MERSEN
Expertise, our source of energy

MECHANICALS

CARBON & GRAPHITE SOLUTIONS FOR MECHANICAL APPLICATIONS

MERSEN JP Grades

CARBON OR GRAPHITE?

The terms « carbon » and « graphite » are often used interchangeably. This is regrettable since each form of the element carbon offers specific properties that can be used to support high performance in the most critical environment.

How paradoxical is Carbon?

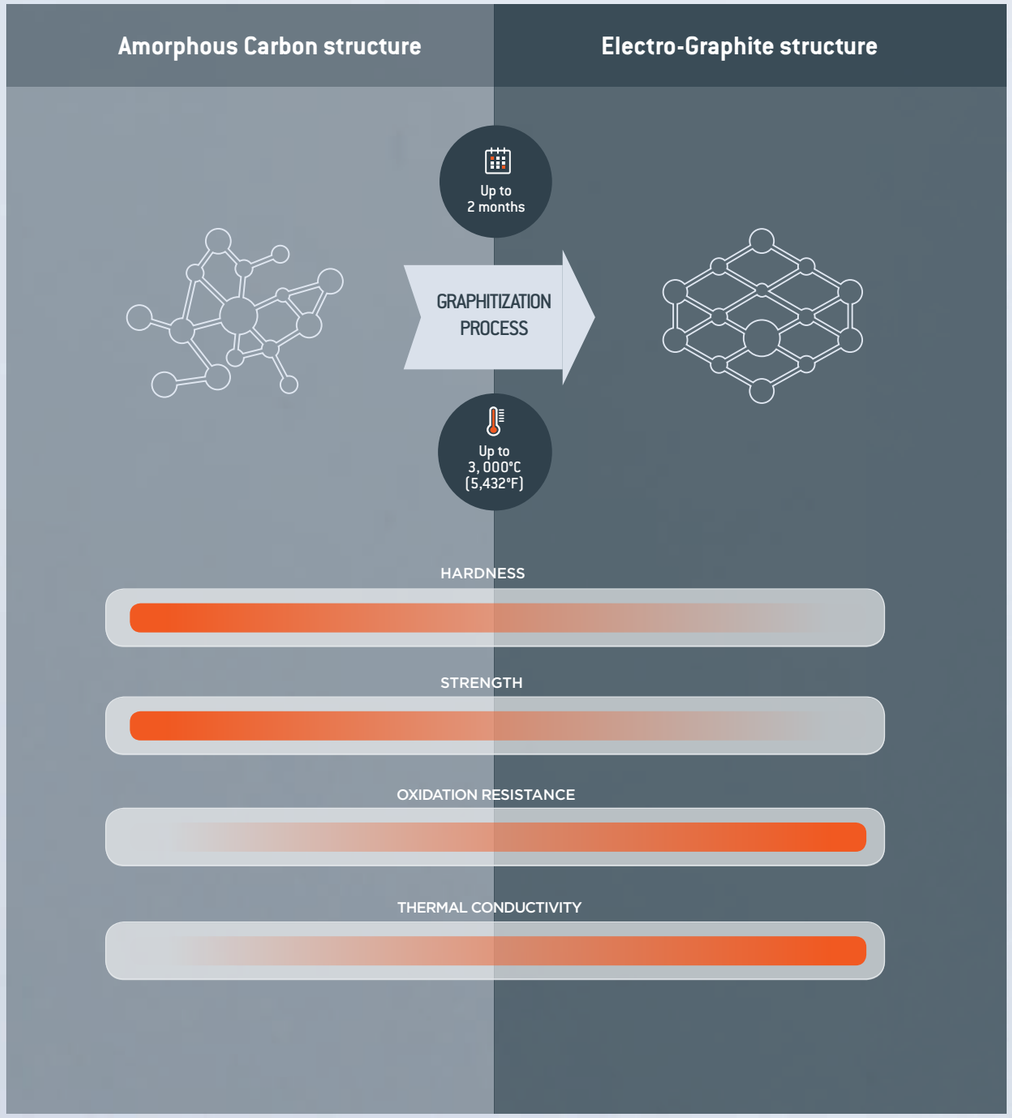
Carbon in the form of diamond is the hardest known substance. Yet this paradoxical material can also be one of the softest. Carbon's wide range of properties makes it highly valuable as an engineering material for a wide range of applications. Through graphitization, Carbon (also called Carbon-graphite as graphite enters in the recipe of the base material) turns into graphite (also called Electro-graphite thanks to its increased electrical conductivity).

