About us

In 35 yrs, Graphite Ferrocarbons Pvt. Ltd. has been a consistent producer of Graphite and Silicon Carbide Products, Graphite Chemicals and Graphite Electrodes. Graphite Ferrocarbons is a part of the Modi Group, one of India’s leading business houses. Since its founding, Graphite Ferrocarbons has been recognized as a world leader in the production of Graphite and Silicon Carbide Products and Graphite Chemicals.

Infrastructure

Pressing

Carbon and graphite materials are manufactured from raw materials such as petroleum coke, pitch and semi-finished products. This process involves the compression of raw materials into graphite blocks. The graphite blocks are then sintered to form graphite composites.

Sintering

Impregnation

Quality Control

Stock

Our Product Range

• CARBON BLANKS
• CARBON SEAL RINGS
• CARBON ROLLER BEARINGS
• CARBON JUICES
• CARBON BLOCKS

Machinable Carbon Blanks

"Gentle when machining Tough when functioning”
Introduction
Carbon and graphite materials are a proven method for the sealing of shafts and their bearings. The special physical and mechanical properties of carbon and graphite, in particular their low coefficient of friction, load carrying and excellent thermal resistance offer solutions to many mechanical engineering and manufacturing problems. Bearings, washers, rings and weeps of carbon and graphite are used for oil or water running applications. Their use is recommended where the following conditions are met:
- The use of hydro carbon lubricants is permitted by high temperature and high pressure atmosphere
- Emergency running abrasives are not present in the atmosphere
- Chemical attacks by the use of other materials
- Maintenance can be carried out only under steady operating conditions
- Dry running and high pressures demand a mechanically sound material with sufficient self lubricating capability, good thermal conductivity and low coefficient of expansion.
Bearings are situated vertically or at an angle in the machine so that the liquid and solid debris will be collected by the machine.

Operating Temperature
The temperature resistance of carbon is very high and can be operated at 1500°C for 500 hours for certain applications. The temperature resistance of graphite is also high and can be operated in a limited application up to 1400°C. However, there are some exceptions which can be operated at higher temperatures.

Chemical Resistance
Carbon and particularly graphite are characterized with excellent chemical resistance due to their innate structure. Exceptions to this are some strong oxidizing acids, alkaline solutions, hydrogen fluoride and methanol.

Frictional Behaviour
Graphite has self lubricating properties because of its crystal structure. The boundary friction coefficient is a function of the load and the lubrication of the sliding interface. In general, the load and the coefficient of friction are inversely proportional. Dry sliding and high pressures demand a mechanically sound material with sufficient self lubricating capability, good thermal conductivity and low coefficient of expansion.

Manufacturing Process and Properties of Carbon and Graphite Materials
Manufacturing process of carbon and graphite materials involves several steps, including calcination, reduction, pressing, and sintering. The resulting materials are consolidated under high pressure and temperature to produce the final product.

Structure & Bonding
The structure of carbon and graphite materials is characterized by a hexagonal lattice of carbon atoms. This structure gives them unique properties such as high conductivity, high tensile strength, and high modulus of elasticity.

Physical & Mechanical Properties
- Good electrical conductivity
- Good thermal conductance
- High strength
- Low thermal expansion
- Good wear resistance
- High wear resistance
- Good fluid lubrication
- Good chemical resistance
- Good modulating characteristics
- Low weight

Manufacturing Process Diagram

Tribofilm of carbon
- The tribofilm of carbon is formed on the sliding surfaces of the bearing or shaft as a result of the frictional forces. The tribofilm acts as a lubricating layer, reducing friction and wear.
- The tribofilm is composed of a variety of carbonaceous materials, including graphite, graphitic carbon, and amorphous carbon.
- The tribofilm is formed through a series of chemical and physical processes, including oxidation, pyrolysis, and graphitization.
- The formation of the tribofilm is influenced by the operating conditions, such as temperature, pressure, and sliding speed.
Guidelines for the Installation & Design of Carbon Seals Rings

Solid Carbon Rings
Normally, the seal rings are used in solid form machined from suitable size of carbon blank. The shape and size of the rings vary according to the design of mechanical seals which are designed for its respective operating conditions. Since carbon-graphite are stable at high temperature, majority of the seal ring designs constitute of solid rings.

