Self-Lubricating Mechanical Components

HELWIG CARBON®
PRODUCTS, INC.

FOR SEALS, BEARINGS, VANES AND OTHER ENGINEERED MECHANICAL NEEDS

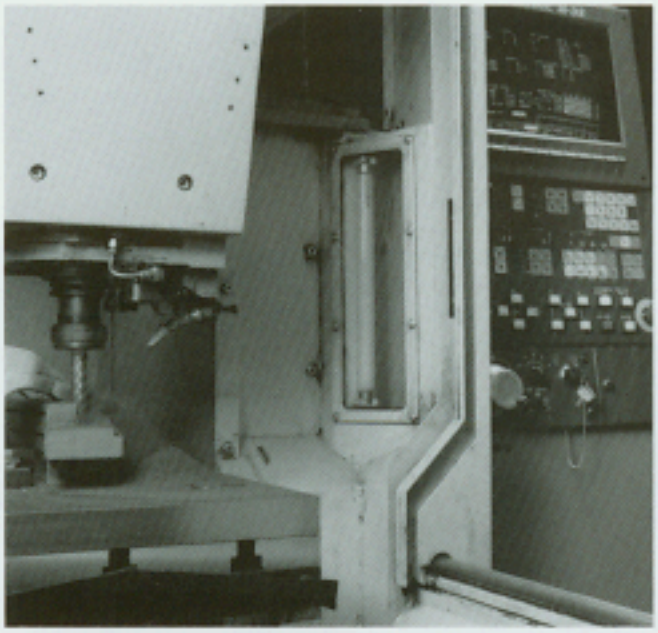
Service and Quality... We deliver

DELIVERY

Helwig Carbon Products, Inc. is dedicated to manufacturing customized, mechanical carbon products.

Our reputation for fast, reliable service is known throughout the carbon brush industry and is carried over into our mechanical carbon division. We can deliver when others cannot.

Our wide selection of materials and dependable service combine to give Helwig the leading edge in the mechanical carbon products industry.

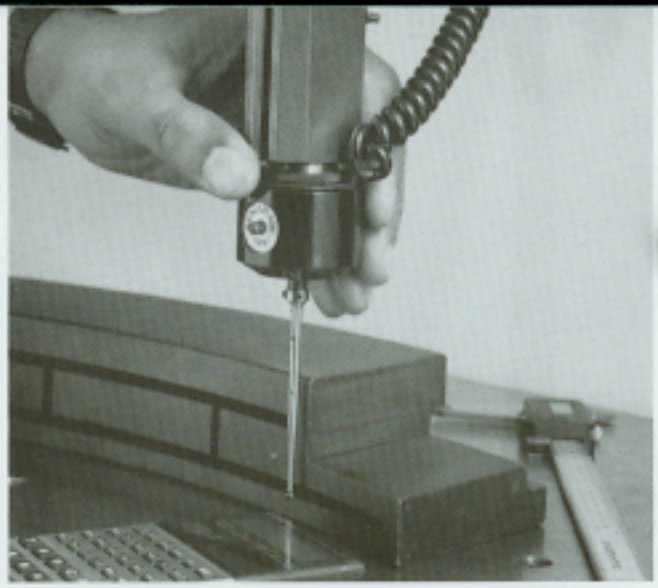


PRECISION MACHINING

Helwig Carbon is able to supply precision machined parts in almost any shape or form.

Our state-of-the-art CNC machining center and CNC lathes are able to produce parts quickly and accurately to conform to your precise requirements.

We routinely hold tolerances of .0005" for diameters and 2 HE lightbands flatness for surface finishes.



QUALITY

Helwig Carbon's quality control is always on the job. From initial set-up to the final operations of an order, we inspect parts to be sure you are getting the quality product needed to fill your mechanical carbon requirements.

Our professional sales organization, reinforced by experienced engineering and quality assurance personnel, are eager to assist with your application requirements. We look forward to working with you for any of your existing mechanical carbon-graphite needs.