Mersen is the global leader of isostatic graphite producers. Thanks to its expertise, Mersen is able to combine amorphous carbon and graphite to take full advantage of the strengths of these two types of carbon in JP grades offering.

\+ MERSEN JP GRADES COMBINE THE SUPERIOR STRENGTH, HARDNESS, AND WEAR RESISTANCE OF CARBON WITH THE NATURAL LUBRICATION PROPERTIES AND RESISTANCE TO OXIDATION OF GRAPHITE.

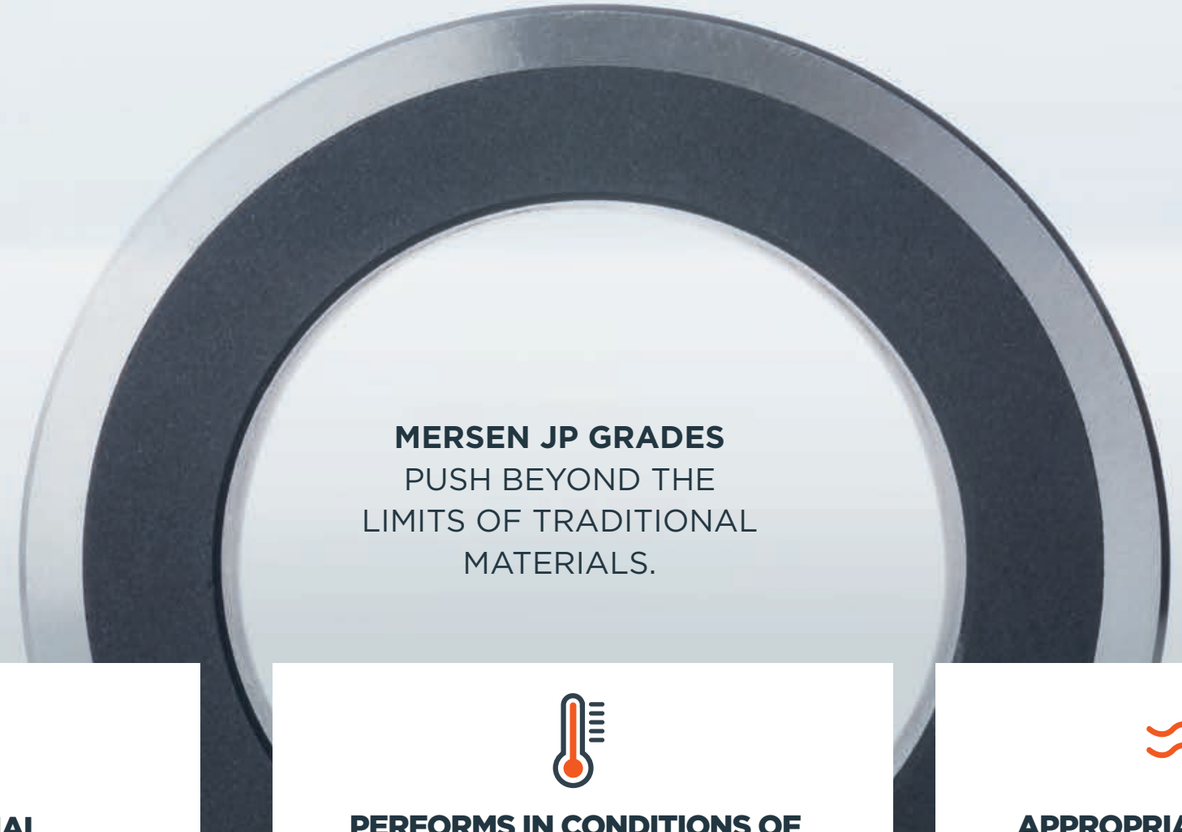
With heat and time, **amorphous carbon structure turns into the crystalline graphite structure.**

This process is called graphitization and is being run at a temperature of 3,000°C (5,432°F). Amorphous carbon has superior strength, hardness and wear resistance. It has a low thermal conductivity. Graphite is on the contrary crystalline. It has natural lubrication properties, a good resistance to oxidation, is chemically inert and has a good thermal conductivity.



