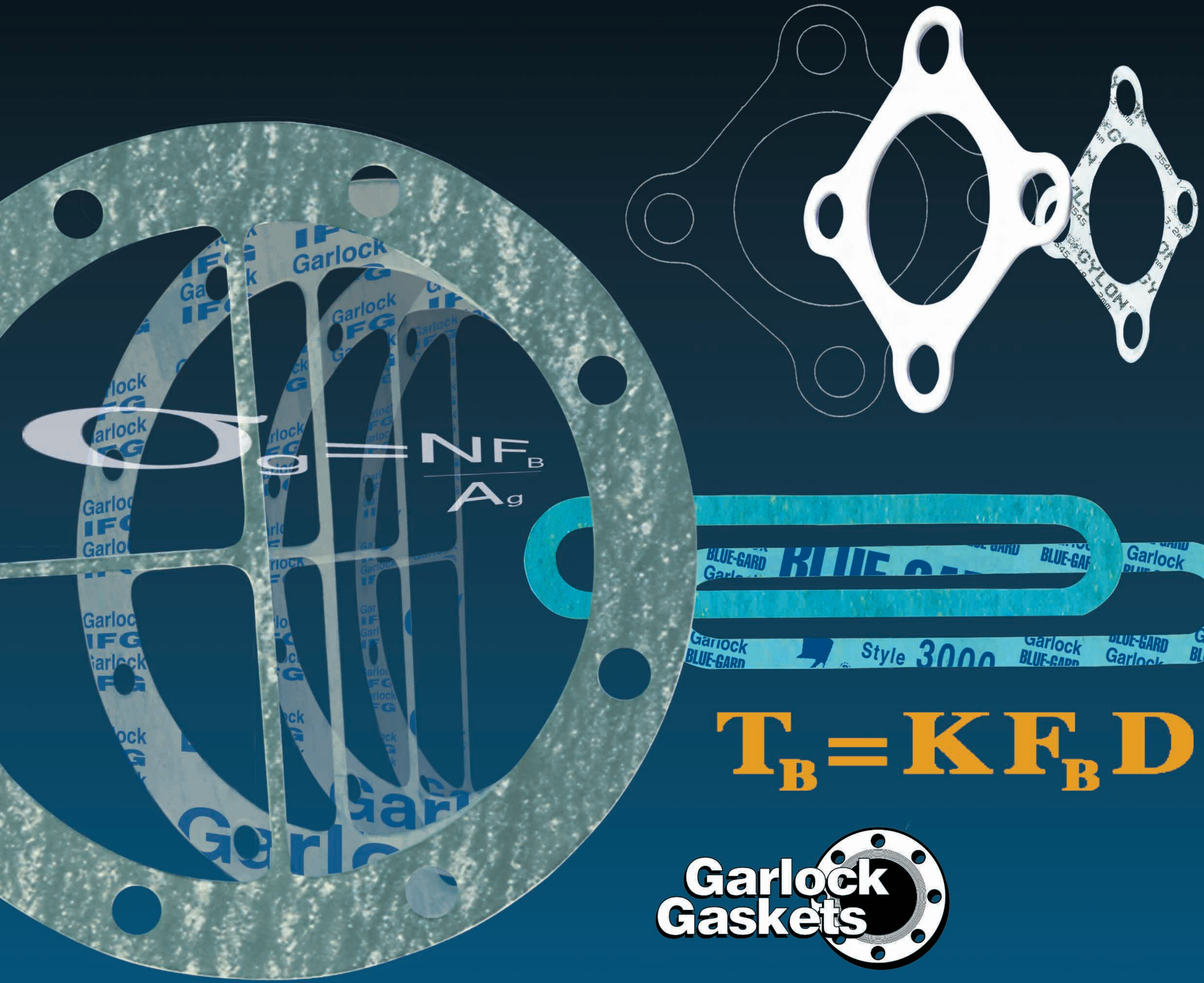
ENGINEERED GASKETING PRODUCTS



Garlock

SEALING TECHNOLOGIES®

Garlock Gasketing

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Garlock Gasketing Products

The demands of modern applications make the choice of the right sealing product an important consideration, both in the design of new equipment and in choosing the new products which will replace those no longer suitable.

This catalog provides some typical examples of appropriate applications, but is not intended to be a warranty of performance. All specific uses of sealing products require independent study and specific evaluation for suitability.

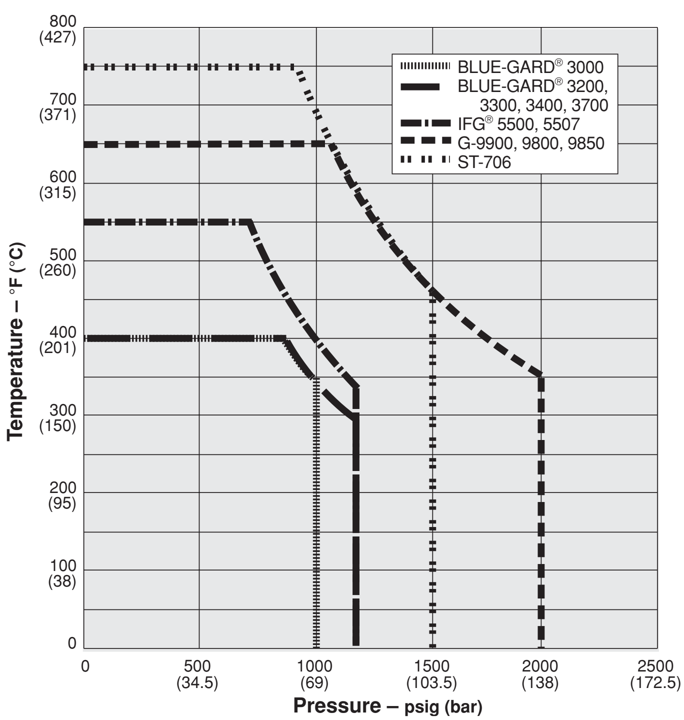
Garlock will provide the technical assistance of its applications engineers, who will give you specific recommendations. Please consult us. We are ready to help you make the right choice. Choosing the wrong sealing product can result in property damage and/or serious personal injury. Do not rely on the general criteria, which may not suit your application as well as one that Garlock Engineering can help you choose. Reliability and service to our customers is what the Garlock name means.

Garlock gasketing products are manufactured in completely modernized facilities. Tight quality controls are used to assure product conformance to specifications and uniformity that results in unvarying performance on the job. Garlock is certified to ISO 9001:2000 standards and is audited annually by the Nuclear Procurement and Issues Committee (NUPIC).

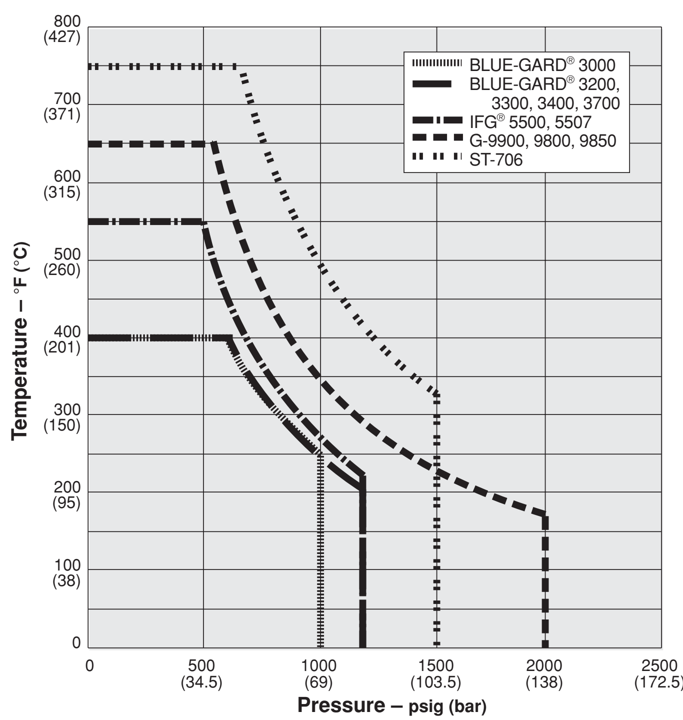
Today's environmental concerns demand positive seals. Garlock gaskets provide that assurance, and perform with proven reliability. Whether your industry is chemical processing, hydrocarbon processing, power generation, pulp and paper, microelectronics or transportation, Garlock gasketing products are the logical choice.

Garlock also manufactures a wide range of elastomeric and metallic gaskets. For products not listed in this catalog, contact Garlock Gasket Applications Engineering at 1-800-448-6688.

P x T Graph for 1/32" and 1/16" Compressed Gasketing[1]



P x T Graph for 1/8" Compressed Gasketing[1]



Notes:

1. Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure or continuous operating temperature, or 50% of maximum PxT, consult Garlock Applications Engineering.
2. Style ST-706 is the only asbestos-free compressed sheet material recommended for superheated steam.

Quick Reference Selection Guide

To be considered acceptable for a specific application, a product must meet the criteria in all four of the categories shown below. Acceptable values are marked with a "■". Also refer to chemical compatibility charts to verify chemical compatibility or call Garlock Engineering for assistance.

This chart does not take special operation conditions into consideration. i.e., pressure surges, temperature cycling and flange design.

Category	Condition	IFG® 5500 General Service	Style G-9900 High Temperature	Style 3125SS/TC High Temperature	Style ST-706 Saturated, Superheated Steam	Style 3500 GYLON® Aggressive Chemicals	Style 3510 GYLON® Aggressive Chemicals	Style 3545 GYLON® Aggressive Chemicals
1. Flange Materials	Metallic	■	■	■	■	■	■	■
	Non-Metallic							*
2. Continuous Operating Temperature (COT)	Ambient to 200°F (20°C to 95°C)	■	■	■	■	■	■	■
	200°F to 300°F (95°C to 150°C)	■	■	■	■	■	■	■
	300°F to 400°F (150°C to 205°C)	■	■	■	■	■	■	■
	400°F to 500°F (205°C to 260°C)	■	■	■	■	■	■	■
	500°F to 650°F (260°C to 345°C)		■	■	■			
	650°F to 750°F (345°C to 400°C)			■	■			
	750°F to 1200°°F (400°C to 650°C)			*				
3. Application Pressure	Vacuum to 250 psig (Vacuum to 17 bar)	■	■	■	■	■	■	■
	Vacuum to 1000 psig (Vacuum to 69 bar)	■	■	■	■	■	■	■
	Vacuum to 1500 psig (Vacuum to 103 bar)		■	■	■			
	Vacuum to 2000 psig (Vacuum to 138 bar)		■	■				
4. PxT Values	0 to 50,000 psig x °F (0 to 1,500 bar x °C)	■	■	■	■	■	■	■
	0 to 350,000 psig x °F (0 to 12,000 bar x °C)	■[1]	■	■	■[2]*	■	■	■
	0 to 700,000 psig x °F (0 to 25,000 bar x °C)		■[3]	■[3]				

* Consult Garlock Applications Engineering at 1-800-448-6688

P x T max. = psig x °F (bar x °C)

[1] 1/8" thick IFG® is rated at 250,000 P x T

[2] 1/8" thick ST-706 is rated at 500,000 P x T

[3] 1/8" thick G-9900 and 3125SS/TC are rated at 350,000 P x T

WARNING:

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Compressed Inorganic Fiber Gasketing

Typical Physical Properties*

		ST-706	IFG® 5500[4]	IFG® 5507[4]
Color		White	Gray	Sage
Binder		Nitrile (NBR)	Nitrile (NBR)	EPDM
Temperature[1]	Maximum Minimum Continuous max.	+1,000°F (+540°C) -40°F (-40°C) +750°F (+400°C)	+800°F (+425°C) -40°F (-40°C) +550°F (+290°C)	+800°F (+425°C) -40°F (-40°C) +550°F (+290°C)
Pressure,[1] continuous max.	psig (bar)	1,500 (105)	1,200 (83)	1,200 (83)
P x T, max.[1] (psig x °F) (bar x °C)	1/32", 1/16" (0.8 mm, 1.6 mm) 1/8" (3.2 mm)	700,000 (25,000) 500,000 (18,500)	400,000 (14,000) 275,000 (9,600)	400,000 (14,000) 275,000 (9,600)
Sealability (ASTM F37B)[2]				
ASTM Fuel A	ml/hr	0.5	0.2	0.1
Nitrogen	ml/hr	4.0	1.0	0.5
Creep Relaxation (ASTM F38)	%	18	15	20
Compressibility Range (ASTM F36)	%	7-17	7-17	7-17
Recovery (ASTM F36)	%	>50	>50	> 50
Fluid Resistance (ASTM F146)				
ASTM #1 Oil at +300°F (+150°C)				
Thickness increase	%	0-10	0-10	25-40
Weight increase	%	< 15	< 15	—
ASTM IRM #903 Oil at +300°F (+150°C)				
Thickness increase	%	0-15	0-15	60-90
Tensile loss	%	< 55	< 40	—
ASTM Fuel A at +70-85°F (+20-30°C)				
Thickness increase	%	0-15	0-10	10-30
Weight increase	%	< 20	< 10	—
ASTM Fuel B +70-85°F (+20-30°C)				
Thickness increase	%	0-20	0-15	15-35
Weight increase	%	< 20	< 15	—
Tensile Strength across grain (ASTM F152)	psi (N/mm^2)	1,400 (9)	1,500 (10)	1,500 (10)
Density	lbs/ft^3 (g/cm^3)	105 (1.68)	110 (1.76)	110 (1.76)
Gas Permeability (DIN 3535 Part 4)[3]	cc/min.	—	0.05	0.04

This is a general guide and should not be the sole means of selecting or rejecting this material. ASTM test results in accordance with ASTM F-104; properties based on 1/32" (0.8mm) sheet thickness.

*** Values do not constitute specification limits**

All styles are furnished with an anti-stick parting agent as standard.

Notes:

1 Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure or continuous operating temperature, or 50% of maximum PxT, consult Garlock Engineering.

2 ASTM F37B Sealability
ASTM Fuel A (isooctane):
Gasket load = 500 psi (3.5 N/mm^2), Int. pressure = 9.8 psig (0.7 bar)
Nitrogen:
Gasket load = 3,000 psi (20.7 N/mm^2), Int. pressure = 30 psig (2 bar)

3 DIN 3535 Part 4 Gas Permeability, cc/min. (1/16" thick)
Nitrogen:
Gasket load = 4,640 psi (32 N/mm^2), Int. pressure = 580 psig (40 bar)

4 Saturated steam service guidelines:
- For optimal performance, use thinner gaskets when possible.
- Minimum recommended assembly stress = 4,800 psi.
- Preferred assembly stress = 6,000 psi to 10,000 psi.
- Retorque the bolts/studs prior to pressurizing the assembly. Never retorque a pressurized assembly.
- If the service is superheated steam, contact Applications Engineering.

Style ST-706

Benefits

Heat and oxidation resistance

- Inorganic, asbestos-free fibers offer superior performance in saturated and superheated steam
- Thermally stable fibers retain effective seal even during thermal cycling to 750°F (400°C)

Long-lasting seal

- Unique manufacturing process minimizes cold flow and creep relaxation problems

Versatile

- Ideal for standard ANSI flanged connectors, as well as turbine crossover piping connectors
- Multiple applications in power generation, chemical processing, hydrocarbon processing, and other industries

Patent #5,603,513

Media

ST-706:	Steam, oils, grease, water, and heat transfer fluids*
IFG® 5500:	Water, aliphatic hydrocarbons, oils, gasoline, saturated steam†, inert gases, most refrigerants
IFG® 5507:	Water, saturated steam†, mild chemicals and mild alkalies

Style IFG®

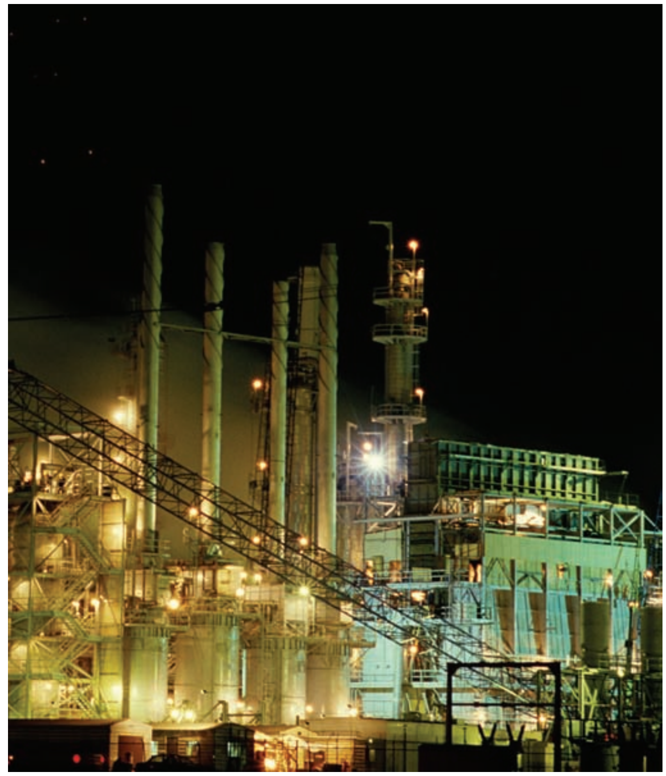
Benefits

Tighter seal

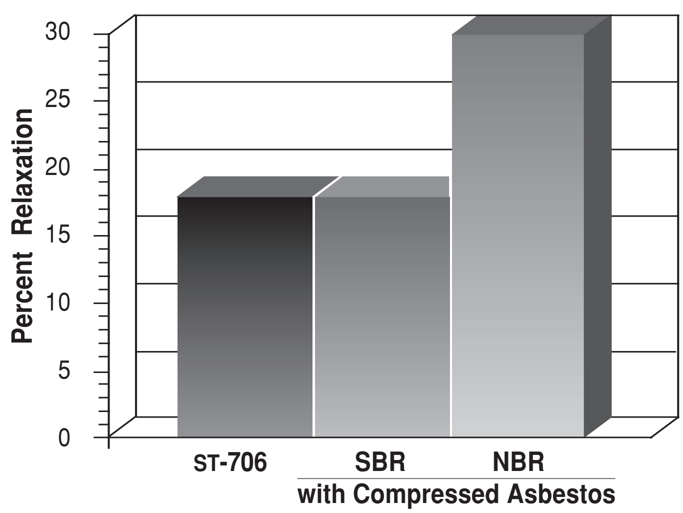
- Inorganic fiber gasketing offers excellent thermal stability with minimal weight loss
- Reduced creep relaxation and improved torque retention provide optimal sealability

Temperature resistant

- Non-oxidizing fibers withstand a continuous operating temperature of up to 550°F (290°C), and maximum spike of 800°F (425°C)
- IFG® 5500 has passed the Garlock Fire Test and is ABS Fire Safe Type Approved.



ASTM F38 Typical Creep Relaxation



* Contact Garlock Engineering with specific transfer fluid application.

† Above 150 psig, contact Engineering.

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High Temp Compressed Graphite or Carbon Fiber Gasketing

Typical Physical Properties*

		G-9900[4]	9800[4]	9850[4]
Color		Mahogany	Black	Black
Composition		Graphite with nitrile	Carbon with SBR	Carbon with nitrile
Temperature[1]	Maximum Minimum Continuous max.	+1,000°F (+540°C) -40°F (-40°C) +650°F (+340°C)	+900°F (+480°C) -40°F (-40°C) +650°F (+340°C)	+900°F (+480°C) -40°F (-40°C) +650°F (+340°C)
Pressure[1]	psig (bar)	2,000 (138)	2,000 (138)	2,000 (138)
P x T, max.[1] (psig x °F) (bar x °C)	1/32", 1/16" (0.8 mm, 1.6 mm) 1/8" (3.2 mm)	700,000 (25,000) 350,000 (12,000)	700,000 (25,000) 350,000 (12,000)	700,000 (25,000) 350,000 (12,000)
Sealability (ASTM F37B)[2] **ASTM Fuel A** **Nitrogen**	 ml/hr ml/hr	 0.1 0.1	 0.1 0.1	 0.1 0.1
Creep Relaxation (ASTM F38)	%	9	15	15
Compressibility Range (ASTM F36)	 %	 7-17	 7-17	 7-17
Recovery (ASTM F36)	%	> 65	> 55	> 56
Fluid Resistance (ASTM F146) **ASTM #1 Oil** at +300°F (+150°C) Thickness increase Weight increase **ASTM IRM #903 Oil** at +300°F (+150°C) Thickness increase Tensile loss **ASTM Fuel A at** +70-85°F (+20-30°C) Thickness increase Weight increase **ASTM Fuel B** +70-85°F (+20-30°C) Thickness increase Weight increase	 % % % % % % % %	 0-5 < 10 0-10 < 35 0-5 < 7 0-10 < 15	 0-10 < 20 15-40 < 65 0-10 < 20 5-20 < 20	 0-5 < 10 0-10 < 35 0-5 < 7 0-10 < 15
Tensile Strength across grain (ASTM F152)	psi (N/mm^2)	1,800 (12)	1,500 (10)	1,800 (12)
Density	lbs/ft^3 (g/cm^3)	110 (1.76)	105 (1.68)	105 (1.68)
Gas Permeability (DIN 3535 Part 4)[3]	 cc/min.	 0.015	 0.015	 0.015

This is a general guide and should not be the sole means of selecting or rejecting this material. ASTM test results in accordance with ASTM F-104; properties based on 1/32" (0.8mm) sheet thickness.

*** Values do not constitute specification limits**

All styles are furnished with an anti-stick parting agent as standard.

Notes:

1 Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure or continuous operating temperature, or 50% of maximum PxT, consult Garlock Engineering.

2 ASTM F37B Sealability
ASTM Fuel A (isooctane):
Gasket load = 500 psi (3.5 N/mm^2), Int. pressure = 9.8 psig (0.7 bar)
Nitrogen:
Gasket load = 3,000 psi (20.7 N/mm^2), Int. pressure = 30 psig (2 bar)

3 DIN 3535 Part 4 Gas Permeability, cc/min. (1/16" thick)
Nitrogen:
Gasket load = 4,640 psi (32 N/mm^2), Int. pressure = 580 psig (40 bar)

4 Saturated steam service guidelines:
- For optimal performance, use thinner gaskets when possible.
- Minimum recommended assembly stress = 4,800 psi.
- Preferred assembly stress = 6,000 psi to 10,000 psi.
- Retorque the bolts/studs prior to pressurizing the assembly.
- If the service is superheated steam, contact Applications Engineering.

Style G-9900

Benefits

Tough and reliable

- Graphite fiber gasketing withstands extreme temperatures and pressures, as well as many chemicals
- Passed Garlock Fire tests, and is ABS Fire Safe Type Approved
- Meets Navy Spec STR 508

Tighter seal

- Maintains superior seal during thermal cycling, even in saturated steam and hot oils
- Significantly reduces emissions to meet stringent Clean Air Act requirements

Easy to install

- Patented* graphite fiber sheet is easier to handle and cut than exfoliated graphite sheets or metal-inserted gasket material

* Patent #4,859,526

Note: For nuclear orders, specify Style G-9920.

At the Garlock on-site fire test facility, valves and sealing materials are tested for functionality in the most extreme applications. G-9900, 9800, 9850 and IFG® 5500 meet these stringent fire test standards.

Hi-Temp Styles 9800 / 9850

Benefits

Heat and pressure resistant

- Carbon fiber gasketing excels in harshest conditions—intense heat, high pressure, saturated steam and hot oils
- Laboratory-tested for fire safety

Tighter seal

- Maintains effective seal during pressure and temperature fluctuations
- Superior torque retention lowers leakage rates and reduces maintenance time

Convenient

- Flexible material is easy to handle and cut
- Sheet sizes to 150" x 150" (3.8 m x 3.8 m) minimize waste and inventory costs

Media

G-9900: Saturated steam, water, inert gases, aliphatic hydrocarbons, oils, gasoline, and most refrigerants

9800: Saturated steam†, water, and inert gases

9850: Water, saturated steam†, aliphatic hydrocarbons, oils, gasoline, most refrigerants

† Above 150 psig, contact Engineering.

