



TOKAI CARBON



GLASS

FOUNDRY

HEAT TREATMENT

**Schunk–Tokai Cooperation
graphite & carbon specialists**

Schunk has been developing high-tech products in the area of carbon technology for key industries all over the world for over a century now. Schunk stands for high-quality materials and components, long-lasting quality, safety and perfection with tradition. Close cooperation with our customers is especially important to us - their needs and goals are our top priority. Schunk offers tailor-made materials and components for a wide range of high-temperature applications – from ambient temperature to 2,800 °C. As an experienced partner, we cover the entire process chain, from the manufacture of basic materials, planning, development and production of components to quality control and testing. We manufacture components varying in size from microscopic dimensions to several meters long. We are dedicated to providing expert advice and a comprehensive service.

Schunk – more than a century of progress



Schunk headquarters - from raw materials to refining

Schunk-Tokai Cooperation

Schunk and Tokai have taken the opportunity, to promote and develop together, a joint cooperation in the market of Poland. This collaboration will have available to it, the strongest portfolio of carbon and graphite products in Europe, isotropic and extruded graphite's and composite products.

It will have the support of a highly qualified technical engineering team, benefit from most advanced machining facilities in Europe and take advantage of the experience and knowledge of the combined companies in application advice, product enhancement with coatings and purification, design and delivery.



● machine shops Schunk and Tokai

A pioneer in the carbon industry for more than 80 years, Tokai Carbon Group has always been steadily expanding the frontiers of technical possibility. In order to generate progress in an increasingly complex and global world, we have developed and diversified the applications of carbon. To satisfy the changing needs of our customers, we have evolved into an all-round carbon product manufacturer. As the combination of corporate globalisation and rapid technical innovation has been changing the face of the world, we have fostered technical improvements and diversification. Directed by a customer - centred management, we are committed to achieving an outstanding role in technology development by increasing the technical power and know-how in the carbon industry. We would like to further increase our efforts toward cultivating our technological competence comparable with the world, securing steady growth in our business operations on the basis of originality and as a reliable international enterprise.



*Tanoura Production Plant
Iso-Static and Extruded Materials*





Every stage of the production process where hot glass is poured, guided and directed results in contact with components made of other materials. The functional safety and material properties of these materials are crucial for an efficient, trouble-free production process and for the excellent finish of the glass products.

That's why we manufacture these components from carbon. Carbon is like no other material, and its unique properties make it ideal for use in the glass industry.



- Carbon prevents stress cracks in the glass, because its thermal conductivity is substantially lower than other metals.
- Carbon leaves no buildup on glass products whatsoever because it has extraordinary chemical resistance.
- Carbon allows for high durability of handling components because it is extremely resistant to high temperatures and oxidation.

For components with extreme mechanical stressability, Schunk offers additional carbon-fiber-reinforced materials.



We accompany our customers through the entire planning and development process. We support you in both the design and dimensioning of your component and in the choice of the most efficient form of production.



Application	Isotropic Graphite	C/C composite	special
Container glass			
Holder QC / FL system			steel
Take-out tongs QC* / FL**	FE479, FE879		
Blowhead inserts	FE779		
Backplates		CF260, CF260Q	
Dead plates	FE519, FH429		
Sweep-out pads		CF260, CF260Q	
Guides		CF260, CF260Q	
Stacker bar pads		CF260Q, CF264Q	
Tubular glass			
Guide blocks	FH42, FE519		
Pins	FH421		
Roller	FH42, FE519, FE779		
Pharmaceutical glass			
Forming mandrels	FE779		
Pins	FH421		
Household glass			
Moulds	FU4960		

*QC= quick chance **FL= floating





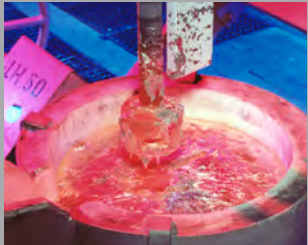
Industries involved with processing molten liquids, in particular metals such as iron, aluminium, copper and precious metals and glass, use casting and metal treatment techniques that require the use of graphite materials resistant to attack by the molten liquid. These graphite materials must also not affect the final composition of the cast metal or deposit any hard particles in the melt that could cause problems during any subsequent post machining operations.



