ROC CARBON COMPANY

Carbon/Graphite Grade Selection Guide

Applications, physical properties, and chemical compatibility tables

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ROC Carbon carbon/graphite materials combine the superior strength, hardness, and wear resistance of carbon with the natural lubricity of graphite. These chemically bonded carbon materials are strong and thermally stable and are inert in most chemical and corrosive applications. When even higher mechanical properties or impervious materials are required, material performance properties can be enhanced by special impregnation with resins or metals. These impregnated carbon grades offer maximum resistance to corrosion, wear, and oxidation.

The grades presented in the guide are only a representative sampling of our many grades. Please call for information on other grades.

In general, ROC Carbon carbon/graphite seals and beaings are used where extreme operating temperatures and/or corrosive fluids would cause conventional lubricants to decompose, where lubricants would contaminate process fluids, and where equipment design make conventional lubricating systems too expensive to install and maintain. Other applications for which ROC Carbon supplies carbon/graphite materials include electrodes and brazing boats, jigs, and fixtures.

Using This Guide

1. Look up the chemical/environment for your application in Table 2 and determine the CR (Corrosion Resistance) Group.

2. Using Table 1, find the materials(s) that match the CR Group found in step 1.

3. Verify the operation temperature does not exceed temperature limit of the material. Remember to consider heat generation in the bearing or seal can cause higher temperatures in the materials.

4. Our Technical Support Group would be happy to assist you in:
   - ◊ material selection
   - ◊ bearing loads
   - ◊ press fits and recommended clearances

Table 1 - Physical Properties of Selected Grades

CR Group	Grade	Composition Code[1]	Apparent Density	Hardness	Flexural Strength		Compressive Strength		Modulus of Elasticity	Coefficient of Thermal Expansion	Temperature Limit			
											Oxidizing Atmosphere		Inert Atmosphere	
			(g/cc)	(Shore Scleroscope)	PSI	MPa	PSI	MPa	(10^6 PSI)	($x10^{-6}$ in/in/°F)	°F	°C	°F	°C
1	R-103	G	1.72	45	4,200	29	9,600	66	-	1.5	750	399	5,000	2,760
1	R-115	G	1.78	76	9,425	65	19,575	135	1.7	3.1	850	454	5,000	2,760
1	R-138	G	1.81	60	8,000	55	14,000	97	-	2.7	800	427	5,000	2,760
1	R-383	G	1.78	55	6,000	41	12,100	83	1.4	2.6	800	427	5,000	2,760
1	R-433	CG	1.72	72	8,400	58	24,000	166	1.5	2.2	650	343	1,800	982
2	R-122	CGI	1.82	84	9,300	64	30,000	207	3.3	2.9	500	260	500	260
2	R-143	CGI	1.86	90	11,000	76	32,000	221	-	2.8	500	260	500	260
2	R-208	CGI	1.80	101	10,150	70	31,900	220	3.7	2.7	400	204	400	204
2	R-211	CGI	1.87	87	11,300	78	35,500	245	3.2	3.1	480	249	480	249
2	R-307	CGI	1.85	85	10,000	69	25,000	172	2.3	2.6	500	260	500	260
4	R-422	GX	1.85	55	5,500	38	14,000	97	1.2	2.1	1,200	649	1,600	871
5	R-190	CG(Cu)	2.85	40	7,500	52	16,000	110	2.8	2.0	700	371	1,700	927
5	R-191	CG(NiCr)	2.40	55	7,500	52	23,000	159	2.8	1.4	700	371	1,700	927
5	R-203	CG(Sb)	2.20	120[2]	11,600	80	36,000	248	4.2	2.2	750	399	1,100	593
5	R-204	CG(B)	2.45	55	4,800	33	23,500	162	2.9	1.9	400	204	400	204
5	R-391	CG(Br)	2.55	55	8,500	59	25,000	172	3.1	2.1	700	371	1,700	927

[1]Composition Codes

B	Babbit
Br	Bronze
C	Carbon
Cu	Copper
G	Graphite
I	Impregnation
NiCr	Nickel chrome
X	Oxidation impregnation
Sb	Antimony

[2]HRB

Note: The physical properties of ROC Carbon grades may vary in relation to the molded part size and configuration; the above values are typical and should be considered only as a guide or reference.

Chemical Compatibility

The tables on this page present general grade recommendations for chemical service. However, a particular grade's resistance to chemical attack can vary substantially according to temperature, concentration, and exposure time. Please consult with ROC Carbon's applications engineering staff to determine the appropriate grade for your specific application.