PERFORM IN THE MOST SEVERE CONDITIONS

MERSEN JP GRADES COMBINE SUPERIOR STRENGTH AND HARDNESS PROPERTIES OF CARBON WITH THE NATURAL LUBRICATION AND RESISTANCE TO OXIDATION FEATURES OF GRAPHITE.



MERSEN JP GRADES
PUSH BEYOND THE LIMITS OF TRADITIONAL MATERIALS.

OIL FREE, SELF LUBRICATING PROPERTIES

Outstanding dry running properties.

LOW COEFFICIENT OF FRICTION: where there is intermittent lubrication or initial dry running on start-up, carbon-graphite bearing offers low start-up torque at any temperature and low frictional moment during operation, even at low speed.

ELIMINATES GALLING OR SEIZING in hot and dry conditions.

HIGH LOADS can squeeze and remove the layer of lubricant generating possible failure, unless the material provides self-lubrication, as carbon-graphite material does.

COMPATIBLE WITH FOOD & PHARMACEUTICALS: thanks to their dry-running properties, carbon-graphite components have a perfect fit when the presence of oil or grease is prohibited, even in vapor form.

INERT MATERIAL

Corrosion resistance to most aggressive media; many grades compliant with FDA regulations.

INHERENTLY STABLE AND CHEMICALLY RESISTANT. The chemical inertness of carbon-graphite is demonstrated through its resistance against liquid chemicals and aqueous solutions. Mechanical Carbons are resistant to most organic and mineral acids, most solvents, light hydrocarbons and alkaline solution.

NON-TOXIC AND IMPERVIOUS FOR FOOD & PHARMACEUTICALS. Carbon-graphite material is non-toxic and cannot contaminate the liquid or gas being handled. It can safely be used in food-processing equipment and in other fields where purity is essential. Impregnated carbon-graphite has greatly reduced porosity and is impervious to contamination.
Our carbon-graphite base grade withstands extreme temperatures in processes ranging from sub-zero temperatures up to -55°C (-67°F) for cooling processes to high temperature over 450°C (842°F) for baking.

PERFORMS IN CONDITIONS OF EXTREME TEMPERATURE

From 450°C (842°F) in oxidizing atmosphere to -55°C (-67°F) for JP base grades, much more on request.

LOW COEFFICICENT OF THERMAL EXPANSION: graphite maintains its dimension accuracy even if it is used at a high temperature. Distortion caused by swelling with heat or contracting with cooling is virtually eliminated.

EXCELLENT THERMAL SHOCK RESISTANCE: when other materials become fragile, graphite has the highest temperature-change resistance properties making it the ideal solution where sudden changes in temperature occur.

RESISTANCE TO EXTREME (HIGH AND LOW) TEMPERATURES: lubricants lose their properties with the heat or start to solidify with the cold. Carbon graphite can be used at temperature ranges where most of the lubricants deteriorate rapidly.
OXIDATION RESISTANCE: increasing the amount of graphite and decreasing the amount of carbon through the graphitization process significantly improves the material's oxidation resistance for applications with high heat.

APPROPRIATE THERMAL CONDUCTIVITY

Heat remover: maintain lower temperature at point of contact.

REMOVES THE HEAT AT POINT OF CONTACT: the heat generated in the seal interface is mainly transferred by conduction through the rings to the surrounding sealed fluid and then removed by convection. Thermal aspects of mechanical seals are a major factor in seal performance and reliability. A good thermal conductivity is critical to remove the heat generated by the friction and gives the ability to maintain lower temperatures at the contact place.

The thermal conductivity of carbon materials varies considerably according to the degree of graphitization. As the friction occurring at the interface can give rise to localized high temperatures, the thermal conductivity of carbon-graphite product should be as high as possible to remove the heat from the friction surface. Electrographite grades have the highest thermal conductivity.

SEALING RINGS FOR SEVERE ENVIRONMENT

SELECTING THE PROPER SEAL MATERIAL IS CRITICAL. A FAILED SEAL CAN DAMAGE EXPENSIVE EQUIPMENT AND RESULT IN COSTLY REPAIRS, MAINTENANCE, AND DOWNTIME.