Carbon-Graphite A unique Engineering Material

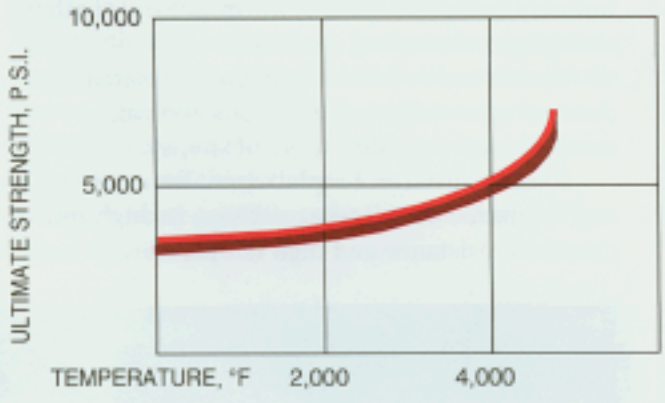
ADVANTAGES

The advantages of using carbon-graphites over other materials for mechanical applications are:

- Self-lubrication
- Thermal stability
- Oxidation resistance
- Low wear rate
- Low coefficient of thermal expansion
- Low coefficient of friction
- Dimensional stability
- Increased strength with increased temperature
- Non-seizing & non-galling
- Chemically inert

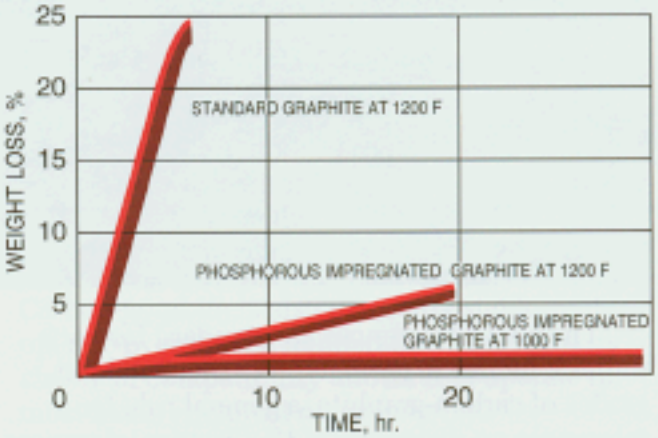
These characteristics, combined in carbon-graphite, make it a unique engineering material. No other material: ceramic, steel or plastic; combines these qualities as do carbon-graphites. This optimum combination of qualities such as thermal resistance, mechanical strength, chemical resistance make carbon-graphite ideal for commercial, aerospace, and chemical processing uses.

Ultimate Tensile Strength of Graphite



OXIDATION RESISTANCE

Oxidation is the most important single chemical reaction of carbon. Carbon will show measurable oxidation at 650 degrees Fahrenheit. Graphite will begin to show oxidation at 750 degrees Fahrenheit. Certain compounds will inhibit the oxidation reaction when added to carbon and graphite, extending the useful range to about 1200 degrees Fahrenheit.



LOW WEAR RATE

Carbon-graphite's low wear rate can be attributed to its low coefficient of friction, self lubricating ability, and high hardness. It will conform to its mating part and will not seize or gall. In most cases, after an initial run-in period, it will show virtually no wear.

THERMAL SHOCK RESISTANCE

Carbon-graphite is able to function in severe cryogenic to pyrogenic applications. It can easily withstand rapid changes in temperatures. It is 100 times more resistant to thermal cracking than steel or ceramics and can be instantaneously submerged in hot or cold fluids. This is especially important in the aerospace industry where temperatures can vary hundreds of degrees in seconds.

DIMENSIONAL STABILITY

Low coefficient of thermal expansion gives carbon-graphite great dimensional stability. Even after repeated heating and cooling, it will retain its original shape. Because of its stability, it will retain its flatness and assure proper sealing during the early stages of operation and after temperatures have stabilized.

Design Carbon-Graphite

Carbon-graphite is manufactured by pressing a powdered material in a mold and furnacing the resulting compact. Some finished parts can be molded to size while others are machined from a molded blank or extruded rod. Generally low volume parts are machined and higher volume parts are molded or partially molded to size.