Cold Pressing
For a cold press fit in steel, where the application is lower than 100°C steel housings made to H7 bore tolerance are normally recommended. If the housing material has a higher coefficient of thermal expansion than steel the temperature limitation is normally lower. When pressing the bearing into its housing a mandrel with collar whose diameter is approximately three tolerances below the drilling tolerance of the carbon bearings as supplied should be used to press the bearings in. The bore diminishes by 70 - 80% of the pressing over-dimension according to the quality and dimension of the housing.

Shrinking
We recommend shrinking carbon seal rings directly into the metal housing which are to be used at operational temperatures of over 100°C. To shrink in the bearings, experience has shown that the tolerance overlap should be in the range corresponding to H7/x8...x8. The selected heating temperature for mounting must be sufficiently high to allow the cold bearing to be easily inserted. On shrinking the carbon bearing bore diminishes by approximately 80...100% of the shrinking overdimension. In the case of the above mentioned shrink fits H7/x8...x8, this diminishes according to the wall thickness ratio. In order to keep to exact tolerances it is advisable to machine the bearing bore to size after shrinking.

Adhesives
Adhesives are only suitable for bearings which are subject to low temperatures (up to 200°C). Bonding to the housing with commercially available adhesives is possible. For higher temperatures, thermal setting, adhesives should be used.

Suitable Counter Face Materials
Suitable : Plain steel, alloyed steel (chrome steel), hardmetal, ceramic & glass.
Suitable under certain conditions : Nonferrous heavy metal, chrome nickel steel, chromium plate materials.
Unsuitable : Aluminum and its alloys.

Surface Quality of The Counter Face Materials
The surface quality of the counter face materials has an important influence on the durability of carbon and graphite. Counter face surfaces with a maximum surface roughness of 5r < 1 μm are recommended. For high pressure lapped and superfinished counter faces with a maximum surface roughness of 5r < 0.5 μm are necessary.

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Carbon Seal Ring

Sliding Seal Ring
Mechanical Seal Ring Materials require high strength and a relatively high modulus of elasticity to withstand deformation at the interface. Carbon-graphite seal materials provide the strength and rigidity which are especially important in high pressure, high vacuum, high temperature and zero leakage mechanical end-face seals. High thermal conductivity is essential in removing heat from the interface.

Pure carbon graphite is strictly speaking a ceramic material, but in the form that it is used for seals it will usually be impregnated with other materials that are provided to variously enhance the seal. By reducing porosity, wear performance or strength is increased. It is widely used, not only as one of the face pair on the vast majority of mechanical seals, but also found as the most popular material for segmented circumferential seals and for piston rings in dry or marginally lubricated conditions.

Impregnation of Carbon-Graphite Seals
Impregnation of carbon seals can be done with a variety of materials to control permeability. In addition to thermoset resins, other types of impregnants include thermoplastics, metals, and inorganic salts or glasses. The temperature limit of the impregnate places an upper limit on the operating temperature of the carbon parts.

Metals such as antimony, silver, copper, nickel, and babbitt can improve the strength, thermal conductivity, and tribological characteristics of the materials. Impregnants made of inorganic salts usually phosphate or borate - and glasses are used in high temperature applications. Carbons impregnated with soluble salts must be handled carefully to avoid exudation, especially under humid conditions, but less of impregnant rarely affects any physical property of a seal other than permeability.

Mechanical seal primary rings can be supplied as per customer drawings and specifications. The rings can be supplied plain, shrink fitted or cemented in metal retaining rings. Mechanical seal rings can also be supplied with the sealing face lapped flat to one halfum limit band.
Carbon Thrust Bearings

At high temperatures, plastic and composite bearings are subject to other problems such as softening, melting, deformation and may extrude out of the bearing area altogether. Because the carbon graphite matrix is very strong, it is not subject to the deformation, melting, or even softening that can occur with plastic bearings at these elevated temperatures.