Continuous casting operations demand the use of graphite for a number of reasons including:

1. a resistance to wetting by the molten metal or glass
2. efficient heat removal and
3. excellent thermal shock resistance

Schunk has developed a reliable refining procedure improving the quality of the cast strand and increasing the life span of the graphite dies.



For processing aluminium alloys during such operations as degassing, graphite shafts and rotors are ideal for the same reasons. Extended life is available with GRAPHOX treated graphite. Tokai uses a post machining technique that ensures the graphite parts are completely impregnated during the process.



Application	Extruded/ Moulded Graphite	Isotropic Graphite	C/C Composite
Continuous Casting			
Grey Iron		G330, G347	
Ductile Iron		G330, G348	
Brasses		G347, G348, G458	
Bronzes		G330, G348	
Copper Nickel		G348	
Nickel Silver		G348	
Precious Metals		G347, G348	
Zinc		G347	
Aluminium Billet & Slab		G330, G347	
General Applications			
Aluminium Degassing	EE250G		
Molten Metal Pumps	EE250G		
Extrusion Run Out Tables	FE250		
Furnace Heating Elements	FE250	G330	CF222, CF226
Furnace Furniture	EE250	G347	CF226, CF227
Furnace Linings			CF226/2, CF227/2
Boats	FE250	G330	
Sinter Trays	EE250	G347	CF226, CF227
Crucibles	G140	G348	
Large Crucibles		G530	

G= Graphox





There are many sectors of industry that use thermal processing in their production cycle. Many of these rely on furnaces that are electrically heated and hence need materials that have high thermal stability and high electrical loading capability. They also need to be resistant to aggressive media, thermal shock and be chemically pure so as not to deposit any unwanted elements during thermal processing. The use of carbon parts offer the user the possibility to work at temperatures that are beyond the capability of metal and ceramic elements. These are usually not used above 2000°C whereas graphite is capable of withstanding temperatures up to 3000°C.



The properties of graphite and c/c composite make them the ideal materials of choice for components used in furnace applications including vacuum and inert atmosphere. Graphite is easily machined and so complex shapes can be made to suit the requirement of the furnace.



Schunk's c/c composite has been developed as a high strength to weight ratio material suitable for many applications including carrier trays, structural parts and heater elements. The material has excellent shock and chemical resistance whilst having a low CTE and high purity. Due to low thermal conductivity and high emissivity Schunk's graphite felt is especially appropriate for the use as insulation material. It provides excellent resistance to chemical attack and a prolonged lifespan due to its high purity. Graphite soft felt is characterized by high flexibility and ease of processing. Rigid felt is an insulation material with a high dimensional stability.



Application	Extruded/Moulded Graphite	Isotropic Graphite	C/C composite and special
Vacuum Furnaces			
Heating Elements	FE250	G330	CF222, CF226
Furnace Furniture	EE250, FE200	G347	CF222, CF226, CF227
Furnace Linings	FE250, FE200		CF226/2, CF227/2
Fasteners			CF222, CF260
Fixture Systems			CF222, CF226, CF227
Boats	FE250	G330	
Sinter Trays	EE250, FE200	G347	CF226, CF227
Crucibles	G140	G348	
Large Crucibles	G140	G530	
Insulation			
Soft felt			GF1, GF2
Rigid felt boards			FU4561, FU2914
Sacrificial skin			Graphite foil, C/C foil
Electrical Steel Production			
Conveyor Rolls	FE250T	G330T	
Carbon Fibre Production			
Furnace Structure			CF226, CF227
Heating Elements	FE250		CF222, CF226, CF227

