CARBON-GRAPHITE PRODUCTS

C/C composite

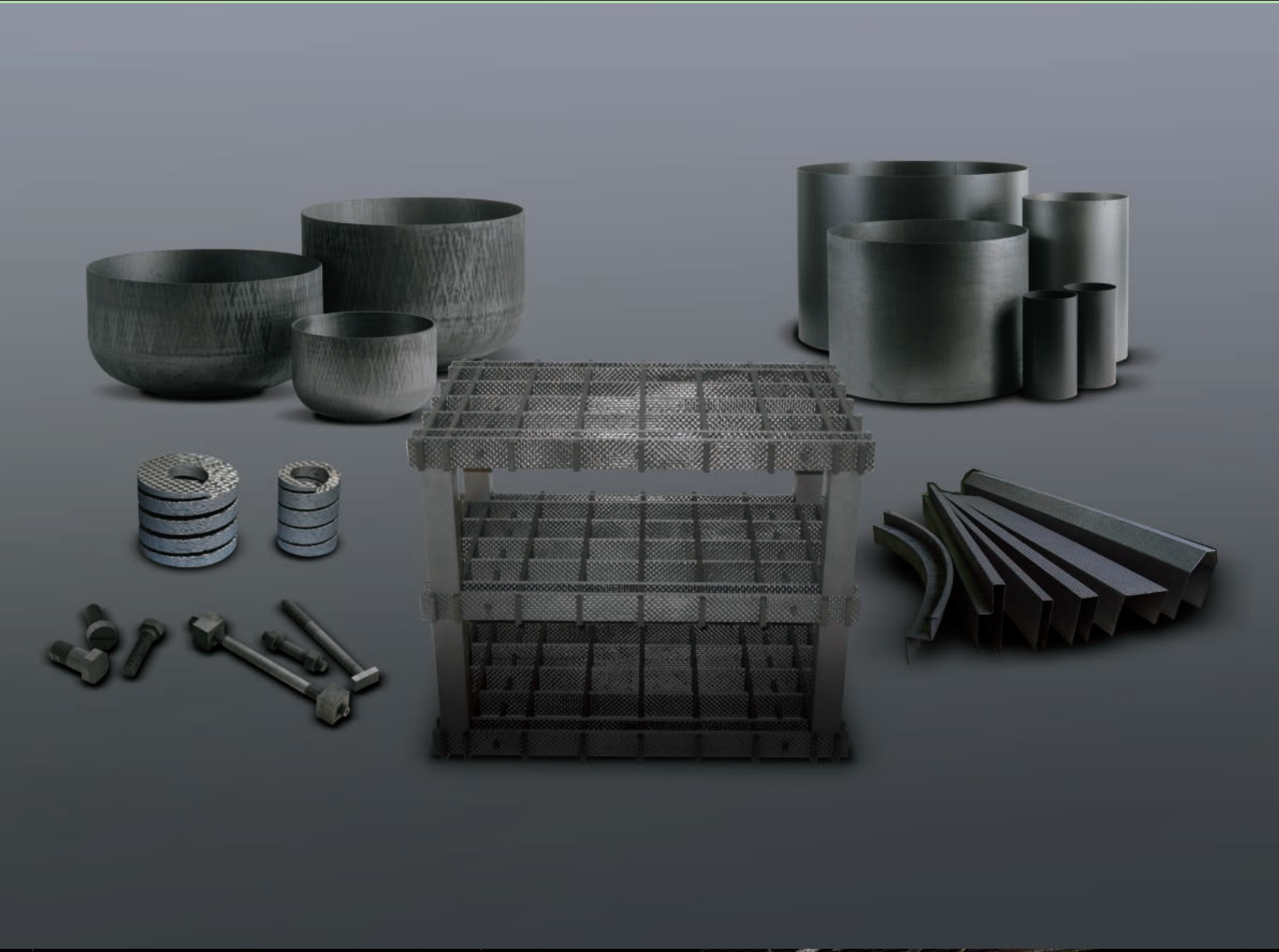
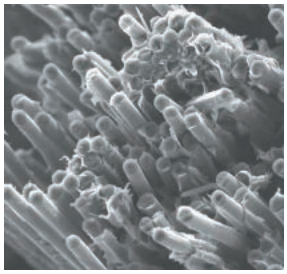


