Carbon Products for Mechanical applications

(1) Rod Packing
(2) Labyrinth Seal
(3) Radial Bearing
(4) Thrust Bearing
(5) Shoe
(6) Slider
(7) Joint Seal
(8) Trolley Wheel
(9) Valve Seat
(10) Vane
(11) Rotor
(12) Piston Ring
(13) Mechanical Seal
(14) Bearing

Features of Carbon Products for Mechanical applications

Carbon sliding materials have excellent self-lubricating properties, heat resistance and chemical resistance. This means they can be used in high-temperature atmospheres where ordinary metal sliding materials cannot and in fields where fluids and lubricants are inappropriate. Toyo Tanso's IG, KC and TUG product series bring together the technical and development capabilities in the field of sliding materials that have been cultivated over many years, to meet the various demands of our customers.

Excellent Self-Lubrication

Carbon has self-lubricating properties due to its layered crystal structure, making it appropriate for use in high-temperature atmospheres and in applications where fluids and lubricants are avoided. In particular, its coefficient of friction in an unlubricated condition is low compared with other materials, making adhesion difficult to occur.

Excellent Thermal Durability

There are virtually no changes in the mechanical strength and slide properties due to heat. Refer to the table on page 36 for the thermal durability of each material.

Excellent Chemical Resistance

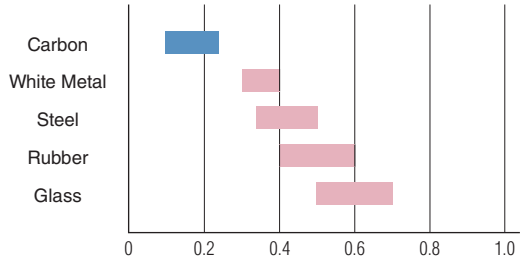
With the exception of inorganic chemicals (strong oxidizers), carbon has excellent chemical resistance. The chemical resistance of each material is shown in the table on page 39.

Thermal Shock Resistance

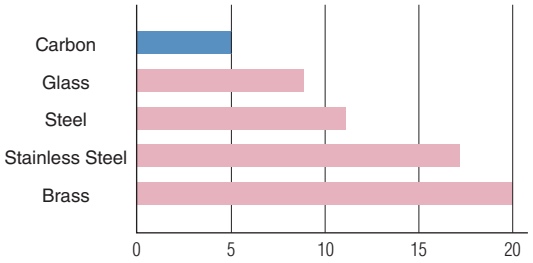
The coefficient of thermal expansion is lower than metal materials, and it has good thermal conductivity. This means that the material hardly ever cracks, even during rapid temperature changes.

Supports Lightweight Designs

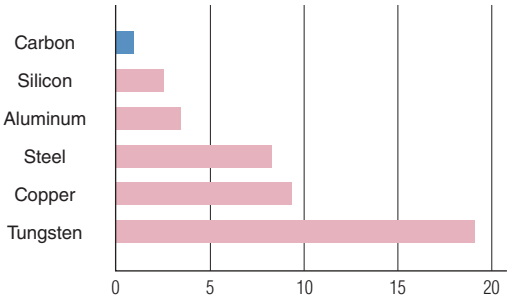
The bulk density is low compared to metal materials, which support lightweight machinery designs and a reduction in friction noise.



Dynamic Coefficient of Friction on a Steel Surface [Atmospheric Room Temperature]

