5	35 ± 1	0.6 0.8
T-8 T-9	 T-8 T-9	4	4.5 $^{+0.3}_{-0.1}$	10 ± 1	5	> 10	0.8 1.0
		5	5.5 $^{+0.3}_{-0.1}$	14 ± 1	7	> 12	0.8 1.0
		6	6.5 $^{+0.3}_{-0.1}$	16 ± 1	8	> 14	1.0 1.2
		8	8.5 $^{+0.3}_{-0.1}$	20 ± 1	10	> 18	1.0 1.2
		10	10.5 $^{+0.3}_{-0.1}$	23 ± 1	12	> 26	1.2

※Where there is no tolerance indicated (excluding t), it is the G dimension ±10%
※The t dimensions for T-8 can be 1.2 for screw numbers 4 and 5, and 1.5 for screw numbers 6 and 8.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

■Tolerance for Thickness, Width, and Length (JIS C2802)

Tolerance for the thickness, width, and length of the brush as well as that of the inner dimensions of the brush holder are as follows:

Unit:mm

Nominal Dimensions	Brush thickness/width tolerance		Holder inner dimension tolerance		Space between brush/holder		Brush length tolerance
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	
1.6 / 2 / 2.5	−0.09	−0.03	+0.05	+0.01	0.14	0.04	±0.3
3.2	−0.09	−0.03	+0.07	+0.02	0.16	0.05	±0.3
4 / 5	−0.11	−0.03	+0.07	+0.02	0.18	0.05	±0.3
6.3 / 8 / 10	−0.11	−0.03	+0.09	+0.03	0.20	0.06	±0.3
12.5 / 16	−0.13	−0.04	+0.10	+0.03	0.23	0.07	±0.5
20 / 25	−0.13	−0.04	+0.12	+0.04	0.25	0.08	±0.5
32 / 40 / 50	−0.15	−0.05	+0.15	+0.05	0.30	0.10	±0.8
64 / 80	−0.15	−0.05	+0.18	+0.06	0.33	0.11	±0.8
100 / 125	——	——	——	——	——	——	±1.0

※Segment brush thickness tolerance of up to 0.02 mm is permissible unless otherwise specified.
However, note that the maximum dimensions of the brush cannot be altered.

Display example $16^{-0.04}_{-0.15} \times 25^{-0.04}_{-0.13} \times 40^{\pm 0.8}$ (two pieces)

※For brushes that has higher thermal expansion, such as metal graphite brushes, the heat expansion dimensions of the above nominal dimensions can be reduced and the above tolerance applied. This is up to the discretion of the manufacturer, and agreement must be reached with the user.
Note that the nominal dimensions in such cases will be displayed as in the table. Letters "a" and "b" in the examples refer to heat expansion.

Display example $16^{-(0.14+a)}_{-(0.13+a)} \times 25^{-(0.04+b)}_{-(0.13+b)} \times 40^{\pm 0.8}$

※Tolerance for the inner dimensions of the holder apply to brush thickness and width direction for the perpendicular-shaped holder.
However, for items such as backlash holders, which do not depend on the interval between brush and holder for brush stability, the maximum specification of the interval thickness direction can be altered upon agreement with the user.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