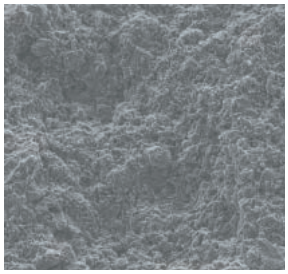
Image: provided by JAXA
Illustrated by Akihiro Ikeshita

Features of C/C Composite Products

C/C composite (Carbon Fiber Reinforced Carbon Composite) is a carbon-carbon composite material reinforced by high strength carbon fiber, which has superior properties such as light weight, high mechanical strength, and high elasticity. Because of their unique features, our C/C composites (CX series) are used in a wide range of fields such as electronics, environment and energy, general industrial furnaces, and automobiles and other means of transport.



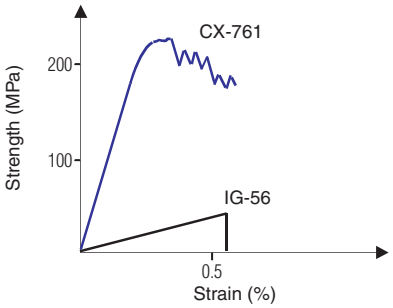
C/C composite (×1000)



Artificial graphite (×200)

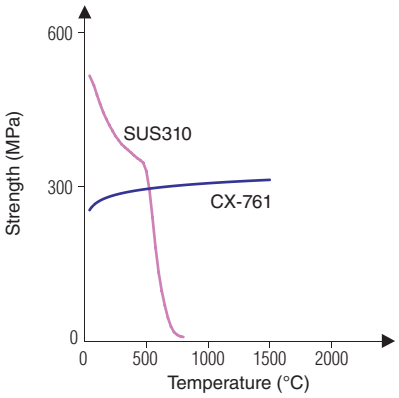
■ High mechanical strength, high elasticity, and high toughness

C/C composites have higher strength, higher elasticity, and resistance to cracking and chipping, compared to isotropic graphite materials. C/C composites can be used with assurance, as the fractures do not propagate rapidly in them.



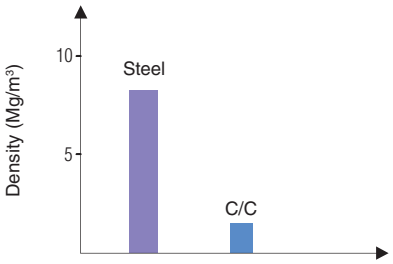
■ Ultra heat resistance

C/C composites have higher strength at high temperatures compared to metallic materials. They can be used even at ultra-high temperatures of 2000°C or higher in inert atmospheres.



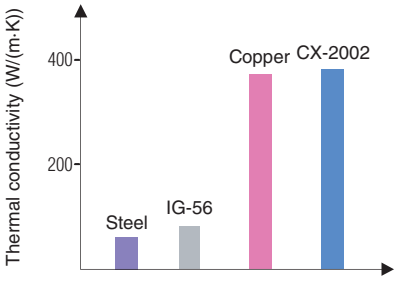
■ Light-weight and easy to handle

C/C composites have low density compared to metallic materials, and therefore, make light weight designing possible.



■ High thermal conductivity

A thermal conductivity higher than copper has been achieved (in CX-2002) through the use of carbon structure control technology, which involves our superior chemical vapor infiltration (CVI) treatment.