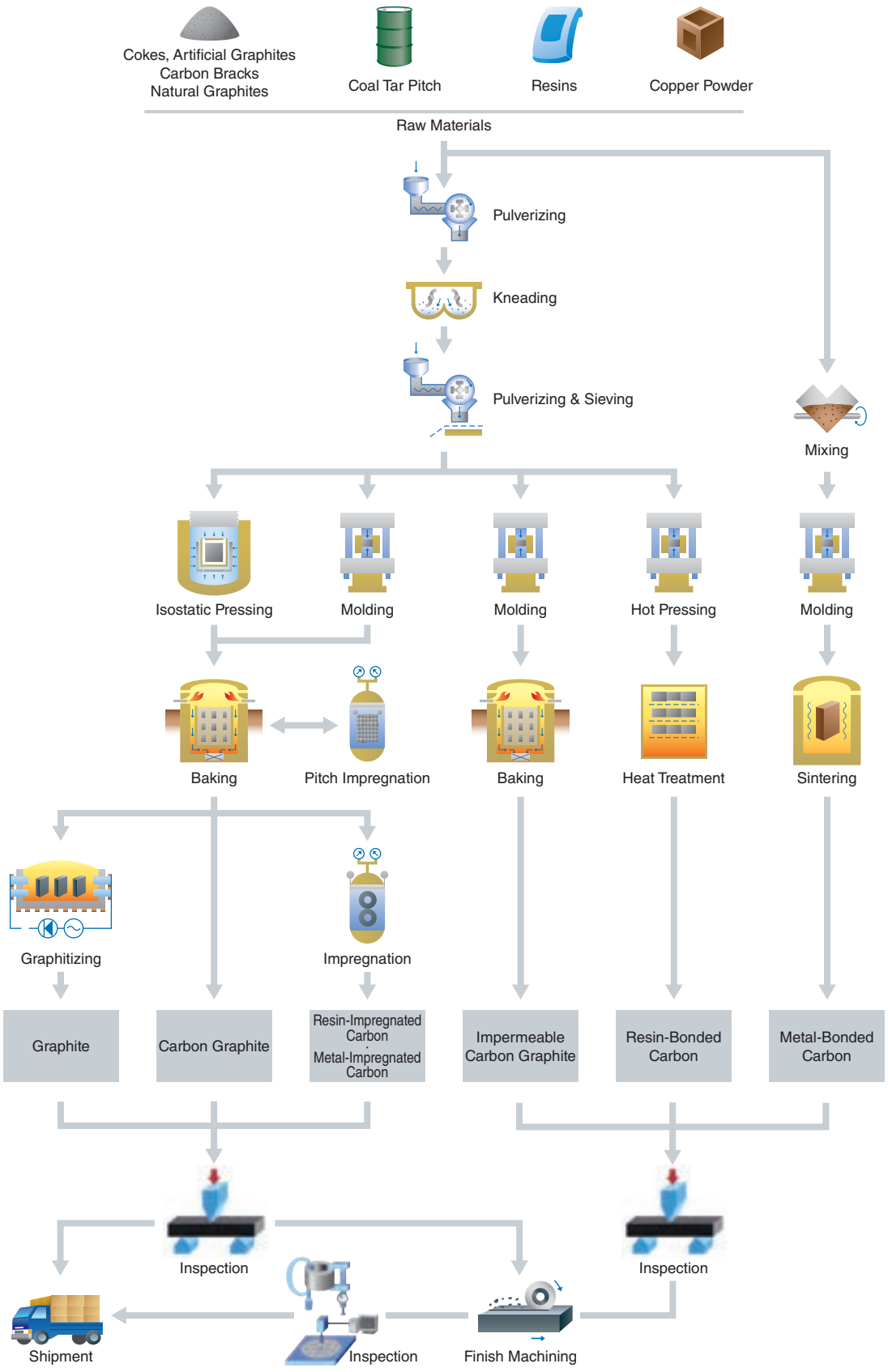


Coefficient of Thermal Expansion [10^{-6}/K]



Bulk Density [Mg/m^3]

