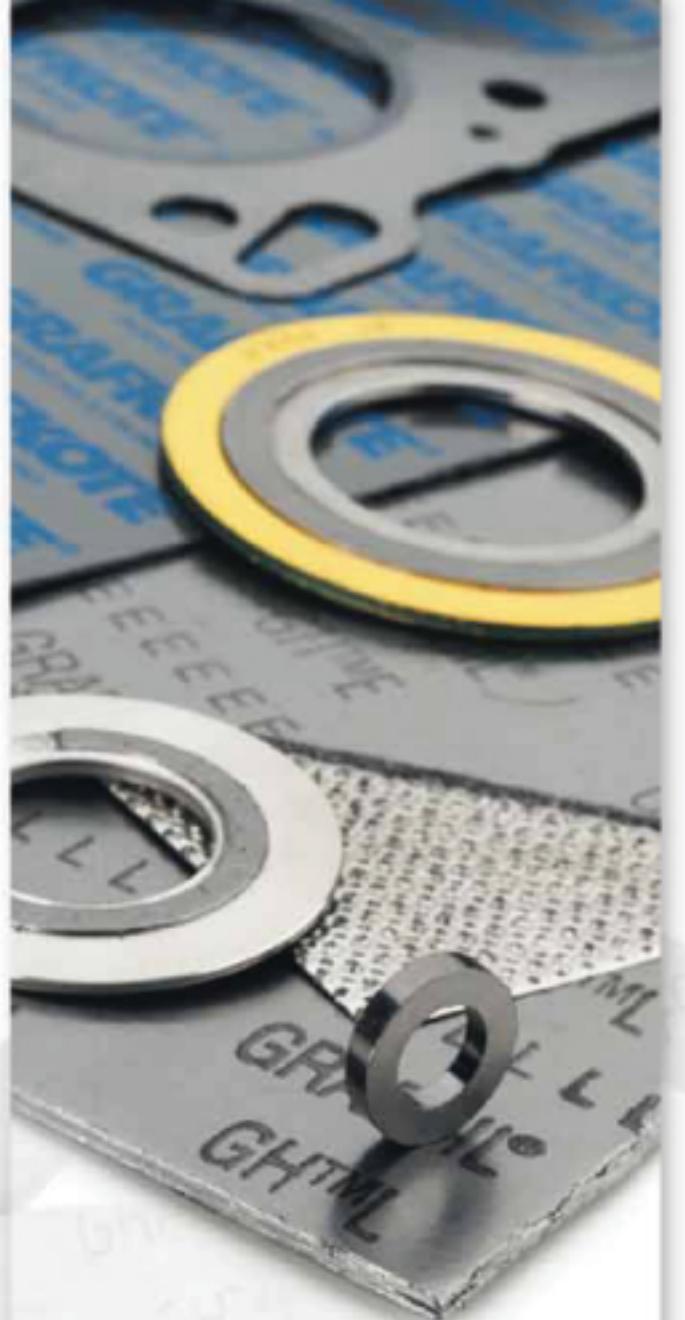


# GRAFOIL®

Flexible Graphite



## GRAFTech

ADVANCED ENERGY TECHNOLOGY INC.

A GraTech International Ltd. company

American Seal & Packing

10661 Ellis Ave. Suite E  
Fountain Valley, CA. 92708  
Ph: 714-593-9780 Fax: 714-593-9701  
[www.americansealandpacking.com](http://www.americansealandpacking.com)

This information is not to be taken as warranty or representation for which GraTech International Ltd. assumes legal responsibility nor as permission or recommendation to practice any patented invention without license. It is offered solely for our consideration and verification.

GRAFOIL, SuperGTO, GTA, GTB, GTJ, GTK, GHA, GHB, GHE, GHO, GHP, GHW, GHN, GRAFOIL, GHR, GHT, GHL, GTF, GTH, GHV, GTZ, Ribbon-Pack, GTC, GHH, GHJ, UCAR 323, EXPANDOGRAF, are trademarks of Advanced Energy Technology Inc.

### Quality

Currently registered to QS-9000:1998 & ISO 9002:1994

© Advanced Energy Technology Inc. 2004 REV.GT-1205



## GRAFTech

ADVANCED ENERGY TECHNOLOGY INC.