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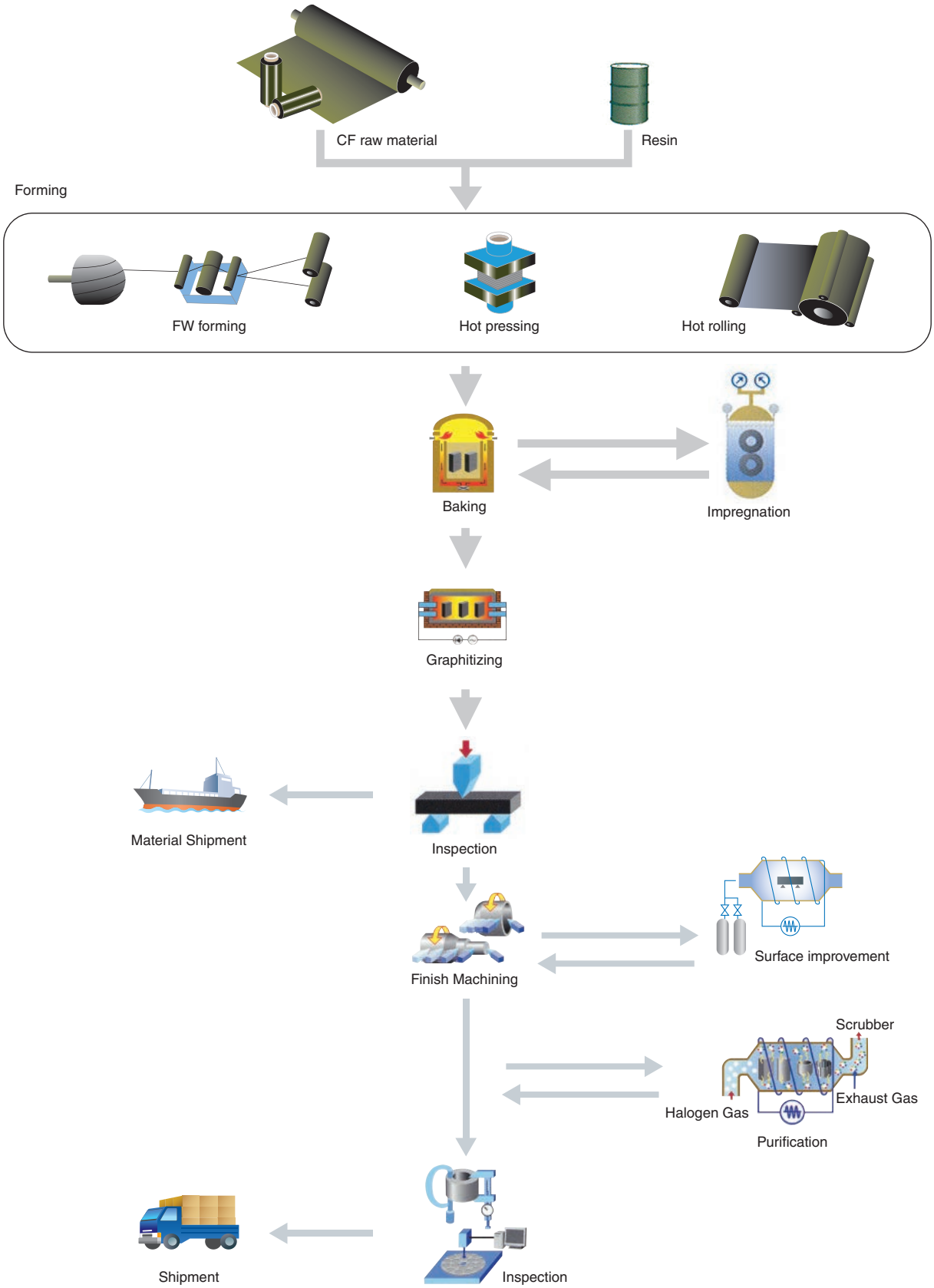
Manufacturing Process



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Application

■ Electronics

● For production of single crystal silicon

Crucibles

Heat shields

■ Environment and Energy

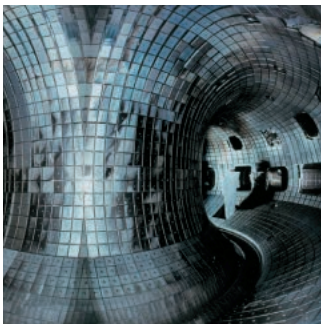
● For production of silicon for solar cells

Rectangular crucibles

Carrier tray for PECVD

● For nuclear energy plants

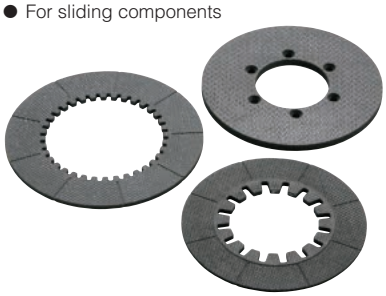
Armor tiles



* Photographs provided by the National Institutes for Quantum and Radiological Science and Technology