Questions? Call Gasket Applications Engineering at 1-800-448-6688.

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BLUE-GARD® Compressed Gasketing

Typical Physical Properties*

		3000	3200† / 3400[4]	3300[4]	3700[4]
Color		Blue	Off-white/ Grey-black	Black	Light grey
Binder		Nitrile (NBR)	SBR	Neoprene (CR)	EPDM
Temperature[1]	Maximum Minimum Continuous max.	+700°F (+370°C) -40°F (-40°C) +400°F (+205°C)	+700°F (+370°C) -40°F (-40°C) +400°F (+205°C)	+700°F (+370°C) -40°F (-40°C +400°F (+205°C)	700°F (+370°C) -40°F (-40°C) +400°F (+205°C)
Pressure, max.[1]	psig (bar)	1,000 (70)	1,200 (83)	1,200 (83)	1,200 (83)
P x T, max.[1] (psig x °F) (bar x °C)	1/32", 1/16" (0.8mm, 1.6 mm) 1/8" (3.2 mm)	350,000 (12,000) 250,000 (8,600)	350,000 (12,000) 250,000 (8,600)	350,000 (12,000) 250,000 (8,600)	350,000 (12,000) 250,000 (8,600)
Sealability (ASTM F37B)[2] **ASTM Fuel A** **Nitrogen**	 ml/hr ml/hr	 0.2 0.6	 0.1 0.4	 0.2 1.0	 0.1 0.7
Gas Permeability (DIN 3535 Part 4)[3]	 cc/min.	 0.05	 0.03	 0.08	 0.04
Creep Relaxation (ASTM F38)	%	21	18	18	25
Compressibility Range (ASTM F36)	 %	 7-17	 7-17	 7-17	 7-17
Recovery (ASTM F36)	%	50	50	50	40
Tensile Strength across grain (ASTM F152)	 psi (N/mm²)	 2,250 (15)	 2,250 (15)	 2,250 (15)	 2,500 (17)
Fluid Resistance (ASTM F146)					
ASTM #1 Oil at +300°F (+150°C)					
Thickness increase	%	0-5	0-10	0-5	20-35
Weight increase	%	< 8	< 20	< 15	—
ASTM IRM #903 Oil at +300°F (+150°C)					
Thickness increase	%	0-15	15-30	15-30	60-100
Tensile loss	%	< 35	< 70	< 50	—
ASTM Fuel A at +70-85°F (+20-30°C)					
Thickness increase	%	0-5	0-15	0-10	10-40
Weight increase	%	< 8	< 25	< 20	—
ASTM Fuel B +70-85°F (+20-30°C)					
Thickness increase	%	0-10	5-20	5-20	20-50
Weight increase	%	< 15	< 30	< 20	—
Density 1/16" (1.6 mm) thick	lbs/ft³ (g/cm³)	100 (1.60)	100 (1.60)	100 (1.60)	100 (1.60)

Notes:

1 Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure or continuous operating temperature, or 50% of maximum PxT, consult Garlock Applications Engineering.

2 ASTM F37B Sealability, milliliters/hour (1/32" thick)
ASTM Fuel A (isooctane):
Gasket load = 500 psi (3.5 N/mm²),
Internal pressure = 9.8 psig (0.7 bar)
Nitrogen:
Gasket load = 3,000 psi (20.7 N/mm²),
Internal pressure = 30 psig (2 bar)

3 DIN 3535 Part 4 Gas Permeability, cc/min. (1/16" thick)
Nitrogen:
Gasket load = 4,640 psi (32 N/mm²),
Internal pressure = 580 psig (40 bar)

4 Saturated steam service guidelines:
- For optimal performance, use thinner gaskets when possible.
- Minimum recommended assembly stress = 4,800 psi.
- Preferred assembly stress = 6,000 psi to 10,000 psi.
- Retorque the bolts/studs prior to pressurizing the assembly. Never retorque a pressurized assembly.
- If the service is superheated steam, contact Applications Engineering.

	2900 / 2950
	Black/Off-white/ Green
	Nitrile (NBR)
	+700°F (+370°C) -40°F (-40°C) +400°F (+205°C)
	1,000 (70)
	350,000 (12,000) 250,000 (8,600)
	0.25 1.00
	—
	25
	7-17
	50
	1,500 (10)
	0-5 0-10 0-15 0-35 0-5 0-10 0-10 0-20
	105 (1.68)

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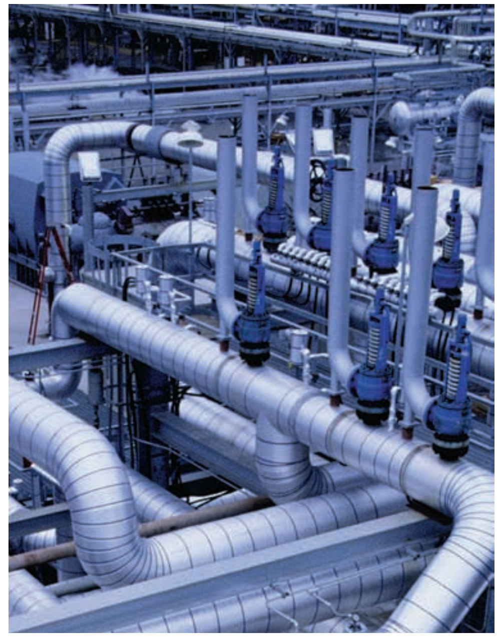
*** Values do not constitute specification limits**

† Meets Mil-G-24696B

All styles are furnished with an anti-stick parting agent as standard.



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BLUE-GARD®
Styles 3000 to 3700

Benefits

Excellent sealability

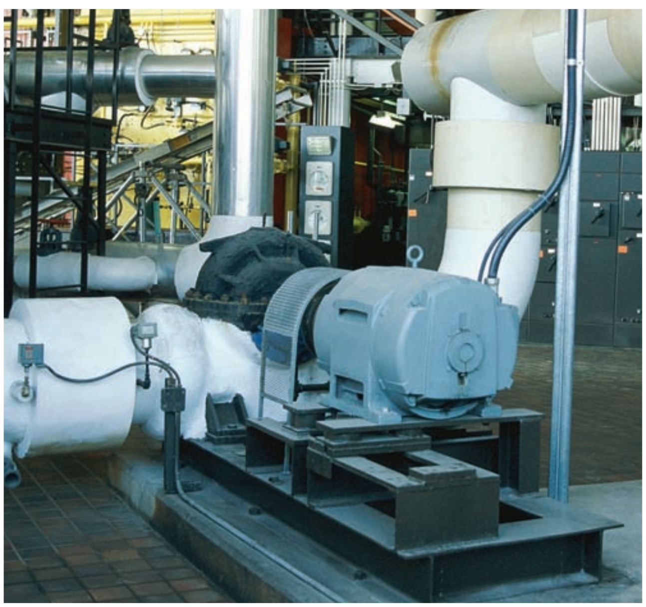
- Unique blend of aramid fibers, fillers and elastomeric binders provides improved torque retention and drastically lowered emissions levels

Versatile

- Variety of elastomers excel in a wide range of services

Cost savings

- Cuts operational costs through reduced:
  - Waste
  - Fluid loss
  - Maintenance
  - Energy consumption
  - Stocked inventory



Styles 2900, 2950

Benefits

Ideal for utility services

- Excellent sealability
- Improved thermal stability
- Good for general service

Media

3000: Water, aliphatic hydrocarbons, oils, and gasoline
- WRC BS 6920 Approved
- Meets BS7531 Grade Y Specifications

3200, 3400: Water, saturated steam†, inert gases (Style 3200 meets MIL-G-24696B)

3300: Water, saturated steam†, refrigerants, oils, and fuels

3700: Water, saturated steam†, and mild chemicals

2900, 2950: Water, aliphatic hydrocarbons, oils, and gasoline

† Above 150 psig, contact Engineering.

AGRI-GARD™ Style 2676   LEAK-GARD™ Style 3750

Benefits

Ideal for ethanol industry

- Designed to excel in saturated steam, water, oils, fuels—over 90% of industry applications

High performance

- Inorganic fiber gasketing offers excellent thermal stability with minimal weight loss
- Reduced creep relaxation and improved torque retention ensure optimal sealability

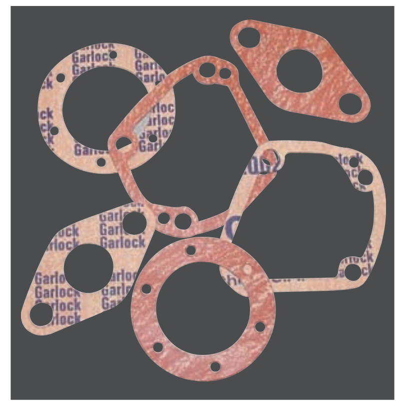
Benefits

Tight seal in oil applications

- Proprietary compound reacts with oil to create tight seal without gasket degradation
- Actually increases bolt load and bolt load retention; compensates for low-load areas

Versatile

- Stops leakage in:
  - Transformers
  - Turbines
  - Gear boxes
  - Generators
  - Fuel pumps



Typical Physical Properties*

		2676	3750
Color		Yellow	Red
Binder		Nitrile (NBR)	Proprietary
Temperature[1]	Minimum Continuous max.	-40°F (-40°C) +550°F (+290°C)	-40°F (-40°C) +400°F (+204°C)
Pressure, max.[1]	psig (bar)	1,200 (83)	1,200 (83)
P x T, max.[1] (psig x °F) (bar x °C)	1/32", 1/16" (0.8mm, 1.6 mm) 1/8" (3.2 mm)	400,000 (14,000) 275,000 (9,600)	350,000 (12,000) 250,000 (8,600)
Sealability (ASTM F37B)[2] **ASTM Fuel A** **Nitrogen**	 ml/hr ml/hr	 0.2 1.0	 – –
Gas Permeability (DIN 3535 Part 4)[3]	 cc/min.	 0.05	 –
Creep Relaxation (ASTM F38)	%	15	22
Compressibility Range (ASTM F36)	 %	 7-17	 10
Recovery (ASTM F36)	%	>50	>52
Tensile Strength across grain (ASTM F152)	 psi (N/mm²)	 1,500 (10)	 3,056 (21)
Fluid Resistance (ASTM F146) **ASTM #1 Oil** at +300°F (+150°C) Thickness increase **ASTM IRM #903 Oil** at +300°F (+150°C) Thickness increase **ASTM Fuel B** +70-85°F (+20-30°C) Thickness increase	 % % %	 – – –	 22.5† 66.4† 22.0†
Density 1/32" (0.8 mm) thk	lbs/ft³ (g/cm³)	110 (1.76)	–

This is a general guide and should not be the sole means of selecting or rejecting this material. ASTM test results in accordance with ASTM F-104; properties based on 1/32" (0.8mm) sheet thickness.

† Thickness measured with a 9 oz. weight before immersion and 3 oz. after immersion.

*** Values do not constitute specification limits**

Notes:

1 Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure or continuous operating temperature, or 50% of maximum PxT, consult Garlock Applications Engineering.

2 ASTM F37B Sealability, milliliters/hour (1/32" thick)
ASTM Fuel A (isooctane):
Gasket load = 500 psi (3.5 N/mm²),
Internal pressure = 9.8 psig (0.7 bar)
Nitrogen:
Gasket load = 3,000 psi (20.7 N/mm²),
Internal pressure = 30 psig (2 bar)

3 DIN 3535 Part 4 Gas Permeability, cc/min. (1/16" thick)
Nitrogen:
Gasket load = 4,640 psi (32 N/mm²),
Internal pressure = 580 psig (40 bar)

4 Saturated steam service guidelines:
- For optimal performance, use thinner gaskets when possible.
- Minimum recommended assembly stress = 4,800 psi.
- Preferred assembly stress = 6,000 psi to 10,000 psi.
- Retorque the bolts/studs prior to pressurizing the assembly. Never retorque a pressurized assembly.
- If the service is superheated steam, contact Applications Engineering.

GYLON® Gasketing

Typical Physical Properties*

GYLON® Styles	3500	3504	3510	3530	3540	3545
Color	Fawn with black brand	Blue with black brand	Off-white with black brand	Black with no brand	White with black brand	White with black brand
Composition	PTFE with silica	PTFE with glass microspheres	PTFE with barium sulfate	PTFE with graphite	Microcellular PTFE	Microcellular PTFE
Temperature[1] Minimum	-450°F (-268°C)	-450°F (-268°C)	-450°F (-268°C)	-450°F (-268°C)	-450°F (-268°C)	-450°F (-268°C)
Cont. max.	+500°F (+260°C)	+500°F (+260°C)	+500°F (+260°C)	+500°F (+260°C)	+500°F (+260°C)	+500°F (+260°C)
Pressure, Cont. max.[1] psig (bar)	1,200 (83)	800 (55)	1,200 (83)	1,200 (83)	1,200 (83)	1,200 (83)
P x T, max.[1] psig x °F (bar x °C) 1/32", 1/16" (0.8 mm,1.6 mm)	350,000 (12,000)	350,000 (12,000)	350,000 (12,000)	350,000 (12,000)	350,000 (12,000)	350,000 (12,000)
1/8" (3.2 mm)	250,000 (8,600)	250,000 (8,600)	250,000 (8,600)	250,000 (8,600)	250,000 (8,600)	250,000 (8,600)
Sealability **ASTM Fuel A** ml/hr (ASTM F37B)[3]	0.22	0.12	0.04	0.02	0.25	0.15
Gas Permeability cc/min. (DIN 3535 Part 4)[4]	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Creep Relaxation % (ASTM F38)	18	40	11	29	10	15
Compressibility Range (ASTM F36) %	7-12	25-45	4-10	7-17	70-85	60-70
Recovery % (ASTM F36)	>40	>30	>40	>40	>8	>15
Tensile Strength psi (ASTM D1708) (N/mm^2)	2,000 (14)	2,000 (14)	2,000 (14)	3,000 (21)	—	—
Flammability	Will not support flame					
Bacterial Growth	Will not support					

Notes:

1 Based on ANSI RF flanges at our preferred torque. When approaching maximum pressure or temperature, or 50% of maximum PxT, consult Garlock Engineering. For Styles HP 3560 and HP 3561, consult Garlock if approaching maximum temperature, or 50% of maximum pressure or P x T.

2 For HP 3560 and HP 3561, 1/16" thickness only; for 3535, 1/4" thickness only.

3 ASTM F37B Sealability, milliliters/hour (1/32" thick)
ASTM Fuel A (isooctane):
Gasket load = 1,000 psi (7 N/mm^2),
Internal pressure = 9.8 psig (0.7 bar)

4 DIN 3535 Part 4 Gas Permeability, cc/min. (1/16" thick)
Nitrogen: Internal pressure = 580 psig (40 bar),
Gasket load = 4,640 psi (32 N/mm^2)

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*** Values do not constitute specification limits**

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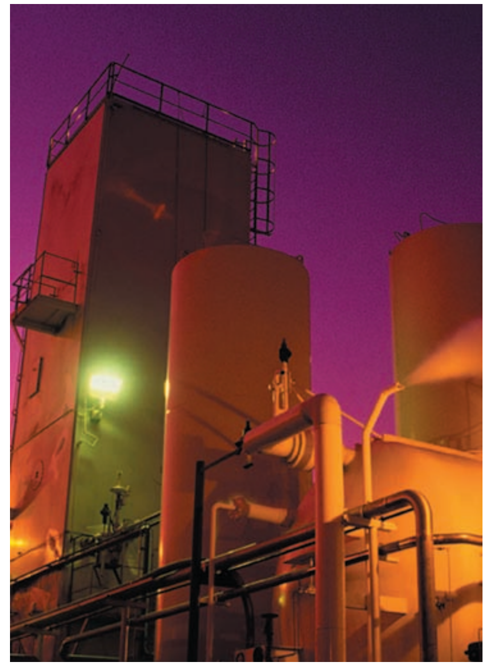
	HP 3560	HP 3561	3565	3591	3594
	Fawn with black brand	Off-white with black brand	White & blue w/black brand	Gold with black brand	Green with black brand
	GYLON® with perforated 316LSS insert	GYLON® with perforated 316LSS insert	PTFE with glass microspheres	PTFE with barium sulfate	PTFE with glass filler
	— — +500°F (+260°C)	— — +500°F (+260°C)	-450°F (-268°C) +500°F (+260°C)	-450°F (-268°C) +500°F (+260°C)	-450°F (-268°C) +500°F (+260°C)
	2,500 (172)	2,500 (172)	1,200 (83)	800 (55)	1,200 (83)
	700,000[2] (25,000) 450,000 (15,000)	700,000[2] (25,000) 450,000 (15,000)	350,000 (12,000) 250,000 (8,600)	350,000 (12,000) 250,000 (8,600)	350,000 (12,000) 250,000 (8,600)
	0.02[2]	0.01[2]	0.33	0.20	0.50
	< 0.015[2]	< 0.015[2]	< 0.015	< 0.015	< 0.015
	20[2]	20[2]	35	35	30
	4-9[2]	3-7[2]	35-50	15-25	10-20
	>45[2]	>50[2]	>35	>40	>45
	5,000[2] (34)	5,000[2] (34)	1,800 (13)	2,000 (14)	2,000 (14)
	Will not support flame				
	Will not support				



Questions? Call Gasket Applications Engineering at 1-800-448-6688.

Test Data

Before

Compression at 2,000 psi (14 N/mm^2) for 1 hour at 500°F (260°C)

After

◀ *Note the uneven cold flow shown by conventional PTFE.*

GYLON® Styles 3500 to 3510

Benefits

Tighter seal
- Improved performance over conventional PTFE
- Reduced product loss and emissions

Reduced creep relaxation
- Unique manufacturing process minimizes cold flow problems typical of skived and expanded PTFE sheets
- Excellent bolt torque retention

Chemical resistance
- Withstands a wide range of chemicals for extended service life in a wide variety of applications

Cost savings
- Cuts operational costs through reduced:
  - Fluid loss
  - Energy consumption
  - Maintenance costs
  - Inventory costs
  - Waste

Largest sheet sizes*
- Offers some of the largest sheet sizes in the industry
- Improved material utilization reduces waste

Branding and color coding
- Easy identification of superior GYLON® products
- Reduces misapplication and use of unauthorized, inferior substitutes

* 60" x 60" (1524 mm x 1524 mm), 70" x 70" (1778 mm x 1778 mm), 60" x 90" (1524 mm x 2286 mm)

Media

GYLON® 3500: Strong acids (except hydrofluoric), solvents, hydrocarbons, water, steam, chlorine, and cryogenics. Conforms to FDA regulations. *(For oxygen service, specify "Style 3502 for oxygen service.")*

GYLON® 3504: Moderate concentrations of acids and some caustics, hydrocarbons, solvents, water, refrigerants, and cryogenics. Conforms to FDA regulations. *(For oxygen service, specify "Style 3505 for oxygen service.")*

GYLON® 3510: Strong caustics, moderate acids, chlorine, gases, water, steam, hydrocarbons, and cryogenics. Conforms to FDA regulations. *(For oxygen service, specify "Style 3503 for oxygen service.")*

GYLON® Style 3530

Benefits

Tighter seal
- Graphite-filled PTFE offers extremely low void content for minimal emissions

Chemical resistance
- Black GYLON® delivers long service against volatile hazardous pollutants (VHAP and VOC)
- Withstands high concentrations of hydrofluoric acids and other glass-dissolving media
- Also ideal for monomer service and cryogenics

Style 3535 Joint Sealant

Benefits

Chemical resistance
- Pure PTFE is chemically inert, withstands a wide range of chemicals
- Conforms to FDA regulations

Easy to install
- Continuous length on spools is easily cut and formed
- Strong adhesive backing aids installation on narrow or hard-to-reach flanges
- Available in widths from 1/8" to 1"

Typical Physical Properties

Sealability	(ASTM F37B)[1]	ml/hr	0.1
Gas Permeability	(DIN 3535 Part 4)[2]	cc/min.	0.05

Notes:

1 ASTM F37B Sealability, milliliters/hour (1/4" thick)
ASTM Fuel A (isooctane):
Gasket load: 3,000 psi (20.7 N/mm²), Internal pressure: 30 psig (2 bar)

2 DIN 3535 Part 4 Gas Permeability, cc/min. (1/4" thick)
Nitrogen:
Internal pressure: 580 psig (40 bar), Gasket load: 4,640 psi (32 N/mm²)

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GARLOCK is a registered trademark for packings, seals, gaskets, and other products of Garlock.

GYLON® Style 3545

1995 WINNER Chemical Processing's VAALER AWARD

Benefits

Tighter seal

- Highly compressible PTFE outer layers seal under low bolt load—suitable for many flat face flanges*
- Compressible layers conform to surface irregularities, especially on warped, pitted or scratched flanges
- Rigid PTFE core reduces cold flow and creep normally associated with conventional PTFE gaskets

Excellent chemical compatibility

- Pure PTFE withstands a wide range of chemicals

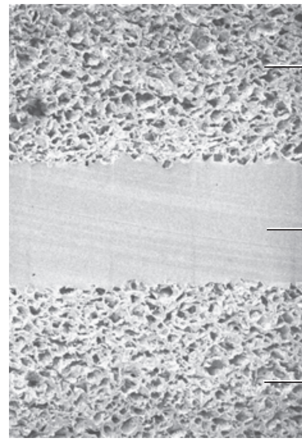
Easy to cut and install

- Soft PTFE can be cut easily from larger sheets, reducing inventory costs and expensive downtime
- Rigid PTFE core facilitates installation, especially on large diameter flanges and hard-to-reach areas

GYLON® Style 3540

- Pure microcellular PTFE
- Similar to Style 3545, but without rigid core
- Ideal for wavy, warped, pitted, or scratched flanges, and for many types of flat face* flanges

Configuration



Cross-sectional view under electron microscope
All layers manufactured using proprietary GYLON® process—thermally fused layers, without the use of adhesives

Media

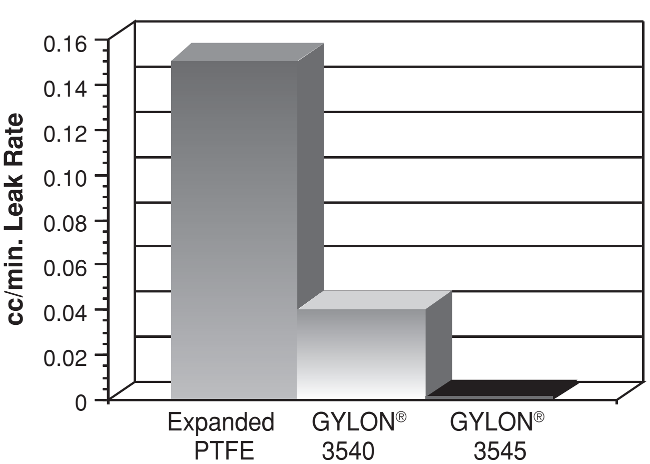
GYLON® 3540: Strong caustics, strong acids, hydrocarbons, chlorine, cryogenics, and glass-lined equipment. Conforms to FDA regulations.

GYLON® 3545: Strong caustics, strong acids, hydrocarbons, chlorine, cryogenics, glass-lined equipment, plastic piping,* and low bolt load applications. Conforms to FDA regulations.

* For flat face flanges, a minimum compressive stress of 1,500 psi (103 N/mm²) is recommended on the contacted gasket area for 150 psig (10.3 N/mm²) liquid service. Consult with the flange manufacturer to confirm that adequate compressive stress is available.

