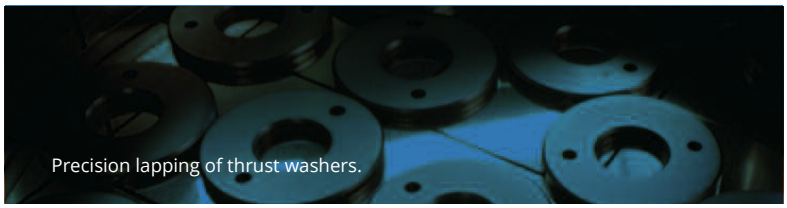
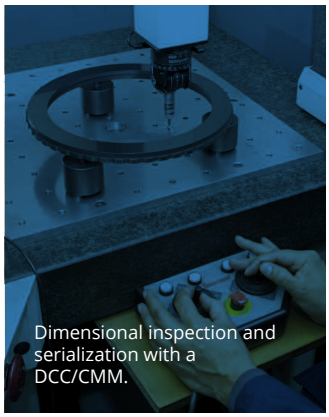
METCAR®
Engineered Carbon/Graphite Solutions
for Severe Service Lubrication


Part-to-part quality repeatability.


Inspecting face condition on a mechanical seal primary ring.


Precision lapping of thrust washers.


Dimensional inspection and serialization with a DCC/CMM.

PHYSICAL CHARACTERISTICS – TEST METHODS

In this brochure, we'll cover the typical physical characteristics of the most popular Metcar grades. The following are definitions of terms and descriptions of methods used to obtain the physical characteristics of Metcar.

Physical characteristics of carbon/graphite materials are sensitive to part size, shape and grain direction. To obtain the data presented here, specimens were tested with the length dimension oriented parallel to the grain direction.

Apparent Density (ANSI/ASTM C 559) is the mass per unit volume including permeable and impermeable voids and pores. Values are calculated in grams per cubic centimeter at 25°C.

Hardness (ANSI/NEMA CB1) is a material's resistance to permanent deformation, particularly indentation or scratching. Shore Scleroscope hardness is determined by dropping a diamond pointed weight on a specimen from a standard height. The rebound up a graduated scale indicates hardness. Six readings taken on opposite sides of the specimen are averaged to obtain an accurate value.

Compressive Strength (ANSI/ASTM C 695) is a material's ability to withstand a uniaxial crushing load. Values are obtained from the ultimate crushing force per unit of cross section. Ultimate strength and yield strength are identical.

Transverse Strength (ANSI/NEMA CB1) is a material's ability to withstand a transverse or flexural load. Values are obtained by loading to failure a rectangular beam suspended on two knife edges.

Tensile Strength (ASTM C 749) is a material's ability to resist being pulled apart. Values are obtained from the uniaxial force at rupture per unit of cross section.

Modulus of Elasticity (ASTM C 747) is a constant which expresses the ratio of stress per unit area to corresponding strain per unit length, the distortion or strain being within the elastic limit. Specimens are vibrated in the transverse mode, and values are calculated from the resonance frequency.

Temperature Limit is the highest temperature that a material can tolerate without significant thermal decomposition or loss in strength; this varies with the amount of oxygen present. Metcar demonstrates an unusual ability to increase in strength with increase in temperature.

Coefficient of Thermal Expansion (ASTM E 228) is the change in unit length per change in degree of temperature. Linear expansion is measured using a vitreous silica dilatometer which indicates dimensional changes of a specimen when subjected to heat. Metcar's CTE increases as temperature increases; values listed represent an average from 50°C to the respective temperature limit.

Thermal Conductivity is a material's ability to transmit heat. Values are obtained from the cooling characteristics of a heated probe brought into contact with a specimen.

Pressure Tight (a function of permeability) is a specification indicating the suitability of a given grade for use in seal ring applications. The internal cavity of a standard ring is pressurized with air. Its outside diameter is coated with a leak detecting fluid. An absence of bubbles (after 2 minutes at 100psi) defines acceptability.