■ Automobiles, other means of transport, etc

● For sliding components



Clutch

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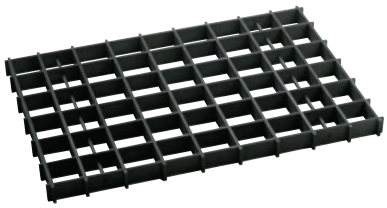
■ General industrial furnaces

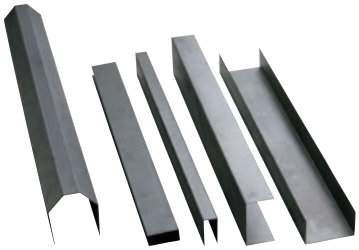
● For heat treatment furnaces



Base tray (Grid)

Basket

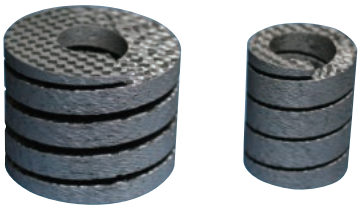
Multi-layer tray



Protective cover for thermal insulation

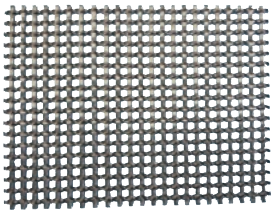
Heaters

Hot press mold

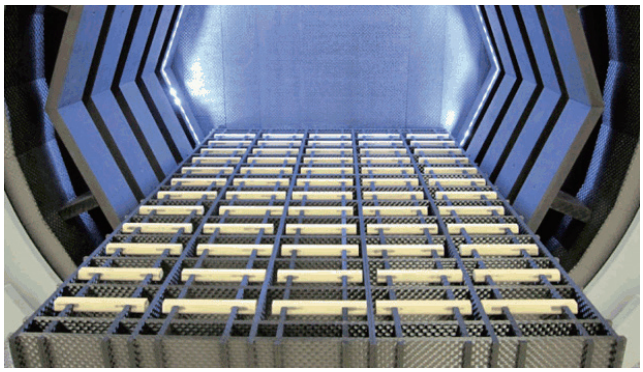


Spring

Nuts and bolts



Mesh



Heat treatment furnace

Robot transfer

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Property Data

■ Typical properties

Shape	Material	Bulk Density (Mg/m³)	Electrical Resistivity (μΩ·m)	Flexural Strength (MPa)	Flexural modulus (GPa)	Tensile strenght (MPa)	Coefficient of Thermal Expansion RT to 1273K (10^{-6}/K)		Thermal Conductivity (W/(m·k))		C/C type	Description
		—	—	—	—	—	(⊥)	(//)	(⊥)	(//)		
Flat plate	CX-741	1.51	23	140	46	185	8.1	<1	6	35	2DC/C	Medium strength (Molding method A)
	CX-761	1.58	20	185	55	250	8.4	<1	9	44		High strength (Molding method A)
	CX-742	1.48	24	130	42	170	7.8	<1	5	34		Medium strength (Molding method B)
	CX-762	1.58	21	170	50	185	8.2	<1	8	42		High strength (Molding method B)
	CX-231	1.63	19	186	52	220	9.3	<1	8	50		Large diameter bolts, nut components, spring components
	CX-31	1.61	22	90	23	98	4.1	<1	12	52		Nut and bolt components
	C/C-201 1)	1.50	30	147	47	127	8.2	<1	5	20		Medium strength, nut and bolt components
Profiles	CX-743	1.48	24	130	—	—	7.8	<1	5	34		Profiles
	CX-763	1.58	21	170	—	—	8.2	<1	8	42		Profiles with high strength
Cylinders	CX-45	1.44	24	105	34	114	8	<1	4	34		Medium strength cylinder
	CX-47	1.52	23	140	45	154	8	<1	6	35		High strength cylinder
Crucibles	CX-510V	1.57	13	195	—	290	7	<1	7	-	FWC/C	FW crucibles
Cylinders	C/C-FW 1)	150	12	245	—	245	—	<1	5	30		FW hot press molds
	CX-55	1.60	11	195	—	290	7.4	<1	7	-		FW cylinders
Tiles	CX-2002U 2)	1.65	2.7, 3.4, 5.1 (X, Y, Z)	47, 43, 17 (X, Y, Z)	—	35, 30, 11 (X, Y, Z)	5.3 (Z)	1.7, 2.3 (X, Y)	190 (Z)	390, 320 (X, Y)	felt C/C	Use in nuclear energy plants
	Isotropic graphite (IG-56)	1.77	12	43	10	27	4.7		104			