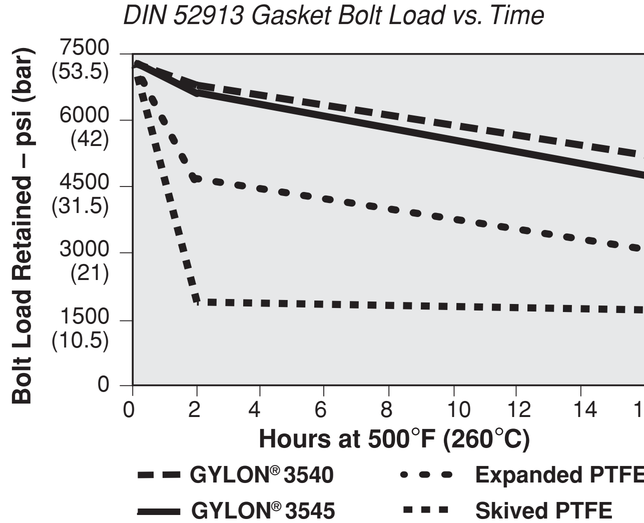
Test Results

DIN 3535 Gasket Permeation Test



Note the dramatically reduced leakage of GYLON® 3540 and 3545. Average of three tests, using 580 psig nitrogen with 4,640 psi gasket load according to DIN 3535 requirements. All samples 1/16" (1.6 mm) thick.

DIN 52913 Gasket Bolt Load vs. Time



High bolt load retention of GYLON® 3540 and 3545, especially at high temperatures, indicates gasket is less likely to incur gross leakage (blowout).

GYLON® Styles HP 3560 / HP 3561

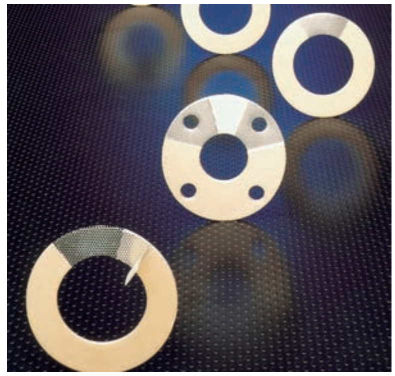
Benefits

Tight seal

- Perforated stainless steel core increases resistance to pressure fluctuations and thermal cycling
- GYLON® offers superior cold flow and creep resistance, eliminating the need for frequent retorquing

Chemical resistance

- Seals aggressive chemicals in hostile environments where safety or blowout resistance is crucial*



Media

HP 3560: Strong acids (except hydrofluoric), solvents, hydrocarbons, water, steam, chlorine, and cryogenics
(For oxygen service, specify "HP 3562 for oxygen service.")

HP 3561: Strong caustics, moderate acids, chlorine, gases, water, steam, hydrocarbons, cryogenics, and aluminum fluoride
(For oxygen service, specify "HP 3563 for oxygen service.")

Style 3565: ENVELON® Moderate concentrations of acids and caustics, hydrocarbons, solvents, cryogenics, and glass-lined equipment. Conforms to FDA regulations.

GYLON® Style 3565 ENVELON® Gasketing**

Benefits

Tighter seal

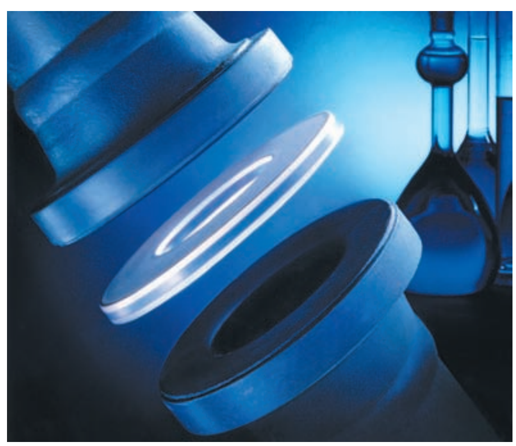
- Soft, deformable exterior conforms to surface irregularities; ideal for worn, warped or pitted flanges
- Stable blue core improves cold flow resistance
- Low bolt load requirements ensure a tight seal on glass-lined or wavy flanges†
- Direct sintering of GYLON® layers prevents leak paths and adhesive contamination

Easy to install

- Unitized construction avoids jacket foldover
- Rigid core facilitates installation of large gaskets

Minimizes inventory

- Custom-cut gaskets from large sheets offer convenience while reducing costly inventory buildup
- Ideal replacement for slit, milled, formed shield and double jacketed envelope gaskets†



* Consult Garlock Applications Engineering when using flanges in pressure classes above 300 lbs.

** Patents #4,961,891; #4,900,629

† When sealing uneven flanges, gasket must be four times thicker than maximum gap between flanges.

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STRESS SAVER®

Benefits

Tighter seal

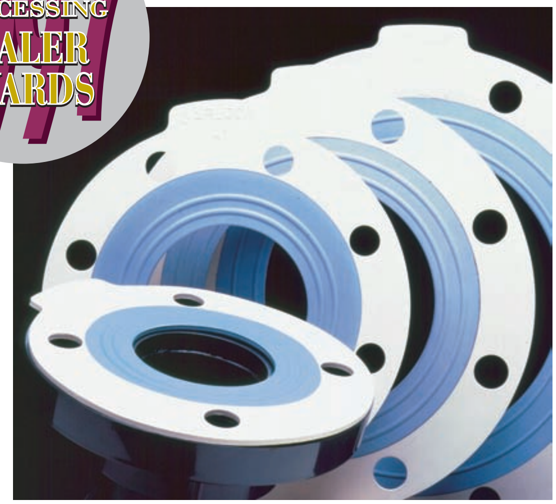
- Raised, molded-in sealing rings seal with 75% less surface area for high performance in non-metallic flanges[†]

Chemical resistance

- Pure PTFE sealing surface resists many chemicals

High purity

- Contaminant-free EPDM is ideal for pure service—electronics,* pharmaceutical and food industries**
- Proprietary process bonds PTFE to elastomer, won’t delaminate or leach
- Special packaging for high-purity applications



Questions? Call Gasket Applications Engineering at 1-800-448-6688.

Typical Physical Properties

STRESS SAVER®		Style 370	Style 6800	XP
Construction		100% Pure PTFE bonded to EPDM	EPDM only (65 durometer)	Proprietary blend of fluoroelastomers (70 durometer)
Color		PTFE: Sky blue	EPDM: Off-white	Black
Temperature	Max. Min.	+300°F (+150°C) -40°F (-40°C)	+300°F (+150°C) -40°F (-40°C)	+400°F (+204°C) -15°F (-26°C)
Pressure, max	psig (bar)	250 (17)	250 (17)	250 (17)
P x T, max.	(psig x °F) (bar x °C)	50,000 (1717)	50,000 (1717)	50,000 (1717)

STRESS SAVER® XP

Benefits

Tighter seal

- Lower seating stress than expanded or specialty PTFE gaskets; ideal for nonmetallic flanges

Chemical resistance

- High-performance fluoroelastomer has greater resistance to severe chemicals than standard fluoroelastomers

Outperforms PTFE envelope gaskets

- Won't fail due to filler attack
- Eliminates envelope foldover during installation

Media

Style 370: Acids, caustics, gases, water, hydrocarbons

Style 6800: Water, very mild acids and caustics

Style XP: Water, steam, most hydrocarbons, gases, solvents, acids, and alcohol

† Flat face flanges strongly recommended.
* Tested by BALASZ Labs for trace metal extractables, Anions, Cations and T.O.C.s. Results available on request.
** Consult Garlock Applications Engineering for FDA information.

GYLON® Style 3522 Diaphragm Material

Benefits

Chemical and temperature resistance

- Withstands aggressive chemicals and temperatures up to +500°F (+260°C). Consult Garlock Engineering regarding your specific application.

Resilience

- Up to three times the flex life of conventional PTFE

Conforms to FDA regulations

Welded GYLON®

Benefits

Effective seal

- Patented** welding process produces large gaskets[††] without dovetailed joints that permit leakage
- GYLON® material provides the excellent chemical resistance of PTFE without creep relaxation and cold flow problems

Versatile

- Ideal for corrosive applications with extra-large flanges
- Styles 3500, 3504, and 3510 can be welded using this unique process

Conforms to FDA regulations

Comparison of Typical Physical Properties*

			GYLON® 3522	Skived PTFE
Color			Clear, translucent	—
Composition			PTFE	—
Temperature	Maximum[†]		+500°F (+260°C)	—
Creep Relaxation	(ASTM F38)	%	35	51
Specific Gravity	(D792)		2.19	2.185
Compressibility	(ASTM F36)	% Range	20-25	20-25
Recovery	(ASTM F36)	%	>50	>50
Tensile Strength (ASTM D1708)				
X direction		psi (N/mm^2)	5,000 (35)	4,050 (28)
Y direction		psi (N/mm^2)	5,100 (36)	3,000 (21)
Ultimate Elongation (ASTM D1708)				
X direction		%	500	550
Y direction		%	520	450
Gas Permeability (ASTM D1434V)		$cc/M^2/24$ hrs	10,000	35,000
Flammability			Will not burn	—
Bacterial Growth			Will not support	—

This is a general guide and should not be the sole means of selecting or rejecting this material. ASTM test results in accordance with ASTM F-104; properties based on 1/32" (0.8mm) sheet thickness.

*** Values do not constitute specification limits**

[†] When approaching maximum pressure and temperature, consult Garlock Applications Engineering.

** Patent #4,990,296

[††] O.D. sizes 70" (1778 mm) and over

Garlock Gaskets®

Questions? Call Gasket Applications Engineering at 1-800-448-6688.

Note:
Due to unique dynamics of actuated pumps, Garlock cannot specify temperature limits for the Style 3522 materials. In a diaphragm pump there are variables such as, but not limited to: geometry, displacement, and pump speed that greatly affect the diaphragm performance. Experienced pump manufacturers have confirmed that pumps used in low and/or elevated service temperatures (40°F to 200°F) should be de-rated with respect to speed and pressure.

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GRAPH-LOCK® Gasketing

Benefits

Excellent resistance

- Pure exfoliated graphite flake material excels in extreme conditions, withstanding heat, pressure, and aggressive chemicals
- Proven fire-safe

Reliable seal

- Seals easily under moderate bolt load, offers superior torque retention
- Retains dimensional stability in high temperatures; seals tightly even during pressure fluctuations

Versatility

- Available in two grades—industrial grade is 98% pure; nuclear grade is 99.5% pure
- Available as standard homogeneous sheet or metal-inserted sheet for applications requiring extra strength

Also available:
Style 3120: Nuclear-grade homogeneous sheet
Style 3122: High-purity homogeneous sheet

Typical Physical Properties*

	3123	3124 / 3126	3125	3125 SS	3125 TC
Description	Homogeneous	316SS Wire Inserted	Laminated	0.002" 316SS Foil Inserted	0.004" 316SS Tang Inserted
Temperature[1], Minimum Max. in atmosphere Max. in steam Continuous in reducing or inert media	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) +5,432°F (+3,000°C)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) —	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) +5,432°F (+3,000°C)	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) —	-400°F (-240°C) +850°F (+454°C) +1200°F (+650°C) —
Pressure, max.[1] psig (bar)	2,000 (140)	2,000 (140)	2,000 (140)	2,000 (140)	2,000 (140)
P x T, max.[1] (psig x °F): 1/32", 1/16" (bar x °C): (0.8 mm, 1.6 mm) 1/8" (3.2 mm)	700,000 (25,000) 350,000 (12,000)	700,000 (25,000) 350,000 (12,000)	700,000 (25,000) 350,000 (12,000)	700,000 (25,000) 350,000 (12,000)	700,000 (25,000) 350,000 (12,000)
Sealability (ASTM F37B)[2] **ASTM Fuel A** ml/hr **Nitrogen** ml/hr	 0.2 0.5	 1.5[3] 0.2	 0.3 0.5	 0.25 0.2	 0.3[3] 0.3
Gas Permeability cc/min. (DIN 3535 Part 4)[4]	0.4	0.1	0.4	0.4	0.4
Creep Relaxation % (ASTM F38)	5	17	10	12	15
Compressibility % (ASTM F36)	40	40	40	35	35
Recovery (ASTM F36) %	>15	>12	>15	>20	>20
Tensile Strength psi (ASTM F152) (N/mm^2)	600 (4)	3,300 (23)	600 (4)	4,500 (31)	3,500 (24)

Notes:

1 Based on ANSI RF flanges at our preferred torque. Maximum temperature of +975°F (+525°C) for GRAPH-LOCK® with oxidation inhibitors. Consult Garlock Applications Engineering when approaching maximum pressure or 50% of maximum PxT.

2 ASTM F37B Sealability, milliliters/hour (1/32" thick)
ASTM Fuel A (isooctane): Gasket load = 500 psi (3.5 N/mm^2),
Internal pressure = 9.8 psig (0.7 bar)
Nitrogen: Gasket load = 3,000 psi (20.7 N/mm^2),
Internal pressure = 30 psig (2 bar)

3 1,000 psi gasket load

4 DIN 3535 Part 4 Gas Permeability, cc/min. (1/16" thick)
Nitrogen: Gasket load = 4,640 psi (32 N/mm^2),
Internal pressure = 580 psig (40 bar)

This is a general guide and should not be the sole means of selecting or rejecting this material. ASTM test results in accordance with ASTM F-104; properties based on 1/32" (0.8mm) sheet thickness.

All styles furnished with an anti-stick parting agent as standard.

*** Values do not constitute specification limits**

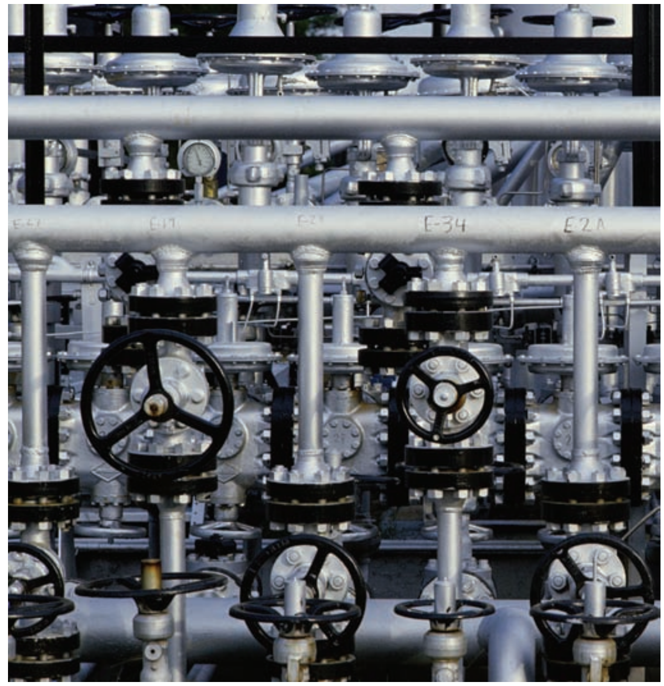
Premium Grade (ASTM) Rubber Gasketing

Typical Physical Properties

	Premium Grade								
Material	EPDM	Neoprene	Neoprene	Neoprene	Nitrile	SBR	Fluoro-elastomer (Type A)	Fluoro-elastomer (Type A)	Fluoro-elastomer Blend
Style	**8314**	**7986**	**7797**	**9064**	**9122**	**22**	**9518**	**9520**	**9780**
Color	Black	Black	Black	Off-White	Black	Red	Black	Black	Black
Hardness (Shore A) ± 5	60	60	80	60	60	75	75	75	65-75
Tensile strength, min. (ASTM D412), psi (N/mm^2)	1,000 (7)	2,000 (14)	1,500 (10)	2,400 (17)	2,000 (14)	700 (5)	1000 (7)	1,000 (7)	1200 (8)
Elongation, min., %	300	350	125	790	500	150	175	180	175
Compression set, ASTM Method B (ASTM D395) 25% deflection, maximum %	22 hrs @ 158°F (70°C) 25	70 hrs @ 212°F (100°C) 35	70 hrs @ 212°F (100°C) 75		22 hrs @ 212°F (100°C) 20	22 hrs @ 158°F (70°C) 40		22 hrs @ 350°F (175°C) 50	
Volume chg after immersion in ASTM #1 Oil (ASTM D471) 70 hrs @ 212°F (100°C), %		-4 to 3	-7 to 0		-10 to 5				
Volume chg after immersion in ASTM #3 Oil 70 hrs @ 212°F (100°C), %		+50 to 80	+45 to 60		0 to 25				
Thickness available, inches	1/16, 3/32, 1/8, 3/16, 1/4	1/16, 3/32, 1/8, 3/16, 1/4 and greater	1/32, 1/16, 3/32, 1/8, 3/16, 1/4 and greater	1/32,1/16, 3/32,1/8, 3/16, 1/4 and greater	1/16, 3/32, 1/8, 3/16, 1/4 and greater	1/16, 3/32, 1/8, 3/16, 1/4 and greater	1/16, 1/8, 3/16, 1/4	1/16, 1/8	1/16, 1/8
Finish available	Thru 1/8": Cloth; Over 1/8": Smooth	Thru 1/8": Cloth; Over 1/8": Smooth	Thru 1/8": Cloth ; Over 1/8": Smooth	Thru 1/8": Cloth; Over 1/8": Smooth	Thru 1/8": Cloth; Over 1/8": Smooth	Thru 1/8": Cloth; Over 1/8": Smooth	Thru 1/8": Satin; Over 1/8": Smooth	Fabric	Fabric
Meets specifications		MIL-R-3065 MIL-Std. 417 Type S Grade SC620 A_1 E_3 E_5	MIL-R-3065 MIL-Std. 417 Type S Grade SC815 A_1 E_3 E_5	21CFR177.2600		HHG-156 Type III ASTM-D-1330 Grade I and II			
Temperature range, °F (°C)	-40°F (-40°C) to +300°F (+150°C)	-20°F (-29°C) to +250°F (+121°C)	-20°F (-29°C) to +250°F (+121°C)	-20°F (-29°C) to +250°F (+121°C)	-20°F (-29°C) to +250°F (+121°C)	-10°F (-23°C) to +200°F (+93°C)	15°F (-26°C) to +400°F (+204°C)	15°F (-26°C) to +400°F (+204°C)	-15°F (-26°C) to +400°F (+204°C)
Pressure, max., psig (bar)	250 (17)	250 (17)	250 (17)	250 (17)	250 (17)	250 (17)	250 (17)	250 (17)	250 (17)
P x T max., psi x °F (bar x °C)	30,000 (900)	20,000 (600)	20,000 (600)	20,000 (600)	20,000 (600)	20,000 (600)	30,000 (900)	30,000 (900)	30,000 (900)

Note:
Please consult Garlock Applications Engineering when approaching maximum temperature, pressure, or P x T limits.

Benefits



Wide range of natural and synthetic rubbers

- Incompressible—can be deformed, depending on durometer and cross section, but can never be reduced in volume
- Extensible—can be assembled over a projection or shoulder and snap tightly within a groove
- Highly impermeable—can serve as a tight barrier against the passage of gases or liquids
- Elastic—little flange pressure required to effect intimate contact with gasket, allowing it to move with the flange surfaces, always maintaining a seal
- Complies with RMA (Rubber Manufacturing Association)

ASTM D2000 Line Callouts

Style	ASTM Line Callout
22	2AA810A13F16EA14
7797	4BC815A14E014E034G21
7986	6BC620E014E034G21
8314	4AA610A13B13B33, BA610A14B13
9064	2BE620A14E014E034F17
9122	5BG620A14B14EA14E014E034
9518	2HK710B3721
9780	2HK715A1-10 B37

Questions? Call Gasket Applications Engineering at 1-800-448-6688.

Standard Commercial Tolerances

Premium-Grade and Reinforced Rubber and Diaphragm Gasketing

Nominal Thickness Fractions	Nominal Thickness Decimals	Tolerance
under 1/32"	0.031"	±0.010"
1/32" up to 1/16"	0.031" up to 0.062"	±0.012"
1/16" up to 1/8"	0.062" up to 0.125"	±0.016"
1/8" up to 3/16"	0.125" up to 0.187"	±0.020"
3/16" up to 3/8"	0.187" up to 0.375"	±0.031"
3/8" up to 9/16"	0.375" up to 0.562"	±0.047"
9/16" up to 3/4"	0.562" up to 0.750"	±0.063"
3/4" up to 1"	0.750" up to 1.00"	±0.093"
1" and up	1.00" and up	±10%

Garlock Gaskets®

Reinforced Rubber Gasketing

Benefits

Elastic yet strong

- Combines elasticity and extensibility of rubber with strength of fabric insert
- Specially compounded in varying burst strengths for almost any service condition

New Style 9200

Benefits

Improved sealability

- Nylon-reinforced nitrile rubber resists leakage
  - No measurable leakage in ASTM F-37 test for nitrogen sealability
  - Resists extrusion; seals at very low compressive stress
- Ideal replacement for cloth-inserted rubber in water applications

Typical Physical Properties

Style No.	19	7992	8798	9200
Material	SBR rubber with 5.0 oz. cotton sheeting with 1/32" thickness as fabric insert; 10.8 oz. cotton chafer in all others	Neoprene with 22 oz. hose duck fabric insert	Neoprene with 13 oz. nylon fabric insert	Nitrile with proprietary nylon insert†
Rubber hardness (Shore A) ±5	80	50	70	70
Burst test across 2" (50 mm) dia. opening, psi (bar)	Not recommended for use as diaphragm material	290 (20) 1/8" – 1 ply	1,000 (7) 1/8" – 1 ply	Not recommended for use as diaphragm material
Number of plies	1/32", 1/16", 3/32": 1 ply 1/8": 2 ply; 3/16": 3 ply 1/4": 4 ply	1/16", 3/32", 1/8": 1 ply 3/16": 2 ply 1/4": 3 ply	1/16", 3/32", 1/8": 1 ply 3/16": 2 ply 1/4": 3 ply	1/16", 1/8": 1 ply
Thickness available	1/32", 1/16", 3/32", 1/8", 3/16", 1/4"	1/16", 3/32", 1/8", 3/16", 1/4"	1/16", 3/32", 1/8", 3/16", 1/4"	1/16", 1/8"
Width available	48"	48"	48"	48"
Finish available	Thru 1/8": Cloth Over 1/8": Smooth	Smooth	Thru 1/8": Cloth Over 1/8": Smooth	Thru 1/8": Cloth Over 1/8": Smooth
Temperature, max.	200°F (95°C)	250°F (120°C)	250°F (120°C)	250°F (120°C)
Internal pressure, max. psig (bar)	250 (17)	NA	NA	250 (17)

† Special insert completely eliminates weepage through insert.

ASTM D2000 Line Callouts

Style	ASTM Line Callout*
19	2AA810A13
7992	2BC520A14B14E014E034F17
8798	3BC715A14E014E034
9200	2BG720EA14E014

* For rubber compound only, not fabric.

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Vegetable Fiber Gasketing

Typical Physical Properties*

		660	670	681
Material		Vegetable fiber with cork granules and glue-glycerin binder	Cellulose fiber with cork, nitrile rubber	Vegetable fiber with glue-glycerin binder
Temperature, max.		+212°F (+100°C)	+300°F (+149°C)	+212°F (+100°C)
Pressure, max	psig (bar)	200 (15)	—	200 (15)
P x T, max.	psig x °F (bar x °C)	40,000 (1,300)	—	40,000 (1,300)
Widths available (standard)	inches	36	43	36
Thicknesses available	inches	0.010, 1/64, 0.021, 1/32, 3/64, 1/16, 3/32, 1/8, 3/16, 1/4	1/64, 1/32, 1/16, 1/8	0.006, 0.010, 1/64, 0.021, 1/32, 3/64, 1/16, 3/32, 1/8, 3/16, 1/4
Fluid Resistance[1]				
ASTM IRM #903 Oil				
Thickness increase	max. %	5	25	5
Weight increase	max. %	30	95	15
ASTM Fuel B				
Thickness increase	max. %	5	25	5
Weight increase	max. %	30	85	15
Distilled Water				
Thickness increase	max. %	30	45	30
Weight increase	max. %	100	70	90
Compressibility at 1,000 psi	Range %	40-55	30-50	25-40
Recovery	%	>40	>30	>40
Tensile Strength, min.	psi (N/mm^2)	1,000 (7)	800 (6)	2,000 (14)
Meets Specifications		ASTM-D-1170-62T, Grade P-3415-A; SAE J90, Grade P-3415-A; MIL-G-12803C, Grade P-3415-A		ASTM-D-1170-62T, Grade P-3313-B; SAE J90, Grade P-3313-B; MIL-G-12803C, Grade P-3313-B; HH-P-96F Type 1

[1] Gasket materials are immersed in fluids for 22 hours at 70°-85°F (21-29°C).