Carbon Graphite is the ideal seal material in every aspect. It is flexible enough to conform to the mating face, very hard, self-lubricating, and resistant to wear. It is also lubricated by almost any fluid and the media being sealed will add additional lubrication. It can be impervious and being inert, resists to most chemicals. Mersen JP seals made of carbon-graphite offer reliable solutions for sealing a wide range of gases, gaseous mixtures, powders, vapor and liquids in machines and plants such as pumps, turbines, fans and compressors.

FEATURES & BENEFITS

WITHSTAND EXTREME TEMPERATURE CONDITIONS

JP grades are capable to run from 450°C (842°F) in oxidizing atmosphere to -55°C (-67°F) for base material, those limits can be pushed to much more with the right impregnation. Our experts in mechanical applications can help you to select the right product enhancement needed.

Thanks to a low Coefficient of Thermal Expansion (CTE), JP carbon-graphite grades are capable to cope with significant temperature swings while keeping their sealing performance.

CAPABLE TO RUN DRY

When the use of lubricants is prevented by high operating temperatures or when the application temperature gets too low, conventional grease will lose their properties, generating wear and ultimately leakages. Carbon-graphite sealing rings have self-lubricated properties and continue to perform without lubrication.
When the use of lubricants is strictly forbidden to avoid contamination in food and pharmaceutical industries or when access to regular maintenance is not possible.

RELIABLE AND HIGH SEALING PERFORMANCE

Graphite has good thermal shock characteristics. Wear will not generate a sudden failure and generate downtimes, disruptions, and operational shutdowns.

Carbon-graphite seal provides strength and rigidity in high pressure, high vacuum, and high temperature conditions. Its high thermal conductivity is essential in removing heat from the interface as it is critical to remove the heat generated by the friction and gives the ability to maintain lower temperatures at the contact place.

INERT AND NON-TOXIC MATERIAL

Carbon and particularly graphite seals are characterized by excellent chemical resistance to most organic and mineral acids, most solvents, light hydrocarbons and alkaline solution. More details can be found in our literature (Mersen Corrosion Resistance Chart)

Carbon-graphite material is non-toxic and cannot contaminate the liquid or gas being handled. It can safely be used in food-processing equipment and in other fields where purity is essential. Mersen JP grades sealing rings are compliant with FDA regulations.

HOW IMPORTANT THE SEAL FLATNESS?

Maintaining flatness at the seal face is critical. The high modulus of elasticity of Mersen JP carbon-graphite grades has the required stability to remain flat during operation at the rubbing faces.

RECOMMANDATIONS

MECHANICAL SEALS

RUNNING TEMPERATURE	TYPE OF FLUID	RUNNING CONDITIONS	MERSEN JP GRADES
< 200 °C (< 392°F)	Phenolic resin compatible with the fluid	Low speed and low pressure	JP1345 - JP545
		High performance (Hard counterfaces)	JP645 - JP545
up to 350 °C (up to 662°F)	Phenolic resin NOT compatible with the fluid	Low speed and low pressure	JP1368 - JP868 - JP968
		High performance (Hard counterfaces)	JP668 - JP568
	Highly corrosive fluid (chlorinated hydrocarbons, concentrated H_2SO_4,…)		JP1328 - JP928

Phenolic impregnation

Recommended for sealing rings facing severe lubrication conditions; running submerged in water, in water based chemicals or in organic chemicals with low friction. Phenolic impregnated carbon-graphite is impervious and has higher mechanical strength. It can be used in pharmaceutical, food and drinkable water applications.

SEATED VALVE FOR HIGH TEMPERATURE AND AGGRESSIVE MEDIA

An optimized alternative to soft - PTFE and metal ball valve seat for high temperature applications is Mersen JP carbon/graphite seat. Graphite provides the high temperature characteristics required together with a soft cushion against the ball to achieve the zero-leakage desired for liquids and saturated steam. Chemically inert, Mersen JP base seats ensure long lasting sealing performance and allow operators to reliably run their operations and optimize the productivity of the plant.

Ball valves are used with a wide range of fluids, especially heating gases (natural gas, lighting gas, propane-butane mixture, biogas, coke-oven gas), water, steam, oxygen, and both corrosive and non-corrosive liquids and gases in general.