Operating Temperature

The temperature resistance in an oxidizing atmosphere can be specified as 400°C maximum for G10 bearing qualities. In a non-oxidizing atmosphere the temperature resistance is determined by the final graphitizing treatment of each individual grade (e.g., upper application limit for graphite is approximately 3000°C). Temperature resistance is also affected by various impregnations. In the case of resin impregnation the maximum operating temperature is 180°C for lead impregnation 200°C and antimony impregnation 500°C.

Frictional Behaviour

Graphite has self-lubricating properties because of its crystalline structure. The low friction coefficient is a function of the low bonding between the structural lattice planes. Dislocation of one against the other is therefore easy. The friction coefficient is particularly low if traces of water or other vapours are present. The friction coefficient is greatly increased when a vacuum is created. Because of the varying conditions of application, no exact data can be given for friction coefficients. In general the following values can be expected for sliding friction:

- Dry friction: 0.10 - 0.30
- Mixed friction: 0.05 - 0.10
- Hydraulic friction: 0.01 - 0.05

The frictional behavior of carbon is also affected by the following factors:

- Running in
- Specific pressure
- Running speed

When running in carbon and graphite bearings, the friction coefficient drops until a constant value is reached once the surfaces are smoothed. The coefficient of friction also drops in the case of constant specific strain and increasing running speed, or inverse.

Advantages of using Carbon Thrust Bearing in Submersible Motors

- Helps the pump to run in dry condition.
- Low generation of heat due to self-lubricating property.
- When carbon is used as material for sliding purpose, there is no generation of heat in that area due to excellent self-lubrication available from carbon. This helps to improve the life of thrust bearing as well as other parts of the pump which may be damaged due to high temperature.
- Contributes in saving of power.
- As the electricity goes costlier day by day, carbon is the best solution for decreasing running cost of the pump.
- Runs with low input power as compared to ferro-asbestos/felton.
- Ferro-asbestos is a breaking material. It causes friction between the thrust pad and bearing resulting in higher requirements of power where as the carbon causes a free movement and the pump starts & runs with minimum energy.
- The motor with carbon thrust bearing and bush does not seize even after prolonged rest.
- Even if the pump is not in use for a long period, the pump with carbon bearing starts immediately with the supply of power.
- The low hp pump with carbon provides same output as high hp pump with ferro-asbestos, felton or nylon.
- Due to excellent self-lubricating properties of carbon, there is no friction between the thrust pad and bearing and as so there is no energy loss and so the pump gives the maximum output.
- The pump with carbon bearing starts at lower voltage compared to the pump with ferro-asbestos or other bearing materials which require higher voltage to start.
- As there is a shortage of electricity and problems of the voltage drop in the villages and urban areas, carbon enables the pump to start at low voltage available whereas ferro-asbestos or other materials fails to start the pump at low voltage of power.
Carbon Vanes

Carbon-graphite materials are used extensively for vanes, rotors, and end plates in rotary vane pumps pumping both liquids and gases. Carbon graphite vanes can withstand the rubbing of the vane tip against the housing bore and the rubbing of the side of the vane against the slots in the rotor. Carbon graphite rotors are light in weight to save energy and can also withstand the rubbing of the vane against the end plates.

Carbon graphite vanes, rotors and end plates are used for pumping liquids with poor lubrication properties (low viscosity) such as water, gasoline and beverages. They are also used for pumping strong chemicals that attack metals.

Carbon-graphite vanes, rotors and end plates are also used to pump gases such as air, vacuum, combustion products and gasoline vapors.

Graphitecarb Products supplies carbon-graphite vanes, rotor, and end plates to rotary pump and compressor manufacturer and rebuilders. The vanes, rotors and end plates can be supplied to customer print and specifications.