T= Treated



Schunk – Material Properties

Isotropic graphite materials

Grade	Density (g/cm ³)	Flexural Strength (MPa)	Compressive Strength (MPa)	Young's Modulus (GPa)	Hardness (Rockwell)	CTE (x10 ⁻⁶ /°C)	Thermal Conductivity (W/mK)	Specific Resistance (μΩm)
FH42	1,65	50	150	18	95	4,0-4,4	11	35
FH421	1,60	50	120		115	4,0	10	
FH429	1,62	50	150	18	110	4,0	11	35
FU4960	1,52	25	50		108			
FE479	1,80	45	100	10	105	6,0	75	15
FE519	1,75	32	70	10	100	4,3	50	25
FE679Q	1,85	70	145	15	110	5,0	45	24
FE779	1,95	90	230	16	120	7,4	62	17
FE879	1,84	80	200		105	5,2	50	25

C/C composite materials

Grade	Density (g/cm ³)	Fibre vol. content (Vol.-%)	Flexural Strength (MPa)	Young's Modulus (GPa)	Strain to failure (%)	CTE* (x10 ⁻⁶ /°C)	Thermal Conductivity (W/mK)**	Specific Resistance (μΩm)***
CF222	1,55	60	200	80	0,25	0,8	10	22
CF226	1,5	60	120	60	0,23	0,8	5	25
CF226/2	1,35	60	100	50	0,18	1,1	2	28
CF227	1,55		170	75	0,3	1,1		22
CF227/2	1,4		100	57	0,2	1,0		28
CF260	1,35	55	80	13	0,8	3,5	5	50
CF260Q	1,40	55	80		0,8		5	50
CF264Q	1,45	55	80		0,8		10	35

* parallel to the plane of reinforcement ** vertical to the plane of reinforcement *** at room temperature

Insulation materials

Grade	Density (g/cm ³)	Thermal Conductivity (W/mK)			Flexural Strength (MPa)	Compressive Strength (MPa)	Ash (ppm)
		at 20°C	at 1000°C	at 2000°C			
GF1/GF2	1,0	0,1	0,3				<300
FU4561	0,17		0,24	0,44	1,0	0,2	<800
FU2914	0,22	0,2	0,3	0,6	2,2	0,1	<500

The data shown above are not guaranteed, but typical values based on our experience. It should be understood that a spread of results can occur due to variations in materials and production processes.

Tokai – Material Properties

Isotropic graphite (fine/ultra-fine grain)

Grade	Density (g/cm ³)	Flexural Strength (MPa)	Compressive Strength (MPa)	Young's Modulus (GPa)	Hardness (Shore)	CTE (x10 ⁻⁶ /°C)	Thermal Conductivity (W/mK)	Specific Resistance (μΩm)
G077	1.82	70	140	11	66	7.1	100	12
G250	1.70	39.2	81	9.8	46	3.5	108	12
G330	1.79	39.2	80	9.8	56	4.8	104	13
G347	1.85	49	100	10.8	58	5.5	116	11
G348	1.92	63.7	128	12.3	68	5.5	128	10
G458	1.86	53.9	108	11.3	54	4.4	139	9.5
G520	1.83	63.7	128	10.8	62	5.5	116	12
G530	1.82	63	126	11.3	64	5.5	104	13
G535	1.82	63.7	128	10.8	72	5.5	81	17
G540	1.85	88.2	178	13.7	78	5.5	93	15

Extruded graphite (medium grain)

Grade	Density (g/cm ³)	Flexural Strength (MPa)	Compressive Strength (MPa)	Young's Modulus (GPa)	Hardness (Shore)	CTE (x10 ⁻⁶ /°C)	Thermal Conductivity (W/mK)	Specific Resistance (μΩm)
FE250	1.75	24.5	50	-	35	3.3	162	8
EE250	1.75	24.5	50	-	35	3.3	162	8

Moulded graphite (medium/coarse grain)

Grade	Density (g/cm ³)	Flexural Strength (MPa)	Compressive Strength (MPa)	Young's Modulus (GPa)	Hardness (Shore)	CTE (x10 ⁻⁶ /°C)	Thermal Conductivity (W/mK)	Specific Resistance (μΩm)
G140	1.68	15.7	32	-	23	3.8	145	8.5
G145	1.70	14.7	29	-	23	3.8	145	8.5
G146	1.68	12.7	26	-	22	3.8	145	8.5

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