Appendix 2 Chemical Compatibility of Materials with Homogeneous GRAFOIL Sheet

Graphite is one of the most thermally stable and chemically resistant materials known to man. GRAFOIL flexible graphite is manufactured employing a process that introduces no organic or inorganic elastomeric binders, fillers, or other potentially fugitive ingredients that could limit it's thermal and chemical stability.

GRAFOIL flexible graphite is resistant to attack from nearly all organic and inorganic fluids with the exception of highly oxidizing chemicals and concentrated, highly oxidizing mineral acids such as nitric or sulfuric acids. GRAFOIL flexible graphite is an extremely chemically resistant material. The classes of organic chemicals that should not be used with GRAFOIL flexible graphite are those that are highly oxidizing, such as nitrates, persulfates, perbenzoate, and peroxides. Unacceptable compatibility for inorganic chemicals would include molten sodium or potassium hydroxide and chlorine dioxide.

If these chemicals are used in a critical or dangerous process, we always recommend their evaluation in a test loop since we do not have control over the environment or process in which the GRAFOIL flexible graphite gaskets are used.

It is much easier to list the chemicals which GRAFOIL flexible graphite is not compatible with instead of listing all of the chemicals it is compatible. Table XVI lists the strong oxidizers in which GRAFOIL flexible graphite would not be compatible and Table XVII lists the vast majority of chemicals which are compatible and could possibly come in contact with GRAFOIL flexible graphite during industrial use.

Table XVI Strong Oxidizers

(not recommended with GRAFOIL flexible graphite)

Aqua Regia	Bromine (dry)	Calcium Chlorate
Calcium Hypochlorite*	Calcium Nitrate	Chlorazotic Acid
Chlorine Dioxide*	Chlorine Trifluoride	Chloric Acid
Chloroazotic Acid	Chloronitrous Acid	Chromates
Chromic Acid	Chromic Anhydride	Chromium
Chromium Trioxide*	Dichloropropionic Acid*	Dichromates
Hydrogen Dioxide	Hydrogen Peroxide**	Lime Nitrate
Lime Saltpeter	Molten Alkaline	Nitrates
Nitric Acid*	Nitric Oxide	Nitrocalcite

Nitrohydrochloric Acid	Nitromuriatic Acid	Norge Niter
Norwegian Saltpeter	Oleum (Fuming Sulfuric Acid)	Oxygen*(above +600°F)
Ozone	Perchloric Acid	Permanganate solutions
Persulfates	Perbenzoates	Perborates
Peroxide	Potassium Bichromate	Potassium Chlorate
Potassium Chromate	Potassium Dichromate	Potassium Nitrate
Sodium Chlorite*(over 4%)	Sodium Hypochlorite*	Sodium Peroxide
Sulfuric Acid	Sulfur Trioxide*	

*GRAFOIL flexible graphite may be acceptable in specific temperature/concentration ranges. Call Graftech to discuss your specific application.
** See special limitation notes on page 30.

Table XVII is a listing for many of the chemicals which are chemically compatible with GRAFOIL flexible graphite. The information has been taken from various sources of information.

Again, if these chemicals are used in a critical or dangerous process, we always recommend their evaluation in a test loop, since we do not have control over the environment or process in which the GRAFOIL gaskets are used.

Care must be taken of what combinations of GRAFOIL flexible graphite, interlayer material, chemicals, temperature and concentration are used together. The combination may not be compatible.

Table XVII Chemicals which are compatible with GRAFOIL Flexible Graphite

Chemical Reagents

Acetaldehyde
Acetate Solvents
Acetic Acid
Acetic Anhydride
Acetone
Acetone, Dry
Acetylene Gas
Acidaldehyde
Acrylonitrile
Air, Instrument
Air, Plant
Air, Process
Air, Starting
Alcohol
Alcohol (Ethyl)
Aldehyde
Alkanes
Alkyl Acetone
Alkyl Alcohol
Alkyl Amine
Alkyl Arylsulphonics
Alkyl Benzene
Alkyl Chloride
Alkylate, Light
Alum
Alum Solution

Table XVII (continued) **Chemicals which are compatible with GRAFOIL Flexible Graphite**