*** Values do not constitute specification limits**

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Vegetable Fiber Tolerances on Thicknesses

Thickness	Tolerance	Thickness	Tolerance
0.006"	± 0.0035"	0.062"	± 0.005"
0.010"	± 0.0035"	0.096" (3/32")	± 0.008"
0.015"	± 0.0035"	0.125"	± 0.016"
0.021"	± 0.005"	0.187"	± 0.016"
0.031"	± 0.005"	0.250"	± 0.016"
0.046"	± 0.005"		

Factors Affecting Gasket Performance

A gasket has one basic function: to create a positive seal between two relatively stationary parts. The gasket must do a number of different jobs well to function properly: first, create an initial seal; second, maintain the seal over a desired length of time; third, be easily removed and replaced. Varying degrees of success are dependent on how well the gasket does the following:

1. Seals system fluid.
2. Chemically resists the system fluid to prevent serious impairment of its physical properties.
3. Deforms enough to flow into the imperfections on the gasket seating surfaces to provide intimate contact between the gasket and the seating surfaces.
4. Withstands system temperatures without serious impairment of its performance properties.
5. Is resilient and resists creep enough to maintain an adequate portion of the applied load.
6. Has sufficient strength to resist crushing under the applied load, and maintain its integrity when being handled and installed.
7. Does not contaminate the system fluid.
8. Does not promote corrosion of the gasket seating surfaces.
9. Is easily and cleanly removable at the time of replacement.

During the gasket product selection process that follows, we recommend that these nine (9) factors be used as a checklist from the viewpoint of the user's degree of need for each factor and the manufacturer's degree of compliance.

Questions? Call Gasket Applications Engineering at 1-800-448-6688

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Gasket Selection

Selecting gasketing materials for particular applications is not an easy task. The variables present in a flanged connection seem endless and yet all of them must be taken into consideration to assure a proper seal. In the past, the acronym "TAMP" (Temperature, Application, Media and Pressure) seemed to give sufficient information to make a gasketing recommendation. Today, items such as: the flange metallurgy, the amount of bolt thread embedment, the amount of flange rotation, the amount of bolt stretch, the additives to the media and the flange surface finish (in addition to other variables) determine how well a gasket will perform. In general, the definition of what a seal is has changed drastically over the years. Leakage measurements have gone from drips a minute to parts per million.

This catalog is designed to help guide you through the various gasketing products and narrow your choices. All industry standard tests are included in order to allow an end user a means of comparison between different materials. Many of the test procedures require that the tests be conducted on 1/32" material. As a rule of thumb, gasket performance decreases as material thickness increases. In addition, compressive loads must be increased with thicker materials. Proper bolting sequences are necessary to ensure those compressive loads are uniform. The temperature, pressure and P x T ratings are all based on optimum conditions. When approaching those extremes, it is suggested that you consult with the Garlock Applications Engineering Department or possibly upgrade to a material that has higher ratings.

As industry standards change and new products are introduced, this catalog will be updated. In the meantime, we urge you to take advantage of our experienced personnel for assistance. In-plant training, instructional video tapes, additional technical information and gasketing recommendations all are available to help in your selection process. Please feel free to call, fax, write, or e-mail us should you have any questions or concerns. Garlock is here to help.

Temperature

In most selection processes, the temperature of the fluid at the gasketed joint should be considered first. This will reduce the number of product candidates quickly, especially as temperatures go from 200°F (95°C) to 1,000°F (540°C). When system operating temperatures approach a particular gasket material's maximum continuous operating temperature limit, an upgrade to a superior material is suggested. In some situations cryogenic temperatures must also be considered.

Application

The most important information under Application is the type of flange and bolts used. The number, size and grade of bolts used in the application determines the load available. The surface area being compressed is calculated from the gasket contact dimensions. The load from the bolts and the contact area of the gasket result in the compressive load available to seal the gasket. We have calculated and tabulated this information on standard ANSI raised face flanges (see page C-45). Compressive stress available on non-standard flanges must be calculated on an individual basis. Without this information, we cannot choose between various types of materials such as elastomeric (rubber) gaskets, compressed sheet, GRAPH-LOCK® and GYLON® styles.

Media

There are thousands of different fluids. We cannot, in this manual, make recommendations for all fluids. Fortunately, however, there are a relatively limited number of fluids that make up the vast majority of the media encountered in industry. A general overview of fluid compatibility is provided for the most popular styles shown in this manual (see Chemical Resistance chart, pages C-26 to C-38). System cleanout and flushes should also be considered. Additional information on products versus fluids is available upon request.

Pressure

Next to be considered is the internal pressure of the fluid at the gasketed joint. We list the maximum pressure limits for each style. If severe and frequent pressure changes are involved, we should be given the details, since an alternative product may be needed.

Pressure (psi or bar) x Temperature (°F or °C)

We strongly recommend that pressure and temperature be considered simultaneously by using the following procedure:

1. First select the Garlock style(s) being considered for your application/service,
2. List the maximum pressure, temperature and P x T value for the style(s),
3. Make sure the actual service conditions do not exceed the style limitations in any of the three criteria. If they don't, the style(s) can be used, provided all other requirements are met. If they do exceed any one limit, another style or styles should be considered. Rarely can a style be recommended when the service conditions of pressure and temperature are both at the maximum limits for that style.

Example: BLUE-GARD® Compressed Asbestos-free Gasketing Style 3000

1.	Pressure Limit:	1,000 psig (70 bar)
2.	Maximum Temperature Limit: Continuous Operating Temp.:	700°F (370°C); 400°F (205°C)
3.	P x T Limit:	350,000* (12,000)

At 1,000 psig (70 bar), maximum temperature is 350°F (180°C).

Important

Maximum pressure and P x T ratings are based on the use of ANSI RF flanges at our preferred torque. The ratings were developed using laboratory tests at ideal gasketing conditions. Field conditions will undoubtedly affect the gasket performance.

We hasten to point out that this method for gasket selection is merely a general guide and should not be the sole means for selecting or rejecting a product.

* P x T based on 1/16" sheet thickness unless otherwise stated.

Garlock Gaskets®

Chemical Resistance of Garlock Compressed Sheet and GYLON®

A general guide for selection of gasketing material

Key: A = Suitable
B = Depends on operating conditions
C = Unsuitable
– = No data or insufficient evidence

Footnotes explained on page C-38.

Medium	Garlock Style Number													
	GYLON®													
	3500	3504 3565 3594	3510 3591	3560	3561	3535 3540 3545	3530	IFG 5500 G-9900 9850	9800	ST-706	2900[14] 3000	2920 3200 3400	2930 3300 3800	IFG 5507 3700
Abietic Acid	A	A	A	A	A	A	A	A	–	A	A	–	–	–
Acetaldehyde	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Acetamide	A	A	A	A	A	A	A	A	C	A	A	C	A	B
Acetic Acid (Crude, Glacial, Pure)	A	A	A	A	A	A	A	B[1]	B[1]	B[1]	B[1]	B[1]	B[1]	B[1]
Acetic Anhydride	A	A	A	A	A	A	A	B[1]	B[1]	B[1]	B[1]	B[1]	B[1]	B[1]
Acetone	A	A	A	A	A	A	A	C	B	C	C	B	B	A
Acetonitrile	A	A	A	A	A	A	A	C	–	C	C	–	B	B
Acetophenone	A	A	A	A	A	A	A	C	C	C	C	C	C	B
2-Acetylaminofluorene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Acetylene	A	A	A	A	A	A	A	A	B	A	A[12]	B	A	B
Acrolein	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	B[1]	C	B[1]	B[1]	C	B[1]	B[1]
Acrylamide	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Acrylic Acid	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	B[1]
Acrylic Anhydride	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	–	–	–	–	–	–	–
Acrylonitrile	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Air	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Allyl Acetate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Allyl Chloride	A	A	A	B	B	A	A	C	C	C	C	C	C	B
Allyl Methacrylate	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Aluminum Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Aluminum Fluoride	C	–	A	C	C	A	A	C	C	C	C	C	C	C
Aluminum Hydroxide (Solid)	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Aluminum Nitrate	A	A	A	A	A	A	–	B	B	B	B	B	B	B
Aluminum Sulfate	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Alums	A	A	A	B	B	A	A	A	A	A	A	A	A	A
4-Aminodiphenyl	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ammonia, Gas, 150°F and below	A	A	A	A	A	A	A	A	A	B	A	A	A	A
Gas, Above 150°F	A	A	A	A	A	A	A	C	C	C	C	C	B	B
Liquid, Anhydrous	A	A	A	A	A	A	A	B	–	B	B	–	A	A
Ammonium Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Ammonium Hydroxide	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ammonium Nitrate	A	A	A	A	A	A	–	B	B	B	B	B	B	B
Ammonium Phosphate, Monobasic	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Dibasic	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Tribasic	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ammonium Sulfate	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Amyl Acetate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Amyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Aniline, Aniline Oil	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Aniline Dyes	A	A	A	A	A	A	A	C	B	C	C	B	B	B
o-Anisidine	A	A	A	A	A	A	A	C	C	C	C	C	C	C

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	GYLON®													
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Aqua Regia	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Aroclors	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Asphalt	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Aviation Gasoline	A	A	A	A	A	A	A	B	C	B	B	C	B	C
Barium Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Barium Hydroxide	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium Sulfide	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Baygon	A	A	A	A	A	A	A	C	C	C	C	C	–	–
Beer[10]	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Benzaldehyde	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Benzene, Benzol	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Benzidine	A	A	A	A	A	A	A	C	C	C	C	C	C	–
Benzoic Acid	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Benzonitrile	A	A	A	A	A	A	A	C	–	C	C	–	–	C
Benzotrichloride	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Benzoyl Chloride	A	A	A	–	–	A	A	C	–	C	C	–	C	C
Benzyl Alcohol	A	A	A	A	A	A	A	C	–	C	C	–	B	B
Benzyl Chloride	A	A	A	–	–	A	A	C	C	C	C	C	C	B
Biphenyl	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Bis(2-chloroethyl)ether	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Bis(chloromethyl)ether	A	A	A	–	–	A	A	C	C	C	C	C	C	B
Bis(2-ethylhexyl)phthalate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Black Sulfate Liquor	C	A	A	C	A	A	A	C	C	C	C	C	C	C
Blast Furnace Gas	A	A	A	A	A	A	A	B	C	B	B	C	B	C
Bleach (Sodium Hypochlorite)	A	A	A	B	B	A	–	C	–	C	C	–	C	C
Boiler Feed Water	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Borax	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Boric Acid	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Brine (Sodium Chloride)	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Bromine	A	A	A	C	C	A	–	C	C	C	C	C	C	C
Bromine Trifluoride	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Bromoform	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Bromomethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Butadiene	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	–	C
Butane	A	A	A	A	A	A	A	A	C	B	A[12]	C	B	C
2-Butanone	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Butyl Acetate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Butyl Alcohol, Butanol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
n-Butyl Amine	A	A	A	A	A	A	A	B	–	B	B	–	C	B
tert-Butyl Amine	A	A	A	A	A	A	A	B	–	B	B	–	C	B
Butyl Methacrylate	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Butyric Acid	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Calcium Bisulfite	A	A	A	A	A	A	A	B	–	B	B	–	B	C
Calcium Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Calcium Cyanamide	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Calcium Hydroxide	–	A	A	–	A	A	A	A	A	A	A	A	A	A
Calcium Hypochlorite	A	A	A	B	B	A	–	B	B	B	C	C	C	C[2]

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Calcium Nitrate	A	A	A	–	–	A	C	–	–	–	–	–	–	–
Calflo AF	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Calflo FG	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Calflo HTF	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Calflo LT	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Cane Sugar Liquors	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Caprolactam	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Captan	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Carbaryl	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Carbolic Acid, Phenol	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Carbon Dioxide, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Wet	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Carbon Disulfide	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Carbon Monoxide	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Carbon Tetrachloride	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Carbonic Acid	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Carbonyl Sulfide	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Castor Oil	A	A	A	A	A	A	A	A	C	A	A	C	B	B
Catechol	A	A	A	A	A	A	A	C	B	C	C	B	–	–
Caustic Soda	C	B	A[6]	C	A[6]	A[11]	A[6]	C	C	C	C	C	C	C
Cetane (Hexadecane)	A	A	A	A	A	A	A	A	C	A	A	C	B	C
China Wood Oil	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Chloramben	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Chlorazotic Acid (Aqua Regia)	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Chlordane	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Chlorinated Solvents, Dry	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Wet	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Chlorine, Dry	A	A	A	A	A	A	A	–	–	–	–	–	–	–
Wet	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Chlorine Dioxide	A	A	A	–	–	A	C	C	C	C	C	C	C	C
Chlorine Trifluoride	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Chloroacetic Acid	A	A	A	C	C	A	A	C	B	C	C	B	C	B
2-Chloroacetophenone	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Chloroazotic Acid (Aqua Regia)	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Chlorobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Chlorobenzilate	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Chloroethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Chloroethylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Chloroform	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Chloromethyl Methyl Ether	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Chloronitrous Acid (Aqua Regia)	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Chloroprene	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Chlorosulfonic Acid	A	A	A	–	–	A	–	C	C	C	C	C	C	C
Chrome Plating Solutions	–[5]	–[5]	A	–[5]	B	A	A	C	C	C	C	C	C	C
Chromic Acid	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Chromic Anhydride	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Chromium Trioxide	A	A	A	B	B	A	C	C	C	C	C	C	C	C

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Citric Acid	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Coke Oven Gas	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Copper Chloride	A	A	A	C	C	A	A	A	A	A	A	A	A	A
Copper Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Corn Oil[10]	A	A	A	A	A	A	A	A	C	A	A	C	B	B
Cotton Seed Oil[10]	A	A	A	A	A	A	A	A	C	A	A	C	B	B
Creosote	A	A	A	A	A	A	A	B	C	B	B	C	B	C
Cresols, Cresylic Acid	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Crotonic Acid	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Crude Oil	A	A	A	B	B	A	A	A	B	A	A[12]	B	B	C
Cumene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Cyclohexane	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Cyclohexanone	A	A	A	A	A	A	A	C	C	C	C	C	C	B
2,4-D, Salts and Esters	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Detergent Solutions	B	B	A	B	A	A	A	A	B	A	A	B	B	A
Diazomethane	A	A	A	A	A	A	A	–	–	–	–	–	–	–
Dibenzofuran	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dibenzylether	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1,2-Dibromo-3-chloropropane	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Dibromoethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dibutyl Phthalate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Dibutyl Sebacate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
o-Dichlorobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1,4-Dichlorobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
3,3-Dichlorobenzidene	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Dichloroethane (1,1 or 1,2)	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1,1-Dichloroethylene	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Dichloroethyl Ether	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Dichloromethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1,2-Dichloropropane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1,3-Dichloropropene	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Dichlorvos	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Diesel Oil	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Diethanolamine	A	A	A	A	A	A	A	B	B	B	B	B	B	B
N,N-Diethylaniline	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Diethyl Carbonate	A	A	A	–	–	A	A	C	–	C	C	–	C	–
Diethyl Sulfate	A	A	A	A	A	A	A	C	C	C	C	C	–	C
3,3-Dimethoxybenzidene	A	A	A	A	A	A	A	C	C	C	C	C	–	–
Dimethylaminoazobenzene	A	A	A	A	A	A	A	–	–	–	–	–	–	–
N,N-Dimethyl Aniline	A	A	A	–	–	A	A	C	C	C	C	C	C	C
3,3-Dimethylbenzidine	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dimethyl Carbamoyl Chloride	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Dimethyl Ether	A	A	A	A	A	A	A	B	C	B	B	C	B	B
Dimethylformamide	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Dimethyl Hydrazine, Unsymmetrical	A	A	A	A	A	A	A	C	B	C	C	B	B	B
Dimethyl Phthalate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Dimethyl Sulfate	A	A	A	A	A	A	A	C	C	C	C	C	–	C

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4,6-Dinitro-o-Cresol and Salts	A	A	A	A	A	A	A	C	C	C	C	C	C	C
2,4-Dinitrophenol	A	A	A	–	–	A	A	C	C	C	C	C	C	C
2,4-Dinitrotoluene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dioxane	A	A	A	A	A	A	A	C	C	C	C	C	C	B
1,2-Diphenylhydrazine	A	A	A	A	A	A	A	C	B	C	C	B	–	–
Diphyl DT	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowfrost	A	A	A	A	A	A	A	B	B	B	B	B	–	B
Dowfrost HD	A	A	A	A	A	A	A	B	B	B	B	B	–	B
Dowtherm 4000	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Dowtherm A	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowtherm E	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowtherm G	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowtherm HT	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowtherm J	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowtherm Q	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Dowtherm SR-1	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Epichlorohydrin	A	A	A	A	A	A	A	C	C	C	C	C	C	B
1,2-Epoxybutane	A	A	A	A	A	A	A	–	C	–	–	C	C	C
Ethane	A	A	A	A	A	A	A	A	B	B	A[12]	B	B	C
Ethers	A	A	A	A	A	A	A	B	C	B	B	C	B	B
Ethyl Acetate	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ethyl Acrylate	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	B[1]
Ethyl Alcohol[10]	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethylbenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ethyl Carbamate	A	A	A	A	A	A	A	C	C	C	C	C	B	B
Ethyl Cellulose	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethyl Chloride	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ethyl Ether	A	A	A	A	A	A	A	B	C	B	B	C	B	B
Ethyl Hexoate	A	A	A	A	A	A	A	C	–	C	C	–	–	B
Ethylene	A	A	A	A	A	A	A	A	B	B	A	B	B	C
Ethylene Bromide	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ethylene Dibromide	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ethylene Dichloride	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ethylene Glycol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethyleneimine	–	–	A	–	–	A	A	C	C	C	C	C	C	C
Ethylene Oxide	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Ethylene Thiourea	A	A	A	A	A	A	A	–	–	–	–	–	C	C
Ethylidine Chloride	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Ferric Chloride	A	A	A	C	C	A	A	A	A	A	B	B	B	B[4]
Ferric Phosphate	A	A	A	–	–	A	A	B	B	B	B	B	B	B
Ferric Sulfate	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Fluorine, Gas	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Fluorine, Liquid	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Fluorine Dioxide	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Formaldehyde	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	B[1]	A[1]	A[1]	B[1]	B[1]	A[1]
Formic Acid	A	A	A	B	B	A	A	C	–	C	C	–	B	B
Fuel Oil	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C

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Fuel Oil, Acid	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Furfural	A	A	A	A	A	A	A	C	C	C	C	C	B	B
Gasoline, Refined	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Sour	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Gelatin	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glucose	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glue, Protein Base	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glycerine, Glycerol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glycol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Grain Alcohol[10]	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Grease, Petroleum Base	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Green Sulfate Liquor	C	A	A	–	A	A	A	C	C	C	C	C	C	C
Heptachlor	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Heptane	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Hexachlorobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Hexachlorobutadiene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Hexachlorocyclopentadiene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Hexachloroethane	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Hexadecane	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Hexamethylene Diisocyanate	A	A	A	A	A	A	A	–	C	–	–	C	–	C
Hexamethylphosphoramide	A	A	A	A	A	A	A	–	C	–	–	C	–	–
Hexane	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Hexone	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Hydraulic Oil, Mineral	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Synthetic	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Hydrazine	A	A	A	A	A	A	A	C	B	C	C	B	B	B
Hydrobromic Acid	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Hydrochloric Acid	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Hydrocyanic Acid	A	A	A	A	A	A	A	A	B	A	A	B	B	A
Hydrofluoric Acid, up to Anhydrous, 150°F & below	C	C	A	C	C	A	A	C	C	C	C	C	C	C
Less than 65%, Above 150°F	C	C	A	C	C	A	A	C	C	C	C	C	C	C
65% to Anhydrous, Above 150°F	C	C	–	C	C	A	A	C	C	C	C	C	C	C
Anhydrous	C	C	C	C	C	A	A	C	C	C	C	C	C	C
Hydrofluorosilicic Acid	C	C	A	C	C	A	A	C	C	C	C	C	C	C
Hydrofluosilicic Acid	C	C	A	C	C	A	A	C	C	C	C	C	C	C
Hydrogen	A	A	A	A	A	A	A	A	A	B	A	A	A	A
Hydrogen Bromide	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Hydrogen Fluoride	C	C	C	C	C	A	A	C	C	C	C	C	C	C
Hydrogen Peroxide, 10%	A	A	A	A	A	A	A	B	B	B	B	B	B	B
10-90%	A	A	A	B	B	A	C	B	–	B	B	–	C	B
Hydrogen Sulfide, Dry or Wet	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Hydroquinone	A	A	A	A	A	A	A	C	B	C	C	B	C	C
Iodine Pentafluoride	–	–	–	–	–	–	C	C	C	C	C	C	C	C
Iodomethane	A	A	A	A	A	A	A	C	C	C	C	C	B	–
Isobutane	A	A	A	A	A	A	A	A	C	B	A[12]	C	B	C
Isooctane	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Isophorone	A	A	A	A	A	A	A	C	C	C	C	C	C	B

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Isopropyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Jet Fuels (JP Types)	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Kerosene	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Lacquer Solvents	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Lacquers	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Lactic Acid, 150°F and below	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Above 150°F	A	A	A	A	A	A	A	–	–	–	–	–	–	–
Lime Saltpeter (Calcium Nitrates)	A	A	A	–	–	A	C	B	B	B	B	B	B	B
Lindane	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Linseed Oil	A	A	A	A	A	A	A	A	B	A	A	B	A	B
Liquified Petroleum Gas (LPG)	A	A	A	A	A	A	A	A	B	C	A[12]	B	B	C
Lithium Bromide	A	A	A	A	A	A	A	A	–	A	A	–	A	A
Lithium, Elemental	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Lubricating Oils, Mineral or Petroleum Types	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Refined	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Sour	A	A	A	A	A	A	A	B	B	B	B	B	B	C
Lye	C	B	A[6]	C	A[6]	A[11]	A[6]	C	C	C	C	C	C	C
Magnesium Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Magnesium Hydroxide	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Magnesium Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Maleic Acid	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Maleic Anhydride	A	A	A	A	A	A	A	C	–	C	C	–	C	C
Mercuric Chloride	A	A	A	C	C	A	A	A	A	A	A	A	B	A
Mercury	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Methane	A	A	A	A	A	A	A	A	B	B	A	C	B	C
Methanol, Methyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Methoxychlor	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Methylacrylic Acid	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Methyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2-Methylaziridine	–	–	A	–	–	A	A	C	C	C	C	C	C	C
Methyl Bromide	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Methyl Chloride	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Methyl Chloroform	A	A	A	A	A	A	A	C	C	C	C	C	C	C
4,4 Methylene Bis(2-chloroaniline)	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Methylene Chloride	A	A	A	A	A	A	A	C	C	C	C	C	C	C
4,4-Methylene Dianiline	A	A	A	A	A	A	A	C	C	C	C	C	C	–
Methylene Diphenyldiisocyanate	A	A	A	–	–	A	A	C	C	C	C	C	C	–
Methyl Ethyl Ketone	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Methyl Hydrazine	A	A	A	A	A	A	A	C	B	C	C	B	B	B
Methyl Iodide	A	A	A	A	A	A	A	C	C	C	C	C	B	–
Methyl Isobutyl Ketone (MIBK)	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Methyl Isocyanate	A	A	A	A	A	A	A	–	C	–	–	C	–	–
Methyl Methacrylate	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
N-Methyl-2-Pyrrolidone	A	A	A	A	A	A	A	C	B	C	C	B	–	–
Methyl Tert. Butyl Ether (MTBE)	A	A	A	A	A	A	A	B	C	B	B	B	C	C
Milk[10]	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Mineral Oils	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C