* The figures above are typical values, and are not guaranteed.
1) Manufactured by Ohwada Carbon Industrial Co., Ltd.;
2) The direction of lamination of the felt is designated as the Z-axis and the directions within the plane as X- and Y-axes.

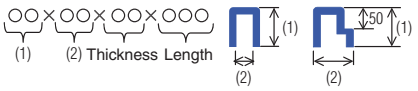
■ Available sizes

Grade	Dimensions (mm)
CX-741, CX-761	0.8-30*1500*2000, 100*500*2000
CX-231	0.8-30*1500*2000
CX-742, CX-762	0.8-30*1500*3000
CX-31	3.2-90t, Max. 400*850
C/C-201	1-12*700*970
CX-45, CX-47	Inner diameter ø300-1400, 1400L

Grade	Dimensions (mm)
CX-743, CX-763	h-profile 107*44*1.5*1000
CX-510V	Max.inner diameter ø1168 (46" crucibles available)
C/C-FW	Max. ø950*800h, 20-150t
CX-55	Inner diameter ø10-1400, 2000L
CX-2002U	40*150*150 (X*Y*Z)

* Please contact us for other sizes.

U-and h-profiles' dimensions



■ An example of impurity analysis of CX-510V (A high purity treated product)

Unit: mass ppm

Element	Na	Mg	Al	K	Ca	Ti	V	Cr	Fe	Ni	Cu
Content	<0.05	<0.02	<0.08	<0.1	<0.04	<0.09	<0.07	<0.07	<0.04	<0.1	<0.08
Method of measurement	AAS	ICP-AES	ICP-AES	AAS	ICP-AES	ICP-AES	AAS	ICP-AES	ICP-AES	ICP-AES	ICP-AES

* The figures above are examples of measured values and are not guaranteed.
* ICP-AES: Inductively coupled plasma atomic emission spectroscopy, AAS: Atomic absorption spectrometry
* CX-510V is a high purity material

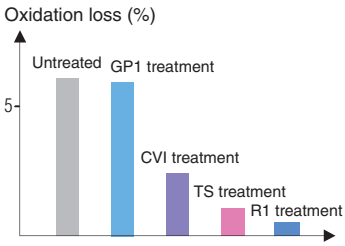
■ Different surface improvements

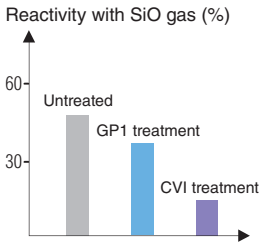
Advantageous properties are imparted by using Toyo Tanso's proprietary surface improvement technologies.

■ Details of surface improvements and their effects

Glassy carbon coated GLASTIX KOTE™ (GP1 treatment)	Impregnation/coating with glassy carbon; it prevents dust formation.
Pyrolytic graphite impregnation (CVI treatment)	Impregnation/coating with pyrolytic carbon; it improves resistance against SiO gas.
Inorganic compound-impregnation (R1 treatment)	Impregnation with inorganic matter; it improves oxidation resistance.
SiC/C composites (TS treatment)	A treatment to convert the surface into SiC; it improves oxidation resistance and prevents dust formation.