For severe environments, conventional valve seat solutions made of soft PTFE or metal reach their limits and can generate leakages, due to high coefficient of thermal expansion rates, and can cause potentially failures.

FEATURES & BENEFITS

IDEAL FOR TEMPERATURE SWINGS

from start-up to 450°C (842°F) in oxidizing atmosphere; oxidation threshold can be raised to 600°C (1,112°F) with an oxidation inhibitor

LOW COEFFICIENT OF THERMAL EXPANSION

distortion caused by swelling with heat or contracting with cooling is greatly reduced.

GOOD TO KNOW

Carbon-graphite works best in clean liquids with some lubricating properties. Within specified limits, the JP grade is serviceable in wet, saturated or super-heated steam.

CHEMICAL STABILITY

Carbon/Graphite is chemically inert in most environments, except those that are strongly oxidizing due to high temperatures.

VERSATILE

within specified limits, the carbon-graphite is serviceable in wet, saturated or super-heated steam, making the material ideal for steam joints.

NO SWELLING

unlike some polymer-based seals, Carbon/Graphite doesn't swell when exposed to fluids.

LOOKING FOR THE RIGHT MATERIAL FOR YOUR BALL VALVE SEAT?

	FLUID	RUNNING CONDITIONS	MERSEN JP GRADES		
ball valves seats / rings and guides	Steam	Low pressure (less than 2 bars)	JP1300	JP1345	JP1368
	Steam	High pressure	JP668	JP968	JP1368

BEARINGS FOR SEVERE SERVICE LUBRICATION

Mersen JP bearings are made of carbon-graphite material answering to the most critical conditions. Since there is no metallic attraction between carbon-graphite and the shaft, these bearings are not prone to galling or seizing, which is a known failure mode of other types of bearings. Carbon-graphite is self-lubricating and can run dry in certain conditions without the need for grease or oil lubrication. Carbon-graphite bearings also have thermal and chemical resistance, which is crucial when pumping hot fluids or caustic chemicals.

GROOVES MACHINED IN THE BEARING: WHAT FOR?

When handling abrasive media, it is desirable to machine one or several straight grooves in the surface in contact with the shaft. In lubricated environment, the presence of grooves assists the formation of a lubricating film. In dry operations, grooves allow the elimination of dust arising from bearing wear.

FEATURES & BENEFITS

SELF LUBRICATING PROPERTIES

Mersen JP Carbon-graphite bearings are especially recommended in poor or challenging lubrication conditions or when access to the moving parts is impossible.

CONDITIONS OF POOR LUBRICATION

when machines operate intermittently over long periods or with dry running on start-up (case for vertical pumps for instance)

CONDITIONS OF PROHIBITED LUBRICATION

To prevent fire hazard, when the equipment runs in potentially explosive working environments (the use of oil or grease together with high temperatures is forbidden); to avoid oil contamination where purity is essential (pharmaceutical and food industries).

CONDITIONS OF DIFFICULT ACCESS

the maintenance of certain types of equipment is virtually impossible due to the difficult access to the moving parts (marine equipment, equipment in the chemical industry) making lubricant replenishment simply not possible.

CONDITIONS OF EXTREME TEMPERATURE

few lubricants can withstand the heat or start to solidify with the cold. Carbon graphite can be used at temperature ranges where most of the lubricants deteriorate rapidly.

IMPREGNATIONS AND BEARINGS

Although the properties of each impregnation type vary significantly, a key function of each is to fill carbon graphite's porosity. Using an impervious material is key for submerged pumps to create a hydrodynamic fluid layer between the bearing and the shaft.

RECOMMANDATIONS

CONDITIONS OF LUBRICATION	SPEED	LOAD	PV	MERSEN JP GRADES
Lubricated running	Low	Low	≤ 2 bars.m/s	JP400 - JP1345
Dry running	Low	Low	≤ 2 bars.m/s	JP928 - JP1368
Lubricated running	Medium	Medium	3 to 4 bars.m/s	JP568
Dry running	Medium	Medium	3 to 4 bars.m/s	JP968 - JP568
Severe	High	High	4+ bars.m/s	JP668
Hot water circulators				JP400 - JP1300 - JP1345

PV RATING OR LOAD CAPACITY OF THE BEARING

Load capacity of slide bearings is calculated using the sliding pressure p and sliding speed v.