Chemical Reagents

Aluminum Chloride
Aluminum Fluoride
Aluminum Hydroxide (Boehmite)
Aluminum Sulfate
Aluminum Sulphate, Aqueous
Amine
Amine, Fat Condensate
Ammonia
Ammonia Liquid
Ammonia, Anhydrous
Ammonia, Aqua
Ammonia, Aqueous
Ammonia, Gas (Dry)
Ammonium Bicarbonate
Ammonium Bifluoride
Ammonium Bisulfate
Ammonium Carbonate
Ammonium Chloride
Ammonium Hydroxide
Ammonium Nitrate
Ammonium Persulfate
Ammonium Phosphate
Ammonium Sulfate
Ammonium Thiocyante
Amyl Acetate
Amyl Alcohol
Amyl Nitrate
Aniline
Aniline Hydrochloride
Aniline Hydrochlorine
Anti-Foaming Agent
Aromatic Fuels
Aniline Hydrochloride
Arsenic Acid
Arsenic Trichloride
Asphalt
Barium Carbonate
Barium Chloride (Aqueous)
Barium Hydroxide
Barium Nitrate (Aqueous)
Barium Sulfate
Barium Sulfide
Beer
Beer Wort
Beet Juice
Beet Pulp
Beet Sugar Solution
Benoic Acid Sol
Benzaldehyde
Benzene
Benzene Hexachloride
Benzoic Acid
Benzol
Benzyl Sulfonic Acid
Black Liquor
Bleach Solution (0-25% conc.@R.T.)
Boiler Feed Water
Borax (Sodium Borate)
Borax Solution
Boric Acid
Boric Acid, Aqueous
Boron Trichloride
Brine Calcium
Brine, Calcium & Sodium Chloride
Brine, Chloride PH8
Brine & Magnesium Chloride
Brine, Sea Water
Bromo Methane
Bunker C Fuel Oil
Butadiene

Table XVII (continued) **Chemicals which are compatible with GRAFOIL Flexible Graphite**

Chemical Reagents

Butane
Butane (LPG)
Butanol
Butyl Acetate
Butyric Acid
Butyl Alcohol
Butylamine
Butyl Caritol
Butylene
Butylene (Butene) (Ethylethylene)
Butyl Phthalate
Calcium Carbonate
Calcium Chloride
Calcium Hydroxide
Calcium Hypochlorite
Calcium Magnesium Chloride
Calcium Phosphate
Calcium Sulfate
Cane Juice
Carbolic Acid
Carbonate of Soda
Carbon Bisulfide
Carbon Dioxide
Carbon Disulfide
Carbonic Acid
Carbonic Acid, Aqueous
Carbon Monoxide
Carbon Tetrachloride
Carbon Tetrachloride (Anhydrous)
Catsup
Caustic
Caustic Cyanogen
Caustic Potash
Caustic Soda
Caustic Strontia
Caustic Sulfide
Caustic Zine Chloride
Chloracetone
Chloral Hydrate
Chloride of Lime
Chloride of Zinc
Chlorinated Solvents
Chlorine
Chlorine (Dry and Wet)
Chlorine Water
Chloroacetic Acid
Chlorobenzene
Chloroethylbenzene
Chloroform
Chloropicrin
Chlorosulfonic Acid
Citric Acid
Citric Acid, Aqueous
Cocoa Butter
Coconut Acid, Fatty
Coconut Oil
Cod Liver Oil
Condensate (Water)
Cooling Water
Copper Acetate
Copper Ammonium Acetate
Copperas
Copper Cyanide
Copper Nitrate
Copper Sulfate
Corn Oil
Creosol, META
Cresols
Creosote (Coal Tar)
Cresylic Acid
Crude Oil
Cupric Chloride

Table XVII (continued) **Chemicals which are compatible with GRAFOIL Flexible Graphite**