Specifications

**Advantages of Carbon Material**

- Chemically resistant
- Compatibility with foods & beverages (FDA) & PTFE impregnated
- Dimensional stability
- High strength to weight ratio
- Impervious (pressure tight)
- Light weight (low centrifugal force)
- Low wear rate running in gas atmospheres
- Low wear rate running in low viscosity liquids

**Dry Running Applications**

- Auto anti-siphon pumps
- Chemical Pumps
- Gasoline vapor pick up pumps
- Oil free air pumps
- Paint spray pumps
- Pumps for automobile locking devices
- Rotary Compressors for fresh air (Breathable air)
- Vacuum Pumps for aircraft gyroscopes
- Vacuum Pumps for milling machines

**Im-Liquid Applications**

- Beverage pumps (vending machine)
- Fuel pumps
- Liquid chemical pumps
- Medical liquid pumps
- Metering pumps or volumeters

**Physical Properties of Carbon Vanes**

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Bulk Density</th>
<th>Compressive Strength</th>
<th>Plastical Strength</th>
<th>Shore Hardness</th>
<th>Ash Content</th>
<th>Porosity</th>
<th>Average Grainularity</th>
<th>Coefficient of Thermal Expansion x 10^5/°C</th>
<th>Young's Modulus (GPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP1-4A</td>
<td>1.85</td>
<td>900</td>
<td>660</td>
<td>60</td>
<td>500/50</td>
<td>22</td>
<td>4.3</td>
<td>11.5x10^5</td>
<td>11.5x10^5</td>
</tr>
</tbody>
</table>
# Carbon Blocks for Fractional Horsepower Brushes

Professional power tools place the highest demands on electric motors. Carbon brushes of these equipment are compelled to work under difficult situations such as:
- High current densities
- Vibration
- Dust formation
- High rotational speeds
- Exposure to weather conditions etc.

G35 grade carbon block is specially made to work under such conditions. Carbon brushes made from G35 grade carbon blocks have shown excellent performance in this field. In addition to research and development, it is the right materials choice combined with superior process technology in our mixing plant and our modern production technology which ensures the high quality of our products.

Carbon brushes made of G35 grade carbon blocks experience a long operating life and high operational reliability. In addition to long life, carbon brushes made from G35 also possess extratful properties such as:
- Not to damage commutator,
- Lower level of radio interference,
- To endure vibration, impact and in some cases, even electric brakes work.

With G35 grade excellent test results have been achieved with small and large angle grinders. Some of the noteworthy results seen are:
- Remarkable increase in lifetime of brush and commutator,
- Low commutator wear,
- Lower operating temperatures
- Low RFI

G35 grade is used to make carbon brush fan:
- Power tools
- Carbon brush is used in the power tool such as drill, circular saw and grinder, etc.
- Home appliances
- Carbon brush is used in the electrical vacuum cleaner, juicer, mixer, hair dryer, and health apparatus etc.

### G35 Grade Standard available sizes of Carbon blocks (L X W X THK)

<table>
<thead>
<tr>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 127 X 77 X 18MM</td>
</tr>
<tr>
<td>2) 127 X 77 X 20MM</td>
</tr>
</tbody>
</table>

### G35 Grade Technical properties (as tested in ERIAD)

<table>
<thead>
<tr>
<th>Properties</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent Density</td>
<td>1.57gm/cc</td>
</tr>
<tr>
<td>Resistivity</td>
<td>40000-60000min ohm- cm</td>
</tr>
<tr>
<td>Hardness</td>
<td>32-37 HSD (iceroscope)</td>
</tr>
<tr>
<td>Transverse Strength</td>
<td>250 Kg/cm²</td>
</tr>
</tbody>
</table>

Moreover, carbon blocks can also be supplied up to 45mm thickness if required.

### Commutator Problems & Solutions

The purpose of this guide is to promote awareness of unsatisfactory carbon brush operation. Early recognition and corrective action can help avoid costly unscheduled down time. The commutator film condition is a primary indicator of the performance of any motor or generator. A consistent color over the entire commutator in the brown tones from light tan to dark brown indicates a satisfactory film condition. In these cases, sufficient film exists for low friction operation, while there is no excessive film to restrict proper flow of current. Incorrect film color and deformation of the commutator surface are warning signs for developing brush conditions with fast brush and commutator wear.