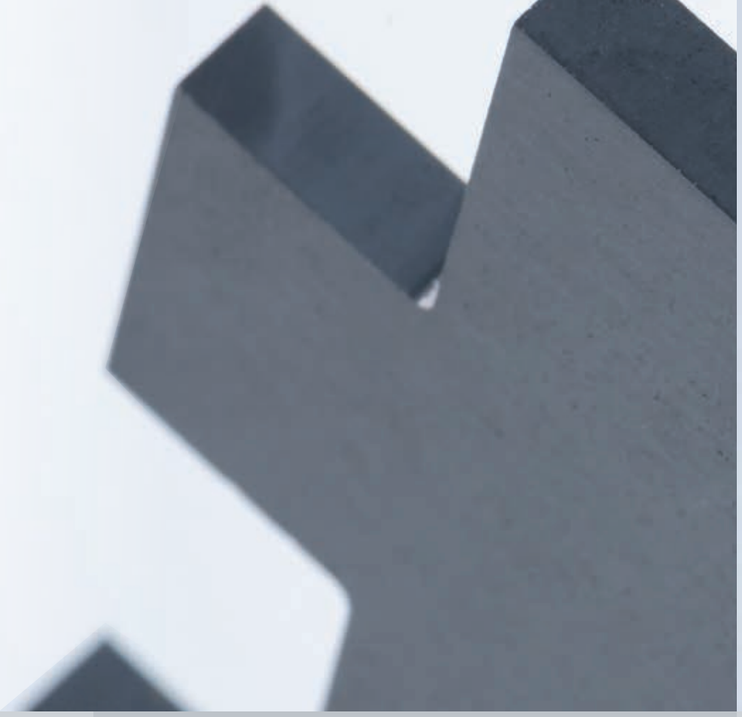
$$PV = \frac{F}{A} \times v$$

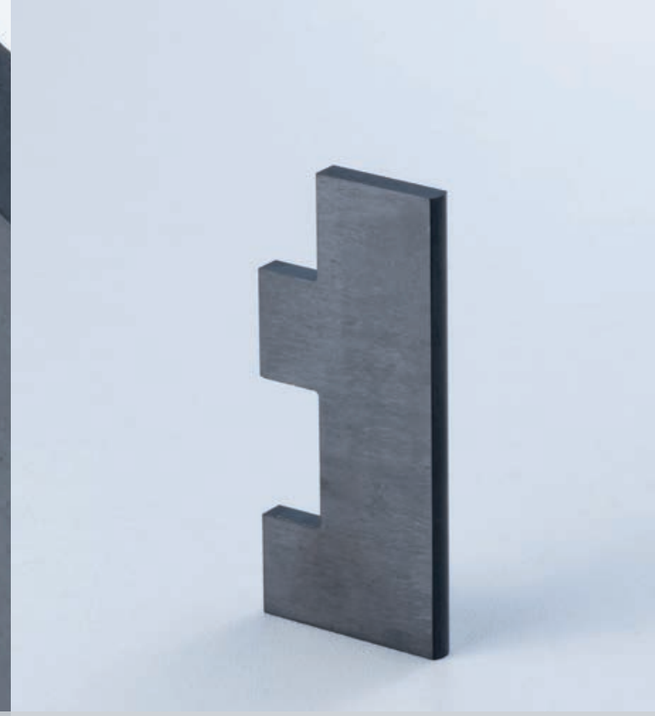
where F = force [N]
A = projected area of bush [mm²]
v = shaft peripheral speed [m/s]

Carbon bearings run under conditions which are so varied that it is impracticable to give maximum load and speed figures which would be universally applicable. An approximate indication is the value of the loading characteristic, the PV factor. Other application specifics have to be taken into consideration before selecting a grade.

ROTOR AND VANES OPERATING BEYOND THE LIMITS OF OTHER MATERIALS

Carbon and graphite are very high temperature and corrosive resistant materials, which are the most important characteristics for vanes material. Carbon vanes are suitable for wet and dry running conditions. Chemically inert, they cannot contaminate the pumped media and therefore are compliant with FDA regulations. Because of their self-lubricating properties, carbon vanes are the prefered choice for handling liquids with poor lubricating properties like petrol or kerozene for instance.