A GraTech International Ltd. company

## TYPICAL GRAFOIL SHEET PROPERTIES

### TYPICAL MATERIAL PROPERTIES

Properties	English	Metric
Density (ASTM F-1315)	70 lb/ft <sup>3</sup>	1.12 g/cc
Leachable Chloride Content - Industrial Grades	<20 ppm	
Premium (Nuclear) Grades	<10 ppm	
Sulfur Content - Industrial Grades	550 ppm	
Premium (Nuclear) Grades	450 ppm	
Carbon Content - Industrial Grades	98%	
Premium (Nuclear) Grades	99.9%	
Compressibility (ASTM F-36)	43%	
Recovery (ASTM F-36)	15%	
Creep Relaxation (ASTM F-38)	<5%	
Sealability (ASTM F-37)	0.017 fluid ounces/hr.	0.5 ml/hr

### TYPICAL PHYSICAL PROPERTIES

Properties	English	Metric
Tensile Strength - (ASTM F-152)		
Along Length & Width		
Industrial Grades	650 psi	4.4 MPa
Premium (Nuclear) Grades	1000 psi	6.9 MPa
Coefficient of Friction against Steel		
@ 4 psi (0.03 MPa)	0.018	
@ 8 psi (0.06 MPa)	0.052	
@ 12 psi (0.08 MPa)	0.157	
Compressive Strength		
Through Thickness (ASTM C-695)	35000 psi	240 MPa
Modulus of Elasticity	0.2 x 10 <sup>6</sup> psi	1380 MPa
Young's Compressive Modulus		
Through Thickness	27000 psi	186 MPa

### NUCLEAR RADIATION RESISTANCE

Exposure Levels	Results
5.5 X 10 <sup>11</sup> NVT @ 1000°C	No Apparent Effect
1.5 x 10 <sup>10</sup> rads Gamma Radiation (1.5 x 10 <sup>11</sup> erg/g)	No Apparent Effect
Source: Oak Ridge National Laboratory (1978)	
Integrated Neutron Flux:	
N = Neutrons/cc	
V = cm/sec	
T = Seconds	
(1 rad = 100 erg/g)	

### TYPICAL THERMAL PROPERTIES

Properties	English	Metric
Functional/Temperature Range		
Neutral or Reducing Atmosphere	-400 to 5400°F	-240 to 3000°C
Oxidizing Atmosphere	-400 to 850°F**	-240 to 450°C**
GT™A Grade	-400 to 975°F**	-240 to 525°C**
GT™B, GT™K, GT™J Grades	-400 to 975°F**	-240 to 525°C**
Thermal Conductivity		
Along Length & Width	960 BTU/in <sup>2</sup> ·ft <sup>2</sup> ·h <sup>-1</sup> ·F <sup>-1</sup>	140 W/m·K
Through Thickness	36 BTU/in <sup>2</sup> ·ft <sup>2</sup> ·h <sup>-1</sup> ·F <sup>-1</sup>	5 W/m·K
Thermal Expansion		
"a" Direction Parallel to Layers	-0.2 x 10 <sup>-5</sup> in/in·°F	-0.4 x 10 <sup>-5</sup> m/m·°C
70°F-2000°F (21°C-1094°C)		
2000°F-4000°F (1094°C-2206°C)	0.5 x 10 <sup>-5</sup> in/in·°F	0.9 x 10 <sup>-5</sup> m/m·°C
"c" Direction, Through Thickness		
70°F-4000° (21°C-2206°C)	15 x 10 <sup>-5</sup> in/in·°F	27 x 10 <sup>-5</sup> m/m·°C

Properties	English	Metric
Specific Heat		
at 75°F (24°C)	0.17 Btu/lb·°F	711 J/kg·K
Heat Storage in a 0.015" layer		
at 1000°F (538°C)	0.035 Btu/in <sup>2</sup> ·°F	0.02 cal/cm <sup>2</sup> ·°C
Surface Emissivity	0.5	0.5
Sublimation Point	(Does not melt)	6000°F
Thermal Shock Resistance	Excellent	Excellent

\*\* The fluid temperature in an oxidizing atmosphere may considerably exceed the indicated temperature without oxidation of the GRAFOIL flexible graphite providing that the bulk temperature of the GRAFOIL gasket is below these temperatures or that the fluid being handled does not come into direct contact with the graphite. Example: a metal spiral-wound gasket with a GRAFOIL, GT™B filter material. GRAFOIL gaskets may be used at higher temperatures with non-oxidizing fluids such as steam.