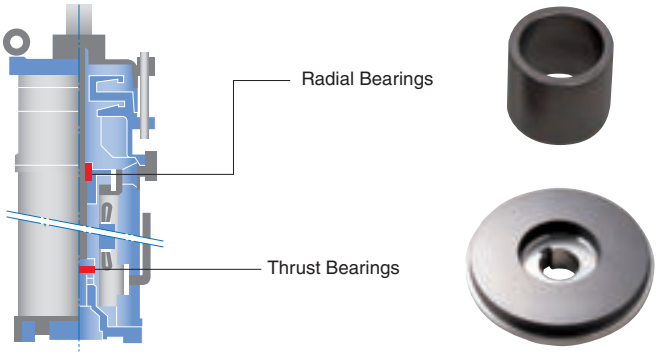
Manufacturing Process



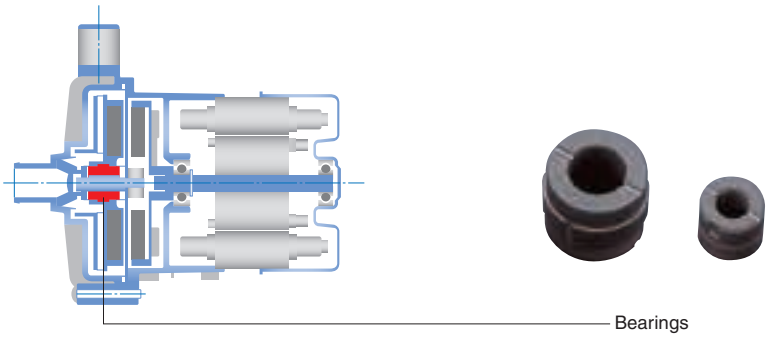
Application

■ Bearings

Deep well underwater motor pumps
Pumps for oil refining and petrochemical processes
Pumps for power station processes
Pumps for general industries
Chemical pumps
Marine pumps
Flowmeter pumps

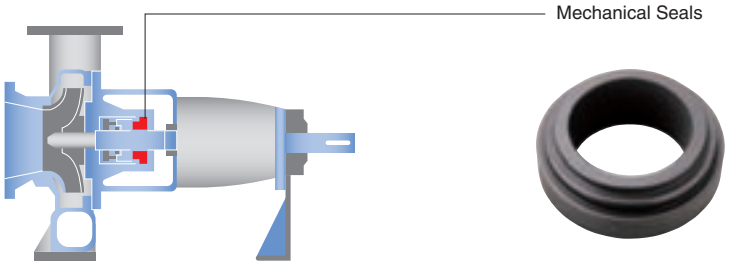


Household hot water circulation pumps
Vending machine circulation pumps
Dishwashers
Plywood dryer

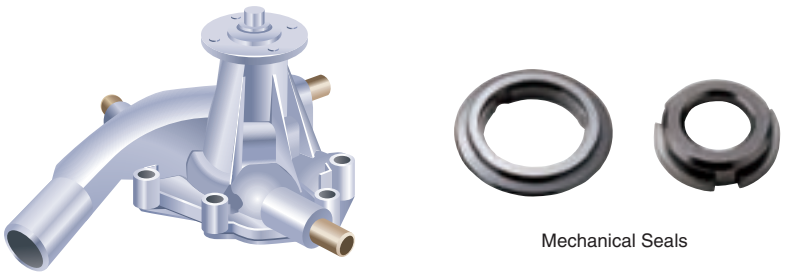


■ Seal rings

Pumps for oil refining and petrochemical processes
Pumps for power station processes
Pumps for general industries
Chemical pumps
Agitator
Marine pumps

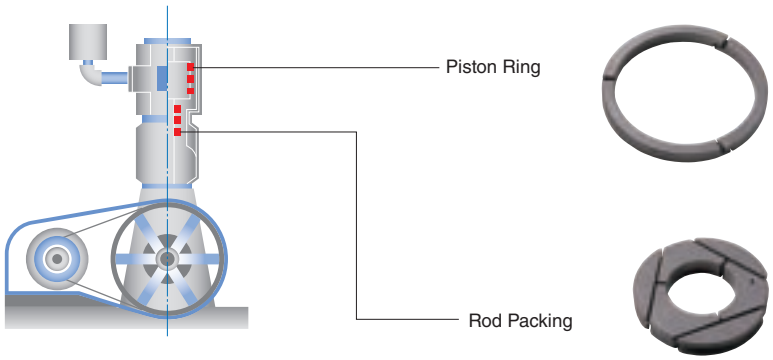


Automobile water pumps
Household hot water circulation pumps
Refrigerator compressors



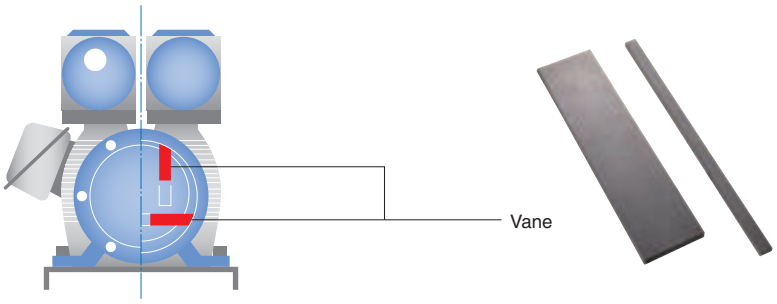
■ Packing

Reciprocal compressors
Screw compressors
Steam turbines
Hydroelectric power generators