The following chart is a guide for typical tolerances for machined and molded parts.

	Molded	Precision Machined	Precision Machined
Outside dia.	+/-.010	+/-.002	+/-.0005
Inside dia.	+/-.010	+/-.002	+/-.0005
Thickness	+/-.005	+/-.002	+/-.0005
Flatness	------	0.0003 bands	3 HE light
Concentricity	0.005	0.002	0.001

The above tolerances are standard for parts under 2 inches in diameter. For most molded grades of carbon-graphite, a general rule for tolerances on diameters is 1%. Tighter tolerances than shown above can be held. Please consult with Helwig Carbon Products engineers on specific parts requiring very close tolerances.

Certain design considerations should be taken into account when working with carbon-graphite. Tolerances tighter than required for satisfactory performance should be avoided. Thickness should be 1/8" minimum for parts of small diameter and 10% to 15% of the diameter for parts over 1" in diameter.

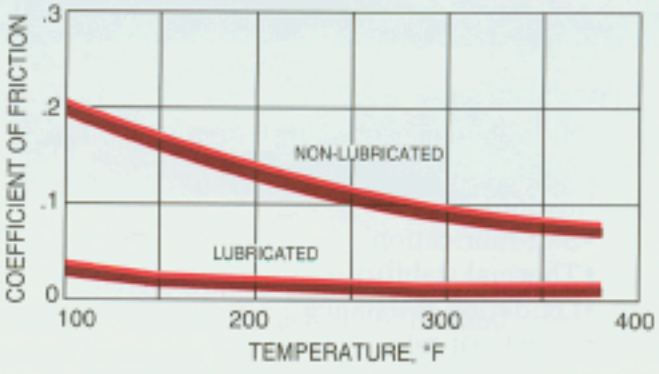
Avoid sharp corners. Sharp edges are subject to chipping during machining and handling. Allow for chamfers, fillets, and rounds. Interference fits should be based on 0.001" to 0.002" minimum for small parts and 0.2% of the outside diameter for parts over 1" in diameter. Parts having undercuts or reentrant angles cannot be molded and will require machining operations.

The inherent porous structure of carbon-graphite does not lend itself to profilometer measurements in RMS values. Finishes must be specified by visual comparison to RMS roughness standards.

Carbon-graphite is capable of operating under an extremely wide range of conditions. The primary factors of importance are lubrication, speed, load, mating materials, and ambient conditions.

Carbon-graphite can be run with or without lubrication. Almost any liquid will provide lubrication for carbon-graphite. Some provision should be made to supply a lubricant to the bearing surface. If the bearing is to be run dry,

Typical Effects of Lubrication



usually there is sufficient water vapor in the surrounding air to provide adequate lubrication.

Mating materials for carbon-graphite should be chosen with care. Stainless steel, carbides, ceramics, chrome plate, cast iron and hardened

MECHANICAL CARBONS AND THEIR USES

Helwig Carbon Products is able to manufacture mechanical carbons in almost any shape and size for almost any application. Although carbon-graphite makes an excellent seal, bearing or bushing material, it has countless other uses as well.

It is used on pumps for vanes and pistons as well as piston rings and bushings where lubrication or high temperatures may be a problem. And carbon-graphite is used extensively in the glass industry for molds, guides, lifting jaws, and other clamping and shaping devices.

Carbon makes an excellent crucible material. It does not react with molten metals and can be machined into a wide variety of shapes.

It can be used as a replacement for more costly and unneeded valve stem packings. Its high purity, chemical resistance and high temperature

Consideration for Components

steel make the best mating materials. The finish of the mating material surface should be 12 micro-inches or less. Carbon-graphite is self- lapping and will conform to the shape of its mating part rapidly. After an initial run-in period, it will show very little wear unless the mating surface changes due to corrosion, abrasion, etc.