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Mobiltherm 600	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Mobiltherm 603	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Mobiltherm 605	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Mobiltherm Light	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Molten Alkali Metals	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Monomethylamine	A	A	A	A	A	A	A	C	B	C	C	B	A	B
MultiTherm 100	A	A	A	A	A	A	A	A	C	A	A	C	B	C
MultiTherm 503	A	A	A	A	A	A	A	A	C	A	A	C	–	C
MultiTherm IG-2	A	A	A	A	A	A	A	A	C	A	A	C	B	C
MultiTherm PG-1	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Muriatic Acid	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Naphtha	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Naphthalene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Naphthols	A	A	A	–	–	A	A	–	–	–	–	–	–	–
Natural Gas	A	A	A	A	A	A	A	A	B	B	A[12]	B	B	B
Nickel Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Nickel Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nitric Acid, Less than 30%	A	A	A	A	A	A	C	C	C	C	C	C	C	C
Above 30%	A	A	A	A	A	A	C	C	C	C	C	C	C	C
Crude	A	A	A	–	–	A	C	C	C	C	C	C	C	C
Red Fuming	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Nitrobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
4-Nitrobiphenyl	A	A	A	A	A	A	A	C	C	C	C	C	C	C
2-Nitro-Butanol	A	A	A	–	–	A	–	C	–	C	C	–	C	–
Nitrocalcite (Calcium Nitrate)	A	A	A	–	–	A	C	B	B	B	B	B	B	B
Nitrogen	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nitrogen Tetroxide	A	A	A	–	–	A	–	C	C	C	C	C	C	C
Nitrohydrochloric Acid (Aqua Regia)	A	A	A	B	B	A	C	C	C	C	C	C	C	C
Nitromethane	A	A	A	A	A	A	A	C	–	C	C	–	C	–
2-Nitro-2-Methyl Propanol	A	A	A	–	–	A	–	C	–	C	C	–	C	–
Nitromuriatic Acid (Aqua Regia)	A	A	A	B	B	A	C	C	C	C	C	C	C	C
4-Nitrophenol	A	A	A	–	–	A	A	C	C	C	C	C	C	C
2-Nitropropane	A	A	A	A	A	A	A	C	–	C	C	–	C	C
N-Nitrosodimethylamine	A	A	A	A	A	A	A	B	B	B	B	B	–	–
N-Nitroso-N-Methylurea	A	A	A	–	–	A	A	–	–	–	–	–	–	–
N-Nitrosomorpholine	A	A	A	A	A	A	A	C	–	C	C	–	C	–
Norge Niter (Calcium Nitrate)	A	A	A	–	–	A	C	B	B	B	B	B	B	B
Norwegian Saltpeter (Calcium Nitrate)	A	A	A	–	–	A	C	B	B	B	B	B	B	B
N-Octadecyl Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	–	A
Octane	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Oil, Petroleum	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Oils, Animal and Vegetable[10]	A	A	A	A	A	A	A	A	C	A	A	C	B	B
Oleic Acid	A	A	A	A	A	A	A	B	–	B	B	–	C	C
Oleum	A	–	C	C	C	A	–	C	C	C	C	C	C	C
Orthodichlorobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Oxalic Acid	A	A	A	B	B	A	A	C	–	C	C	–	B	B
Oxygen, Gas	See Note 7							C	C	C	C	C	C	C

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Ozone	A	A	A	A	A	A	C	C	C	C	C	C	C	C
Palmitic Acid	A	A	A	A	A	A	A	A	B	A	A	B	B	A
Paraffin	A	A	A	A	A	A	A	A	B	A	A	B	B	C
Paratherm HE	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Paratherm NF	A	A	A	A	A	A	A	A	C	A	A	C	–	C
Parathion	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Paraxylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Pentachloronitrobenzene	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Pentachlorophenol	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Pentane	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Perchloric Acid	A	A	A	C	C	A	C	C	C	C	C	C	C	C
Perchloroethylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Petroleum Oils, Crude	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Refined	A	A	A	A	A	A	A	A	B	A	A[12]	B	B	C
Phenol	A	A	A	A	A	A	A	C	C	C	C	C	C	B
p-Phenylenediamine	A	A	A	A	A	A	A	C	C	C	C	C	–	–
Phosgene	A	A	A	B	B	A	A	C	–	C	C	–	–	B
Phosphate Esters	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Phosphine	A	A	A	A	A	A	A	–	–	–	–	–	–	–
Phosphoric Acid, Crude	C	C	A	C	B	A	A	C	C	C	C	C	C	C
Pure, Less than 45%	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Pure, Above 45%, 150°F and below	B	B	A	B	B	A	A	C	C	C	C	C	C	C
Pure, Above 45%, Above 150°F	C	B	A	C	B	A	A	C	C	C	C	C	–	–
Phosphorus, Elemental	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Phosphorus Pentachloride	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Phthalic Acid	A	A	A	A	A	A	A	C	–	C	C	–	B	–
Phthalic Anhydride	A	A	A	A	A	A	A	C	–	C	C	–	C	B
Picric Acid, Molten	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Water Solution	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Pinene	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Piperidine	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Polyacrylonitrile	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Polychlorinated Biphenyls	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Potash, Potassium Carbonate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Acetate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Bichromate	A	A	A	A	A	A	C	A	B	A	A	B	B	A
Potassium Chromate, Red	A	A	A	A	A	A	C	A	B	A	A	B	B	A
Potassium Cyanide	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium Dichromate	A	A	A	A	A	A	C	A	B	A	A	B	B	A
Potassium, Elemental	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Potassium Hydroxide	C	B	A[6]	C	A[6]	A[11]	A[6]	C	C	C	C	C	C	C
Potassium Nitrate	A	A	A	A	A	A	–	B	B	B	B	B	B	B
Potassium Permanganate	A	A	A	A	A	A	–	B	–	B	B	–	B	B
Potassium Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Producer Gas	A	A	A	A	A	A	A	A	C	B	A[12]	C	B	C
Propane	A	A	A	A	A	A	A	A	C	B	A[12]	C	B	C
1,3-Propane Sultone	A	A	A	–	–	A	A	–	–	–	–	–	–	–

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Beta-Propiolactone	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Propionaldehyde	A	A	A	A	A	A	A	C	C	C	C	C	–	–
Propoxur (Baygon)	A	A	A	A	A	A	A	C	C	C	C	C	–	–
Propyl Alcohol	A	A	A	A	A	A	A	A	A	A	A[12]	A[12]	A[12]	A[12]
Propyl Nitrate	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Propylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Propylene Dichloride	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Propylene Glycol	A	A	A	A	A	A	A	A	A	A	A	A	–	A
Propylene Oxide	A	A	A	A	A	A	A	C	C	C	C	C	C	B
1,2-Propylenimine	–	–	A	–	–	A	A	C	C	C	C	C	C	C
Prussic Acid, Hydrocyanic Acid	A	A	A	A	A	A	A	A	B	A	A	B	B	A
Pyridine	A	A	A	B	B	A	A	C	C	C	C	C	C	B
Quinoline	A	A	A	B	B	A	A	C	C	C	C	C	C	C
Quinone	A	A	A	A	A	A	–	–	–	–	–	–	–	–
Refrigerants	See Specific Ratings Below													
10	A	A	A	B	B	A	A	C	C	C	C	C	C	C
11	A	A	A	A	A	A	A	A	C	B	A	C	C	C
12	A	A	A	A	A	A	A	A	A	B	A	A	A	A
13	A	A	A	A	A	A	A	A	A	B	A	A	A	A
13B1	A	A	A	A	A	A	A	A	A	B	A	A	A	A
21	A	A	A	A	A	A	A	C	C	C	C	C	A	C
22	A	A	A	A	A	A	A	B	B	B	B	B	A	A
23	A	A	A	A	A	A	A	C	A	C	C	A	A	A
31	A	A	A	A	A	A	A	C	A	C	C	A	A	A
32	A	A	A	A	A	A	A	A	A	B	A	A	A	A
112	A	A	A	A	A	A	A	A	C	B	A	C	A	C
113	A	A	A	A	A	A	A	A	A	B	A	A	A	C
114	A	A	A	A	A	A	A	A	A	B	A	A	A	A
114B2	A	A	A	A	A	A	A	A	C	B	A	C	A	C
115	A	A	A	A	A	A	A	A	A	B	A	A	A	A
123	A	A	A	A	A	A	A	C[3]	C	C[3]	C[3]	C	A[3]	C
124	A	A	A	A	A	A	A	C	A	C	C	A	A	A
125	A	A	A	A	A	A	A	–	A	–	–	A	A	A
134a	A	A	A	A	A	A	A	B	A	B	B	A	A	A
141b	A	A	A	A	A	A	A	A	–	B	A	–	A	–
142b	A	A	A	A	A	A	A	A	A	B	A	A	A	A
143a	A	A	A	A	A	A	A	–	A	–	–	A	A	A
152a	A	A	A	A	A	A	A	A	A	B	A	A	A	A
218	A	A	A	A	A	A	A	A	A	B	A	A	A	A
290 (Propane)	A	A	A	A	A	A	A	A	C	B	A[12]	C	B	C
500	A	A	A	A	A	A	A	A	–	B	A	–	A	–
502	A	A	A	A	A	A	A	A	A	B	A	A	A	–
503	A	A	A	A	A	A	A	C	A	C	C	A	A	A
507	A	A	A	A	A	A	A	B	–	C	B	–	A	A
717 (Ammonia)	A	A	A	A	A	A	A	B	B	C	B	B	B	B
744 (Carbon Dioxide)	A	A	A	A	A	A	A	A	A	A	A	A	A	A
C316	A	A	A	A	A	A	A	A	A	B	A	A	A	A

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Chemical Resistance of Garlock Compressed Sheet and GYLON®

Medium	Garlock Style Number													
	GYLON®													
	3500	3504 3565 3594	3510 3591	3560	3561	3535 3540 3545	3530	IFG 5500 G-9900 9850	9800	ST-706	2900[14] 3000	2920 3200 3400	2930 3300 3800	IFG 5507 3700
C318	A	A	A	A	A	A	A	A	A	B	A	A	A	A
HP62	A	A	A	A	A	A	A	A	–	B	A	–	A	–
HP80	A	A	A	A	A	A	A	–	–	–	–	–	A	–
HP81	A	A	A	A	A	A	A	–	–	–	–	–	A	–
Salt Water	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Saltpeter, Potassium Nitrate	A	A	A	A	A	A	–	B	B	B	B	B	B	B
2,4-D Salts and Esters	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Sewage	A	A	A	A	A	A	A	A	B	A	A	B	B	B
Silver Nitrate	A	A	A	A	A	A	–	B	A	B	B	A	A	A
Skydrols	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Soap Solutions	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Soda Ash, Sodium Carbonate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Bicarbonate, Baking Soda	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Bisulfate, Dry	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Bisulfite	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Sodium Chlorate	A	A	A	A	A	A	A	C	–	C	C	–	C	C
Sodium Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Sodium Cyanide	C	C	A	C	C	A	A	C	C	C	C	C	C	C
Sodium, Elemental	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Sodium Hydroxide	C	B	A[6]	C	A[6]	A[11]	A[6]	C	C	C	C	C	C	C
Sodium Hypochlorite	A	A	A	B	B	A	–	C	–	C	C	–	C	C
Sodium Metaborate Peroxyhydrate	A	A	A	B	B	A	C	B	B	B	B	B	B	B
Sodium Metaphosphate	B	A	A	B	A	A	A	A	A	A	A	A	A	A
Sodium Nitrate	A	A	A	A	A	A	–	B	B	B	B	B	B	B
Sodium Perborate	A	A	A	B	B	A	C	B	B	B	B	B	B	B
Sodium Peroxide	A	A	A	A	A	A	C	C	C	C	C	C	C	C
Sodium Phosphate, Monobasic	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Dibasic	B	B	A	B	A	A	A	B	B	B	B	B	B	B
Tribasic	C	B	A	C	A	A	A	B	B	B	B	B	B	B
Sodium Silicate	B	B	A	B	A	A	A	B	B	B	B	B	B	B[4]
Sodium Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Sulfide	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Superoxide	A	A	A	A	A	A	C	C	C	C	C	C	C	C
Sodium Thiosulfate, "Hypo"	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Soybean Oil[10]	A	A	A	A	A	A	A	A	C	A	A	C	B	B
Stannic Chloride	A	A	A	C	C	A	A	B	B	B	B	B	–	B
Steam, Saturated, to 150 psig[13]	A	A	A	A	A	A	A	A[13]	A[13]	A[13]	B[9]	B[9]	B[9]	B[9]
Superheated	–	–	–	–	–	–	–	C	C	A	C	C	C	C
Stearic Acid	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Stoddard Solvent	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Styrene	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Styrene Oxide	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Sulfur Chloride	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Sulfur Dioxide	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Sulfur, Molten	A	A	A	A	A	A	A	C	C	C	C	C	B	C
Sulfur Trioxide, Dry	A	A	A	A	A	A	–	C	C	C	C	C	C	C
Wet	A	A	A	B	B	A	B	C	C	C	C	C	C	C

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Sulfuric Acid, 10%, 150°F and below	A	A	A	B	B	A	–	C	C	C	C	C	C	C
10%, Above 150°F	A	A	A	C	C	A	–	–	C	–	–	C	C	C
10-75%, 500°F and below	A	A	A	C	C	A	–	–	C	–	–	C	C	C
75-98%, 150°F and below	A	A	B	C	C	A	C	C	C	C	C	C	C	C
75-98%, 150°F to 500°F	A	B	B	C	C	A	C	C	C	C	C	C	C	C
Sulfuric Acid, Fuming	A	–	C	C	C	A	C	C	C	C	C	C	C	C
Sulfurous Acid	A	A	A	B	B	A	–	B	B	B	B	B	–	–
Syltherm 800	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Syltherm XLT	A	A	A	A	A	A	A	B	B	B	B	B	B	B
Tannic Acid	A	A	A	–[8]	–[8]	A	A	A	A	A	A	A	A	A
Tar	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Tartaric Acid	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2,3,7,8-TCDB-p-Dioxin	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Tertiary Butyl Amine	A	A	A	A	A	A	A	B	–	B	B	–	C	B
Tetrabromoethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Tetrachlorethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Tetrachloroethylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Tetrahydrofuran, THF	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol 44	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol 55	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol 59	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol 60	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol 66	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol 75	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol D12	A	A	A	A	A	A	A	B	C	B	B	C	B	C
Therminol LT	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol VP-1	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Therminol XP	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Thionyl Chloride	A	A	A	C	C	A	A	C	C	C	C	C	C	C
Titanium Sulfate	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Titanium Tetrachloride	A	A	A	C	C	A	A	B	C	B	C	C	C	C
Toluene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
2,4-Toluenediamine	A	A	A	A	A	A	A	–	C	–	–	C	C	C
2,4-Toluenediisocyanate	A	A	A	–	–	A	A	C	C	C	C	C	C	B
Toluene Sulfonic Acid	A	A	A	–	–	A	A	C	C	C	C	C	C	C
o-Toluidine	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Toxaphine	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Transformer Oil (Mineral Type)	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Transmission Fluid A	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Trichloroacetic Acid	A	A	A	C	C	A	A	C	C	C	C	C	C	C
1,2,4- Trichlorobenzene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
1,1,2-Trichloroethane	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Trichloroethylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
2,4,5-Trichlorophenol	A	A	A	–	–	A	A	C	C	C	C	C	C	C
2,4,6-Trichlorophenol	A	A	A	–	–	A	A	C	C	C	C	C	C	C
Tricresylphosphate	A	A	A	A	A	A	A	C	C	C	C	C	C	B
Triethanolamine	A	A	A	–	–	A	A	B	B	B	B	B	B	B

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Triethyl Aluminum	A	A	A	–	–	A	A	C	–	C	C	–	C	–
Triethylamine	A	A	A	A	A	A	A	B	B	B	B	B	B	A
Trifluralin	A	A	A	A	A	A	A	C	C	C	C	C	C	C
2,2,4-Trimethylpentane	A	A	A	A	A	A	A	A	C	A	A[12]	C	B	C
Tung Oil	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Turpentine	A	A	A	A	A	A	A	A	C	A	A[12]	C	C	C
UCON Heat Transfer Fluid 500	A	A	A	A	A	A	A	A	B	A	A	B	B	B
UCON Process Fluid WS	A	A	A	A	A	A	A	A	B	A	A	B	B	B
Urea, 150°F and below	A	A	A	A	A	A	A	B	–	–	B	–	A	A
Above 150°F	A	A	A	A	A	A	A	–	–	–	–	–	–	–
Varnish	A	A	A	A	A	A	A	B	C	B	B	C	C	C
Vegetable Oil[10]	A	A	A	A	A	A	A	A	C	A	A	C	B	B
Vinegar[10]	A	A	A	A	A	A	A	B	B	B	B	B	A	A
Vinyl Acetate	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	B[1]	C	B[1]	B[1]	C	B[1]	B[1]
Vinyl Bromide	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Vinyl Chloride	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Vinylidene Chloride	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	A[1]	C	C	C	C	C	C	C
Vinyl Methacrylate	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Water, Acid Mine, with Oxidizing Salt	A	A	A	C	C	A	–	B	–	B	B	–	B	–
No Oxidizing Salts	A	A	A	A	A	A	A	A	–	A	A	–	B	A
Water, Distilled	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Return Condensate	A	A	A	A	A	A	A	A	A	A	A	–	–	A
Seawater	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Tap	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Whiskey and Wines[10]	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Wood Alcohol	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Xceltherm 550	A	A	A	A	A	A	A	B	C	B	B	C	B	C
Xceltherm 600	A	A	A	A	A	A	A	A	C	A	A	C	B	C
Xceltherm MK1	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Xceltyherm XT	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Xylene	A	A	A	A	A	A	A	C	C	C	C	C	C	C
Zinc Chloride	A	A	A	B	B	A	A	A	A	A	A	A	A	A
Zinc Sulfate	A	A	A	A	A	A	A	A	A	A	A	A	A	A

Key: A = Suitable; B = Depends on operating conditions; C = Unsuitable; – = No data or insufficient evidence

NOTES:

1. Consult the factory regarding your specific applications. See "Monomers" in Gasketing Terms Section, page C-52.
2. IFG® Style 5507 is rated "B".
3. There have been conflicting field reports concerning the suitability of NBR and neoprene bound gaskets in 123. End users should take note.
4. IFG® Style 5507 is rated "A".
5. Some chromium plating baths contain fluorides that can attack silica and silicate type fillers in some GYLON® styles. If the bath is known to contain little or no fluoride, all GYLON® styles should be suitable for use.
6. These GYLON® styles can be expected to be suitable to 45-59% concentration at temperatures up to 250°F (121°C).
7. Use GYLON® styles 3502, 3503, 3505, 3562, 3563. These styles are specially processed, cleaned and packaged for oxygen service.
8. This GYLON® contains a stainless steel insert. There is a possibility that this might contribute traces of iron to form iron tannates, resulting in undesirable color in the tannic acid.
9. These styles are not preferred choices for steam service, but are successful when adequately compressed.
10. If a gasketing material that conforms to FDA requirements is desired, contact factory for specific recommendations.
11. These GYLON® gasket styles can be expected to be suitable to 75% concentration at temperatures up to 400°F (204°C).
12. Not a fire-tested material.
13. Minimum recommended assembly stress = 4,800 psi.
    Preferred assembly stress = 6,000-10,000 psi.
    Gasket thickness of 1/16" strongly preferred.
    For saturated steam above 150 psig, consult Garlock Engineering.
14. Styles 2900 and 2950 exhibit identical chemical resistance properties.

Call Gasket Applications Engineering at 1-800-448-6688 for specific recommendations.

Sheet Sizes and Tolerances

Compressed Gasketing

	60" x 60"						60" x 120"						60" x 180"						150" x 150"		
	1/64"	1/32"	3/64"	1/16"	3/32"	1/8"	1/64"	1/32"	3/64"	1/16"	3/32"	1/8"	1/64"	1/32"	3/64"	1/16"	3/32"	1/8"	1/32"	1/16"	1/8"
ST-706	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
IFG®	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
G-9900	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
9800 / 9850	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
BLUE-GARD®	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

GYLON® Gasketing

	60" x 60"						70" x 70"				60" x 90"			40" x 40"				24" x 24"		20" x 20"		
	1/64"	1/32"	1/16"	1/8"	3/16"	1/4"	1/32"	1/16"	1/8"	1/4"	1/32"	1/16"	1/8"	1/64"	1/32"	1/16"	1/8"	1/16"	1/8"	1/32"	1/16"	1/8"
Style 3500	■	■	■	■	■	■		■	■			■	■									
Style 3504			■	■	■	■		■	■	■		■	■		■							
Style 3510	■	■	■	■	■	■		■	■			■	■									
Style 3522																		■	■	■	■	■
Style 3530			■	■										■	■	■	■					
Style 3540		■	■	■	■	■	■	■	■		■	■	■		■							
Style 3545		■	■	■	■	■		■	■			■	■									
Style HP-3560																		■	■			
Style HP-3561																		■	■			
Style 3565		■	■	■	■	■		■	■	■		■	■									

Flexible Graphite Gasketing

	24" x 24"			39.4" x 39.4"			60" x 60"		
	1/32"	1/16"	1/8"	1/32"	1/16"	1/8"	1/32"	1/16"	1/8"
Style 3123	■	■		■	■		■	■	
Style 3124	■	■	■	■	■	■	■	■	■
Style 3125			■			■			■
Style 3125SS	■	■	■	■	■	■	■	■	■
Style 3125TC		■	■		■	■		■	■
Style 3126	■	■	■	■	■	■	■	■	■

Note: Tolerance is ±10% of thickness.

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Standard Commercial Tolerances of Compressed Fiber and GYLON® Gasketing

Nominal Thickness	Variation	Tolerance
1/64" (0.016")*	0.014" - 0.021"	+0.005"/-0.002"
0.020"	0.018" - 0.025"	+0.005"/-0.002"
1/32" (0.031")	0.026" - 0.036"	± 0.005"
3/64" (0.047")	0.042" - 0.052"	± 0.005"
1/16" (0.062")	0.056" - 0.068"	± 0.006"
5/64" (0.078")	0.071" - 0.085"	± 0.007"
3/32" (0.094")	0.086" - 0.102"	± 0.008"

Nominal Thickness	Variation	Tolerance
7/64" (0.109")	0.100" - 0.118"	± 0.009"
1/8" (0.125")	0.115" - 0.135"	± 0.010"
9/64" (0.141")	0.126" - 0.156"	± 0.015"
5/32" (0.156")	0.141" - 0.171"	± 0.015"
3/16" (0.188")	0.173" - 0.203"	± 0.015"
7/32" (0.219")	0.204" - 0.234"	± 0.015"
1/4" (0.25")	0.230" - 0.270"	± 0.020"

* 1/64" GYLON® tolerance = ±0.005"

Close tolerance sheet available upon request.

"M" and "Y" Data

"M" and "Y" data are to be used for flange designs only as specified in the ASME Boiler and Pressure Vessel Code Division 1, Section VIII, Appendix 2. They are not meant to be used as gasket seating stress values in actual service. Our bolt torque tables give that information and should be used as such.

"M" - Maintenance Factor

A factor that provides the additional preload needed in the flange fasteners to maintain the compressive load on a gasket after internal pressure is applied to a joint. The net operating stress on a pressurized gasket should be at least (m) x (design pressure, psi).