Table 2 - Corrosion Resistance by Specific Chemical

✔ Compatible ○ Questionable ✘ Not Recommended

	CR Groups						CR Groups						CR Groups						CR Groups				
	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
Abietic Acid	✔	✔	✔	○	✔	Carbolic Acid (Phenol)	✔	✔	✔	✘	✔	Hydrocyanic (Prussic) Acid	✔	✔	✔	✘	○	Potassium Alum	✔	✔	✔	✘	○
Acetaldehyde	✔	✔	✔	○	✔	Carbon Dioxide to 600° F	✔	✔	✔	✔	○	Hydrofluoric Acid to 48%	✔	✔	✔	✘	○	Potassium Bicarbonate	✔	✔	✔	✘	✔
Acetanilide	✔	✔	✔	✘	✔	Carbon Dioxide above 600° F	○	○	○	✔	○	Hydrogen	✔	✔	✔	✔	✔	Potassium Carbonate	✔	✔	✔	✘	✔
Acetic Acid to 350° F	✔	✔	✔	✘	○	Carbon Disulfide	✔	✔	✔	○	✔	Hydrogen Chloride	✔	✔	✔	○	✔	Potassium Chlorate	○	✔	✔	✘	○
Acetic Anhydride to 350° F	✔	✔	✔	✘	○	Carbon Monoxide	✔	✔	✔	✔	✔	Hydrogen Fluoride	✔	✔	✔	○	✔	Potassium Choride	✔	✔	✔	✘	✔
Acetone	✔	✔	✔	○	✔	Carbon Tetrachloride	✔	✔	✔	✔	✔	Hydrogen Sulfide	✔	✔	✔	○	✔	Potassium Cyanide	✔	✔	✔	✘	✘
Acetophenone	✔	✔	✔	○	✔	Castor Oil	✔	✔	✔	○	✔	Hydrogen Peroxide	○	○	✔	✘	○	Potassium Hydroxide to 350° F	✔	✔	✔	✘	○
Acetylene	✔	✔	✔	✔	✔	Caustic Soda	✔	✔	✔	✘	○	Hydroxylamine	✔	✔	✔	✘	✔	Potassium Nitrate to 300° F	✔	✔	✔	✘	✔
Acetylsalicylic Acid (Aspirin)	✔	✔	✔	○	✔	"Cellosolves"	✔	✔	✔	○	✔	Hypochlorous Acid	○	○	✔	○	✘	Potassium Permanganate to 300° F	✔	✔	✔	✘	○
Acrolein	✔	✔	✔	○	✔	Cellulose Acetate (rayon)	✔	✔	✔	○	✔	Isobutyl/Isopropyl Alcohols	✔	✔	✔	○	✔	Potassium Phosphate	✔	✔	✔	✘	✔
Acrylonitrile	✘	○	✔	✔	○	Chloracetic Acid	✔	✔	✔	○	✔	Isophthalic Acid	✔	✔	✔	✘	✔	Propane	✔	✔	✔	✔	✔
Adipic Acid	✔	✔	✔	○	✔	Chloral	✔	✔	✔	✔	✔	Kerosene	✔	✔	✔	✔	✔	Propionic Acid	✔	✔	✔	✘	○
Air to 600° F	✔	○	✔	✔	○	"Chlorethene"	✔	✔	✔	✔	✔	Lactic/Lauric Acids	✔	✔	✔	○	✔	Propylene	✔	✔	✔	✔	✔
Air above 600° F	○	✘	○	✔	✘	Chlorine	✔	✔	✔	○	✔	Lead (Molten)	✔	○	✔	○	✘	Pyridine	✔	✘	✔	✘	✔
Alkyl Aryl Sulfonate	✔	✔	✔	○	✔	Chlorobenzene	✔	✔	✔	✔	✔	Lithium Carbonate	✔	✔	✔	✘	✔	Pyroligneous Liquor	✔	✔	✔	✘	○
Allyl Chloride	✔	✔	✔	✘	✔	Chloroform	✔	✔	✔	✔	✔	Lithium Hydroxide	✔	✔	✔	✘	○	Sal Ammonia	✔	✔	✔	✘	○