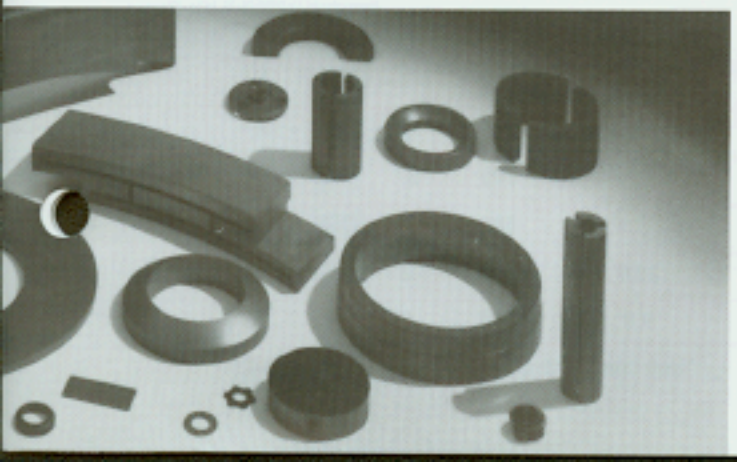
A common rule-of-thumb when considering the limits of a bearing material is the P-V factor. The P-V factor is the product of pressure (in pounds per square inch) times velocity (in feet per minute). For dry applications, carbon-graphite has a low wear rate at P-V values up to 15,000. Lubricated, most carbon-graphites can operate successfully up to a P-V value of 150,000. Under ideal conditions, some grades of carbon-graphite can operate at P-V values of 1,000,000.

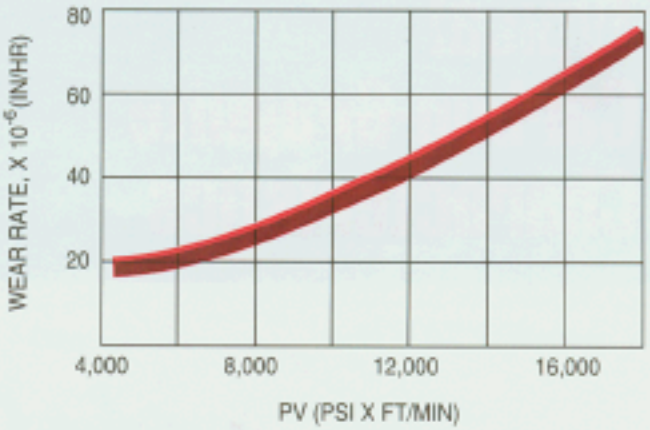
resistance make it ideal for this application.

Carbon-graphite has long been used for gland rings and segmented shaft seals. Helwig manufactures segmented rings in many styles and sizes from three segmented rings with 1-1/2" OD to 8 and 12 segmented rings with diameters over 5 feet.

Rotary pressure steam joints and guides are manufactured by Helwig Carbon in all styles and sizes. Carbon-graphite's self-lubrication, low porosity, and self-lapping characteristics make it the ideal seal and bearing material for this application.

Additional areas of use for carbon-graphite bearings are in the plywood industry and on oven conveyor applications where high temperature and lubrication are a major concern. Its self-lubrication and high thermal resistance have shown carbon-graphite to be the best material for these applications.





SEAL DESIGN WITH CARBON-GRAPHITE

Carbon-graphite is an excellent seal material. Characteristics such as self-lapping, high hardness, low wear rate, low porosity, and excellent lubricating ability make it an ideal seal material. Carbon-graphite is also thermally stable so it can operate over a wide temperature range and its chemical compatibility allows it to operate in most harsh chemical environments.

The successful operation of any seal depends on a boundary layer of lubricant at the seal surface. This can only be achieved when the seal face and the mating counterface are geometrically perfect in fit. Carbon-graphite can be lapped flat to a very close tolerance to avoid long initial run-in periods.

Choosing the correct seal material for a particular application will depend on several factors. For pressures less than 10 psi, plain carbon-graphite is sufficiently impermeable to do the job. Higher pressures require either a resin or metal impregnated carbon-graphite material. Chemical compatibility will also be a factor, especially for the impregnated carbon-graphites.