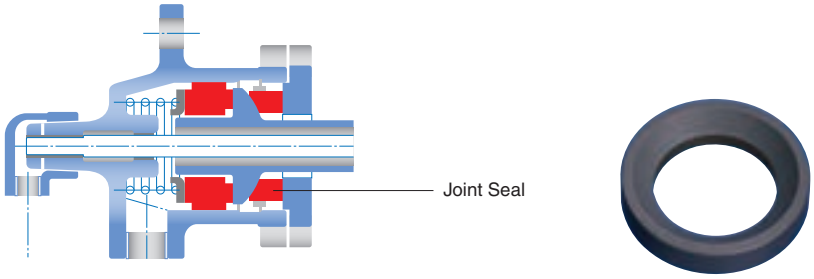
■ Vanes

Various vacuum pumps
Air blowers
Flow meters
Oscillating compressors
Jet heaters



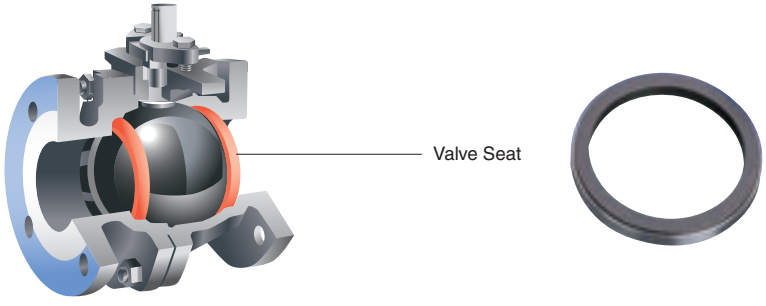
■ Joint Seals

Papermaking dryers
Drum dryers
Mixing mills
Printers



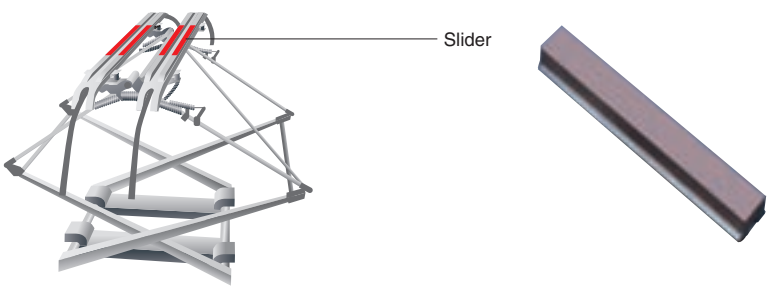
■ Valve Seats

Ball valves



■ Pantograph Sliders

JR regular lines
Japanese private railways



Typical Properties

We provide many different kinds of carbon products as sliding materials for mechanical applications, including graphite, carbon graphite, resin-impregnated carbon, metal-impregnated carbon, SiC/C composites, inorganic-compound impregnated carbon, impermeable graphite, resin-bonded carbon and metal-bonded carbon. Select the product most appropriate for your application.

■ Graphite

It has excellent heat and chemical resistant characteristics compared with other compositions, and virtually no charge in factors such as the slide properties.

■ Carbon Graphite

It is a general carbon sliding material composed of carbon and graphite. We provide products suitable for your applications.

■ Resin-Impregnated Carbon and Metal-Impregnated Carbon

Resin or metal is impregnated in the pores in carbon to improve strength, impermeability and slide properties.

■ SiC/C Composites

It has excellent slurry and blister resistance. The composite layer depth can be 2 to 4 mm from the surface layer.

■ Inorganic Compound-Impregnated Carbon

Inorganic compound is impregnated into isotropic graphite.
It has anti-oxidizing properties in high-temperature atmospheres.