### SIZES AVAILABLE

Sheet Thickness: 0.005" to 0.060" in 0.005" increments  
 Width: 24", 39.4", 60", or custom slit to your requirements  
 Length: 50', 100', 108', 250', 300', 500', 1000', 2000', 3000', 4000'  
 Laminate Thickness: 1/32", 1/16", 1/8"  
 Length x Width:  
 24" x 24"                          610 mm x 610 mm  
 39.4" x 39.4"                          1000 mm x 1000 mm  
 60" x 60"                                  1524 mm x 1524 mm  
 39.4" x 78.8"                                  1000 mm x 2000 mm  
 GH™R, GH™E, GH™L, GH™P - 1/32", 1/16" is available in coils  
 39.4" x 100 ft  
 39.4" x 250 ft  
 39.4" x 500 ft

### GRAFOIL Gasketing Techniques

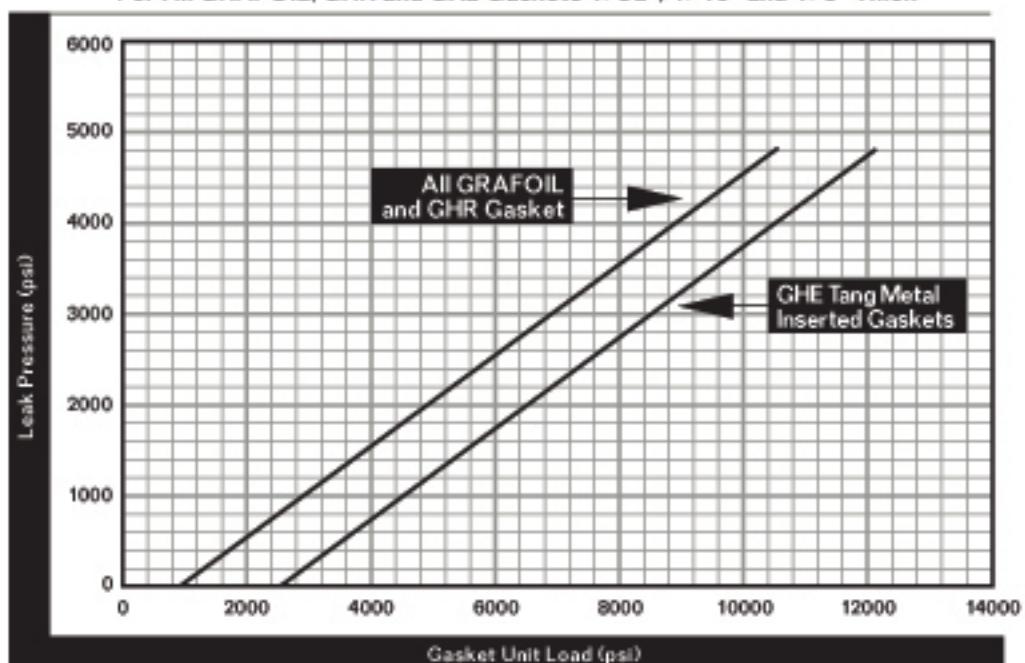
GRAFOIL flexible graphite is a resilient form of graphite that has excellent properties as a gasketing material. It seals about as readily as rubber, it is chemically compatible with a very wide range of chemicals, it is recommended for temperatures up to 975°F in oxidizing conditions, and it does not creep or harden with age or temperature. GRAFOIL flexible graphite can be fabricated into metal core laminates or into spiral wound gaskets for an even wider recommended range of applications. GRAFOIL gaskets will seal the maximum pressure specified on properly designed, correctly manufactured and suitably maintained equipment when loaded to the recommended gasket stress.