Counterface material is another important aspect to consider when designing a mechanical seal. Carbon-graphite will perform best when run against a hard mating surface. Satisfactory counterface materials include: cast-iron, hardened steel, chrome plated steel, ceramics as well as another grade of carbon-graphite. It is important to look at the chemical compatibility of the counterface. Some applications may require that carbon-graphite run against itself to perform satisfactorily.

Typical Carbon-Graphite Characteristics

GRADE	DENSITY (gm/cc)	HARDNESS	COMPRESSIVE STRENGTH (psi)	TRANSVERSE STRENGTH (psi)	TENSILE STRENGTH (psi)	MODULUS OF ELASTICITY (x 10^6 psi)	COEFFICIENT OF THERMAL EXPANSION (10^{-6} in/in/°F)	THERMAL CONDUCTIVITY (Btu/ft. ^{2}°F/Hr)	MAX OPERATING TEMPERATURE IN AIR (deg. F)	POROSITY (% volume)	COMPOSITION	CHEMICAL RESISTANCE*
015	1.57	40	8500	3600					700	23	CG	A
250	1.77	70	18000	5400	2800	1.7	2.9	8.0	750	15	CG	A
3499	1.66	36	7000	3600	1700	1.1	2.5		800	26	EG	A
3499Z	1.80	75	23000	8000	5000				500	2	CGR	C
580	1.76	53	13000	4800	2000	2.0	2.6	24.0	750	24	G	A
580Z	1.80	70	22000	9000					500	2	GR	C
7205	1.76	40	8000	4200				75.0	1200	20	CGH	D
8735	1.73	38	6500	3100					750	23	CG	A
8905	1.66	34	7000	3200					750	26	CG	A
F11	1.75	75	27500	8000		3.2	2.8	8.0	750	7	CG	A
F151	1.82	84	30000	9300		3.3	2.9	8.0	500	1	CGR	B
F10	1.60	67	20000	6500		2.6	2.0	7.0	750	15	CG	A
E65	1.80	75	16000	6400		2.1	1.7	38.0	1200	8	CGH	D
EH	1.64	40	6000	3400	2000	1.1	2.5		750	27	EG	A
F10C	1.80	80	34000	11000	9000	3.0	2.3	7.6	500	1	CGR	C
F15	1.90	90	36000	12500	9500	3.0	2.3	7.6	600	1	CGR	B
F16	1.75	75	25000	7500	5500	2.4	2.2	7.0	700	6	CG	A
F161	1.90	90	36000	12500	9500	3.0	2.3	7.6	500	8	CG	A
F40	1.85	85	30000	9500	6500	3.2	2.9	8.0	500	1	CGR	B
F41	1.80	95	40000	12500	8500	3.3	3.2	6.0	500	1	CGR	B
F422	1.70	90	30500	8000		2.5	2.8		400	2	CGR	C
F58	1.85	80	22000	8500	6000	1.8	2.0	40.0	1200	8	CGH	D
F9CP	2.95	60	29000	11000	6000	5.8	4.5		550	1	CGBr	E
F82	1.80	90	36000	10000		3.5	2.1		700	3	CG	A
H	1.64	55	12500	4600	3000	1.7	2.1		700	27	CG	A
HZ	1.78	70	23000	8500					500	3	CGR	C
F159	3.00	35	13000	6000	4000	2.9	2.1	20.0	400	2	CGBa	E
F162	2.40	65	26000	10000	7500	3.7	3.0	9.0	400	2	CGBa	E

All above values are typical and should not be used for specifications.

*See chemical compatibility chart on page 7.