■ Impermeable Carbon Graphite

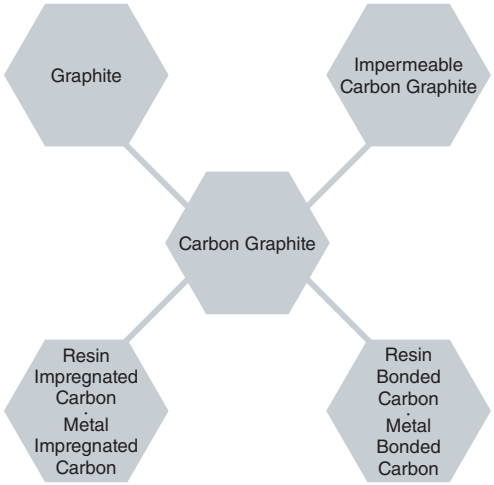
It is a non-impregnated material with excellent impermeability.
It is easily mass-produced by die-molding to any desirable shape.

■ Resin-Bonded Carbon

It is a carbon and resin bonded material. It is easily mass-produced by die-molding to any desirable shape.

■ Metal-Bonded Carbon

It is a sintered material with carbon and metal. It has self-lubricating properties, and is appropriate for fields where lubricants are avoided.



The slide properties of carbon are greatly affected by the usage conditions (e.g. pressure, circumferential velocity, contacting materials, atmosphere, temperature, etc.).
Toyo Tanso has a wide range of carbon and graphite grades available to meet your requirements.
Before actually using one of our products, please be sure to contact our sales department to consult on selecting the most appropriate grade.

Composition	Grade	Bulk Density	Hardness	Flexural Strength	Compressive Strength	Young's Modulus	Coefficient of Thermal Expansion	Thermal Conductivity	Thermal Durability
		Mg/m^3	HSD	MPa	MPa	GPa	$10^{-6}/K$	W/(m·K)	°C
Graphite	IG-11	1.77	51	39	78	10	4.5 a)	120	400
	ISO-68	1.82	80	76	172	13	5.6 a)	70	450
Carbon Graphite	KC-36	1.72	65	48	135	15	3.5	15	300
	KC-57	1.78	105	70	270	20	4.0	5	350
	KC-67	1.77	72	60	185	20	3.5	10	350
	KC-83K	1.74	80	55	160	15	4.0	10	350
	KP-001	1.72	90	70	240	17	5.0	4	250
	KP-002	1.73	60	58	170	17	3.5	7	250
Resin-Impregnated Carbon	KC-360	1.78	75	58	165	17	4.0	15	250
	KC-570*	1.85	110	84	370	22	5.0	5	300
	KC-573*	1.85	110	85	370	22	5.5	5	250
	KC-670*	1.87	87	78	240	22	5.0	10	300
	KC-673*	1.87	87	78	245	22	5.5	10	250
	KC-830K	1.84	90	70	205	17	5.0	10	300
	IKC-433	1.97	70	70	140	20	6.0	139	200
Metal-Impregnated Carbon	KC-5709*	2.25	110	100	430	27	5.0	5	400
	KC-6709*	2.30	88	90	300	27	5.0	13	400
	IKC-6809	2.67	88	105	300	21	6.0	80	450
	PC-78A	2.90	95	110	410	27	6.5	13	350
SiC/C Composites	TS-002	2.31/2.75	63/70	113/78	300/205	18/16	4.5/5.2	80/80	500
	TS-003	2.28/1.82	83/80	116/76	410/172	30/13	5.4/5.6	70/70	400
	TS-004	2.28/1.92	83/86	116/88	410/235	30/15	5.4/7.5	70/60	200
	TS-005	2.28/2.67	83/88	116/105	410/300	30/21	5.4/6.0	70/80	500
Inorganic Compound-Impregnated Carbon	IG-11R1	1.85	55	46	92	11	4.5 a)	120	500
	IG-43R1	1.88	57	59	108	12	4.8 a)	140	500
	ISO-68R1	1.87	84	83	190	15	5.6 a)	70	500
Impermeable Carbon Graphite	TUG-105	1.67	90	60	250	20	4.0	—	250
	TUG-110	1.78	105	90	290	20	4.0	—	250
	TUG-120	1.68	95	70	245	20	4.0	—	250
	TUG-308	1.87	90	65	215	23	3.5	—	250
	TUG-309	1.85	80	55	185	20	3.5	—	250
	TUG-3095	1.81	75	50	170	20	3.5	—	250
	TUG-505	1.89	80	68	185	20	3.0	—	250
Resin-Bonded Carbon	W-1500	1.77	70	75	175	15	23.0 b)	—	150
	W-3500*	1.63	85	90	250	12	30.0 b)	—	200
	LS	1.77	60	70	100	15	15.0 b)	—	150
	NLA	1.70	75	85	175	15	23.0 b)	—	150
	MR-10*	1.43	78	100	230	10	35.0 b)	—	200
Metal-Bonded Carbon	GM-1	4.60	18	25	55	—	12.0	—	200
	GM-5	6.20	18	205	350	—	12.0	—	400