FEATURES & BENEFITS

SELF-LUBRICATING

Carbon vanes are self-lubricating and are recommended when handling liquids such as petrol with poor lubricating properties. They can also operate in unlubricated compressors to deliver air or gas uncontaminated by oil or grease. In this case, carbon grades give a fine polish to the cylinder wall which reduces the wear rate of the vane.

LOW COEFFICIENT OF THERMAL EXPANSION

Even at 400°C (752°F), thermal expansion of Mersen JP grades is minimal (they are also non-hygroscopic and do not swell after immersion in hot or cold water). The vane clearance in its rotor slot can therefore be fine for an improved performance of the equipment.

CHEMICALLY INERT & NON-TOXIC

Carbon vanes are chemically inert, non-toxic and cannot contaminate the liquid or gas being handled. They can safely be used in food-processing equipment and in other fields where purity is essential. Carbon vanes are totally unaffected by water, most acids, alkalis, or oil solvents such as petrol or paraffin. In these conditions, the liquid can reduce friction and wear by providing lubrication.

RELIABLE AND HIGH SEALING PERFORMANCE

One of the most important requirements for vane materials is high mechanical strength. The mechanical strength of carbon product is, whatever their degree of graphitization, a function of the bonds between graphite crystallites. Therefore, there is no plastic deformation at ambient temperatures and mechanical strength increases with temperature making Mersen JP grades a reliable material for demanding applications.

HOW IMPORTANT IS THE LOW COEFFICIENT OF THERMAL EXPANSION?

Thanks to its low Coefficient of Thermal Expansion (CTE), end-plates made of Carbon-graphite are pressure tight, dimensionally stable and provide a close clearance seal with the rotor and vanes.