Alum (ammonia)	✔	✔	✔	✘	✔	Chlorosulfonic Acid	✔	✔	✔	✘	✔	Lubricating Oil	✔	✔	✔	✔	✔	Sal Soda—Na2CO3 • 10 H20	✔	✔	✔	✘	✔
Alum (chrome)	✔	✔	✔	✘	✔	Chromic Acid to 300° F	○	○	✔	✘	✔	Lye	✔	✔	✔	✘	○	Salicylic Acid	✔	✔	✔	✘	✔
Alum (potash)	✔	✔	✔	✘	✔	Chromium Potassium Sulfate	✔	✔	✔	✘	✔	Magnesium (Molten)	✔	○	✔	✘	✘	Sea Water	✔	✔	✔	✘	✔
Aluminum (molten)	✔	○	✔	○	✘	Citric Acid (citrus juices)	✔	✔	✔	✘	✔	Magnesium Bisulfite	✔	✔	✔	✘	✔	Sewage	✔	✔	✔	✘	✔
Aluminum Chloride	✔	✔	✔	✘	○	Coal Tar	✔	✔	✔	✔	✔	Magnesium Sulfate	✔	✔	✔	✘	○	Silver	✔	○	✔	○	✘
Aluminum Sulfate	✔	✔	✔	✘	✔	Copper	✔	○	✔	○	✘	Maleic Acid	✔	✔	✔	✘	○	Soap and Soap Liquors	✔	✔	✔	✘	✔
Ammonia (wet) to 300° F	✔	✔	✔	✘	✔	Copper Sulfate	✔	✔	✔	✘	✔	Maleic Anhydride	✔	✔	✔	✘	○	Soda Ash	✔	✔	✔	✘	✘
Ammonia (anhydrous)	✔	✔	✔	✔	✔	Cottonseed Oil	✔	✔	✔	○	✔	Mercuric Chloride	✔	✔	✔	✘	✘	Sodium Salts-see Potassium Salts					
Ammonium Chloride	✔	✔	✔	✘	○	Creosote	✔	✔	✔	○	✔	Mercury	✔	✔	✔	✘	✘	Sodium Bisulfite	✔	✔	✔	✘	✔
Ammonium Hydroxide	✔	✔	✔	✘	✔	Cresols, Cresylic Acid	✔	✔	✔	○	✔	Methane	✔	✔	✔	✔	✔	Sodium Dichromate	✔	✔	✔	✘	✔
Ammonium Nitrate	✔	✔	✔	✘	✔	Crotonaldehyde	✔	✔	✔	○	✔	Methyl Alcohol (Methanol)	✔	✔	✔	○	✔	Sodium Hypochlorite	○	○	✔	✘	○
Ammonium Phosphate .	✔	✔	✔	✘	✔	Cumene	✔	✔	✔	✔	✔	Methyl Chloride	✔	✔	✔	✔	✔	Sodium Metaphosphate	✔	✔	✔	✘	✔
Amyl Acetate	✔	✔	✔	○	✔	Cupric Chloride	✔	✔	✔	✘	✔	Methylene Dichloride	✔	✔	✔	✔	✔	Sodium Nitrate (Nitrate Melt)	○	✘	○	○	○
Amyl Alcohol	✔	✔	✔	○	✔	Cuprous AmmoniumAcetate-Viscose	✔	✔	✔	✘	✔	Methyl Ethyl Ether	✔	✔	✔	○	✔	Sodium Perborate	○	✔	✔	✘	○
Amyl Amines	✔	✔	✔	✘	✔	Cyanic Acid	✔	✔	✔	○	○	Methyl Ethyl Ketone	✔	✔	✔	○	✔	Sodium Perchlorate	○	✔	✔	✘	○
Amyl Chloride	✔	✔	✔	✘	✔	Cyanide Plating Solutions	✔	✔	✔	✘	○	Methyl Isobutyl Ketone	✔	✔	✔	○	✔	Sodium Sulfate	✔	✔	✔	✘	○
Aniline	✔	✔	✔	✔	✔	Cyclohexane	✔	✔	✔	✔	✔	Methyl Salicylate	✔	✔	✔	○	✔	Sodium Sulfide	✔	✔	✔	✘	○
Anthracene	✔	✔	✔	✔	✔	Detergents	✔	✔	✔	✘	✔	Milk	✔	✔	✔	✘	✔	Sodium Tetraborate (Borax)	✔	✔	✔	✘	○