* The figures above are typical values, and are not guaranteed.
* The SiC/C composite values show both of the "SiC/C composite layer" and "substrate (+ impregnation)".
* The SiC/C composite thermal durability shows that of the "substrate (+ impregnation)".
* Thermal durability varies with usage conditions. Values provided for reference purposes only.
* The measurement temperature range for the coefficient of thermal expansion is: a) 350 to 450°C, b) 50 to 150°C, and others: 100 to 200°C.
* Unit conversion: MPa=kgf/cm^2 x 0.098 GPa=kgf/mm^2 x 0.0098 W/(m·K)=kcal/h·m·°C x 1.16

Product Selection Table by Usage

Composition	Grade	Bearings										Seal Rings					
		Non-Lubricated					Lubricated					Mechanical Seal					
		For high temperatures	For high loads	For low loads	For high load mass production	For low load mass production	For high loads	For low loads	For high load mass production	For low load mass production	For slurry resistance	For high loads	For low loads	For high load mass production	For low load mass production	For blister resistance	
Graphite	IG-11	○															
	ISO-68	○															
Carbon Graphite	KC-36			◎													
	KC-57						○	◎									
	KC-67			○				○									
	KC-83K			○				○									
	KP-001								◎								
	KP-002									◎							
Resin-Impregnated Carbon	KC-360		○	◎													
	KC-570, KC-573						◎					◎					
	KC-670, KC-673							◎					◎				
	KC-830K							◎					○				
Metal-Impregnated Carbon	KC-5709						◎				○	◎				○	
	KC-6709						○	◎					○				
	IKC-6809						○										
	PC-78A																
SiC/C Composites	TS-002						◎				◎	◎				◎	
	TS-003						◎				◎						
	TS-004											◎				◎	
	TS-005						◎				◎	◎				◎	
Inorganic Compound-Impregnated Carbon	IG-11R1	○															
	IG-43R1	◎															
	ISO-68R1	◎															
Impermeable Carbon Graphite	TUG-105								◎								
	TUG-110													◎		○	
	TUG-120								◎								
	TUG-308													◎		○	
	TUG-309								○					○			
	TUG-3095				○												
	TUG-505													○			
Resin-Bonded Carbon	W-1500					○				○					○		
	W-3500					◎				◎					◎		
	LS					○											
	NLA									◎							
	MR-10																
Metal-Bonded Carbon	GM-1																
	GM-5		◎														

	Seal Rings											Vanes		Slider			Special Applications	
	Joint Seal					Compressors			Shaft Seals		Valve Seat	Non-Lubricated	Lubricated	Trolley wheels and shoes	For trains	For brakes	Jigs for glass production	Structural materials for high temperatures
	For high loads	For low loads	For high load mass production	For low load mass production	For large sizes	For air	For special gas	For dry gas	For steam	For hydropower								
							◎		◎					○				
																		○
												◎						
														◎				
													○					
						◎			○			◎						
	○				○													
		◎																
		◎			◎	○				○		○	○					
	◎									◎								
	○										○							
											◎		○					
														◎	◎			
																	◎	
												◎					◎	◎
			○															
			○															
				○									○					
				◎														
				○						◎								
						○		◎				○						
																◎		
														◎		○		

* ◎···Most appropriate ○···Appropriate
* A variety of stock sizes are available.
Please contact our sales team for details.
* The maximum dimensions are subject to change due to manufacturing technology developments.
* There are additional products for special applications that are not show in the table.

Toyo Tanso has a wide range of carbon and graphite grades available to meet your requirements.
Before actually using one of our products, please be sure to contact our sales department to consult on selecting the most appropriate grade.