Chemical Compatibility Chart

Chemical	Category ABCDE	Chemical	Category ABCDE
Acetic Acid	g g g f g	Isobutyl Alcohol	g g g f g
Acetic Anhydride	g g g p f	Isopropanol	g g g p g
Acetone	g g g f g	Lactic Acid	g g g f g
Acetylene	g g g g g	Magnesium Hydroxide	g g g p f
Acetylene Tetrachloride	g g g g g	Manganese Sulfate	g g g p f
Ammonia	g g g g g	Methane	g g g f g
Ammonium Carbonate	g g g p f	Methanol	g g g f g
Ammonium Chloride	g g g p f	Mineral Oil	g g g g g
Ammonium Hydroxide	g g g p g	Monochlor Benzene	g g g g g
Ammonium Thiocyanate	g g g p f	Muriatic Acid	g g g p f
Anti-freeze	g g g f g	Nickel Chloride	g g g p f
Aqua Regia	f p g p p	Nickel Sulfate	g g g p g
Arsenic	g g g p g	Nitric Acid (to 78%)	f f g p p
Benzene	g g g g g	Oleic Acid	g g g p g
Benzoic Acid	g g g f g	Oxalic Acid	g g g p f
Boric Acid	g g g p g	Parasdichlorobenzene	g g g p g
Bromine	f p g f f	Pentane	g g g g g
Butyl Alcohol	g g g f g	Phenol	g f g p g
Calcium Chloride	g g g p g	Phosphoric Acid	g g g p f
Calcium Hydroxide	g g g p f	Picric Acid	g g g p g
Carbolic Acid	g g g p g	Polystyrene	g g g g g
Carbon Disulphide	g g g p f	Polyurethane	g g g g g
Carbon Tetrachloride	g g g g g	Potassium Carbonate	g g g p g
Carbonic Acid	g g g f g	Potassium Chloride	g g g p g
Chlorethyl Benzene	g g g p f	Potassium Hydroxide	g g g p f
Chlorine (Anhydrous)	g g g g g	Potassium Nitrate	g g g p g
Chlorofora	g g g g g	Potassium Sulfate	g g g p g
Chrome Plating Solution	g g g p g	Propane	g g g g g
Chromic Acid	f f g p g	Silicone	g g g g g
Citric Acid	g g g p g	Silver-cyanide	g g g f f
Copper Chloride	g g g p g	Soda	g g g p f
Copper Sulfate	g g g p g	Sodium Borate	g g g p g
Cyclohexane	g g g g g	Sodium Chloride	g g g p g
Dichlorobenzene	g g g g g	Sodium Hydroxide	g g g p f
Ethane	g g g g g	Sodium Hypochloride	f f g p p
Ethyl Alcohol	g g g f g	Sodium Hypochlorite Soda	f f g p p
Ethyl Chloride	g g g p g	Sodium Nitrate	g g g p f
Ethylene	g g g g g	Sodium Peroxide	g g g p f
Ferric Chloride	g g g p f	Sodium Sulfate	g g g p f
Ferrous Sulfate	g g g p g	Stannic Chloride	g g g p f
Formaldehyde	g g g f g	Steam	g f g f f
Formic Acid	g g g p f	Sulfuric Acid	g g g p g
Gasoline	g g g g g	Tartaric Acid	g g g p g
Glycol	g g g f g	Tetrachloroethane	g g g g g
HCL saturated with C12	g g g p g	Toluene	g g g g g
Hydrobromic Acid 48%	g g g p f	Trichloroethylene	g g g g g
Hydrochloric Acid	g g g p f	Vinyl Chloride	g g g g g
Hydroflouric 68%	g g g p f	Water	g g g p g
Hydrogen Peroxide 3%max	g g g p g	Zinc Chloride	g g g p g
Hydrogen Sulfide	g g g f g	Zinc Sulfate	g g g p g

Category Ratings: g=good, f=fair, p=poor.

Mechanical Carbon-Graphite Specialty Data Sheet

Name:

Address:

City: State: ZipCode:

Telephone Number:

Description of component, i.e. seal, bearing, bushing etc:

Type of machine and manufacturer:

Drawing number:

Load or pressure to be sealed:

Speed: (rpm/fpm) (constant/fluctuating):

Shaft diameter:

Environment or medium to be sealed; (liquid, gas, contaminants, etc.):

Temperature:

Mating materials and finishes:

Lubrication:

Special considerations:

Estimated annual usage:

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