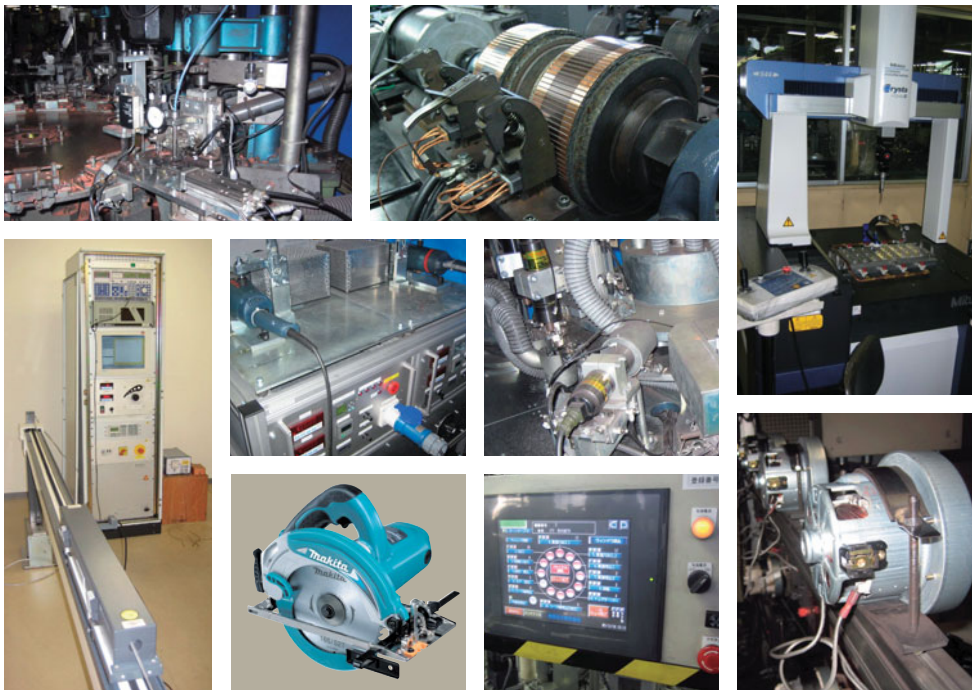
Lead Wire Structure (JIS C2802)

Nominal cross-section mm²	Recommended values								Reference
	Maximum OD	Minimum weight	Independent wire diamter 0.05mm		Independent wire diamter 0.08mm		Independent wire diamter 0.10mm		Allowable current
			number of wires/ wire diameters	Cross-section calculation	number of wires/ wire diameters	Cross-section calculation	number of wires/ wire diameters	Cross-section calculation	
	mm	g/m	mm	mm²	mm	mm²	mm	mm²	A
0.06	0.5	0.48	3/10/0.05	0.06	12/0.08	0.06	—	—	2
0.10*	0.6	0.72	3/17/0.05	0.10	20/0.08	0.10	—	—	3
0.15*	0.7	1.00	3/26/0.05	0.15	30/0.08	0.15	—	—	4
0.20*	0.8	1.40	3/34/0.05	0.20	40/0.08	0.20	—	—	4.8
0.25	1.0	2.00	3/42/0.05	0.25	3/17/0.08	0.26	—	—	5.5
0.30	1.1	2.20	3/51/0.05	0.30	3/20/0.08	0.30	—	—	6
0.35	1.1	2.80	3/60/0.05	0.35	3/23/0.08	0.35	3/15/0.10	0.35	7
0.40	1.2	2.90	—	—	3/27/0.08	0.41	3/17/0.10	0.40	8
0.50	1.3	4.00	—	—	3/33/0.08	0.50	3/21/0.10	0.49	9
0.75*	1.6	5.60	—	—	3/50/0.08	0.75	3/32/0.10	0.75	12
0.90	1.7	6.50	—	—	7/26/0.08	0.91	7/16/0.10	0.88	13
1.00	1.8	8.00	—	—	7/28/0.08	0.99	7/18/0.10	0.99	15
1.25	2.0	10	—	—	7/36/0.08	1.27	7/23/0.10	1.26	17.5
1.40	2.1	11	—	—	7/40/0.08	1.41	7/25/0.10	1.37	19
1.50*	2.2	13	—	—	7/43/0.08	1.51	7/27/0.10	1.48	20
2.00	2.4	16	—	—	7/57/0.08	2.01	7/36/0.10	1.98	24
2.50	2.7	20	—	—	7/71/0.08	2.50	7/46/0.10	2.53	28
3.20	3.0	26	—	—	7/91/0.08	3.20	7/58/0.10	3.19	32
3.50	3.2	28	—	—	7/100/0.08	3.52	7/64/0.10	3.52	34
4.00	3.3	32	—	—	7/114/0.08	4.01	7/73/0.10	4.01	38
4.50	3.5	36	—	—	7/127/0.08	4.47	7/82/0.10	4.15	40
5.50	3.7	44	—	—	7/157/0.08	5.52	7/100/0.10	5.50	45
6.00	4.2	48	—	—	7/170/0.08	5.98	7/109/0.10	5.99	50
6.50	4.4	52	—	—	—	—	7/119/0.10	6.54	53
8.00	4.7	64	—	—	—	—	7/146/0.10	8.03	60
10.00	5.3	80	—	—	—	—	7/182/0.10	10.01	75
12.50	5.9	100	—	—	—	—	7/7/32/0.10	12.32	85
16.00	6.7	128	—	—	—	—	7/7/42/0.10	16.16	100