**Fast Wear:** Accelerated brush wear due to a variety of conditions causing excessive dust or arcing.
- **Cause:** All of the items listed below will contribute to fast wear. Also, roughness or irregularity of the commutator surface such as high bars, misfit of bars, or an out-of-round contact surface condition will cause radial movement and resulting arcing and chatter.
  - **Recommendations:** Check that commutator is in good condition, that spring pressure is adequate at the face of the brush, and that the proper number of brushes are in use based on operating current densities.

**Light Load:** Low current density for the grade in use or inadequate filling or high friction conditions.
- **Cause:** Equipment is set for the maximum loads and the product dictates operation at less than nameplate resulting in light load. High friction, brush dust and eventual arcing.
  - **Recommendations:** Increase current density by removing brushes or consider light load rating grade.

**Threading:** Mating the copper transfer from the rotating surface to the brush face and the resulting wear on the surface from metal to metal interaction.
- **Cause:** Often due to brush current density and inadequate spring pressure, may also be caused by contamination.
  - **Recommendations:** Verify actual operating sheds and spring pressure to be sure they are in the proper range for the grade in use. If possible, eliminate any contamination present.

**Grooving:** Surface of the busbar or excessive electrical wear of contact surface or wiring surface.
- **Cause:** Mostly due to static electrical contact resulting in arcing and electrical mACHining of the commutator. Can also be due to mechanical wear or overly abrasive grade. Inadequate spring pressure, low current densities, or excessive current are also possible causes.
  - **Recommendations:** Check the contact surface that roughness is within 0.02 with less than 0.0005 variation from bar to bar. Vibration should be less than 6 m/s. Check current density and spring pressure.

**Arcing:** Arcing and burning at the brush face.
- **Cause:** Due to poor electrical contact, inadequate spring pressure (too short), rough commutator, or ring deposits or bars in brush holder.
  - **Recommendations:** Contact surface should be round within 0.02. Check spring pressure to ensure it is 4-6 psi for industrial DC applications and remove deposits in holders.

**Chipping:** Brushes chipping or breaking at the face.
- **Cause:** Roughness or irregularity of commutator surface, high bars, misfit of bars can break the entering edge of the brush, and cause brush bounce or chatter.
  - **Recommendations:** Check contact surface condition to be sure it is within tolerance, check spring pressure, and brushing condition.

**Spring Pressure:** The most common cause of unsatisfactory film condition is inadequate spring pressure. For reference, the chart below indicates the recommended ranges of spring pressure for various applications and the method for calculating spring pressure from the measured spring force.

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Thrust Bearing Assembly

Using Carbon Thrust Bearing in Sub Motor (G10Z Grade Carbon)

- Saves electricity upto 10%
- Increases Pump efficiency upto 5%
- Starts & runs the Pump even at low fluctuating voltage
- Motor runs at full RPM
- Gives upto 10% more output of water in LPM as compared to tetlon/fibre
- Makes pump rotates freely & silently
- The motor does not get locked even after prolonged stop

Submersible motors are fitted with Hydrodynamic Self Adjusting Tilting Shoe Thrust Bearings to take the axial "down thrust" from the pump. These are a complex and clever part of a reliable submersible motor and probably not understood very well.

Principle

The Hydrodynamic thrust bearing transmits the rotating shaft's axial thrust load to the frame of the motor, which is mechanically supported in the well. The axial thrust load is transmitted through the bearing on a self-renewing film of lubricant, which is water in most motors. The pressure in the fluid film supports the load without the thrust disc or pivot shoes making contact.

Theory

Fluids tend to stick to most surfaces due to viscosity, and in the case of loose segments thrust bearing, we rely on the fluid sticking to the surface on the rotating thrust disc. This fluid is then dragged between the thrust bearing disc and the face of the pivot shoe by centrifugal force, and forms a wedge shaped film. This wedge shaped film is essential for the successful operation of the thrust bearing. When the bearing is operating correctly there is no contact between the disc and the face of the pivot shoe. The only time there is contact is when the motor is stopping or starting. This means there should be only negligible wear between the faces — and no wear while the motor is operating.