*Abbreviation for Chemical Vapor Infiltration





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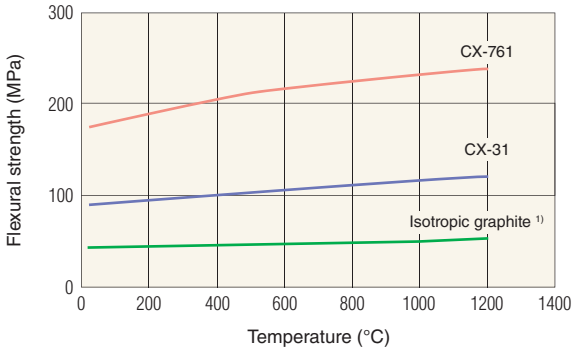
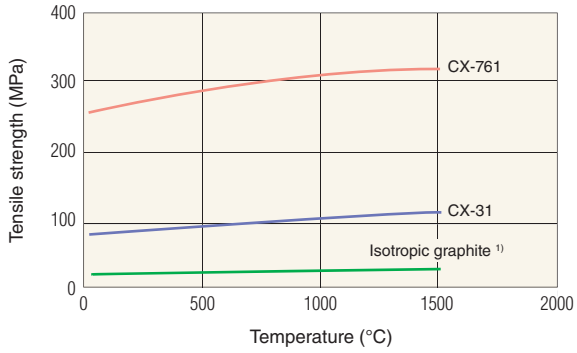
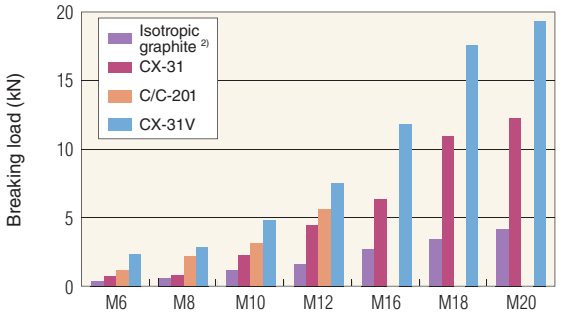
■ Flexural strength



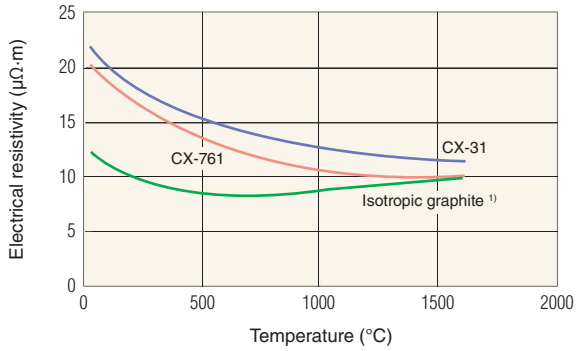
■ Tensile strength



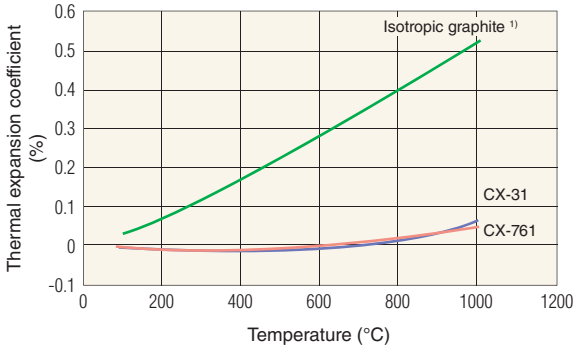
■ Bolt breaking load



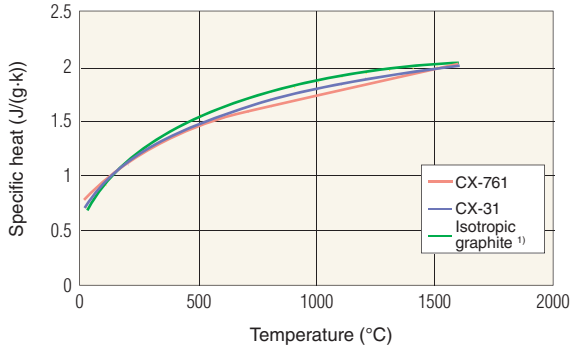
■ Electrical resistivity



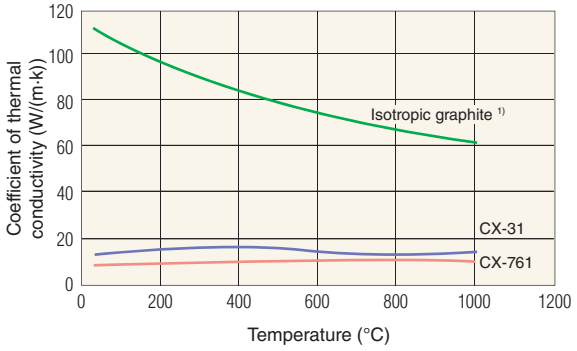
■ Linear thermal expansion coefficient (//)