Chemical Reagents

Cupric Sulfate
Cupros Ammonia Acetate
Cutting Oil
Cyanogen in Water
Cyclohexene
Cycloxexanone
DDT Solution (Kerosine Solv)
DDT Solution (Toluene Solv)
De-Butanizer Reflux
De-Ethanizer Charge
Demineralized Water
Denatured Alcohol
De-Propanizer Reflux
Diacetone Alcohol
Dibromoethyl Benzene
Dibutyl Amine
Dibutyl Cellusolve Adipate
Dibutyl Phthalate
Dibutylether
Dichlorobenzene
Dichloroethane
Diesel Fuel
Diethanolamine (Dea)
Diethyl Carbonate
Diethyl Ether
Diethylamine
Diethylene Glycol
Diethylene Triamine
Di-Isobutyl Ketone
Di-Isopropyl Ketone
Dimethyl Formaldehyde
Dimethyl Hydrazene
Dimethyl Phthalate
Dimethyl Terephthalate
Dinitrochlorobenzene
Dinitrochlorobenzene & Styrene
Dinitrotoluene
Dioctyl Phthalate
Dioctyl-Amine
Diphenyl
Dow Corning Silicone Fluid
Dowtherm (All Types)
Dye Wood Liquor
Esso Therm 500
Ethane
Ethanol (Ethyl Alcohol)
Ethanolamine
Ether
Ethyl Acetate
Ethyl Acrylate
Ethyl Alcohol (Ethanol)
Ethyl Benzoate
Ethyl Cellosolve
Ethyl Chloride
Ethyl Chlorocarbonate
Ethyl Chloroformate
Ethyl Chlorohydrin
Ethylene (Ethene)
Ethylene Chloride
Ethylene Chlorohydrin
Ethylene Diamine
Ethylene Bromide
Ethylene Dichloride
Ethylene Glycol (anti-freeze)
Ethylene Oxide
Ethylene Oxide & Freon 12
Ethylene Trichloride
Ethyl Ether (Ethyl Oxide)
Ethyl Formate
Ethyl Hexanol

Table XVII (continued) **Chemicals which are compatible with GRAFOIL Flexible Graphite**

Chemical Reagents

Ethyl Mercaptain-water
Ethyl Oxide
Ethyl Pyridine
Fatty Acids
Fatty Acids, Oleic
Ferric Chloride
Ferric Chloride (Aqueous)
Ferric Nitrate
Ferric Sulfate (Aqueous)
Ferrous Chloride
Ferrous Sulfate
Flourolube
Fluoboric Acid
Fluorine
Fluosilicic Acid
Folic Acid
Formaldehyde (Methanol)
Formalin
Formic Acid
Freon 11 & Refrig. Oil
Freon 113 & Refrig. Oil
Freon 114 & Refrig. Oil
Freon 12 & Refrig. Oil
Freon 121 & Refrig. Oil
Freon 22 & Refrig. Oil
Freons, Liquid
Fruit Acid
Fruit Juices
Fuel Oil
Fuel Oil #6
Fuel Oil, Acidic
Furfural
Furnace Oil
Gas Oil
Gasoline
Gasoline 100 & 130 Oct.
Gasoline Aromatic
Gasoline Hi-Test w/Mercaptan, H_2S
Gelatin
Glaubers Salt
Glycerine (Glycerol)
Glycols
Grease
Glue Sizing
Green Sulphate Liquor
Halon
Heat Transfer Fluids (Petroleum-Oil Based)
Helium
Heptane
Hexachloro Acetone
Hexane
Hexanol
Hexene (Butylethylene)
Hexone
Hexyl Alcohol (Hexanol)
Hops
Hydrazine
Hydrobromic Acid
Hydrochloric Acid
Hydrocyanic Acid
Hydroflouric Acid
Hydrogen
Hydrogen Chloride
Hydrogen Fluoride
Hydrogen Sulfide
Hydrogen Sulfide-water
Hypochlorous Acid
Hydrogen Chloride
Insecticides (Aromatic)
Insecticides (Nonaromatic)
Iodine
Iodoform

Table XVII (continued) **Chemicals which are compatible with GRAFOIL Flexible Graphite**

Chemical Reagents

Iso-Octane
Isobutane
Isobutyl Alcohol
Isobutyl Methyl Ketone
Isobutylene
Isodecane
Isopentane
Isopropanol
Isopropyl Acetate
Isopropyl Alcohol
Isopropyl Chloride
Isopropyl Ether
Isopropylamine
Isopropyl Acetone
JP-3
JP-4
JP-5
JP-6
JP-X
Kerosene
Ketones
Lacquer (MEK Sol)
Lacquer Thinners
Lactic Acid
Lard (Animal Fat)
Latex
Lavender Oil
Lead Acetate (Liquid)
Lead Nitrate
Lead Sulphamate
Lindol
Linseed Oil
Liquor, Steep
Liquor, Sulphate
Lithium Bromide Brine
Lithium Chloride (Aqueous)
Lye, Caustic
Lye, Salty
Magnesium Chloride (Bischofite)
Magnesium Hydroxide (Brucity)
Magnesium Sulfate (Epsom Salt)
Magnesium Sulfate (Aqueous)
Magnesium Sulfite (Aqueous)
Maleic Anhydride
Maleic Hydrazide
Manganese Chloride (Aqueous)
Manganese Sulfate (Aqueous)
Marsh Gas (Methane)
Marsh, Anti-Biotic Fermentation, No Solvent
Marsh, With Solvent
Mayonnaise
MEA (Monoethanolamine)
MEA- With Copper Sulfate
Melamine Resins
Mercaptan
Mercuric Chloride
Mercury
Mercury Salts
Mecury Vapors
Mesityl Oxide (Ketone)
Methane (Marsh Gas)
Methonol (Methyl Alcohol)
Methyl Acetate
Methyl Acrylate
Methyl Alcohol (Methanol)
Methyl Bromide (Bromomethane)
Methyl Butyl Ketone
Methyl Cellosolve
Methyl Chloride (Chloromethane)
Methyl Chloride (Anhydrous)