While being flexible and resilient, GRAFOIL flexible graphite is still all graphite. It has no resins, binders, filler materials, or other additives that might detract from the chemical inertness and temperature resistance of pure graphite. GRAFOIL gaskets will not cold flow, become brittle, or vulcanize to gasketing surfaces in service. The unique chemical and physical properties of GRAFOIL flexible graphite combine to make it a nearly universal gasketing material especially suitable to high temperature and cryogenic service and/or corrosive environments.

### General Points To Remember When Gasketing With GRAFOIL Flexible Graphite

- The flange surfaces must be clean, and free of nicks, scratches, burrs, metal filings, scale or other foreign matter.
- Use proper bolt tightening sequence to insure a uniform load is applied to the joint (see ASME PCC-1 Bolted Joint Assembly Procedure). The use of a torque wrench or other measurable tightening procedure is advantageous to ensure that a uniform tensile stress is applied to each bolt.
- GRAFOIL GH™E 316 stainless steel tang metal inserted gaskets should not be used between any metal surfaces that are softer than the stainless steel (i.e. aluminum, brass, bronze), or between glass or ceramic surfaces. When GRAFOIL GHE gaskets are used, the metal tangs must be compressed such that the GRAFOIL facing begins to seal. Due to the minimum seating stress recommended for these gaskets (2500 psi), the metal tangs can make small indentations in the softer metal of the flange face. The tangs can also create stress concentration points on glass or ceramic surfaces.
- GRAFOIL flexible graphite gaskets must be loaded with a net compressive unit load greater than shown in the Unit Load versus Leak Pressure Curve, Figure 1.

Leak Pressure vs. GRAFOIL Gasket Unit Load  
For All GRAFOIL, GHR and GHE Gaskets 1/32", 1/16" and 1/8" Thick



5. The initial thickness of the GRAFOIL gasket must be such that when it is compressed between two mating surfaces, the GRAFOIL gasket is strained sufficiently at all points in the joint to seal the maximum service pressure. If the flange surfaces are scratched, serrated, or warped, the initial gasket thickness must be large enough to completely fill and compensate for the effect of surface defects when the joint is made and the gasket compressed.

6. The flatness of the flange surfaces is as essential to good gasketing practice as the proper gasket unit load. If for any reason the gasketed surfaces are not flat while in service, the gasket unit load can be less at some point or points than the amount required to seal the operating or test pressures. In general, if when the flange faces are brought together (i.e. just touching and under no bolt load), a 0.001" feeler gage can not be inserted anywhere around the circumference of the joint, then a 1/64" thick GRAFOIL gasket can be used. If this criterion can not be met, then a thicker GRAFOIL gasket will be required.

### Important Points Concerning Flange Surface Finish And 'Standard' Serrations

Under equivalent compressive unit loads, GRAFOIL gaskets will seal where flange surface finishes range from 5 RMS (root mean squared) to 500 RMS. Within that range any RMS finish will seal well. As a matter of practice, we recommend a 125 to 250 RMS surface finish that complies with ASME B16.5 requirements.

Flanges ordered with "standard serrations" or a "standard finish" usually have finished surfaces machined in accordance with MSS Standard Practice SP-6 that allows for considerable latitude in surface finish. The SP-6 Standard refers to AARH finishes or arithmetic average roughness. AARH values are different from RMS values for any given surface. RMS measurements are made with a stylus tracer instrument, whereas AARH finishes are evaluated by "sight and touch" comparisons with standard specimens.

The standard serration may be concentric or spiral. If concentric, there may be up to 32 serrations per inch, and the depth of the serration may range from 0.005" to 0.015". The serration cross section can range from a radiused "u" cut to a "v" cut.

Spiral serrations can range from 20 to 50 per inch in number and from 0.001" to 0.006" in depth. Spiral serrations in contrast to concentric serrations, can form a continuous leak path if the gasket material does not deform and seal all the way to the bottom of the groove. Consequently,

the greater the depth of the spiral serration, the greater the required thickness of the GRAFOIL gasket in order to seal.

Concentric serrations have shown a very slight improvement in helping GRAFOIL gaskets to seal. Because of the highly conformable nature of GRAFOIL gaskets, they will seal serrations more dependably than most other gasket materials.