METCAR AVERAGE PHYSICAL CHARACTERISTICS

Of Interest	Metcar Grade #	Apparent Density (gm/cc)	Hardness-Shore Scleroscope C2	Compressive (psi)	Transverse (psi)	Tensile (psi)	Modulus of Elasticity (psix10^6)	Strength	Temp. Limit	Coefficient of Thermal Expansion (in/in/°Fx10^{-6})	Thermal Conductivity (W/m-K)	Pressure Tight	Corrosion Resistance Classification	Composition
								Neutral Atmosphere (°F)	Oxidizing Atmosphere (°F)					
☐	M-10	1.70	85	30,000	9,000	6,000	2.5	1,700	700	2.1	6	No	C 1	CG
☐	M-11	1.75	65	20,000	7,500	4,500	2.3	1700	700	2.0	8	No	C 1	CG
☐	M-19	1.80	75	20,000	8,000	5,500	1.6	6000	900	1.9	40	No	C 1	G
☐	M-58	1.85	80	22,000	8,500	6,000	1.8	1,500	1,200	2.0	40	No	C 4	GH
☐	M-100	1.85	80	27,000	9,000	6,000	3.1	500	500	2.9	8	No	C 2	CGR
☐	M-105	1.85	85	22,000	8,500	6,000	2	500	500	1.9	40	Yes	C 2	GR
☐	M-106	1.85	95	41,000	12,500	8,500	3.3	500	500	3.2	6	Yes	C 2	CGR
☐	M-110	1.85	90	28,000	9,000	6,500	2.2	800	800	2.6	40	Yes	C 3	GR
☐	M-130	1.85	95	42,000	12,000	9,000	3.0	500	500	2.6	6	Yes	C 3	CGR
☐	M-133	1.85	95	42,000	12,000	9,000	3.6	500	500	2.8	6	Yes	C 3	CGR
☐	M-161	2.55	50	20,000	7,000	5,500	2.9	400	400	1.9	15	No	C 5	CGB
☐	M-162	2.40	65	26,000	10,000	7,500	3.7	400	400	3.0	9	No	C 5	CGB
☐	M-199	2.35	75	35,000	13,000	8,000	3.8	1,700	700	2.9	10	No	C 6	CGCu
☐	M-201	2.50	55	24,000	8,500	6,500	2.8	1,700	700	1.8	20	No	C 6	CGCu
☐	M-234	2.50	95	45,000	14,000	10,500	4.1	1,500	700	3.1	9	No	C 7	CGAg
☐	M-259	3.10	60	31,000	12,000	7,500	3.3	1,500	700	3.1	30	No	C 7	CGAg
☐	M-271	2.45	90	50,000	15,000	9,500	4.2	1,700	700	3.8	8	No	C 8	CGBr
☐	M-272	2.55	55	25,000	8,500	6,500	3.1	1,700	700	2.1	19	No	C 8	CGBr
☐	M-310	2.40	55	23,000	7,500	5,500	2.8	1,700	700	1.4	18	No	C 9	CGNiCr
☐	M-312	2.40	95	55,000	16,000	10,000	4.4	1,700	700	2.5	8	No	C 9	CGNiCr
☐	M-400	1.85	85	30,000	9,500	6,500	3.2	500	500	2.9	8	Yes	C 2	CGR
☐	M-444	2.30	90	40,000	15,000	9,000	4.2	1,100	700	2.3	8	Yes	C 10	CGSb
☐	M-444B	2.30	90	40,000	12,000	9,000	3.8	1,100	700	2.3	8	No	C 10	CGSb
☐	M-595	1.85	70	20,000	10,000	7,500	2.2	1,500	800	2.4	40	No	C 4	GH

COMPOSITION KEY

CG = Carbon Graphite
G = Graphite

R = Resin Impregnation
B = Babbitt Impregnation
Br = Bronze Impregnation
Cu= Copper Impregnation

Sb= Antimony Impregnation
Ag = Silver Impregnation
NiCr = Nickel Impregnation
H = Oxidation Inhibitor Impregnation

CORROSION RESISTANCE CLASSIFICATIONS

Resistant ●
Not Resistant ○
Conditionally Resistant* ◐

*Conditionally Resistant rating indicates that factors such as temperature, concentration, and exposure time prohibit unconditionable approval of certain grades in a particular chemical group. Consult Metcar engineering.

METCAR CORROSION RESISTANCE BY CHEMICAL CATEGORY

Refer to the Physical Properties Table for the Corrosion Resistance Classification of each Metcar Grade.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Inorganic										
Neutral Salts	●	●	●	○	●	●	●	●	●	●
Acid Forming Salts	●	●	●	○	◐	◐	◐	◐	◐	◐
Alkali Forming Salts	●	●	●	○	◐	◐	◐	◐	◐	◐
Non-Oxodizing Mineral Acids	●	●	●	○	◐	◐	◐	◐	◐	◐
Oxidizing Mineral Acids	◐	◐	●	◐	◐	◐	◐	◐	◐	◐
Non-Oxodizing Mineral Alkalis	●	●	●	○	◐	◐	◐	◐	◐	◐
Oxidizing Mineral Alkalis	◐	●	●	○	◐	◐	◐	◐	◐	◐

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Organic										
Neutral (Solvents,Oils,etc.)	●	●	●	◐	●	●	●	●	●	●
Acid Forming Salts	●	●	●	○	◐	◐	◐	◐	◐	◐
Weak Acids	●	●	●	◐	●	●	●	●	●	●
Strong Acids	●	◐	●	○	◐	◐	◐	◐	◐	◐
Weak Alkalis	●	●	●	○	●	◐	●	◐	●	●
Strong Alkalis	●	●	●	○	◐	◐	◐	◐	◐	◐

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Melts										
Neutral Salts	●	◐	●	◐	◐	◐	◐	◐	◐	◐
Acid Salts	●	◐	●	◐	◐	◐	◐	◐	◐	◐
Alkaline Salts	●	◐	●	○	○	◐	◐	◐	◐	◐
Oxidizing Salts	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
Metals (Listed)	●	◐	●	◐	○	◐	◐	◐	◐	◐

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Gases										
Inert	●	●	●	●	●	●	●	●	●	●
Acid	●	●	●	◐	◐	◐	◐	◐	◐	◐
Alkaline	●	●	●	○	◐	◐	◐	◐	◐	◐
Oxidizing	◐	◐	◐	●	◐	◐	◐	◐	◐	◐
Reducing	●	●	●	●	●	●	●	●	●	●