Table XVII (continued) Chemicals which are compatible with GRAFOIL Flexible Graphite

Chemical Reagents

Methyl Cyclopentane
Methyl Dichloride
Methyl Ether
Methyl Ethyl Ketone (MEK)
Methyl Formate
Methyl Isobutyl Ketone
Methyl Isopropyl Ketone
Methylene Chloride (Dichloromethane)
Methylene Dichloride
Milk
Milk of Lime
MIL F-25558 (RJ-1)
MIL H-5606 (HFA)
MIL H-5606 (J43)
MIL L-7808
MIL O-8200 (Hydr)
MIL O-8515
Mine Water
Mineral Spirits
Miscella 20% Soya Oil
Mobiltherm
Molasses
Monochlorobenzene
Monoethanolamine (MEA)
Naphtha
Naphtha Crude
Napthalene
Natural Gas Liquid
Neatsfoot Oil
Nickel Acetate
Nickel Chloride
Nickel Cobalt Sulfate, 5% H_2SO_4
Nickel Salts
Nickle Sulfate
Nicotine Sulfate
Nitrochloroform
Nitrobenzene
Nitrobenzine
Nitroethane
Nitromethane
Nitrogen Gas
Nitropropane
Oakite
Oil & Ammonia
Oil, Animal, Bone
Oil, Animal, Cod
Oil, Animal, Lard
Oil, Animal, Menhadden
Oil, Animal, Neatsfoot
Oil, Animal, Sperm
Oil, Animal, Whale
Oil, Bunker 'C'
Oil, Coal Tar
Oil, Creosote, Sweet
Oil, Crude, Sweet
Oil, Diesel, #2D
Oil, Diesel, #3D
Oil, Diesel, #4D
Oil, Diesel, #5D
Oil, Essential
Oil, Fed. Spec #9170, #9250 #9370, #9500
Oil, Fed. Spec #10, #20, #30
Oil, Fed. Spec SAE 20, 30, 40, 50, 60, 70, 90, 140, 250
Oil, Fuel #1, #2, #3, #5A, #5B, #6
Oil, Insulating
Oil, Kerosene
Oil, Lean
Oil, Linseed (Raw)

Table XVII (continued) Chemicals which are compatible with GRAFOIL Flexible Graphite

Chemical Reagents

Oil, Lubricating #8
Oil, Lubricating Diesel #9110
Oil, Mineral Lard Cutting, Fed. Spec. #1
Oil, Mineral Lard Cutting, Fed. Spec. #2
Oil, Navy Spec., Navy II
Oil, Quenching
Oil, Rich
Oil, Turbine Lube
Oil, Vegetable, Castor
Oil, Vegetable, China Wood
Oil, Vegetable, Cocoanut
Oil, Vegetable, Corn
Oil, Vegetable, Cottonseed
Oil, Vegetable, Linseed (Raw)
Oil, Vegetable, Olive
Oil, Vegetable, Palm
Oil, Vegetable, Peanut
Oil, Vegetable, Rape Seed
Oil, Vegetable, Rosin
Oil, Vegetable, Sesame
Oil, Vegetable, Soya Bean
Olefin, Crude
Oleums
Orthodichloro Benzene
Oxygen, Liquid and Gaseous (below 600°F)
Paracymene
Paradichlorobenzene
Paraffin, Liquid
Pectin, Liquor
Penicillin, Liquid
Pentachlorophenol
Pentane
Pentasol
Perchloroethylene
Petrolatum
Petroleum Ether
Phenol (Carbolic Acid)
Phenol, Formaldehyde Mix
Phenyl Acetic Acid
Phidolene
Phosphoric Acid
Phosphorous Trichloride
Photographic Developers
Phthalic Anhydride
Phthalic Esters
Picric Acid, Molten
Picric Acid, Water Solution
Plasticizer
Plating Solutions (Not Chrome)
Poly Glycols
Poly Vinyl Acetate
Potable Water
Potash (Plant Liquor)
Potash Alum
Potash, Sulfide
Potassium Bicarbonate
Potassium Bromide
Potassium Carbonate
Potassium Chloride
Potassium Cyanides
Potassium Hydroxide
Potassium Perfluoro Acetate
Potassium Permanganate
Potassium Phosphate
Potassium Sulfate
Potassium, Bicarbonate
Propane
Propiolactone, Beta
Propionaldehyde
Propyl Alcohol