"Y" - Minimum Design Seating Stress

The minimum compressive stress in pounds per square inch (or bar) on the contact area of the gasket that is required to provide a seal at an internal pressure of 2 psig (0.14 bar).

Style	Thickness	M	Y (psi)
ST-706	1/16"	11.4*	4,800
	1/8"	22.0*	6,500
3000	1/16"	4.2	3,050
	1/8"	5.2	4,400
3123 / 3125	1/16"	2.0	2,500
	1/8"	2.0	2,500
3124	1/16"	2.0	2,500
(Wire-inserted)	1/8"	2.0	2,500
3125SS	1/16"	6.5	3,300
	1/8"	11.8*	5,900
3125TC	1/16"	2.6	2,500
	1/8"	6.0	3,000
3200 / 3400	1/16"	3.5	2,100
	1/8"	6.6	3,000
3300	1/16"	2.1	3,050
	1/8"	4.0	3,500
3500	1/16"	5.0	2,750
	1/8"	5.0	3,500
3504	1/16"	3.0	1,650
	1/8"	2.5	3,000
	3/16"	2.5	3,000
	1/4"	2.5	3,000
3510	1/16"	2.0	2,350
	1/8"	2.0	2,500
3530	1/16"	2.8	1,650
	1/8"	2.0	1,650
3535	1/4"	2.0	3,000
3540	1/16"	3.0	1,700
	1/8"	3.0	2,200
	3/16"	2.0	2,200
	1/4"	2.0	2,500

Style	Thickness	M	Y (psi)
3545	1/16"	2.6	1,500
	1/8"	2.0	2,200
	3/16"	2.0	2,200
	1/4"	7.0	3,700
(in envelope)	1/8"	2.0	800
HP 3560	1/16"	5.0	3,500
	1/8"	5.0	4,000
HP 3561	1/16"	5.0	3,500
	1/8"	5.0	4,000
3565	1/16"	2.8	1,400
	1/8"	3.7	2,300
	3/16"	5.5	2,800
	1/4"	6.0	2,800
3591	1/16"	4.3	1,650
	1/8"	2.0	1,650
3594	1/16"	3.0	1,650
	1/8"	3.0	2,500
3700	1/16"	3.5	2,800
	1/8"	6.7	4,200
IFG® 5500	1/16"	6.6	2,600
	1/8"	6.6	3,300
IFG® 5507	1/16"	3.5	2,400
	1/8"	5.5	3,900
9800	1/16"	3.5	2,350
	1/8"	8.0	3,200
9850	1/16"	6.5	2,550
	1/8"	8.0	2,800
G-9900	1/16"	4.5	4,100
	1/8"	6.0	4,100
STRESS SAVER® 370	1/8"	2.0	400

* These M values, based on ambient temperature leakage with nitrogen, are high. Field experience has shown that lower values would be workable in elevated temperatures. Consult Applications Engineering.

Gasket Constants

Style	Thickness	Gb	a	Gs	S100	S1000	S3000	S5000	S10000	Tpmin	Tpmax
3123	1/16"	970	0.384	0.05	5,686	13,765	20,989	25,537	33,325	—	—
3125SS	1/16"	816	0.377	0.066	4,631	11,033	16,694	20,240	26,284	—	—
3125TC	1/16"	1400	0.324	0.01	6,225	13,126	18,738	22,110	27,678	—	—
3500	1/16"	949	0.253	2.60E+00	3,043	5,448	7,194	8,187	9,756	373	16,890
	1/8"	1980	0.169	3.93E-01	4,313	6,365	7,663	8,354	9,393	223	25,375
3504	1/16"	183	0.357	4.01E-03	947	2,155	3,190	3,828	4,903	3,097	14,817
	1/8"	1008	0.221	2.23E+00	2,793	4,649	5,928	6,638	7,739	141	72,992
3510	1/16"	289	0.274	6.61E-11	1,021	1,918	2,592	2,981	3,605	11,881	25,501
	1/8"	444	0.332	1.29E-02	2,048	4,399	6,336	7,507	9,449	1,770	17,550
3535	3/8"	430	0.286	1.69E-09	1,605	3,101	4,245	4,913	5,991	373	
3540	1/16"	550	0.304	7.64E-01	2,230	4,491	6,272	7,326	9,044	973	23,670
3545	1/16"	162.1	0.379	1.35E-09	927	2,217	3,361	4,079	5,303	18,209	61,985
	1/8"	92.48	0.468	2.50E-03	799	2,349	3,930	4,992	6,907	4,460	53,307
	3/16"	628	0.249	7.93E-05	1,977	3,507	4,611	5,236	6,222	373	
3561	1/16"	72.3	0.466	2.16E-01	618	1,808	3,016	3,827	5,286	1,688	21,755
3591	1/16"	35	0.582	1.90E-04	517	1,975	3,745	5,041	7,547	1,410	29,194
3594	1/16"	151	0.41	1.64E-05	998	2,564	4,023	4,961	6,591	10,318	41,724
	1/8"	66	0.523	4.98E-06	739	2,462	4,373	5,712	8,208	6,308	24,174
3700	1/8"	1,318	0.258	6.00E-01	4,324	7,833	10,400	11,865	14,188	373	—
5500	1/16"	1,247	0.249	1.10E+01	3,925	6,964	9,155	10,397	12,356	373	—
9850	1/16"	1,591	0.239	9.30E+00	4,783	8,292	10,782	12,182	14,377	141	110,005
9900	1/16"	2,322	0.133	1.80E+01	4,284	5,819	6,735	7,208	7,904	199	128,434
ST-706	1/16"	2,455	0.267	6.22E-01	8,396	15,526	20,818	23,860	28,711	—	—

Gb = stress at which seal is initiated; "a" = the slope of the log/log tightness curve; Gs = intersection of the unload curve with the vertical axis (Tp1).

Note: For a 5" OD gasket at 800 psig, Tp100 = 102ml / min. leakage, Tp1,000 = 1.02ml / min. leakage, Tp10,000 = 0.01 ml / min. leakage.

ASTM F104 Line Callouts

Style[1]	ASTM Line Callout	A9: Leakage in Fuel A (Isooctane)[2]	A9: Leakage in Nitrogen[3]	E99: % Increase in ASTM Fuel B	K: Thermal Conductivity*	M9: Tensile Strength
ST-706	F712100A9B3E34K5M9	Typical: 0.5 ml/hr Max: 1.5 ml/hr	—	—	K5	1400 psi min. (9.7 N/mm² min.)
3000	F712100A9B4E22K5M6	Typical: 0.2 ml/hr Max: 1.0 ml/hr	Typical: 0.6 ml/hr Max: 1.5 ml/hr	—	K5	—
3124, 3125 SS and TC	F516000A9B1M3	Typical: 0.2 ml/hr Max: 1.0 ml/hr	Typical: 0.5 ml/hr Max: 1.5 ml/hr	—	—	—
3200/3400	F712400A9B4E45K5M9	Typical: 0.1 ml/hr Max: 1.0 ml/hr	Typical: 0.4 ml/hr Max: 1.0 ml/hr	—	K5	2,000 psi min. (14 N/mm² min.)
3300	F712400A9B4E34K5M6	Typical: 0.2 ml/hr Max: 1.5 ml/hr	Typical: 1.0 ml/hr Max: 2.0 ml/hr	—	K5	2,000 psi min. (14 N/mm² min.)
3700[4]	F712900A9B4E99K5M9	Typical: 0.1 ml/hr Max: 1.0 ml/hr	Typical: 0.7 ml/hr Max: 2.0 ml/hr	Weight: 100% max. Thickness: 20-50%	K5	2,250 psi (15 N/mm² min.)
IFG® 5500	F712100A9B2E23K7M5	Typical: 0.2 ml/hr Max: 1.0 ml/hr	Typical: 0.5 ml/hr Max: 1.5 ml/hr	—	K7	—
IFG® 5507	F712500A9B2E36K9M5	Typical: 0.1 ml/hr Max: 1.0 ml/hr	Typical: 0.5 ml/hr Max: 1.5 ml/hr	—	K9: 0.61 W/m°K (4.27 btu·in./h·ft²·°F)	—
9800	F712400A9B2E34K8M9	Typical: 0.1 ml/hr Max: 0.5 ml/hr	Typical: 0.1 ml/hr Max: 0.5 ml/hr	—	K8	1400 psi min. (9.7 N/mm² min.)
9850	F712200A9B2E22K8M9	Typical: 0.1 ml/hr Max: 0.5 ml/hr	Typical: 0.1 ml/hr Max: 0.5 ml/hr	—	K8	1600 psi min. (11 N/mm² min.)
G-9900	F712100A9B2E22K9M5	Typical: 0.1 ml/hr Max: 0.5 ml/hr	Typical: 0.1 ml/hr Max: 0.5 ml/hr	—	K9: 0.87 W/m°K (6.0 btu·in./h·ft²·°F)	—

GYLON® Style[6]	ASTM Line Callout	Fourth Numeral 9: % Increase in IRM Oil #903	Fifth Numeral 9: % Increase in IRM Oil #903	Sixth Numeral 9: % Increase in Water	A9: Leakage in Fuel A (Isooctane)[7]	E99: % Increase in ASTM Fuel B
3500	F451999A9B1E99K6M6	Thickness: 1.0% max.	Weight: 2.0% max.	Weight: 1.0% max.	Typical: 0.22 ml/hr Max: 1.0 ml/hr	Weight: 2.0% max. Thickness: 1.0% max
3504	F456999A9B7E99K3M6	Thickness: 1.0% max.	Weight: 2.0% max.	Weight: 1.0% max.	Typical: 0.12 ml/hr Max: 1.0 ml/hr	Weight: 2.0% max. Thickness: 1.0% max.
3510	F451999A9B2E99K5M6	Thickness: 1.0% max.	Weight: 2.0% max.	Weight: 1.0% max.	Typical: 0.04 ml/hr Max: 1.0 ml/hr	Weight: 2.0% max. Thickness: 1.0% max.
3540[5]	F419000A9B2	—	—	—	Typical: 0.25 ml/hr Max: 1.0 ml/hr	—
3545[5]	F419000A9B3	—	—	—	Typical: 0.15 ml/hr Max: 1.0 ml/hr	—
HP 3560[8]	F451999A9B1E99K6M6	Thickness: 1.0% max.	Weight: 2.0% max.	Weight: 1.0% max.	Typical: 0.22 ml/hr Max: 1.0 ml/hr	Weight: 2.0% max. Thickness: 1.0% max.
HP 3561[8]	F451999A9B2E99K5M6	Thickness: 1.0% max.	Weight: 2.0% max.	Weight: 1.0% max.	Typical: 0.04 ml/hr Max: 1.0 ml/hr	Weight: 2.0% max. Thickness: 1.0% max.
3565	F457999A9B6E99M6	Thickness: 1.0% max.	Weight: 2.0% max.	Weight: 1.0% max.	Typical: 0.33 ml/hr Max: 1.0 ml/hr	Weight: 2.0% max. Thickness: 1.0% max.

Style[1]	ASTM Line Callout
660	F328148M4
681	F326128M6
3123	F517100B1M3

1 For these styles, thickness is 1/32".

2 Gasket load = 500 psi (3.5 N/mm²); internal pressure = 9.8 psig (0.7 bar).

3 Gasket load = 3,000 psi (20.7 N/mm²); internal pressure = 30 psig (2 bar).

4 Fourth numeral 9: F146 Thickness Increase in #903 Oil: 60-100%

5 Third numeral 9: F36 Compressibility 3540: 70-85%; 3545: 60-70%; 3900, 3920: 15-30%

6 For Styles 3500 thru 3545, thickness is 1/32"; for Styles 3560-3565, thickness is 1/16".

7 Gasket load = 1,000 psi (7.0 N/mm²); internal pressure = 9.8 psig (0.7 bar).

8 Line callout = OFMF9: 9 = Perforated stainless steel,
F = F451999A9B1E99K6M6 (HP 3560);
F = F451999A9B2E99K5M6 (HP 3561).

* **NOTE:**
K1 thru K9 thermal conductivity characteristics shall be determined in accordance with F-104, 9.10. The K-factor obtained in W/m°K (btu·in./h·ft²·°F) shall fall within the ranges indicated by the numeral of the K symbol:

- K1 = 0 to 0.09 (0 to 0.65)
- K2 = 0.07 to 0.17 (0.50 to 1.15)
- K3 = 0.14 to 0.24 (1.00 to 1.65)
- K4 = 0.22 to 0.31 (1.50 to 2.15)
- K5 = 0.29 to 0.38 (2.00 to 2.65)
- K6 = 0.36 to 0.45 (2.50 to 3.15)
- K7 = 0.43 to 0.53 (3.00 to 3.65)
- K8 = 0.50 to 0.60 (3.50 to 4.15)
- K9 = as specified

Bolting and Flange Information

The gasket's function is to seal two different surfaces held together by one of several means, the most common being screw-threaded devices such as bolts. Sometimes the fastener itself must be sealed, as in the case of a steel drum bung.

The bolt is a spring. It is an elastic member that has been stretched to develop a load. The more spring provided by the bolt, the better the retention of stress on the gasket to maintain a leakproof joint. It must not be over-elongated (over-strained), or the elastic limit of the steel will be exceeded. The bolt then deforms and, with continued loading (stressing), may rupture.

To avoid such problems with bolt tightening, the use of a torque wrench is recommended. The torque tables on page C-44 show the recommended torque values for Garlock compressed sheet, GYLON® and GRAPH-LOCK® gasketing materials in 150 lb. and 300 lb. raised face flanges. The equipment designer may specify the recommended torque to prevent damage to the equipment from overtorquing. Garlock's recommended assembly stresses, page C-43, may help the equipment designer determine the maximum allowable torque per bolt. The load will be retained better by using a bolt with a longer grip, thereby ensuring a leakproof joint.

There are limits on the degree of flange surface imperfection that can be sealed successfully with a gasket. Large nicks, dents, or gouges must be avoided, since a gasket cannot properly seal against them. The surface finish of a flange is described as follows:

1. **Roughness**: Roughness is read in millionths of an inch (or meter) as the average of the peaks and valleys measured from a midline of the flange surface. This is expressed either as rms (root mean square) or AA (arithmetic average). The difference between these two methods of reading is so small that they may be used interchangeably. Roughness is also expressed as AARH (arithmetic average roughness height).
2. **Lay:** Lay is the direction of the predominant surface-roughness pattern. Example: multidirectional, phonographic spiral serrations, etc.
3. **Waviness:** Waviness is measured in thousandths or fractions of an inch. Basically, it is the departure from overall flatness.

Typical roughness readings can be from 125 to 500 micro-inches for serrated flanges and 125-250 micro-inches for non-serrated flanges. Fine finishes, such as polished surfaces, should be avoided. Adequate "bite" in the surface is required to develop enough friction to prevent the gasket from being blown out or from extruding or creeping excessively.

The lay of the finish should follow the midline of the gasket if possible. Take, for example, concentric circles on a round flange, or a phonographic spiral. Every effort should be made to avoid lines across the face, such as linear surface grinding, which at 180° points will cross the seal area at right angles to the gasket, allowing a direct leak path.

Waviness is seldom a problem under normal conditions. There are two areas that must be watched, however, since excessive waviness is very difficult to handle.

The first area is glass-lined equipment where the natural flow of the fused glass creates extreme waviness. Often the answer here is to use thick and highly compressible gasketing.

The second area of concern is warped flanges. If warpage is caused by heat or internal stresses, re-machining is generally sufficient. However, warpage due to excessive bolt loads or insufficient flange thickness results in what is generally called bowing.

The solution is to redesign for greater flange rigidity. Sometimes backer plates can be added to strengthen the design without having to replace the parts. Another step would be to add more bolts. When this is done, usually smaller bolt diameters are possible, thus adding more bolt stretch and better joint performance.

Questions? Call Gasket Applications Engineering at 1-800-448-6688

Garlock Gaskets®

Before Installation

- Remove old gasket, and clean flange surface of all debris. For best results, use a metal flange scraper, an aerosol gasket remover and a wire brush, then inspect the flange for damage. Be sure surface finish and flatness are satisfactory.
- Use the thinnest possible gasket. However, flanges that are warped, bowed or severely pitted require thicker gaskets.
- Whenever possible, use ring gaskets. Full face gaskets have more surface area, requiring additional compressive load on the gasket.
- Use dry anti-seize, rather than wet. Talc is best, while graphite and mica are also acceptable. Never use metal-based anti-seize, since particles may accumulate in the surface imperfections, thereby creating a flange surface that is too smooth to be effective.

Installation

- Center the gasket on the flange. This is extremely vital where raised faces are involved.
  Note: Standard ANSI ring gaskets, when properly cut, should center themselves when the bolts are in place.
- Use a torque wrench and well-lubricated fasteners with hardened flat washers to ensure correct initial loading.
- Tighten bolts to compress gasket uniformly. This means going from side to side around the joint in a star-like crossing pattern. See diagrams at right.
- All bolts should be tightened in one-third increments, according to proper bolting patterns.
- Retorque 12 to 24 hours after start-up, whenever possible. All applicable safety standards including lockout/tagout procedure should be observed.
- Never use liquid or metallic based anti-stick or lubricating compounds on the gaskets. Premature failure could occur as a result.

Gasket Assembly Stress Recommendations

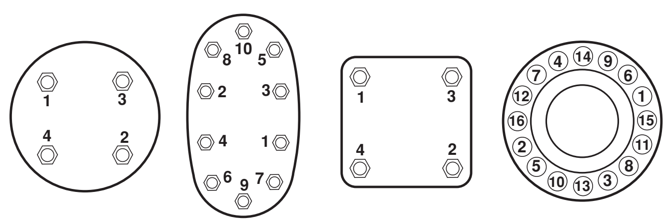
The minimum recommended assembly stress for Garlock compressed sheet, GYLON® and GRAPH-LOCK® products differs from "M" and "Y" values. "M" and "Y" do not take factors such as flange condition and blowout resistance into account. Garlock offers the following minimum assembly stresses as rules of thumb to use to calculate installation bolt torques.

Operating Pressure in psig (bar)	Minimum Assembly Stress Recommended psi (N/mm²)		
	1/32" (0.8 mm) Thick	1/16" (1.6 mm) Thick	1/8" (3.2 mm) Thick
Up to 300 (21)	2,500 (17)	3,600 (25)	4,800 (33)
Up to 800 (55)	4,800 (33)	5,400 (37)	6,400 (44)
Up to 2,000 (140)	7,400 (51)	8,400 (58)	9,400 (65)

Maximum recommended compressive stress for:

- Compressed fiber and GYLON® gaskets = 15,000 psi
- GRAPH-LOCK® gaskets = 10,000 psi
- Rubber gaskets = 600 to 1,200 psi
- STRESS SAVER® gaskets = 600 to 1,500 psi

Correct Bolting Patterns



Circular Four-Bolt | Noncircular Multibolt | Square Four-Bolt | Circular Multibolt

WARNING:
Properties/applications shown throughout this brochure are typical. Your specific application should not be undertaken without independent study and evaluation for suitability. For specific application recommendations consult Garlock. Failure to select the proper sealing products could result in property damage and/or serious personal injury.

Performance data published in this brochure has been developed from field testing, customer field reports and/or in-house testing.

While the utmost care has been used in compiling this brochure, we assume no responsibility for errors. Specifications subject to change without notice. This edition cancels all previous issues. Subject to change without notice.

Torque and Stress Tables

Bolt Torque Tables for ASME B 16.5 Raised Face Flanges with A193 Gr B7 Bolts

Compressed Sheet and GYLON® Gaskets 150# Flanges

Nom. Pipe Size (Inches)	No. of Bolts	Size of Bolts (Inches)	Internal Pressure (psig)	Minimum Torque (ft.-lbs.)	Preferred Torque (ft.-lbs.)
0.50	4	0.50	300	9	28
0.75	4	0.50	300	13	40
1.00	4	0.50	300	17	53
1.25	4	0.50	300	26	60
1.50	4	0.50	300	35	60
2.00	4	0.63	300	69	120
2.50	4	0.63	300	81	120
3.00	4	0.63	300	119	120
3.50	8	0.63	300	66	120
4.00	8	0.63	300	84	120
5.00	8	0.75	300	117	200
6.00	8	0.75	300	148	200
8.00	8	0.75	300	200	200
10.00	12	0.88	300	188	320
12.00	12	0.88	300	250	320
14.00	12	1.00	300	317	490
16.00	16	1.00	300	301	490
18.00	16	1.13	300	448	710
20.00	20	1.13	300	395	710
24.00	20	1.25	300	563	1,000

Compressed Sheet and GYLON® gaskets 300# Flanges

Nom. Pipe Size (Inches)	No. of Bolts	Size of Bolts (Inches)	Internal Pressure (psig)	Minimum Torque (ft.-lbs.)	Preferred Torque (ft.-lbs.)
0.50	4	0.50	800	12	28
0.75	4	0.63	800	21	51
1.00	4	0.63	800	28	67
1.25	4	0.63	800	43	102
1.50	4	0.75	800	64	151
2.00	8	0.63	800	46	108
2.50	8	0.75	800	60	141
3.00	8	0.75	800	88	200
3.50	8	0.75	800	99	200
4.00	8	0.75	800	125	200
5.00	8	0.75	800	156	200
6.00	12	0.75	800	131	200
8.00	12	0.88	800	205	320
10.00	16	1.00	800	219	490
12.00	16	1.13	800	319	710
14.00	20	1.13	800	287	652
16.00	20	1.25	800	401	912
18.00	24	1.25	800	439	1,000
20.00	24	1.25	800	484	1,000
24.00	24	1.50	800	662	1,552

GRAPH-LOCK® Gaskets 150# Flanges

Nom. Pipe Size (Inches)	No. of Bolts	Size of Bolts (Inches)	Internal Pressure (psig)	Minimum Torque (ft.-lbs.)	Preferred Torque (ft.-lbs.)
0.50	4	0.50	300	9	20
0.75	4	0.50	300	13	27
1.00	4	0.50	300	17	35
1.25	4	0.50	300	26	54
1.50	4	0.50	300	35	60
2.00	4	0.63	300	69	120
2.50	4	0.63	300	81	120
3.00	4	0.63	300	119	120
3.50	8	0.63	300	66	120
4.00	8	0.63	300	84	120
5.00	8	0.75	300	117	200
6.00	8	0.75	300	148	200
8.00	8	0.75	300	200	200
10.00	12	0.88	300	188	320
12.00	12	0.88	300	250	320
14.00	12	1.00	300	317	490
16.00	16	1.00	300	301	490
18.00	16	1.13	300	448	710
20.00	20	1.13	300	395	710
24.00	20	1.25	300	563	1,000

GRAPH-LOCK® Gaskets 300# Flanges

Nom. Pipe Size (Inches)	No. of Bolts	Size of Bolts (Inches)	Internal Pressure (psig)	Minimum Torque (ft.-lbs.)	Preferred Torque (ft.-lbs.)
0.50	4	0.50	800	12	20
0.75	4	0.63	800	21	34
1.00	4	0.63	800	28	45
1.25	4	0.63	800	43	68
1.50	4	0.75	800	64	101
2.00	8	0.63	800	46	72
2.50	8	0.75	800	60	94
3.00	8	0.75	800	88	138
3.50	8	0.75	800	99	154
4.00	8	0.75	800	125	196
5.00	8	0.75	800	156	200
6.00	12	0.75	800	131	200
8.00	12	0.88	800	205	320
10.00	16	1.00	800	219	341
12.00	16	1.13	800	319	498
14.00	20	1.13	800	287	435
16.00	20	1.25	800	401	608
18.00	24	1.25	800	439	1,000
20.00	24	1.25	800	484	1,000
24.00	24	1.50	800	662	1,035

Note: Consult Engineering for all other torque tables.