Chemical Resistance

With the exception of some inorganic chemicals (strong oxidizers), carbon is resistant to chemical corrosion. Carbon has excellent chemical resistance when compared to general metal materials, and so is used in a wide variety of applications. Refer to the table below for the chemical resistance of carbon for mechanical application, as compared to general chemicals. The chemical resistance varies according to the chemical density, temperature and carbon composition, so please contact Toyo Tanso for further details.

Chemical Name	Chemical Formula	Concentration (mass %)	Temperature	Composition				
				Graphite	Carbon Graphite			Resin Bonded
					Non-Impregnated	Resin-Impregnated	Metal-Impregnated	
Ammonia (Gas)	NH_3	100	H	○	○	○	○	○
Chlorine (Gas)	Cl_2	100	H	○	○	○	×	×
Hydrogen Chloride (Gas)	HCl	100	H	○	○	○	×	×
Bromine (Gas)	Br_2	100	C	×	×	×	×	×
Hydrogen Bromide (Gas)	HBr	100	H	○	○	○	×	×
Sulfur Dioxide (Gas)	SO_2	100	H	○	○	○	×	×
Fluorine (Gas)	F_2	100	C	×	×	×	×	×
Hydrogen Fluoride (Gas)	HF	100	W	○	○	○	×	×
Ammonium Hydroxide	NH_4OH	25	W	○	○	○	○	○
Potassium Hydroxide	KOH	60	C	○	○	○	○	○
		60	H	○	○	×	×	×
Sodium Hydroxide	NaOH	60	C	○	○	○	○	×
		60	H	○	○	×	×	×
Sodium Chlorite	$NaClO_2$	20	H	×	×	×	×	×
Sulfurous Acid	H_2SO_3	100	C	○	○	○	○	×
Hydrochloric Acid	HCl	36	H	○	○	○	×	×
Aqua Regia (Hydrochloric Acid/ Nitric Acid)	HCl/HNO_3	100	C	○	○	○	×	×
Potassium Permanganate	$KMnO_4$	7	C	○	○	○	○	○
		7	H	×	×	×	×	×
Chromic Acid	H_2CrO_4	20	C	○	○	○	×	×
		20	H	○	○	○	×	×
		40	C	○	○	○	×	×
		40	H	○	×	×	×	×
		60	C	×	×	×	×	×
Mixed Acid (Nitric Acid/Sulfuric Acid)	HNO_3/ H_2SO_4	100	C	×	×	×	×	×
Nitric Acid	HNO_3	38	H	○	○	○	×	×
		65	C	○	×	×	×	×
		65	W	○	×	×	×	×
		65	H	×	×	×	×	×

Chemical Name	Chemical Formula	Concentration (mass %)	Temperature	Composition				
				Graphite	Carbon Graphite			Resin Bonded
					Non-Impregnated	Resin-Impregnated	Metal-Impregnated	
Sodium Hypochlorite	NaClO	7	H	○	×	×	×	×
		13	W	○	×	×	×	×
		23	C	×	×	×	×	×
Hydrofluoric Acid	HF	40	W	○	×	×	×	×
		60	C	×	×	×	×	×
Fuming Sulfuric Acid	$H_2SO_4+SO_3$	98	C	×	×	×	×	×
Sulfuric Acid	H_2SO_4	48	H	○	○	○	×	×
		98	H	×	×	×	×	×
Phosphoric Acid	H_3PO_4	85	C	○	○	○	○	○
		85	H	○	○	○	×	×
Acetone	CH_3COCH_3	100	C	○	○	○	○	×
Aniline	$C_6H_5NH_2$	100	C	○	○	○	○	○
Ether	R-O-R	100	C	○	○	○	○	○
Formic Acid	HCOOH	100	C	○	○	○	×	×
Citric Acid	$C_6H_8O_7$	100	C	○	○	○	○	○
Glycerin	$C_3H_5(OH)_3$	100	C	○	○	○	○	×
Chloroform	$CHCl_3$	100	C	○	○	○	×	○
Carbon Tetrachloride	CCl_4	100	C	○	○	○	○	○

* H···100°C W···50°C C···20°C ○···Resistant ×···Infused