Antimony	✔	○	✔	○	✘	Dibutyl Phosphate	✔	✔	✔	○	✔	Mineral Oil	✔	✔	✔	✔	✔	Sodium Thiosulfate (Hypo)	✔	✔	✔	✘	✔
Argon	✔	✔	✔	✔	✔	Diethanol Amine	✔	✔	✔	✘	✔	Molasses	✔	✔	✔	✘	✔	Sorbitol	✔	✔	✔	○	✔
Arsenic (Molten)	✔	○	✔	○	✘	Diethyl Sulfate (Ethyl Sulfate)	✔	✔	✔	✘	✔	Monoethanol Amine	✔	✔	✔	✘	✔	Stannic Chloride	✔	✔	✔	✘	○
Asphalt	✔	✔	✔	✔	✔	Disodium Phosphate	✔	✔	✔	✘	✔	Muriatic Acid	✔	✔	✔	✘	○	Steam to 600° F	✔	✔	✔	○	○
Aromatic Fuels	✔	✔	✔	✔	✔	"Dowtherm"	✔	✔	✔	✘	✔	Naphtha	✔	✔	✔	✔	✔	Steam 600 to 1500° F	○	✘	○	✔	○
Babbitt Metal (molten)	✔	○	✔	○	✘	Epichlorohydrin	✔	✔	✔	✘	✔	Naphthalene	✔	✔	✔	✔	✔	Stearic Acid	✔	✔	✔	○	✔
Baking Soda	✔	✔	✔	✘	✔	Ethane	✔	✔	✔	✘	✔	Nickel Chloride	✔	✔	✔	✘	○	Styrene	✔	✔	✔	✔	✔
Barium Hydroxide	✔	✔	✔	✘	○	Ether (Ethyl Ether)	✔	✔	✔	○	✔	Nickel Sulfate	✔	✔	✔	✘	✔	Sugar	✔	✔	✔	✘	✔
Barium Sulfide	✔	✔	✔	✘	✔	Ethyl Acetate	✔	✔	✔	○	✔	Nitrating Acid to 75% total acid	○	○	✔	✘	○	Sulfate Liquors	✔	✔	✔	✘	✔
Battery Acid (90% H2S04)	✔	○	✔	✘	○	Ethyl Alcohol	✔	✔	✔	○	✔	Nitric Acid to 15%	✔	✔	✔	✘	○	Sulfite Liquors	✔	✔	✔	✘	✔
Beer	✔	✔	✔	✘	✔	Ethyl Benzene	✔	✔	✔	✔	✔	Nitric Acid 15 to 100%	✔	○	✔	✘	✘	Sulfur	✔	○	✔	○	○
Benzaldehyde	✔	✔	✔	○	✔	Ethyl Chloride and Dichloride	✔	✔	✔	✘	✔	Nitrobenzene	✔	✔	✔	✔	✔	Sulfur Dioxide to 500° F	✔	✔	✔	○	○
Benzene (benzol)	✔	✔	✔	✔	✔	Ethylene	✔	✔	✔	✔	✔	Nitrogen	✔	✔	✔	✔	✔	Sulfuric Acid to 77%, 300° F	✔	✔	✔	✘	✔
Benzene Sulfonic Acid	✔	✔	✔	○	✔	Ethylene Glycol	✔	✔	✔	○	✔	Nitrogen Tetroxide	○	✘	○	✔	✘	Sulfuric Acid 77-98% to 200° F	✔	○	✔	✘	○
Benzoic Acid	✔	✔	✔	○	✔	Ethylene Oxide	✔	✔	✔	○	✔	Nitro Paraffins	✔	✔	✔	✔	✔	Tar	✔	✔	✔	✔	✔
Beta-Naphthol	✔	✔	✔	○	✔	Fatty Acids	✔	✔	✔	○	○	Oleic Acid	✔	✔	✔	○	✔	Terephthalic Acid	✔	✔	✔	✘	✔
Bismuth (Molten)	✔	✔	✔	✘	✔	Ferric Chloride	✔	✔	✔	✘	○	Oleum (Fuming H2S04) to 100° F	○	○	✔	✘	○	Tetrachloroethylene	✔	✔	✔	✔	✔
Black Ash	✔	✔	✔	✘	✔	Ferric Sulfate	✔	✔	✔	✘	✔	Olive Oil	✔	✔	✔	○	✔	Tin	✔	○	✔	○	✘
Black Sulfate Liquor .	✔	✔	✔	✘	✔	Fluorine gas	○	○	○	✔	○	Ortho Phosphoric Acid to 400° F	✔	✔	✔	✘	○	Toluene	✔	✔	✔	✔	✔