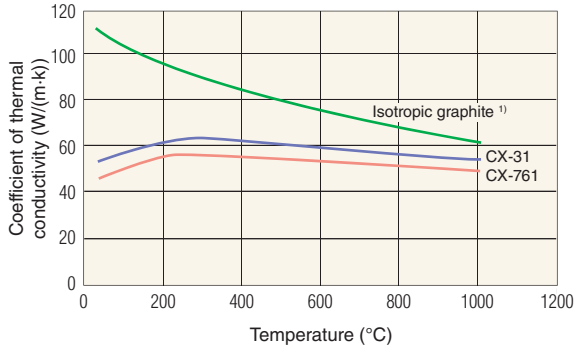
■ Specific heat



■ Thermal conductivity (⊥)



■ Thermal conductivity (//)



1) Our product: Large-sized isotropic graphite material, IG-56
2) Our product: High strength isotropic graphite material, ISO68

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Examples of Designing C/C Composite Products

We select suitable materials and design products according to customer's use conditions and requirements.

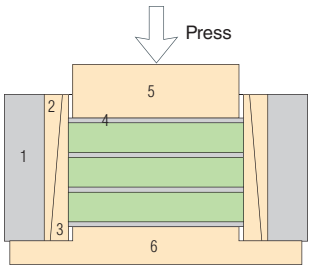
■ Hot press mold

■ Features

1. The device can be made smaller, and the cost of installing the facility reduced.
2. Large-sized sintered bodies can be made, which improves productivity.
3. Heat capacity is less, which can reduce energy costs.

■ Designing

<Design example> Molding pressure: 30 MPa; Job diameter: 200 mm; Height: 250 mm



	Parts	Material
1	C/C die	C/C-FW
2	Outer sleeve with slit	IG-70
3	Two-piece inner sleeve	OP-4800N
4	C/C spacer	C/C-201
5	Upper punch	ISO-68
6	Receiver cradle	IG-70

C/C compsite
Graphite
Sintered body

	Tensile strength	Die outer diameter	Die weight
C/C-FW die	245 MPa	ø340	23 kg
Carbon die	31 MPa	ø520	83 kg

The tensile strength of the C/C composite is higher than of ordinary carbon, which permits a small die outer diameter to be used. This enables the designing of compact equipment.
Manufacturer: Ohwada Carbon Industrial Co., Ltd.

[Examples of products]

■ Heat treatment tray

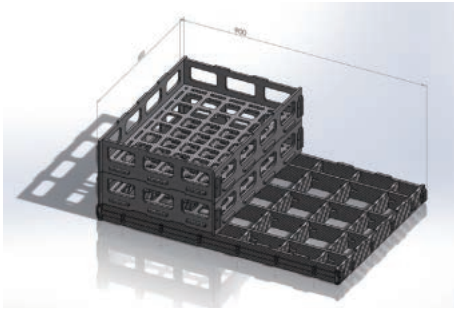
■ Features

Because C/C composites are lightweight and resistant to heat deformation, they can be used for trays and baskets used in heat treatments.
We can propose custom designs to significantly improve both work and production efficiency.

Features

1. Lightweight
   (1) Capable of reducing heating energy.
   (2) Capable of improving workability while reducing worker load.
   (3) Capable of enhancing workpiece packing as jigs become more lightweight.
2. Resistant to deformation
   (1) No more need to repair jigs due to heat deformation.
   (2) No more decreased workpiece packing due to jig deformation.
   (3) Enhanced quality thanks to no transfer of distortion from deformed jigs to workpieces.
   (4) Workpieces and jigs can be automatically transferred via robots to achieve manpower reductions.
3. Custom designs
   Designs can be created in line with customer specifications.

■ Designing



Load capacity (Kgf)	Size (mm)
≤500	900 x 600 x 40
≤750	900 x 600 x 45
≤1000	900 x 600 x 50

[Examples of products]

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