RECOMMANDATIONS

	MERSEN JP GRADES		
Vanes and distributors	JP400	JP945	JP1345

MERSEN JP GRADES

	DENSITY		POROSITY	HARDNESS	COEFFICIENT OF THERMAL EXPANSION		THERMAL CONDUCTIVITY		MAXIMUM TEMPERATURE		MODULUS OF ELASTICITY		FLEXURAL STRENGTH		COMPRESSIVE STRENGTH		STANDARD BLOCK SIZE	
	lbs/feet^3	g/cm^3	%	Shore	10^{-6}/°F	10^{-6}/°K	Btu-Ft/Ft²Hr°F	W/m°K	°F	°C	psi x 10^{-6}	GPa	psi	MPa	psi	MPa	inch	mm
JP4 **00**	113	1,81	3.8	42	4.0	7,0	1.7	3,0	356	180	1.74	12	7,250	50	14,500	100	1.1X6X12”	28X152X305
JP5 **00**	105	1,68	11	60	2.7	4,9	4.6	8,0	750	400	2.00	13	5,500	38	22,500	155	5.7X3.1X23.6”	145X180X600
JP5 **45**	115	1,84	<0.5	90	3.4	6,0	4.6	8,0	392	200	2.00	15	9,450	65	20,300	140	ON REQUEST	ON REQUEST
JP5 **68**	150	2,40	2	85	3.4	6,0	11.0	20,0	752	400	2.00	15	11,600	80	23,900	165	ON REQUEST	ON REQUEST
JP6 **00**	105	1,68	10	88	3.0	5,2	4.6	8,0	752	400	2.30	16	8,700	60	18,100	125	5.7X3.1X23.6”	145X180X600
JP6 **45**	112	1,80	<0.5	90	3.3	5,8	4.3	7,5	392	200	2.75	19	11,300	78	23,900	165	ON REQUEST	ON REQUEST
JP6 **68**	143	2,30	2	90	3.5	6,0	11.0	20,0	752	400	2.75	19	11,600	80	24,300	168	ON REQUEST	ON REQUEST
JP9 **00**	114	1,83	10	60	3.0	5,2	49.0	85,0	842	450	1.45	10	8,250	57	17,400	120	12.1X24.4X40”	308X620X1016
JP9 **28**	120	1,92	3	60	3.0	5,2	49.0	85,0	482	250	1.45	10	8,700	60	18,800	130	ON REQUEST	ON REQUEST
JP9 **32**	117	1,88	9	60	3.0	5,2	49.0	85,0	1,022	550	1.45	10	8,250	57	17,400	120	ON REQUEST	ON REQUEST
JP9 **33**	117	1,88	9	60	3.0	5,2	49.0	85,0	1,112	600	1.45	10	8,250	57	17,400	120	ON REQUEST	ON REQUEST
JP9 **45**	122	1,95	<0.5	70	3.3	6	49.0	85,0	392	200	2.30	16	10,150	70	23,200	160	ON REQUEST	ON REQUEST
JP9 **68**	150	2,40	2	72	3.4	6,0	52.0	90,0	842	450	2.00	14	10,850	75	22,500	155	ON REQUEST	ON REQUEST
JP10 **00**	119	1,90	8	80	3.3	5,8	46.0	80,0	850	450	2.30	16	10,850	75	30,500	210	6X12X24”	152X305X610
JP10 **33**	121	1,94	7	75	3.4	6,0	46.0	80,0	1,112	600	2.00	14	12,300	85	24,600	170	ON REQUEST	ON REQUEST
JP13 **00**	108	1,74	13	70	2.3	4,0	4.6	8,0	752	400	1.45	10	7,950	55	16,700	115	12X25X36	305X635X915
JP13 **28**	115	1,84	3	65	2.3	4,0	4.6	8,0	482	250	1.45	10	7,950	55	16,700	115	ON REQUEST	ON REQUEST
JP13 **45**	116	1,87	<0.5	85	2.9	5,0	4.6	8,0	392	200	2.00	14	10,850	75	23,200	160	ON REQUEST	ON REQUEST
JP13 **51**	112	1,80	2	75	2.9	5,0	4.6	8,0	752	400	1.45	10	7,950	55	16,700	115	ON REQUEST	ON REQUEST
JP13 **68**	153	2,45	2	80	2.9	5,0	11.0	20,0	752	400	2.00	15	12,600	87	26,800	185	ON REQUEST	ON REQUEST
JP19 **00**	115	1,84	10	100	3.4	6,0	40.0	70,0	850	450	2.30	16	14,500	100	33,350	230	6X12X24”	152X305X610
JP19 **32**	119	1,91	8	91	3.4	6,0	40.0	70,0	1,022	550	2.00	15	14,500	100	30,500	210	ON REQUEST	ON REQUEST

IMPREGNATION OPTIONS

00
BASE GRADE WITHOUT IMPREGNATION ENHANCEMENT

STANDARD PERFORMANCE GRADE WIITH OXIDATION RESISTANCE UP TO 450°C (842°F)

28
PTFE IMPREGNATION

IMPROVED CHEMICAL RESISTANCE AND TRIBOLOGY PROPERTIES. MAX OPERATING TEMPERATURE 250°C (482°F)

32
MINERAL SALT IMPREGNATION

OXIDATION RESISTANCE IMPROVED. MAX OPERATING TEMPERATURE 550°C (1,022°F)

33
HIGH PERFORMANCE MINERAL SALT IMPREGNATION

HEAVY DUTY OXIDATION RESISTANCE. MAX OPERATING TEMPERATURE 600°C (1,112°F)

45
PHENOLIC IMPREGNATION FDA COMPLIANT

RESIN IMPREGNATION PRODUCES MATERIALS THAT ARE IMPERMEABLE AND HAVE IMPROVED LUBRICATING PROPERTIES. MAX OPERATING TEMPERATURE 200°C (392°F) JP GRADES ENDING BY 45 ARE COMPLIANT WITH FDA REGULATIONS.

51
PITCH IMPREGNATION

PERMEABILITY OF CARBON IS IMPROVED ; COST EFFECTIVE SOLUTION FOR IMPROVED TRIBOLOGY PROPERTIES AT LOW SPEED AND HIGH LOAD. MAX OPERATING TEMPERATURE 400°C (752°F)

68
ANTIMONY IMPREGNATION

ANTIMONY IS EFFICIENT AT REDUCING POROSITY AND IMPROVED MECHANICAL STRENGTH OF CARBON-GRAPHITE. MAX OPERATING TEMPERATURE 450°C (842°F)

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