Bleaching Powder	✔	○	✔	○	✘	Fluorosilicic Acid	✔	○	✔	✘	○	Oxalic Acid	✔	✔	✔	✘	○	Toluene Sulfonic Acid	✔	✔	✔	✘	○
Borax	✔	✔	✔	✘	✔	Formaldehyde	✔	✔	✔	○	✔	Oxygen to 500° F	✔	✔	✔	✔	✔	Toluic Acid	✔	✔	✔	✘	○
Boric Acid	✔	✔	✔	✘	✔	Formamide	✔	✔	✔	✘	✔	Oxygen above 500° F	○	○	○	✔	✘	Trichloroethylene	✔	✔	✔	✔	✔
Boron Trifluoride	✔	✔	✔	✘	✔	Formic Acid	✔	✔	✔	✘	○	Palmitic Acid	✔	✔	✔	○	✔	Triethanol Amine	✔	✔	✔	✘	✔
Brass (Molten)	✔	○	✔	○	✘	Freons	✔	✔	✔	✔	✔	Paraffin	✔	✔	✔	✔	✔	Trisodium Phosphate	✔	✔	✔	✘	✔
Bromine	✔	○	✔	○	○	Fruit juices	✔	✔	✔	✘	✔	Pentaerythritol	✔	✔	✔	○	✔	Turpentine	✔	✔	✔	✔	✔
Bronze (Molten)	✔	○	✔	○	✘	Fuel Oil	✔	✔	✔	✔	✔	Perchloric Acid to 72%, 200° F	○	○	✔	✘	✘	Urea	✔	✔	✔	✘	✔
Butadiene	✔	✔	✔	✔	✔	Furfural	✔	✔	✔	○	✔	Perchloroethylene	✔	✔	✔	✔	✔	Vegetable Oil	✔	✔	✔	○	✔
Butane	✔	✔	✔	✔	✔	Gallium	✔	○	✔	○	○	Petroleum	✔	✔	✔	✔	✔	Vinegar	✔	✔	✔	✘	○
Butter, Buttermilk	✔	✔	✔	○	✔	Gasoline	✔	✔	✔	✔	✔	Phenol	✔	○	✔	✘	✔	Vinyl Acetate	✔	✔	✔	○	✔
Butyl Acetate	✔	✔	✔	○	✔	Glutamic Acid	✔	✔	✔	○	✔	Phosphoric Acid to 400° F	✔	✔	✔	✘	○	Vinyl Chloride	✔	✔	✔	✔	✔
Butyl Alcohol	✔	✔	✔	○	✔	Glycerine	✔	✔	✔	○	✔	Phosphorus	✔	○	✔	○	○	Viscose	✔	✔	✔	✘	✔
Butyl Amines	✔	✔	✔	✘	✔	Gold (Molten)	✔	✔	✔	✘	✔	Phosphorus Oxychloride	✔	✔	✔	✘	○	Water to 300° F	✔	✔	✔	✘	✔
Butylene	✔	✔	✔	✔	✔	Green Sulfate Liquor	✔	✔	✔	✘	✔	Phosphorus Trichloride	✔	✔	✔	○	○	Water Glass (Na2SiO3)	✔	✔	✔	✘	✔
Cadmium (Molten)	✔	○	✔	○	✘	Helium	✔	✔	✔	✔	✔	Phthalic Acid/Anhydride	✔	✔	✔	✘	○	Wood Pulp	○	✔	✔	✘	✔
Calcium Bisulfite	✔	✔	✔	✘	✔	Hexane	✔	✔	✔	✔	✔	Picric Acid	✔	✔	✔	✘	✔	Xylene	✔	✔	✔	✔	✔
Calcium Chloride	✔	✔	✔	✘	✔	Hydrazine	✔	✔	✔	✘	✔	Polyethylene	✔	✔	✔	✔	✔	Zinc	✔	○	✔	○	○
Calcium Hydroxide	✔	✔	✔	✘	○	Hydrobromic Acid	✔	✔	✔	✘	○	Polystyrene	✔	✔	✔	✔	✔	Zinc Chloride	✔	✔	✔	✘	✔
Calcium Hypochlorite	○	○	✔	✘	✘	Hydrochloric (muriatic) Acid	✔	✔	✔	✘	○	Polyurethane	✔	✔	✔	✔	✔	Zinc Sulfate	✔	✔	✔	✘	✔

✔ Compatible ○ Questionable ✘ Not Recommended