Table XVII (continued) Chemicals which are compatible with GRAFOIL Flexible Graphite

Chemical Reagents

Propylene (Propane)
Propylene Glycol
Propylene Oxide
Pulp Stock
Pyridine
Pyrogallic Acid
Pyroligneous Acid
Raffinate
Refrigerants 11, 12, and 134A
Sal Ammoniac (Ammonium Chloride)
Salt Cake
Salt Water
Sea Water
Sewage
Shellac
Silicone Oils and Greases
Silver Nitrate
Skydrol 500, 7000
Soap, Liquors
Soap, Solutions
Sodium Acetate
Sodium Aluminate
Sodium Bicarbonate
Sodium Bisulfate
Sodium Bisulfite
Sodium Borate
Sodium Chloride
Sodium Chloride Sol (Salt)
Sodium Cyanamide
Sodium Hydroxide
Sodium Hydrosulfite
Sodium Metasilicate
Sodium Perborate
Sodium Phosphate, Dibasic
Sodium Phosphate, Meta
Sodium Phosphate, Mono
Sodium Phosphate, Tribasic
Sodium Plumbite
Sodium Silicate
Sodium Sulfate
Sodium Sulfide
Sodium Tetraborate
Sodium Thiosulfate
Solvasol 1, 2, 3, 73, 74
Sorbitol
Stannic Chloride
Starch
Steam
Steam, Superheated
Stearic Acid & Oleic
Steric Acid (Octadecandic Acid)
Stoddard Solvent
Strontium Nitrate
Styrene (Monomer) (Vinylbenzene)
Sulfate of Lime
Sulfide of Hydrogen
Sulfide of Sodium
Sulfite Pulp
Sulfur Chloride
Sulfur Dioxide
Sulfur Monochloride
Sulphonated Fatty Alcohol
Sulphonated Vegetable Oils
Sulphuric Chlorohydrin
Syrup
Tall Oil
Tallow
Tannic Acid
Tanning Liquors
Tar & Ammonia w/Water
Tar, Bituminous

Table XVII (continued) **Chemicals which are compatible with GRAFOIL Flexible Graphite**

Chemical Reagents

Tar, Pine
Tartaric Acid, Aqueous
Terephthalic Acid
Tetrachloroethane
Tetrachloroethylene
Tetrahydrofuran
Tetraphenyl
Therminol (All Types)
Therminol #1, 2 & 3
Titanium Tetrachloride
Toluene (Toluol) (Methylbenzene)
Tomato Pulp
Toxaphene
Trichlorobenzene
Trichloroethane
Trichloroethylene
Trichloronitromethane
Tricresylphosphate
Triethylamine
Trifluorovinylchloride
Trisodium Phosphate
Turpentine
Ucon (All types)
Urea
Varnish, Aromatic
Varnish, Non-Aromatic
Vegetable Juices
Vetrocoke Solution
Vinegar
Vinyl Chloride
Vinyl Pryidine
Vinylidine Chloride
Water, Boiler Feed
Water, Borated
Water, Brackish
Water, Clean Untreated
Water, Condensate
Water, Cooling Tower
Water, Deaerated
Water, Distilled
Water, Fresh
Water, Heavy
Water, Hot
Water, Mine
Water, River
Water, s/Sol. Oil
Water, Salt & Sea, Solution
Water, Soapy
Whiskey
White Liquor
White Water, Paper Mill
Wine
Wood Pulp (Stock)
Wood Vinegar
Wort (Beer Wort)
Xylene (Dimethylbenzene)
Yeast
Zeolite Treated Water
Zinc Ammonium Chloride
Zinc Chloride
Zinc Cyanide
Zinc Nitrate
Zinc Phosphate
Zinc Sulfate