※Figures based on JIS C3664 standards (IEC60228).
※The material of lead wire having 0.05/0.08mm independent diameter is based on JIS 3103 while lead wire having 0.10mm independent diameter is based onJIS3102.
※Where the lead wire is fitted into a tube, lead wire thickness can be adjusted upon agreement with the user.
※Where there is a possibility of excess current or insufficient cooling capability, adjust the lead wire thickness upon agreement with the user.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

Research & Development, Production, and Quality Control



At Toyo Tanso, we believe in the boundless possibilities of carbon, and our basic and applied research initiatives never stop.

Through unflagging research and development on a day-to-day basis, we have fostered an unsurpassed level of technology, which enables us to offer products that meet the vast and sundry needs of our customers. By embarking on joint research projects with users both in Japan and overseas, we continue to identify more and more applications for carbon. Our production facilities, where carbon constantly takes on new forms, boast cutting-edge facilities and technology, enabling us to maintain a superior quality level. In addition, we also have an extensive network between our plants, which encompasses a system that can handle or improve any issues that may arise, and also enables the plants to complement each other. As for quality control, in addition to ISO 9001 certification, we have built a superb product quality control system through which the Toyo Tanso group fulfills the quality goals encapsulated in the slogan, “Customer First/Quality First.” In addition, Totan Kako Co., Ltd., which functions as a production base of carbon products for electrical application, was certified according to International Standard by Environmental Management System, “ISO 14001” in April 2006. As a leading company in the world of special-use carbon, we are proud--and very pleased--to offer only the best materials in an entire range of fields.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

TOYO TANSO

Catalog Disclaimers

1. Catalog Contents Disclaimer

- All information in this catalog is based on Toyo Tanso information that was current at the time of production. The catalog provides general information on Toyo Tanso products and product applications.
- The product data in this catalog consists of typical values, which are not guaranteed.
- The product applications in this catalog are only examples. Please use your own discretion and judgment to evaluate our products before use, and check the performance, effects and safety.
- The information in this catalog is subject to change without notice, based on the judgment of Toyo Tanso.

2. Intellectual Property Rights Disclaimer

- There is no guarantee that the product application examples in this catalog do not infringe the intellectual property rights of a third party.
- No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

3. Product Usage Disclaimer

- Please read the Material Safety Data Sheet issued by Toyo Tanso before using our products.
- Some of Toyo Tanso's products are subject to export restrictions due to the Foreign Exchange and Foreign Trade Control Law or by order of the related government authorities. These products cannot be exported overseas without permission from the government. Please be aware of these restrictions and contact Toyo Tanso in advance for more information.

No information in this catalog may be used or reproduced without the prior consent of Toyo Tanso.

TOYO TANSO
Inspiration for Innovation

Toyo Tanso Co., Ltd.

http://www.toyotanso.co.jp

■ Head Office
Umeda Daibiru, 10th Fl. 3-3-10 Umeda, Kita-Ku, Osaka 530-0001, Japan
Tel: 81-6-6451-2114 Fax: 81-6-6451-2186

No.TBE-05-01 2011.12.＊＊＊＊