Bolt Stress to Bolt Torque Conversion Tables

Load on Machine Bolts and Cold Rolled Steel Stud Bolts Under Torque

Nominal Diameter of Bolt (inches)	Number of Threads Per Inch	Diameter of Root of Thread (inches)	Area at Root of Thread (sq. in.)	Stress 7,500 psi Torque (ft. lbs.)	Stress 7,500 psi Clamping Force (lbs./bolt)	Stress 15,000 psi Torque (ft. lbs.)	Stress 15,000 psi Clamping Force (lbs./bolt)	Stress 30,000 psi Torque (ft. lbs.)	Stress 30,000 psi Clamping Force (lbs./bolt)
1/4	20	0.185	0.027	1	203	2	405	4	810
5/16	18	0.240	0.045	2	338	4	675	8	1,350
3/8	16	0.294	0.068	3	510	6	1,020	12	2,040
7/16	14	0.345	0.093	5	698	10	1,395	20	2,790
1/2	13	0.400	0.126	8	945	15	1,890	30	3,780
9/16	12	0.454	0.162	12	1,215	23	2,430	45	4,860
5/8	11	0.507	0.202	15	1,515	30	3,030	60	6,060
3/4	10	0.620	0.302	25	2,265	50	4,530	100	9,060
7/8	9	0.731	0.419	40	3,143	80	6,285	160	12,570
1	8	0.838	0.551	62	4,133	123	8,265	245	16,530
1-1/8	7	0.939	0.693	98	5,190	195	10,380	390	20,760
1-1/4	7	1.064	0.890	137	6,675	273	13,350	545	26,700
1-3/8	6	1.158	1.054	183	7,905	365	15,810	730	31,620
1-1/2	6	1.283	1.294	219	9,705	437	19,410	875	38,820
1-5/8	5-1/2	1.389	1.515	300	11,363	600	22,725	1,200	45,450
1-3/4	5	1.490	1.744	390	13,080	775	26,160	1,550	52,320
1-7/8	5	1.615	2.049	525	15,368	1,050	30,735	2,100	61,470
2	4-1/2	1.711	2.300	563	17,250	1,125	34,500	2,250	69,000

Load on Alloy Steel Stud Bolts Under Torque

Nominal Diameter of Bolt (inches)	Number of Threads Per Inch	Diameter of Root of Thread (inches)	Area at Root of Thread (sq. in.)	Stress 30,000 psi Torque (ft. lbs.)	Stress 30,000 psi Clamping Force (lbs./bolt)	Stress 45,000 psi Torque (ft. lbs.)	Stress 45,000 psi Clamping Force (lbs./bolt)	Stress 60,000 psi Torque (ft. lbs.)	Stress 60,000 psi Clamping Force (lbs./bolt)
1/4	20	0.185	0.027	4	810	6	1,215	8	1,620
5/16	18	0.240	0.045	8	1,350	12	2,025	16	2,700
3/8	16	0.294	0.068	12	2,040	18	3,060	24	4,080
7/16	14	0.345	0.093	20	2,790	30	4,185	40	5,580
1/2	13	0.400	0.126	30	3,780	45	5,670	60	7,560
9/16	12	0.454	0.162	45	4,860	68	7,290	90	9,720
5/8	11	0.507	0.202	60	6,060	90	9,090	120	12,120
3/4	10	0.620	0.302	100	9,060	150	13,590	200	18,120
7/8	9	0.731	0.419	160	12,570	240	18,855	320	25,140
1	8	0.838	0.551	245	16,530	368	24,795	490	33,060
1-1/8	8	0.963	0.728	355	21,840	533	32,760	710	43,680
1-1/4	8	1.088	0.929	500	27,870	750	41,805	1,000	55,740
1-3/8	8	1.213	1.155	680	34,650	1,020	51,975	1,360	69,300
1-1/2	8	1.338	1.405	800	42,150	1,200	63,225	1,600	84,300
1-5/8	8	1.463	1.680	1,100	50,400	1,650	75,600	2,200	100,800
1-3/4	8	1.588	1.980	1,500	59,400	2,250	89,100	3,000	118,800
1-7/8	8	1.713	2.304	2,000	69,120	3,000	103,680	4,000	138,240
2	8	1.838	2.652	2,200	79,560	3,300	119,340	4,400	159,120
2-1/4	8	2.088	3.423	3,180	102,690	4,770	154,035	6,360	205,380
2-1/2	8	2.338	4.292	4,400	128,760	6,600	193,140	8,800	257,520
2-3/4	8	2.588	5.259	5,920	157,770	8,800	236,655	11,840	315,540
3	8	2.838	6.324	7,720	189,720	11,580	284,580	15,440	379,440

These tables are for reference only. See torque tables for recommended installation torques.

Values shown in these tables are based on steel bolting that has been well-lubricated with heavy graphite and oil mixture. Research has shown that a non-lubricated bolt has about 50% of the efficiency of a well-lubricated bolt. It has been further found that different lubricants produce results varying between the limit of 50% and 100% of the tabulated stress figures.

Available Gasket Stress vs. Bolt Stress

150# Flat Face Flanges

This table is for information purposes only; see notes below.

Nom. Pipe Size (inches)	Number of Bolts	Size of Bolts (inches)	Bolt Stress 30,000 psi Bolt Torque (ft. lbs.)	30,000 psi Gasket Stress (psi)	60,000 psi Bolt Torque (ft. lbs.)	60,000 psi Gasket Stress (psi)	75,000 psi Bolt Torque (ft. lbs.)	75,000 psi Gasket Stress (psi)	Minimum Recommended Assembly Stress 1/32" Thick (psi)	1/16" Thick (psi)	1/8" Thick (psi)
0.5	4	0.50	30	1,929	60	3,857	75	4,821	2,500	3,600	4,800
0.75	4	0.50	30	1,557	60	3,114	75	3,893	2,500	3,600	4,800
1	4	0.50	30	1,302	60	2,605	75	3,256	2,500	3,600	4,800
1.25	4	0.50	30	1,125	60	2,250	75	2,813	2,500	3,600	4,800
1.5	4	0.50	30	973	60	1,946	75	2,432	2,500	3,600	4,800
2	4	0.63	60	1,100	120	2,201	150	2,751	2,500	3,600	4,800
2.5	4	0.63	60	803	120	1,606	150	2,008	2,500	3,600	4,800
3	4	0.63	60	740	120	1,479	150	1,849	2,500	3,600	4,800
3.5	8	0.63	60	1,194	120	2,388	150	2,985	2,500	3,600	4,800
4	8	0.63	60	1,099	120	2,197	150	2,746	2,500	3,600	4,800
5	8	0.75	100	1,466	200	2,931	250	3,664	2,500	3,600	4,800
6	8	0.75	100	1,299	200	2,598	250	3,247	2,500	3,600	4,800
8	8	0.75	100	906	200	1,813	250	2,266	2,500	3,600	4,800
10	12	0.88	160	1,497	320	2,993	400	3,742	2,500	3,600	4,800
12	12	0.88	160	1,031	320	2,062	400	2,577	2,500	3,600	4,800
14	12	1.00	245	1,099	490	2,198	613	2,748	2,500	3,600	4,800
16	16	1.00	245	1,220	490	2,440	613	3,050	2,500	3,600	4,800
18	16	1.13	355	1,613	710	3,226	888	4,033	2,500	3,600	4,800
20	20	1.13	355	1,713	710	3,425	888	4,282	2,500	3,600	4,800
24	20	1.25	500	1,730	1,000	3,460	1,250	4,326	2,500	3,600	4,800
26	24	1.25	500	1,886	1,000	3,771	1,250	4,714	—	4,049	5,249
28	28	1.25	500	2,006	1,000	4,012	1,250	5,015	—	4,075	5,275
30	28	1.25	500	1,811	1,000	3,622	1,250	4,528	—	4,092	5,292
32	28	1.50	800	2,329	1,600	4,659	2,000	5,823	—	4,076	5,276
34	32	1.50	800	2,550	1,600	5,099	2,000	6,374	—	4,115	5,315
36	32	1.50	800	2,335	1,600	4,670	2,000	5,838	—	4,129	5,329
38	32	1.50	800	2,025	1,600	4,050	2,000	5,063	—	4,111	5,311
40	36	1.50	800	2,194	1,600	4,389	2,000	5,486	—	4,145	5,345
42	36	1.50	800	2,034	1,600	4,068	2,000	5,085	—	4,157	5,357
44	40	1.50	800	2,124	1,600	4,247	2,000	5,309	—	4,175	5,375
46	40	1.50	800	2,033	1,600	4,066	2,000	5,083	—	4,201	5,401
48	44	1.50	800	2,108	1,600	4,217	2,000	5,271	—	4,217	5,417
50	44	1.75	1,500	2,873	3,000	5,746	3,750	7,182	—	4,247	5,447
52	44	1.75	1,500	2,690	3,000	5,379	3,750	6,724	—	4,256	5,456
54	44	1.75	1,500	2,525	3,000	5,050	3,750	6,313	—	4,264	5,464
56	48	1.75	1,500	2,553	3,000	5,105	3,750	6,381	—	4,262	5,462
58	48	1.75	1,500	2,406	3,000	4,812	3,750	6,015	—	4,269	5,469
60	52	1.75	1,500	2,544	3,000	5,089	3,750	6,361	—	4,299	5,499

Notes:

1. The values shown are not recommended values. The intent of this table is to illustrate the relationship between bolt torque, bolt stress, gasket stress, and how these three factors relate to the contact area of ASME B16.5 & B16.47 Series A flat face flanges.
2. Full face gaskets will typically seal at stresses well below the minimum recommended values shown. See also "Flanges" on page C-50.
3. Contact Garlock Applications Engineering at 1-800-448-6688 for further discussions regarding the use of compressed non-asbestos, GYLON® or GRAPH-LOCK® products in flat face flanges.

Available Gasket Stress vs. Bolt Stress

300# Flat Face Flanges

This table is for information purposes only; see notes below

Nom. Pipe Size (inches)	Number of Bolts	Size of Bolts (inches)	Bolt Stress						Minimum Recommended Assembly Stress		
			30,000 psi		60,000 psi		75,000 psi				
			Bolt Torque (ft. lbs.)	Gasket Stress (psi)	Bolt Torque (ft. lbs.)	Gasket Stress (psi)	Bolt Torque (ft. lbs.)	Gasket Stress (psi)	1/32" Thick (psi)	1/16" Thick (psi)	1/8" Thick (psi)
0.5	4	0.50	30	1,632	60	3,264	75	4,081	4,800	5,400	6,400
0.75	4	0.63	60	1,650	120	3,300	150	4,125	4,800	5,400	6,400
1	4	0.63	60	1,506	120	3,013	150	3,766	4,800	5,400	6,400
1.25	4	0.63	60	1,328	120	2,656	150	3,319	4,800	5,400	6,400
1.5	4	0.75	100	1,428	200	2,857	250	3,571	4,800	5,400	6,400
2	8	0.63	60	1,924	120	3,848	150	4,810	4,800	5,400	6,400
2.5	8	0.75	100	2,124	200	4,247	250	5,309	4,800	5,400	6,400
3	8	0.75	100	1,798	200	3,597	250	4,496	4,800	5,400	6,400
3.5	8	0.75	100	1,525	200	3,051	250	3,813	4,800	5,400	6,400
4	8	0.75	100	1,226	200	2,453	250	3,066	4,800	5,400	6,400
5	8	0.75	100	1,099	200	2,198	250	2,748	4,800	5,400	6,400
6	12	0.75	100	1,341	200	2,682	250	3,352	4,800	5,400	6,400
8	12	0.88	160	1,357	320	2,714	400	3,393	4,800	5,400	6,400
10	16	1.00	245	1,928	490	3,855	613	4,819	4,800	5,400	6,400
12	16	1.13	355	1,841	710	3,682	888	4,602	4,800	5,400	6,400
14	20	1.13	355	1,808	710	3,615	888	4,519	4,800	5,400	6,400
16	20	1.25	500	1,924	1,000	3,847	1,250	4,809	4,800	5,400	6,400
18	24	1.25	500	2,016	1,000	4,031	1,250	5,039	4,800	5,400	6,400
20	24	1.25	500	1,728	1,000	3,457	1,250	4,321	4,800	5,400	6,400
24	24	1.50	800	1,909	1,600	3,818	2,000	4,773	5,000	5,600	6,400
26	28	1.63	1,100	2,562	2,200	5,124	2,750	6,405	—	6,171	7,171
28	28	1.63	1,100	2,272	2,200	4,544	2,750	5,680	—	6,193	7,193
30	28	1.75	1,500	2,491	3,000	4,982	3,750	6,228	—	6,247	7,247
32	28	1.88	2,000	2,703	4,000	5,406	5,000	6,758	—	6,299	7,299
34	28	1.88	2,000	2,493	4,000	4,987	5,000	6,234	—	6,336	7,336
36	32	2.00	2,200	3,058	4,400	6,115	5,500	7,644	—	6,378	7,378
38	32	1.50	800	2,921	1,600	5,841	2,000	7,301	—	7,365	8,365
40	32	1.62	1,100	3,026	2,200	6,052	2,750	7,566	—	7,286	8,286
42	32	1.62	1,100	2,878	2,200	5,756	2,750	7,194	—	7,378	8,378
44	32	1.75	1,500	3,077	3,000	6,155	3,750	7,693	—	7,369	8,369
46	28	1.88	2,000	2,800	4,000	5,600	5,000	7,000	—	7,323	8,323
48	32	1.88	2,000	3,119	4,000	6,237	5,000	7,796	—	7,441	8,441
50	32	2.00	2,200	3,287	4,400	6,574	5,500	8,217	—	7,428	8,428
52	32	2.00	2,200	3,156	4,400	6,311	5,500	7,889	—	7,506	8,506
54	28	2.25	3,180	3,095	6,360	6,190	7,950	7,737	—	7,372	8,372
56	28	2.25	3,180	2,981	6,360	5,963	7,950	7,453	—	7,443	8,443
58	32	2.25	3,180	3,346	6,360	6,693	7,950	8,366	—	7,552	8,552
60	32	2.25	3,180	3,230	6,360	6,460	7,950	8,075	—	7,623	8,623

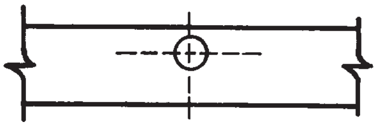
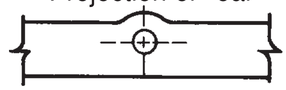
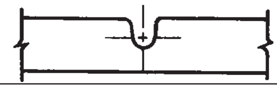
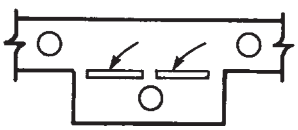
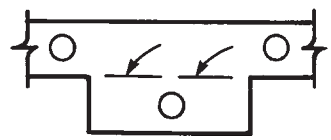
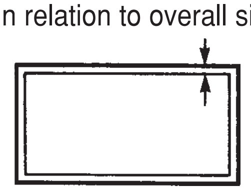
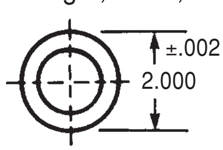
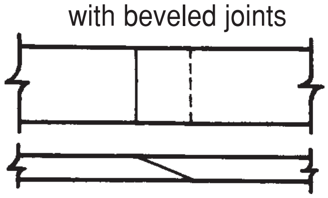
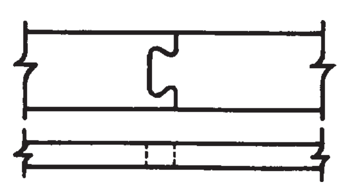
Notes:

[1] The values shown are not recommended values. The intent of this table is to illustrate the relationship between bolt torque, bolt stress, gasket stress, and how these three factors relate to the contact area of ASME B16.5 & B16.47 Series A flat face flanges.

[2] Full face gaskets will typically seal at stresses well below the minimum recommended values shown. See also "Flanges" on page C-50.

[3] Contact Garlock Applications Engineering at 1-800-448-6688 for further discussions regarding the use of compressed non-asbestos, GYLON® or GRAPH-LOCK® products in flat face flanges.

Gasket Design Tips

Problem	Result	Suggested Solutions
Bolt holes close to edge 	Causes breakage in stripping and assembling	Projection or "ear"  Notch instead of hole 
Very small bolt holes or non-circular openings  	Require handpicking… easy to miss	Avoid hole sizes under 3/32" diameter. If small hole is for locating or indexing, change to notch. 
Tear-away parts with open slots at attached edges 	Slots require handpicking, costly dies and die maintenance	Simple perforation 
Thin walls, delicate cross-section in relation to overall size 	High scrap loss; stretching or distortion in shipment or use. Restricts choice to high tensile strength materials	Have the gasket in mind during early design stages
Metalworking tolerances applied to gasket thickness, diameters, length, width, etc. 	Results in perfectly usable parts being rejected at incoming inspection. Requires time and correspondence to reach agreement on practical limits. Increases cost of parts and tooling. Delays delivery.	Most gasket materials are compressible. Many are affected by humidity changes. Try standard or commercial tolerances before concluding that special accuracy is required.
Transference of fillets, radii, etc. from mating metal parts to gasket 	Unless part is molded, such features mean extra operations and higher cost	Most gasket stocks will conform to mating parts without pre-shaping. Be sure radii, chamfers, etc., are functional, not merely copied from metal members.
Large gaskets made in sections with beveled joints 	Extra operations to skive or glue. Difficult to obtain smooth, even joints without steps or transverse grooves. 	Die-cut dovetailed joint 

Gasketing Terms

American Bureau of Shipping

Garlock styles on the American Bureau of Shipping Type Approval program:

- ST-706
- BLUE-GARD® 3000, 3200
- GRAPH-LOCK® 3125SS, 3125TC
- GYLON® 3500, 3504, 3510
- IFG® 5500*
- 8459**
- 9200
- G-9900*

Anti-Stick

While we prefer that gaskets be installed with only the factory-applied anti-stick, experience shows that additional anti-stick is helpful in some situations, such as areas where flanges cannot be separated easily. Coatings should be as light as possible. Dry powders are strongly recommended over pastes and grease-type compounds, which can drastically reduce the crush strength and blowout resistance of the gasket. Additionally, grease or paste type materials may deteriorate or dissolve in service, leaving a possible leak path across the gasket.

Aviation Gasoline

Gasoline with a high octane number is used for prop driven airplane engines, as opposed to jet fuel for jet engines. Aviation gasoline contains a high percentage of aromatics. GYLON® is preferred; compressed sheet styles with nitrile binders can be successful in some applications (see Jet Fuel). Consult Engineering if you are unsure.

Bubble Tests

Some end users perform bubble tests of their system to check gasket tightness. This information is helpful before specifying a gasket. Bubble tests are an extremely tough test for a gasketed joint, and may not be an appropriate means to verify correct installation. Lightweight flanges with low available compressive load may never achieve "bubble tight" results.

* Accepted for use where "fire safe" requirements are specified by ABS rules, and US Coast Guard regulations.

** Non-stocked item.

Chlorine Service

We recommend our GYLON® styles for chlorine. The style selection is made based on flange information. Style 3510 is listed in the Chlorine Institute's Pamphlet 95. Garlock Metallic Gasket Division products are also listed, including the GRAPHONIC® gasket.

Compression

The amount of compression expected on a particular gasket type depends on its compressibility data and the load applied. Sealing problems are often a result of lack of compression. Graphs of compression vs. load on popular gasketing styles are available upon request. Close tolerance sheet should be considered for applications requiring tight internal clearances such as split case pumps (see Modulus of Elasticity).

Compressive Stress

Undercompression: Underloaded gaskets will have higher leak rates and lower blowout resistance than properly loaded gaskets. This has a profound effect on performance and is the most frequent cause of joint problems.

Overcompression: Overcompression can lead to crushing, which accelerates the degradation of the gasket and can even cause immediate failure.

Uneven Compression: Gaskets resist blowout based on the friction of the gasket against the flange. The higher the compressive load, both initially and during service, the higher the blowout resistance. When areas of high and low compression exist in a flange joint, the areas of low compression are prime candidates for blowout.

Crush Strength

Garlock recommends a maximum compressive stress of 15,000 psi on compressed fiber and GYLON® gasketing, and 10,000 psi on GRAPH-LOCK® gasketing. The actual crush strength of these materials is typically higher than that of homogeneous rubber.

Cryogenic Service

We recommend our GYLON® styles down to -450°F (-268°C), and our compressed sheet gasketing is typically recommended to -40°F (-40°C).

Dielectric Breakdown Voltage

Many applications require a gasket which is not a good conductor of electricity. Garlock has dielectric breakdown voltage test data available on our most popular gasketing styles. Generally speaking, GYLON® styles and compressed sheet that does not use carbon or graphite fibers have high dielectric breakdown values. Under humid or wet conditions, Styles 3504 and 3565 are particularly resistant to dielectric breakdown.

Emissions

There is certainly a great deal of interest in limiting emissions of the numerous chemicals and other substances regulated under the Clean Air Act. Garlock has performed testing in this area and our report, available on request, covers the effects of gasket type, compressive load, internal pressure and flange finish on relative emissions levels. The use of heavier flanges where possible and the selection of premium gasket materials with good sealability numbers are the easiest ways to reduce emissions. Due to the aggressive nature of these chemicals, we recommend our GYLON® family of products.

FDA

Style 3500 (Fawn) and **Style 3510** (Off-White) comply with FDA regulation 21CFR177.1550. They meet ingredient and extract requirements. The fillers are also acceptable under 21CFR177.2600 and coloring agents (where used) under 21CFR178.3297. The branding ink complies with 21CFR175.300. Style 3500 (Fawn) has USDA approval for direct contact in meat and poultry applications.

Style 3504 (Blue), **Style 3565** (ENVELON®), **Style 3591** (Gold), and **Style 3594** (Green) comply with FDA regulation 21CFR177.1550. They meet the ingredient and extract requirements. The filler is listed in the Food Chemicals Codex (FCC 3rd Edition) and is considered GRAS (generally recognized as safe – 21CFR170.30). The branding ink complies with 21CFR175.300.

Style 3522 (Clear) complies with FDA regulation 21CFR177.1550.

The ingredients for **Style 3540** (Microcellular) and **Style 3545** (Microcellular with Rigid Core) comply with FDA regulations 21CFR177.1550, 21CFR182.1, 21CFR182.1217, and 21CFR175.300. The branding ink complies with 21CFR175.300.

The PTFE resins used in **Style 3535** PTFE joint sealant comply with FDA regulation 21CFR177.1550. The PSA tape used to hold the joint sealant material in place meets 21CFR175.105.

Fire Tests

Garlock has developed a Fire Test Standard modeled after industry fire tests API 589 and 607. Styles G-9900, 9850, ST-706, IFG® 5500 and GRAPH-LOCK® styles have all passed this fire test. Test procedures and results are available upon request.

Flanges

Flanges come in all shapes and sizes, and the type of flange used in a service has a large impact on the type of gasketing material recommended. Standard ANSI raised face flanges are best suited for use with compressed fiber and GYLON® gaskets. Elastomer (rubber) gaskets may be crushed in these flanges.

Flat faced non-metallic flanges seal best with elastomeric (rubber) gaskets, such as the various STRESS SAVER® gasket styles. GYLON® Style 3545 may also be suitable for some applications. Compressed fiber and standard GYLON® are frequently used in flat-faced carbon steel flanges, but the compressive stress available in these flanges is well below our minimums. The result is that the gaskets are compressed very little; if there is a significant flange irregularity present, the gasket may not seal. Since leakage rates of gaskets depend on the available compressive stress, the joint may not be as tight as the customer would like.

Glass-lined flanges are found in many chemical applications. Due to the inherent "waviness" created when these flanges are fired to apply the glass, the softer GYLON® styles such as Styles 3545, 3565, and 3504 are preferred. The gap between the flanges, when placed together empty, must be measured before the gasket is ordered. Gasket thickness should be four to five times the maximum gap observed.

Stainless steel (SS) flanges are common in many plants for chemical service, and often utilize low strength SS bolts. Due to the chemicals present and the low compressive stress generated by the bolts, Styles 3545, 3565, and 3504 are often recommended. We do prefer, however, the use of high strength, strain-hardened stainless steel bolts.

Flange Finish

We recommend the flange finish conform, whenever possible, to 30-55 serrations per inch, in a concentric or spiral pattern, cut with a 1/16" radius, round-nosed tool. This finish is usually difficult or impossible to create in non-circular flanges. We recommend that machined surfaces which can not be serrated have a surface finish with a multi-directional lay and roughness of 125-250 micro-inch RMS.

Fuel Additives

The chemical MTBE (methyl t-butyl ether) has become a very common fuel additive and gasketing compatibility inquiries on this material are frequent. Garlock in-house testing has shown GYLON® gasketing to be unaffected by MTBE. We have also found compressed sheet Styles 9850 and 3000 to be suitable for MTBE service. These materials are recommended for MTBE alone or mixed with gasoline.

Full Face Gaskets

See Flanges.

Gasket Constants

ASTM is working on a new system and new set of numbers to be used in the ASME code calculations for flange design. These new constants address leak rates at installation and during loss of compressive load and therefore are meant to help end users design for a certain leak level. The use of a defined leak rate will generally generate much higher bolt load requirements for the flanges, which should improve performance of designed joints. ***For gasket constant values, see page C-40.*** *Also see M & Y Values and Emissions.*

Gasket Grooves

Gaskets installed in grooves or tongue and groove flanges require one extra consideration: the compressed height of the gasket must fill the groove. This is typically important where a highly compressible gasket such as GYLON® Styles 3545 and 3540 or one of the GRAPH-LOCK® styles is used to replace a compressed sheet gasket. The fully compressed thickness, not the original thickness, must be greater than the groove depth or the space between the tongue and groove when flanges contact each other. Ideally, the tongue should be at least as tall as the groove depth.

Gasohol

Gasohol is a blend of gasoline with an alcohol—usually 15% ethyl alcohol. GYLON® styles are preferred; nitrile-bound compressed sheet styles should be acceptable; most rubber gaskets are not recommended.

Installation

Garlock strongly recommends the use of calibrated torque wrenches to tighten bolts to the correct load. We have an installation procedure and discussion available upon request. A video covering the same material is also available.

Insulation Kits

Customers will occasionally ask for a flange insulation or isolation kit or gasket to electrically insulate one flange from the mating flange. Kits are available from a variety of distributors and include an insulating gasket along with a sleeve for the bolts and insulating washer to be installed under the steel washers and nuts.

Garlock does not currently sell kits, but we do offer many gasket styles with good electrical insulating properties (see Dielectric Breakdown Voltage).

Jet Fuels

Jet fuels are typically refined petroleum products similar to kerosene. We recommend our GYLON®, nitrile bound compressed sheet and GRAPH-LOCK® products. (See Aviation Gasoline)

Leachable Levels (chemical)

Some pipe specifications call out maximum levels of "leachables" for gaskets. These limits are usually most concerned with leachable chlorides, fluorides, halogens and sulfur. These ions, or charged particles, are of concern due to their tendency to promote corrosion of piping systems. Garlock keeps test results for numerous gasket styles on file and we will test and certify leachable chlorides, etc., where required. There is a charge for these tests. Due to the nature of this type of analysis, we publish "typical" leachables only on certain styles such as our nuclear grade Style 9920.

"M" and "Y" Values for Flange Design

See page C-40.

Note: Our testing shows an increase in "M" and "Y" values as gasket thickness increases. This is the opposite of the trend found in the ASME Code. Fugitive emission and gasket blowout studies have validated this trend.

Modulus of Elasticity

Some flange programs ask for the modulus of elasticity for the gasket material. This could be erroneous, since only rubber gaskets are elastic. Other types of gasketing do not have a true modulus. Garlock Applications Engineering does have compression vs. load curves which can be inverted to calculate a rough estimate for use in these calculations (see Compression).

Monomers

Monomers are materials, such as styrene and vinyl chloride, which can combine with themselves and become polymers, such as polystyrene and polyvinyl chloride. GYLON® Styles 3510 and 3530 are recommended for monomers, since elastomer-bound gaskets are rarely compatible with monomers. Some monomers, under certain conditions, will penetrate a gasket and polymerize inside the gasket, causing the gasket to swell and, occasionally, rupture. This effect is known as "popcorning". This effect can be reduced or eliminated with additional compressive load which lowers the void space inherent in a gasket.

Oxidizers

Certain chemicals are known as strong oxidizers and, as such, will readily combine with organic compounds. We recommend our GYLON® material for use in oxidizers.

Oxygen Service

We recommend GYLON® Styles 3502, 3505, 3503 and metal-inserted Styles 3562 and 3563. These gaskets are specially manufactured and packaged to eliminate contamination by organic material.

pH

The pH scale is a measure of the acidity or alkalinity of a solution. A pH of 7 is a neutral reading; it is neither acidic or alkaline. Readings of 1-2 are strongly acidic, while 13-14 indicates a strong alkaline or caustic media.

Note: A pH reading alone without the names of the chemicals involved is not enough to select a gasket. Also, since the pH scale is quite limited in range, a reading of "1" or "14" does not fully describe the concentration. We need the concentration expressed as a percentage. For example, sodium hydroxide at a concentration of around 4% will "peg" the pH scale at 14, the same reading produced by a 40% concentration.

Pressure Spikes

Very high pressure spikes can occur in any line pumping a liquid if a valve is closed rapidly, leaving the fluid flow nowhere to go. The inertia of the fluid may create extreme pressure spikes. These spikes occur too rapidly to be detected by a pressure gage but can cause a gasket to blow out.

Radiation Resistance

We have conducted gamma radiation tests on our compressed sheet Styles 3000, 3200, 3400, 3700, 5500, 5507, 9800, 9850, 9920 and ST-706. These tests indicate our compressed non-asbestos styles will handle a total exposure of approximately 5×10^7 rads of gamma radiation. GYLON® Styles 3510 and 3545 have been tested. Test results are available.

Refrigerants

A number of new refrigerants have been introduced in an effort to protect the environment. CFC-type refrigerants, believed to be responsible for depleting the ozone layer, are being phased out and replaced by HCFCs and HFCs. Our most frequent compatibility inquiries concentrate on R-134a, R-123 and R-141b. Information provided by refrigerant manufacturers indicates Style 3300 will be preferred for R-134a and R-123. Styles 5500, 3000 and 3300 are recommended for R-141b. Refer to the Chemical Resistance chart for a complete listing of refrigerants. The compatibility of the lubricants used with these refrigerants should be considered.

Reuse of Gaskets

We are frequently asked about reusing a gasket. We do not recommend this practice. A gasket's function is to conform to flange high and low spots when compressed, and its ability to reseal decreases after it is compressed. Gaskets which contain rubber and which have experienced elevated temperatures will be even less likely to reseal.

Shelf Life

Garlock has spec sheets detailing proper storage conditions and expected shelf life for our products. Available upon request.

Spacers in Flanges

Some installations require a very thick gasket to fill a large gap between flanges. We do not recommend stacking numerous gaskets in the same flange. In-house tests have shown that a better way to fill a 1/2" gap, for example, is to install a 1/16" gasket on each side of a 3/8" thick incompressible spacer ring. Ideally, the spacer ring will be consistent with piping metallurgy, serrated, and cut to the same dimensions as the gasket. We recommend higher minimum torques when using this arrangement.

Steam

Steam can be found in plants in two forms: saturated and superheated. Saturated steam is standard boiler steam and has a definite temperature for each pressure. Superheated steam is steam at a higher temperature than is found on the saturated steam curve for that particular pressure. We recommend ST-706 and our GRAPH-LOCK® styles for superheated steam. Please be aware of the pressure and P x T limits for each style when making a selection, and consult with Garlock Engineering when approaching these limits. Also see notes on steam service found on fiber gasket specification pages.

Thermal Conductivity

See F104 Line Callouts.

Thickness, Gasket

Garlock recommends the use of thinner gaskets wherever possible. This not only lowers the cost of the gasket, it increases the performance of the joint by lowering emissions and product loss and increasing blowout resistance. Thinner gaskets will not seal as many flange irregularities as thicker gaskets, however, and require flatter flanges. Experience with the particular flange system is often an important guide when specifying a gasket thickness. A more complete discussion of the subject is available.

Torques, Bolt

We realize many end users resist using a torque wrench for installation. We have found the use of a torque wrench to be the least painful way to gain a substantial increase in performance. Any method which accurately controls the compressive load on the gasket is acceptable.

See Bolt Torque Tables for ANSI/ASME B16.5 RF flanges on page C-44. For non-standard flanges, contact Applications Engineering.

The maximum torque values for flanges such as glass-lined or PTFE-lined, FRP and PVC-type flanges are established by the flange manufacturer to avoid damage to the flanges. We recommend the use of the maximum allowable torque for each size. These maximum torques are usually lower, and often much lower, than we would recommend.

Traced Lines (Heat Traced)

Heat traced lines pumping materials which are solid at ambient temperature can present a number of problems for gaskets:

1. The bolts are usually hotter than the flanges since the heat is applied from outside the pipe. This causes the bolts to expand more than the pipe, which lowers the compressive stress on the gasket.
2. Any line which is shut down will freeze solid. When the line is reheated on start-up, there is occasionally a plug of solid material blocking a section of the pipe. The heating may cause some areas of the material to liquefy and then expand. The expansion can create extremely high pressures inside the joint if the solid plug is blocking a section of the line.

USDA

See FDA.

Test Procedures

Blowout of Gasket Products
(No ASTM Designation)

Garlock developed the equipment and test procedure used for testing the blowout resistance of gaskets at varying pressures and temperatures.

This test method and procedure enable us to compare the blowout resistance of all types of non-metallic gasketing products. The test fluid is nitrogen gas. Internal pressures can be varied from atmospheric to approximately 5,000 psig (345 bar). The flanges and gaskets can be exposed to temperatures up to 1,000°F (540°C).

Garlock blowout tests are primarily used to compare various products, and do not represent results that can be expected under actual field conditions. The experience gained over many years in blowout testing provides part of the technical backup of our data on longer term P (psig or bar) x T (°F or °C) values.

Compressibility and Recovery of Gasket Material
ASTM Designation: F36

This method covers determination of the short-time compressibility and recovery at room temperature of sheet gasket materials.

This test method is not intended as a test for compressibility under prolonged stress applications, generally referred to as "creep", or for recovery following such prolonged stress applications, the inverse of which is generally referred to as "compression set".

Some initial compressibility is essential for proper installation of a gasket and is required to compensate for any flange irregularities such as minor flaws or nicks, non-parallelism, corrosion and variations in groove depth. Voids must be filled to obtain proper seating of the gasket or premature failure will occur.

In addition, good recovery upon release of load is indicative of torque retention of a gasketed joint.

Compressibility and recovery as defined by ASTM are two worthwhile physical property criteria for supplier and purchaser to agree upon as routine tests.

Creep Relaxation of Gasket Material
ASTM Designation: F38 Method B

Measured by means of a calibrated bolt with dial indicator, ASTM F38 provides a means for measuring the amount of creep relaxation of a gasket material at a stated time after a compressive stress has been applied. There is no fluid involved.

This method is designed to compare related products under controlled conditions in regard to their ability to maintain a given compressive stress as a function of time. A portion of the torque loss on the bolted flange is a result of creep relaxation. Creep relaxation is defined by ASTM as: "A transient stress-strain condition in which the strain increases concurrently with the decay of stress." The result of creep relaxation is loss of thickness of a gasket, which causes bolt torque loss, resulting in leakage.

Torque loss also can be caused by elongation of bolts, flange distortion and vibration. Therefore, results obtained in lab conditions should be correlated with field results.

Also see Torque Retention Test for further information.

Fluid Resistance of Gasket Materials
ASTM Designation: F146

These methods provide a standardized procedure for measuring the effect of immersion on physical properties of non-metallic gasketing materials in specified fluids under defined conditions of time and temperature. The types of materials covered are those included in the first numeral described in Classification F104. They are not applicable to the testing of vulcanized rubber, a method described in Test Method D471.

The test fluids and conditions outlined were selected as typical for the purposes of comparing different materials, and can be used as a routine test when agreed upon between the supplier and purchaser. The results of immersion tests are not intended to give any direct correlation with service conditions in view of the wide variations in temperature and special uses encountered in gasket applications.

Gas Permeability

DIN* Designation: 3535

This standard provides a means of measuring leakage of a gas through a gasket. This test is designed to compare the leakage rates of different products.

The fluid used is nitrogen gas at an internal pressure of 580 psig (40 bar) and a gasket loading of 4,640 psi (32 N/mm^2). The apparatus is considerably more versatile than that used in ASTM F37. The sample gasket size can be varied; much higher internal pressures can be used. Normally measurements are made at room temperature. However, we have the ability to test at elevated temperatures.

The test measures the effects on leakage rates due to changes in gasket products themselves, in gasket thicknesses, in gasket flange widths, in varying internal pressures, in varying gasket loads, and at varying temperatures.

Helium Mass Spectrometer Test

The ability to control and detect leakage on an ever-decreasing scale is a requirement of industry today. Mass spectrometer technology is used where stringent leak detection is needed, such as in the manufacture of devices used in body implants, nuclear vessels and cathode ray tubes.

The Helium Mass Spectrometer Leak Detector (HeMSLD) develops a high vacuum, which enables it to detect trace amounts of helium that are present. Helium gas is used as a test media in standard flange fixtures on the DIN 3535 gas permeability fixture. The HeMSLD detects the helium leakage through the gasketed joint by way of a hand-held "sniffer" probe or by a hard-piped connection from the DIN 3535 fixture or equipment where other leak detection systems are used. Leakage as low as 1 x 10^{-9} standard cc He/second can be detected.

Questions? Call Gasket Applications Engineering at 1-800-448-6688

* DIN: Deutsches Institut für Normung e.V.

Other ASTM Tests

Purchasers may want to consider the use of the following ASTM test methods, depending on their gasketing needs:

- F147 Test Methods for Flexibility of Non-Metallic Gasket Materials
- F363 Method for Corrosion Testing of Gaskets
- F607 Test Method for Adhesion of Gasket Materials to Metal Surfaces

Sealability of Gasket Materials

ASTM Designation: F37

Test methods A and B provide a means of evaluating fluid sealing properties at room temperature. Method A is restricted to liquid measurements and Method B (most common) can be used for both gas and liquid measurements.

These test methods are suitable for evaluating the sealing characteristics of a gasket product under differing compression flange loads. Since this physical property is so important to the proper function of a gasket, it should be used as an acceptance test when test methods are agreed upon between supplier and purchaser as follows: fluid, internal pressure of fluid, and flange load on the gasket specimen.

The most commonly used fluids are isooctane and nitrogen gas. Gasket load, fluid and internal pressures can vary according to customer needs. However, our experience indicates a strong preference for nitrogen gas, with a gasket load of 3,000 psi (20.7 N/mm^2) at an internal pressure of 30 psig (2 bar).

These precise measurements of leakage rates are designed to compare gasketing products under controlled conditions. The leakage measured comes either through the gasket, or between the gasket and the flange faces, or both. Our experience over many years with thousands of test samples indicates that, in most cases, the leakage measured is a result of leakage through the gasket.

It is not a question of whether or not any fibrous type gasketing product allows leakage through the gasket, but *how much* leakage, under any set of given conditions of time, temperature and pressure.

Standard Classification for Non-metallic Gasket Materials

ASTM Designation: F104

This classification system provides a means for specifying or describing pertinent properties of commercial non-metallic gasket materials. Materials composed of asbestos, cork, cellulose, and other non-asbestos materials in combination with various binders or fillers are included. Materials normally classified as rubber compounds are covered in Method D2000.

Since all the properties that contribute to gasket performance are not included, use of the classification system as a basis for selecting materials is limited.

The purpose of the classification system is intended to provide a common language for communication between suppliers and purchasers; to guide engineers and designers in the test methods commonly used for commercially available materials, and be versatile enough to cover new materials and test methods as they are introduced.

It is based on the principle that non-metallic gasket materials should be described, insofar as possible, in terms of specific physical and functional characteristics. An infinite number of such descriptions can be formulated by use of one or more standard statements based on standard tests.

All fibrous and PTFE type gasketing materials in this catalog show our F104 Line Callout.

Steam Trap Test

The use of steam traps for functional testing of gasketing products is an excellent method for qualifying products. Tests are severe since gasket flange widths are narrow and, in several steam trap designs, the steam enters the trap at a rather high velocity right at the gasket I.D.

A variety of different steam trap designs are cycled on and off at 250 psig (15 bar) and 405°F (205°C) to test the life and function of the gasket.

Tests continue until visible leaks occur or, if no such leakage occurs, for a period of one year.

Tension of Non-metallic Gasket Materials

ASTM Designation: F152

The Universal Tester is used to determine the tensile strength of non-metallic gasketing products. The types of products covered are those containing various organic fibers, inorganic fibers, flexible graphite, or fluorocarbons as described in F104.

F152 is not applicable to the testing of vulcanized rubber, a method that is described in Test Method D142, nor for rubber O-rings, a method that is described in D1414.

The measurement of tensile strength characterizes various classes and grades of products of a given type. It also will aid the purchaser in determining whether the gasketing product approved for a given application is being manufactured to acceptable quality. Various procedures are given for different types of materials, and in order to compare results from one lab to another, it is imperative that the applicable procedure be used.

The measurement of tensile strength should not be construed as an indication of the performance of that product in use.

Thermal Analysis Test

Thermal Analysis, often referred to as TA, is a series of techniques that characterize materials by measuring and analyzing changes in their physical and chemical properties resulting from controlled and measured changes in temperature. The TA techniques include DSC (Differential Scanning Calorimetry), TGA (Thermal Gravimetric Analysis) and TMA (Thermal Mechanical Analysis).

DSC measures heat flow into or out of a material as it is undergoing a programmed thermal profile. The resulting plot of heat flow vs. temperature can reveal a great deal of information about a material. DSC is being used to determine such things about a material as specific heat, melting point, crystallinity, glass transition temperature, degree of cure of thermosets, purity, oxidative stability, and reaction kinetics.

TGA measures changes in the weight of a material. By heating a sample in a controlled manner in various atmospheres, the composition of various materials can be determined. The technique is also useful for performing thermal stability studies.

TMA provides measurements of penetration, expansion, contraction, extension, and relaxation of materials as a function of either time or temperature. By using various probes and accessories, TMA can be used to determine expansion coefficients, softening points, heat-deflection temperatures, viscosity, creep, and stress relaxation.

Torque Retention

DIN 52913

This test is designed to determine the torque retention capabilities of gasketing products, when subjected to the compression load and operating temperature as defined by the test procedure.

The test consists of applying a predetermined load on the test gasket via a tension screw, then heating the gasket/flange assembly to the desired temperature (there is no internal pressure). The standard test period is either sixteen (16) hours or one hundred (100) hours. At the end of the required time period, the compression load which is left acting on the test gasket is measured. This allows one to calculate the torque retention capabilities of various gasketing products.

Garlock Gaskets®

Questions? Call Gasket Applications Engineering at 1-800-448-6688

Infrared Analyzer

This instrument is equipped with a number of attachments that allow scanning of liquids and solids either by transmittance or reflectance. The spectrum of the scanned sample can be compared against standard spectra contained in internal libraries within the instrument. The search program automatically finds the best match. The sample and library spectra can be displayed together on the screen for comparison.

Programmable, Multi-Functional Test Stand (A.S.T.—Advanced Seal Tester)

This highly sophisticated, PC-driven test stand evaluates properties of gasketing materials under varying conditions; it can be programmed to test leak rates from high vacuum to 300 psig internal pressure, with different compressive loads or test temperatures. Any of the parameters listed below can be programmed to ramp up while the other conditions are held constant, to study the effects these conditions have on the sealability of materials. A Helium Mass Rate Spectrometer can monitor leak rates; gasket thickness and leak rates are monitored to determine percent compression vs. load, leak rate vs. compressive stress, maximum crush resistance, and more.

Programmable Parameters:

- Compressive load (stress)
- Time
- Temperature
- Internal pressure or vacuum
- Leak rate measurement

Capabilities:

- Compressive load:
  To 107,000 lbs force (475 KN) at room temperature
  To 73,000 lbs force (325 KN) at 570°F (300°C)
- Temperature: to 840°F (450°C)
- Gasket thickness: 0-5/16" (0-8mm)
- Internal pressure: High vacuum (10^{-3} mbar) to 300 psig He (20 bar)
- Helium leak rate measurement: 1 standard cc/ second down to 1×10^{-11} standard cc/ second

Gasket Application Data Form

Date ______________________________
For: Garlock Gasketing Engineering
Fax 315-597-3290
Page: 1 of ______________________
Drawing attached ❑ Yes ❑ No

From ______________________________
Title ______________________________
Company ____________________________
Address ____________________________
City / State / Zip __________________
Phone ______________________________
Fax ________________________________
E-mail _____________________________

Application

❑ Pipe Flange
❑ Heat Exchanger
❑ Manway
❑ Compressor
❑ Pumps – centrifugal / horizontal split case
❑ Flue Duct
❑ Valve Bonnet
❑ Other ____________________________

Service Conditions

Maximum Temperature ______________ °F / °C
Internal Pressure ________________ psig / bar
Thermal Cycling ________________ / 24 hours
Continuous Operating Temperature ______ °F / °C
PSIG / bar ❑ Continuous ❑ Intermittent
Vibration ❑ Yes ❑ No
Other (specify) ____

Bolts

Grade ______________________________
Length _____________________________
Diameter ___________________________
Number _____________________________

Chemical Compatibility

Media ______________________________
Concentration _______________________
pH _________________________________
Liquid or Gas _______________________

Flange

Standard

Material ___________________________
Size ______________ Rating ___________
Surface Finish ___________________ RMS
❑ Phonographic ❑ Concentric
Face (raised, flat, tongue & groove, etc.) _______
____

Non-Standard

Material ___________________________
I.D. / O.D. _________________________
Flange Thickness ____________________
Bolt Circle Diameter _________________
Surface Finish ___________________ RMS
❑ Phonographic ❑ Concentric
Face (raised, flat, tongue & groove, etc.) _______
____

Comments: ____
____
____

Questions? Call Gasket Applications Engineering at 1-800-448-6688

More than just great products…

Beyond offering you the widest available range of products for packing and sealing, Garlock enhances the value of its products with technical services and comprehensive training programs:

- ISO 9001:2000 registration for Industrial Gasketing, Industrial Packing, KLOZURE® Oil Seals, Bearing Protectors, and Mechanical Seals, Expansion Joints, Hydraulic Components,and Industrial Rubber Products.
- A global network of stocking Authorized Garlock Distributors.
- Factory sales representatives and applications engineers available for problem solving when and where it is needed.
- Toll-free 800 telephone and fax numbers for immediate product information.
- In-plant surveys of equipment and processes, providing the customer with recommendations to identify and eliminate sealing and packing problems before they start.
- The most sophisticated and most comprehensive test facilities available.
- Technical field seminars on all Garlock products.
- Factory-sponsored product training programs, including hands-on seminars, to ensure that Garlock representatives and their distributor personnel are the best in the industry.
- Technical Bulletins to keep you up-to-date on product enhancements and changes.

Customers who specify Garlock fluid sealing products get, at no extra cost, the high quality support needed to run a profitable operation.

AUTHORIZED REPRESENTATIVE

ISO 9001

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WARNING:
Properties/applications shown throughout this brochure are typical. Your specific application should not be undertaken without independent study and evaluation for suitability. For specific application recommendations consult Garlock. Failure to select the proper sealing products could result in property damage and/or serious personal injury.

Performance data published in this brochure has been developed from field testing, customer field reports and/or in-house testing.

While the utmost care has been used in compiling this brochure, we assume no responsibility for errors. Specifications subject to change without notice. This edition cancels all previous issues. Subject to change without notice.

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